NATIONAL SCIENCE FOUNDATION

FY 2014 Budget Request to Congress

April 10, 2013

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NSF FY 2014 Budget Request to Congress

The National Science Foundation Act of 1950 (Public Law 81-507) sets forth our mission: ***To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense.***

*The National Science Foundation Strategic Plan for FY 2011 – 2016, "Empowering the Nation Through Discovery and Innovation," defines our vision: "****a nation that capitalizes on new concepts in science and engineering and provides global leadership in advancing research and education.****"*

The National Science Foundation (NSF) is the only federal agency dedicated to the support of basic research and education across all fields of science and engineering. For over 60 years, NSF has had a profound impact on our Nation's innovation ecosystem by funding transformative research that has explored – and extended – the frontiers of scientific knowledge, promoted new industries, and addressed societal challenges.

In an era of fiscal austerity and focus on return on investment for the U.S. taxpayer, the strategic investments in NSF's FY 2014 portfolio sustain national economic growth, create new high technology jobs, support the transition to a clean energy economy, and train and develop the Nation's globally competitive science and engineering (S&E) workforce.

NSF's FY 2014 Budget Request is $7.626 billion, an increase of $592.69 million (8.4 percent) over the 2012 Enacted level. This request reflects a rigorous prioritization of activities across the Foundation. Even as the overall budget grows, the Agency Operations and Award Management account increases only $4.89 million (1.6 percent) as administrative costs are kept constrained. Approximately $37 million in lower priority education and research programs are terminated, reduced, or consolidated.

NSF Funding by Account
(Dollars in Millions)

	FY 2012 Enacted	FY 2014 Request	FY 2014 Request Change Over FY 2012 Enacted Amount	Percent
Research & Related Activities	$5,689.00	$6,212.29	$523.29	9.2%
Education & Human Resources	829.00	880.29	51.29	6.2%
Major Research Equipment & Facilities Construction	197.06	210.12	13.07	6.6%
Agency Operations & Award Management	299.40	304.29	4.89	1.6%
National Science Board	4.44	4.47	0.03	0.7%
Office of Inspector General	14.20	14.32	0.12	0.8%
Total, NSF	**$7,033.10**	**$7,625.78**	**$592.69**	**8.4%**

Totals may not add due to rounding.

FY 2014 Priorities

Funding for FY 2014 Priorities
(Dollars in Millions)

Investment Priority	FY 2012 Enacted	FY 2014 Request	FY 2014 Request Change Over FY 2012 Enacted Amount	Percent
Cyber-Enabled Materials, Manufacturing and Smart Systems (CEMMSS)	$141.65	$300.42	$158.77	112.1%
Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)	78.00	155.47	77.47	99.3%
NSF Innovation Corps (I-Corps)	7.50	24.85	17.35	231.3%
Integrated NSF Support Promoting Interdisciplinary Research & Education (INSPIRE)	20.35	63.00	42.65	209.6%
Science, Engineering, and Education for Sustainability (SEES)	157.00	222.79	65.79	41.9%
Secure and Trustworthy Cyberspace (SaTC)	111.75	110.25	-1.50	-1.3%

Investments may have funding overlap and thus should not be summed.

The investments that form this Budget Request flow from the goals established in the agency's strategic plan: Transform the Frontiers, Innovate for Society, and Perform as a Model Organization. In FY 2014, key NSF investments in all fields of science and engineering strive to create new knowledge, stimulate discovery, address complex societal problems, and promote national prosperity.

In keeping with NSF's mission of advancing basic research in science, engineering, and education, this Request ensures the health of fundamental science and engineering across all disciplines, primarily through merit reviewed awards to researchers at colleges and universities throughout the country. There are six areas where core research is encouraged to enable scientists to address problems that require integration across more than one discipline. These priority investments, which encompass roughly 11 percent of the FY 2014 Request, focus on areas where progress in basic research is vital to addressing key national challenges, such as spurring innovation in manufacturing, improving data storage and analysis (e.g., Big Data), securing critical infrastructure, and promoting innovation and economic growth generally. Priorities include:

- **Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS**) ($300.42 million) will transform static systems, processes, and edifices into adaptive, pervasive "smart" systems with embedded computational intelligence that can sense, adapt, and react. Through CEMMSS, NSF participates in the Administration's Materials Genome Initiative (MGI), the National Robotics Initiative (NRI), and the Advanced Manufacturing Partnership. These investments fund research in areas of national importance, such as cyber-physical systems and advanced robotics research, materials processing and manufacturing, and advanced semiconductor and optical device design. These efforts are integral to the Administration's overall emphasis on strengthening advanced manufacturing.

- **Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)** ($155.47 million) aims to expand investment in the Big Data/National Data Infrastructure program, a joint solicitation with the National Institutes of Health (NIH). NSF, as the lead agency, strives to coordinate development of new knowledge, tools, practices, and infrastructure that will enable breakthrough discoveries in science, engineering, medicine, commerce, education, and national security.

- **NSF Innovation Corps (I-Corps)** ($24.85 million) continues to build a national innovation ecosystem by improving NSF-funded researchers' access to resources that can assist in bridging the gap between discoveries and downstream technological applications, including commercialization of new technologies, products, and processes. In FY 2014, NSF will continue investment in Innovation Teams, and will expand support for I-Corps Nodes and I-Corps Sites.

- **Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE)** ($63.0 million) investment will continue to strengthen NSF's support of interdisciplinary, potentially transformative research by complementing existing efforts with a suite of highly innovative Foundation-wide activities and funding opportunities.

- **Science, Engineering, and Education for Sustainability (SEES)** ($222.79 million) addresses the need to develop a sustainable world where human needs are met equitably without harm to the environment and without sacrificing the ability of future generations to meet their needs. SEES uses a systems-based approach to understanding, predicting, and reacting to change in the linked natural, social, and built environment and addresses challenges in environmental and energy research and education. In FY 2014, NSF focuses on enhancing the Water Sustainability and Climate, Cyber-SEES, Hazards, and Sustainable Chemistry, Engineering and Materials (SusChEM) programs.

- The **Secure and Trustworthy Cyberspace (SaTC)** ($110.25 million) investment aligns NSF's cybersecurity investments with the four thrusts outlined in the national cybersecurity strategy, *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program*. SaTC seeks to protect the Nation's information technology infrastructure from a wide range of threats that challenge its security, reliability, availability, and overall trustworthiness.

Additional Priorities and Highlights

- NSF aims to increase the operational efficiency of **U.S. activities in the Antarctic** ($22.0 million) by implementing the recommendations of the U.S. Antarctic Program Blue Ribbon Panel (BRP) report, *More and Better Science in Antarctica through Increased Logistical Effectiveness*. Emphases include safety and health improvements, investments with positive net present value, and facilities renewal at McMurdo and Palmer stations. Additionally, NSF aims to plan and execute more effective observational approaches to the Antarctic science community, as outlined in the 2011 National Research Council report, *Future Science Opportunities in Antarctica and the Southern Ocean*.

- In FY 2014, NSF introduces three activities to improve program effectiveness and efficiency by:

    - Ensuring **Public Access** ($2.50 million) to NSF research. This initiative reflects the Administration and NSF priority to make government more open and accessible by improving public access to NSF-funded research. In FY 2014, NSF establishes a policy framework that will build on and refine existing technology to track research products, allow investigators and awardees to make their products known and available, and allow the general public, researchers, and policy makers to locate and make use of those products. This effort includes establishing a

publicly-accessible repository for publications, leveraging existing federal infrastructure to the maximum extent possible.

- Establishing an **Evaluation Capability** ($5.50 million) to improve NSF's ability to inform policy decisions and improve the impact of research grant investments. In FY 2014, NSF will build a central evaluation expertise and support capability to promote rigor, transparency, and independence of evaluations. The centralized capability will coordinate the evaluation of NSF-wide activities, expand data collection, and ensure that the results of evaluation are used to improve NSF programs.

- Improving the operational execution of the **Merit Review Process** ($4.09 million), an essential step to address the extraordinary pressures the Foundation faces due to a growing number of proposals and intense competition for NSF funding. The FY 2014 Request will support a multi-year effort to improve major aspects of this process, including use of virtual meeting technologies for merit review; technological support for the management of reviewers and reviews; increased automation of the preliminary processing of proposals; and demand management.

- **Clean Energy** ($372.45 million): NSF's clean energy investments include research related to sustainability science and engineering, such as the conversion, storage, and distribution of diverse power sources (including smart grids), and the science and engineering of energy materials, energy use, and energy efficiency.

- **Research at the Interface of Biological, Mathematical and Physical Sciences, and Engineering (BioMaPS)** ($50.67 million) is a collaboration among the Directorates for Biological Sciences, Mathematical and Physical Sciences, and Engineering, that seeks to discover fundamental knowledge at the intersections of these established disciplines. This activity will produce critical knowledge needed to catalyze the development of new technologies essential to the Nation's prosperity and economic competitiveness and will advance emerging areas of the bioeconomy, as described in the Administration's *National Bioeconomy Blueprint*.

- The **Cognitive Science and Neuroscience** investment ($13.85 million) supports a focused, cross-foundation activity with three multi-year goals: to advance understanding of adaptation to the ever-changing world; to determine the mechanisms underlying decision-making and problem-solving in a dynamic environment; and to break the neural code by elucidating how the brain represents the world around us. This builds on ongoing NSF-wide support (approximately $70 million per year) for fundamental research relevant to cognitive science and neuroscience. NSF's funding in FY 2014 will also contribute to the Administration's multi-agency research initiative designed to revolutionize understanding of the human brain. FY 2014 activities include workshops held to identify specific gaps in our current understanding of these issues and intractable technology problems that prevent scientific breakthroughs. These will allow development of a framework for future efforts in the Administration's initiative.

- **The Faculty Early Career Development program (CAREER)** ($223.73 million) develops the future STEM workforce through support of young faculty who are dedicated to integrating research with teaching and learning. In FY 2014, NSF will support approximately 500 new awards. The CAREER portfolio includes projects that range across all fields of science and engineering supported by the Foundation, including high priority fields such as clean energy, climate change, STEM education, and cybersecurity. Within CAREER, NSF will support more fully utilizing the talents of individuals in all sectors of the American population by promoting Career-Life Balance, including

supplemental funding requests to employ research technicians or the equivalent for up to three months to sustain research when principal investigators are on family leave.

Science, Technology, Engineering, and Mathematics (STEM) Education

NSF maintains a strong commitment to advancing science and engineering education at all levels and to strengthening the Nation's workforce in STEM. The Administration is proposing a government-wide reorganization of STEM education programs to support a cohesive national STEM strategy. As part of this reorganization, in FY 2014 NSF presents a comprehensive agency-wide program to address undergraduate education and expands its leadership role in graduate education.

- The **National Graduate Research Fellowship program (NGRF)** ($325.14 million) builds on and expands the longstanding NSF Graduate Research Fellowship program (GRF) to incorporate features and opportunities that allow fellows to gain specialized experiences and training in key STEM areas. Through this expanded program, an increase of approximately 700 fellows is expected, bringing the total estimated number of new fellows awarded in FY 2014 to 2,700.

- The **NSF Research Traineeships (NRT)** program ($55.07 million) is the Foundation's investment in traineeships that focus on strategically identified research areas, mutually leveraging NSF's traineeship and research investments. NRT will build on NSF's previous investments – particularly the Integrative Graduate Education and Research Traineeship (IGERT) program – to encourage effectual innovation and design of graduate programs to support opportunities within specific disciplines.

- **Catalyzing Advances in Undergraduate STEM Education (CAUSE)** ($123.08 million) is a comprehensive agency-wide program for FY 2014 that aims to maximize the impact of NSF's considerable ongoing investments in STEM undergraduate education. CAUSE aims to improve STEM learning and learning environments; broaden participation in STEM and increase institutional capacity; and build the STEM workforce of tomorrow.

- Funding for the **Research Experiences for Undergraduates (REU) Sites and Supplements** ($79.18 million total) is increased $13.19 million over the FY 2012 Enacted. This additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*.

Major Research Equipment and Facilities Construction

In FY 2014, NSF requests funding to continue construction of four projects: the Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO), the Advanced Technology Solar Telescope (ATST), the National Ecological Observatory Network (NEON), and the Ocean Observatories Initiative (OOI).

Funds are also requested to begin construction of the Large Synoptic Survey Telescope (LSST), a partnership with the Department of Energy (DOE). LSST was ranked as the number one priority for a large ground-based astronomical facility in the National Academies' most recent *Decadal Survey of Astronomy and Astrophysics* (August 2010).

- **Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO).** A planned upgrade of the existing Laser Interferometer Gravitational-Wave Observatory (LIGO), AdvLIGO will be ten times more sensitive, powerful enough to approach the ground-based limit of gravitational-wave detection.
- **Advanced Technology Solar Telescope (ATST).** ATST will enable study of the sun's magnetic fields, which is crucial to our understanding of the types of solar variability and activity that affect Earth's civil life and may impact its climate.
- **Large Synoptic Survey Telescope (LSST).** LSST will produce an unprecedented wide-field astronomical survey of our universe, including the deepest, widest-field sky image ever. The LSST survey will change every field of astronomical study, from the inner solar system to the large scale structure of the universe.
- **National Ecological Observatory Network (NEON).** NEON will consist of geographically distributed field and lab infrastructure networked via cybertechnology into an integrated research platform for regional to continental scale ecological research.
- **Ocean Observatories Initiatives (OOI).** OOI will enable continuous, interactive access to the ocean via multiple types of sensors linked by cutting-edge cyberinfrastructure, which will produce never-before-seen views of the ocean's depths.

MREFC Account Funding, by Project
(Dollars in Millions)

	FY 2012 Enacted	FY 2014 Request
Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO)	$20.96	$14.92
Atacama Large Millimeter Array (ALMA)	3.00	-
Advanced Technology Solar Telescope (ATST)	10.00	42.00
Large Synoptic Survey Telescope (LSST)	-	27.50
National Ecological Observatory Network (NEON)	60.30	98.20
Ocean Observatories Initiative (OOI)	102.80	27.50
Total, MREFC	**$197.06**	**$210.12**

Totals may not add due to rounding.

Model Organization

To "Perform as a Model Organization" is an internally focused strategic goal that emphasizes the agency's desired outcome of attaining excellence in all aspects of its operations. Model Organization underpins NSF programmatic activities and encompasses all the agency's management activities. It also includes support for the activities of the Office of Inspector General (OIG) and the National Science Board (NSB), which are provided in separate appropriations.

iTRAK

NSF will continue to modernize its financial management systems through the implementation of iTRAK. iTRAK will transition NSF from its legacy financial system to a fully integrated financial management solution. In FY 2014, the total request for iTRAK is $2.60 million.

Promoting Efficient Spending

Efforts are underway in multiple accounts to reduce administrative costs through efficiencies in response to the Administration's Promoting Efficient Spending initiative (Executive Order 13589) and *Promoting Efficient Spending to Support Agency Operations* (OMB M-12-12). Travel costs across NSF will be held at no more than $27.67 million in FY 2014, an amount $5.60 million below FY 2010 levels. This is accomplished through strategic efficiencies that achieve savings while preserving the travel necessary for mission-critical oversight and management responsibilities. In addition, NSF will also employ strategic sourcing of administrative support contracts, specifically for printing and wireless devices.

Model Organization by Appropriations Account

(Dollars in Millions)

	FY 2012 Enacted	FY 2014 Request	FY 2014 Request Change Over FY 2012 Enacted Amount	Percent
Agency Operations and Award Management	$299.40	$304.29	$4.89	1.6%
Office of Inspector General	14.20	14.32	0.12	0.8%
National Science Board	4.44	4.47	0.03	0.7%
Program Support:				
Research & Related Activities	94.12	108.20	14.08	15.0%
Education and Human Resources	15.39	16.57	1.18	7.7%
Subtotal, Program Support	109.51	124.77	15.26	13.9%
Total	**$427.55**	**$447.85**	**$20.30**	**4.7%**

Performance and Evaluation

NSF embraces the use of goals to drive performance improvements. In FY 2014, NSF has set ten performance goals so that NSF can strategically monitor and oversee progress being made on the Foundation's most important activities: priority program investments, research infrastructure investments and key management initiatives. NSF's goals are:

- **Ensure that Key Program Investments are on track:** Meet critical targets for several key program investments: CEMMSS, CIF21, I-Corps, INSPIRE, SaTC, and SEES. Progress will be monitored using a set of common milestones and indicators.

- **Ensure that Infrastructure Investments are on track:** Ensure program integrity and responsible stewardship of major research facilities at varying stages of their lifecycle. This involves construction project monitoring, response to advisory reports, and deployment of the first implementation of the NSF Public Access system.

- **Use Evidence to Guide Management Decisions:** The Foundation will use evidence-based reviews to guide management investments.

- **Improve Undergraduate Education:** The Foundation will establish an NSF-wide undergraduate STEM education program that is evidence-based and evidence-building.

- **Enhance National Graduate Research Fellowships:** NSF will enhance the Graduate Research Fellowship program to provide a wider range of career development opportunities.

- **Promote Career-Life Balance Policies and Practices:** NSF aims to promote policies and practices that support more fully utilizing the talents of individuals in all sectors of the American population, principally women, underrepresented minorities, and persons with disabilities.

- **Foster an Environment of Diversity and Inclusion:** The Foundation seeks to foster an environment of diversity and inclusion while ensuring compliance with the agency's civil rights programs.

- **Modernize Financial System:** iTRAK is the Foundation-wide effort to transition NSF from its legacy financial support system to a fully integrated financial management shared services solution to ensure continuous improvement and achieve high levels of customer service.

- **Make Timely Award Decisions:** NSF aims to inform applicants whether their proposals have been declined or recommended for funding within 182 days, or six months of deadline, target, or receipt date, whichever is later.

- **Enable Increased Use of Virtual Merit Review:** NSF seeks to incorporate technological innovations into the merit review process by expanding the use of virtual merit review panels.

Please refer to performance.gov for information on NSF's agency Priority Goals and NSF's contributions to the federal Cross-Agency Priority (CAP) goals.

Cuts, Consolidations, and Savings

NSF's FY 2014 Request follows a thorough examination of programs and investments across NSF to determine where the potential exists for more innovative investments. In addition to last year's proposals, this Request includes six terminations; two reductions; and one consolidations, totaling $36.86 million below FY 2012 Enacted level.

Nanoscale Science & Engineering Centers (NSECs) (-$18.61 million)**:** six NSEC centers are terminated due to center graduations and a transition to the Nanosystems Engineering Research Centers (NERCs) program. NSF will continue to support five continuing NSECs in FY 2014.

Two programs are eliminated within the Directorate for Mathematical and Physical Sciences (MPS). **CCAT** (formerly the Cerro Chajnantor Atacama Telescope) **Design and Development** (-$1.50 million total) concludes in FY 2013. Future NSF contributions to construction and/or operations will depend on a successful proposal to a competed midscale activities program. The **International Materials Institutes (IMI)** (-$1.58 million total) were concluded after an internal evaluation of program achievements found that despite the success of individual projects, the collective effort has not made the intended impact.

Virtual Organizations (-$5.0 million total) has achieved its programmatic goals to support scientific research to advance understanding of the effectiveness of virtual organizations and how they can enable and enhance science and engineering research and education. The transition to supporting application of virtual organizations to science and engineering communities is now underway in multiple programs within the Directorate for Computer and Information Science and Engineering.

The **Sensors and Sensing Systems (SSS)** program (-$3.0 million) is reduced because there are other programs both within NSF and at other agencies that principal investigators can apply to for support. The program will be refined to have a narrower and more targeted focus.

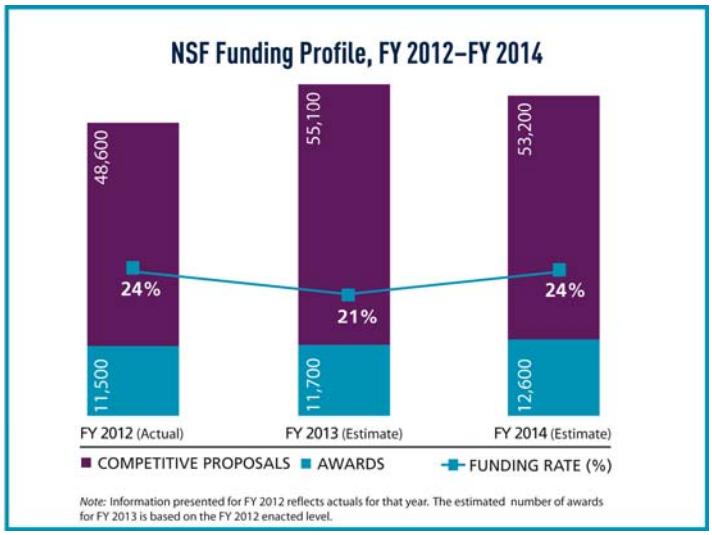
University Radio Observatories (UROs) (-$1.80 million) is being superseded scientifically by NSF's Atacama Large Millimeter/submillimeter Array (ALMA). It is expected that UROs will be eligible to compete for future funding in a broader midscale activities program.

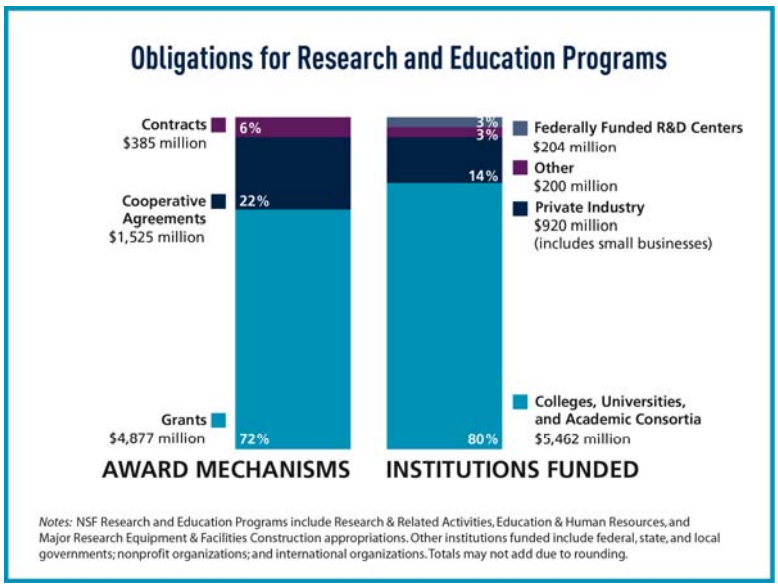
The Directorate for Education and Human Resources (EHR) will shepherd two major realignments to the current NSF STEM Education portfolio in order to use existing resources more effectively through a streamlined and consolidated approach. The new **Catalyzing Advances in Undergraduate STEM Education (CAUSE)** program includes undergraduate programs in EHR as well as Research and Related Activities (R&RA) directorates. NSF will take a leadership role in the coordination of government-wide graduate STEM education programs while developing national fellowship and traineeship programs.

As part of NSF's realignment of its STEM Education portfolio, two programs are terminated within the Directorate for Geosciences (GEO). The goals of the **Geoscience Teacher Training (GEO-Teach)** (-$2.0 million) program continue to be served through other STEM education initiatives at NSF. The **Centers for Ocean Science Education Excellence (COSEE)** (-$3.37 million) is terminated as the program has fulfilled its original goals. GEO will turn its attention to new educational initiatives through CAUSE.

NSF by the Numbers

NSF by The Numbers: In FY 2014 NSF expects to evaluate over 53,000 proposals through a competitive merit review process and make over 12,000 new awards. This will require over 260,000 proposal reviews, engaging on the order of 40,000 to 50,000 members of the science and engineering community participating as panelists and proposal reviewers. In a given year, NSF awards reach nearly 1,900 colleges, universities, and other public and private institutions in 50 states, the District of Columbia, and Puerto Rico. In FY 2014, NSF support is expected to reach approximately 276,000 researchers, postdoctoral fellows, trainees, teachers, and students.





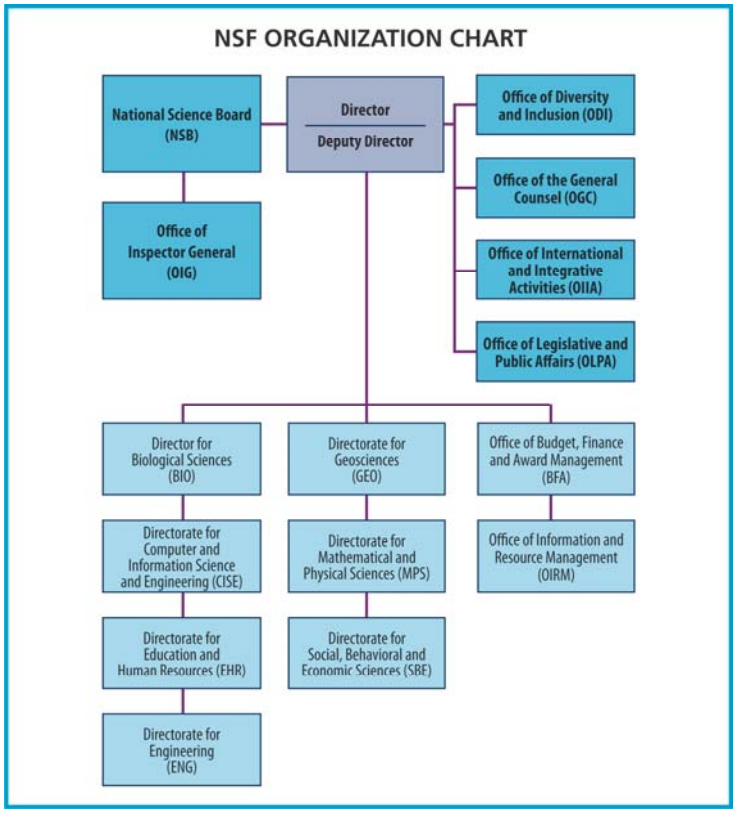
The chart on the left shows the distribution of NSF's obligations by institution type and funding mechanism. While the data are based on FY 2012, the relative shares should provide a good indication of the FY 2014 distribution. As shown on the graph, 94 percent of NSF's FY 2012 projects were funded using grants or cooperative agreements. Grants can be funded either as standard awards, in which funding for the full duration of the project is provided in a single fiscal year, or as continuing awards, in which funding for a multi-year project is provided in increments. Cooperative agreements are used when the project requires substantial agency involvement during the project performance period (e.g., research centers, multi-user facilities, etc.). Contracts are used to acquire products, services, and studies (e.g., program evaluations) required primarily for NSF or other government use.

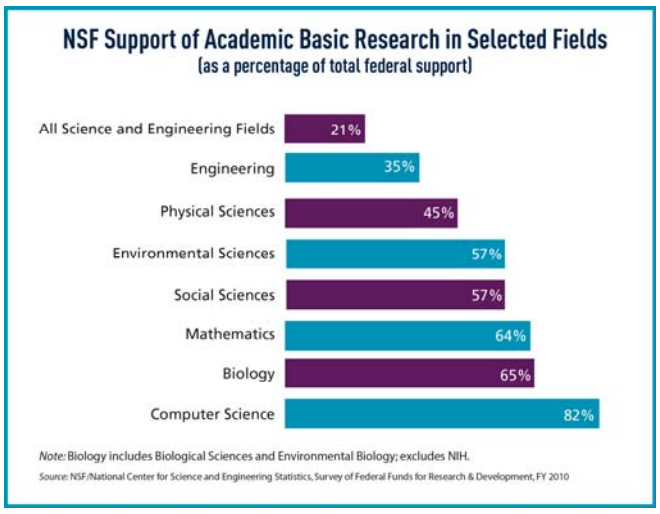
Most NSF awards are to academic institutions. Nonprofit organizations include state and local governments and international organizations. For-profit businesses include private and small businesses. Federal agencies and laboratories include funding for Federally Funded Research & Development Centers.

Organization and Role in the Federal Research Enterprise

NSF's comprehensive and flexible support of meritorious projects with broad societal impacts enables the Foundation to identify and foster both fundamental and transformative discoveries within and among fields of inquiry. NSF has the latitude to support emerging fields, high-risk ideas, interdisciplinary collaborations, and research that pushes – and even transforms – the very frontiers of knowledge. In these ways, NSF's discoveries inspire the American public – and the world.

NSF's organization represents the major science and engineering fields, including: biological sciences; computer and information science and engineering; engineering; geosciences; mathematical and physical sciences; and social, behavioral, and economic sciences. NSF also carries out specific responsibilities for education and human resources, cyberinfrastructure, integrative activities, international science and engineering, and polar programs. The 25-member National Science Board sets the overall policies of the Foundation.





NSF's annual budget represents 21 percent of the total federal budget for basic research conducted at U.S. colleges and universities, and this share increases to 58 percent when medical research supported by the National Institutes of Health is excluded. In many fields NSF is the primary source of federal academic support.

Highlights

Artificial Leaf Offers New Approach to Energy Production

Researchers at the Powering the Planet Center for Chemical Innovation at Caltech have created an artificial leaf. Just as a natural leaf converts sunlight into water, oxygen and sugar, this stand-alone device captures solar energy and splits water into hydrogen and oxygen gas. The artificial leaf converts sunlight into chemical fuel using a silicon photovoltaic cell and relatively inexpensive catalysts – materials that jump-start chemical reactions. To compete with cheap fossil fuels, novel materials are needed to generate fuels from solar energy. The materials must be inexpensive and abundant and their production simple and low-cost. Through a sustainable distribution infrastructure, the artificial leaf could become a viable energy source for both developed and developing countries. This finding was cited by Time magazine as an innovation of the year for 2011.

Credit: Dan Nocera, Massachusetts Institute of Technology

Detecting Explosives With Carbon-based Materials

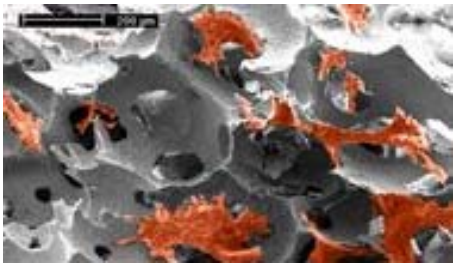
Researchers have created a novel carbon-based framework that produces materials for detecting explosive devices. Jeffrey Moore and his team at the University of Illinois, Urbana-Champaign, developed new methods to produce functionally useful materials based on carbon-rich nanostructures while reducing the generation of wasteful byproducts. The new methods allow for efficient, large-scale production and higher yields than previous methods.

Credit: Dorothy Loudermilk and Jeffrey Moore

This new environmentally friendly approach to explosive sensing materials has major implications for homeland security as well as combat soldiers who are targets of improvised explosive devices. These new materials are now being incorporated into field portable explosives detection devices.

Building Better Bone With Ceramics

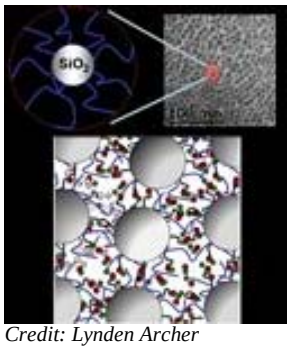
Researchers at the University of Florida have developed new ceramic foams that act as scaffolds for bone repair. These foams could mean an end to the use of metal plates as bone substitutes. Bioceramic foams are lightweight, porous, and possess a large surface area; porosity allows biofluids and arteries to flow through a ceramic implant, while high surface area allows more bone regeneration to occur. In experiments, the researchers demonstrated how cells spread across the foam struts, attach to inner foam pores and spread along foam contours. All of these steps are essential for bone regeneration and fracture healing.



Credit: Juan C. Nino, University of Florida

Highlights

Longer Life Lithium Batteries



Credit: Lynden Archer
Cornell University

Researchers from Cornell University have created a hybrid material that is particularly suitable for use as a solid electrical conductor or electrolyte in high-energy lithium batteries. Lynden Archer and his colleagues designed and refined new materials, composed of hard silica nanoparticles and a soft lithium-conducting polymer. The materials are stable, and have low flammability and volatility under battery operating conditions. Rechargeable lithium batteries are commonly used in consumer electronics and increasingly are finding applications in electric vehicles and defense. The new material will prolong the life of these batteries and allow them to provide higher powers than current technologies. A new start-up company – NOHMs Technologies – in Ithaca, N.Y., will manufacture and commercialize lithium batteries based on the new material.

Diagnosing Hidden Brain Trauma on the Field

The frontal cortex – the brain area directly behind the forehead – is vulnerable to damage. Scientists at the University of Texas Health Science Center in Houston, led by Anne Sereno and Saumil Patel, have discovered that people with impairments of the frontal cortex produce slower and more error-prone voluntary eye movements, but their reflexive eye and finger movements are unaffected. To evaluate whether even very mild injury to the frontal cortex has similar effects, the scientists developed a simple, tablet-based tool. The research team included a high-school student in the tool's development and tested the device with a local high-school women's soccer team. Results showed that frequent heading of balls – striking the ball with the forehead – disrupted and slowed voluntary movements in players tested right after soccer practice. These findings suggest that even mild injury to the frontal cortex can produce immediate, though short-lived, cognitive and behavioral changes that can affect one's ability to attend and respond to information or learn new information. This simple, tablet-based tool may be extremely useful for diagnosing deficits and evaluating treatment in mild traumatic brain injury at the time of injury, as well as for later follow-up care.

Credit: Anne Sereno,
University of Texas
Health Science Center

Imaging Groundwater Aquifers

Credit: Rosemary Knight, Stanford University

Most of the Earth's liquid fresh water exists as groundwater, a resource that lies beneath the Earth's surface. Conventional approaches to discover groundwater involve drilling and pumping wells, which are expensive and time-consuming. A Grant Opportunities for Academic Liaison with Industry (GOALI) project, involving researchers at Stanford University, the U.S. Geological Survey (USGS), and several industrial partners, used an alternative approach – surface nuclear magnetic resonance – which permits remote sampling and imaging of groundwater in less time, reducing monitoring costs. The approach also has applications in understanding the relationship between plant transpiration and groundwater.

Highlights

Understanding Urban Flooding

Credit: Parks & People Foundation

Although researchers agree that urban development affects flooding, in the past they have disagreed on how factors such as increases in impervious areas change the density of streams in the area. They have also debated whether the addition of storm drains affects flooding. A team of investigators from the University of Wyoming and University of Connecticut have gained new insights into how human and geological factors influence urban-area flooding. Using simulations, they discovered that the inability of surfaces to absorb water has a greater effect during heavy rainfall than during truly extreme events. In addition, small changes in drainage density--that is, the total length of streams and rivers in an area--significantly affect flood peaks in areas of already low drainage density. Subsurface storm drains can increase drainage density in areas lacking streams and rivers by providing more places for water to drain. However, the researchers found that depending on the existing stream network, watershed topography, and intensity and magnitude of a storm event, the addition of storm drains may have only a limited effect on the peak discharge.

PhysTEC Addresses Shortage of Physics Teachers

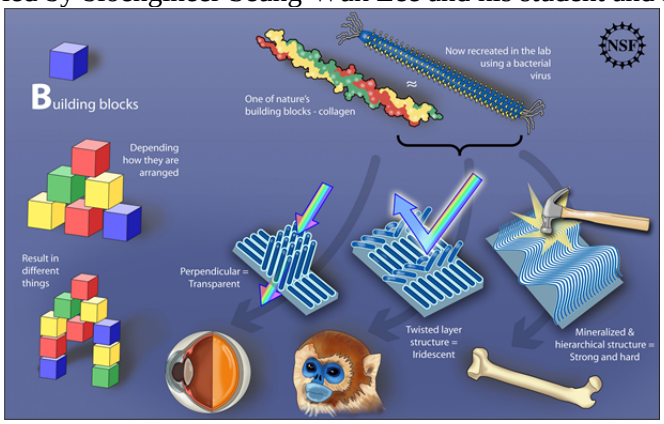
Credit: The Physics Teacher Education Coalition

School districts report a greater shortage of teachers in physics than in any other academic discipline. Only 35 percent of high-school physics teachers have a degree in physics or physics education. More than 250 colleges and universities have joined the Physics Teacher Education Coalition (PhysTEC), committing to educate greater numbers of highly qualified physics teachers. The PhysTEC project seeks to engage physics departments more deeply in teacher education so that every student will have the opportunity to learn physics from a qualified teacher. The PhysTEC members represent nearly one-third of all institutions offering physics degrees. Together these institutions graduate about 300 high-school physics teachers per year, addressing a significant fraction of the growing national need for 1400 new physics teachers per year. PhysTEC also organizes conferences and workshops, publishes articles and reports, and hosts listservs and websites (phystec.org and ptec.org) to more broadly connect with the physics community.

Highlights

Manufacturing Goes Viral

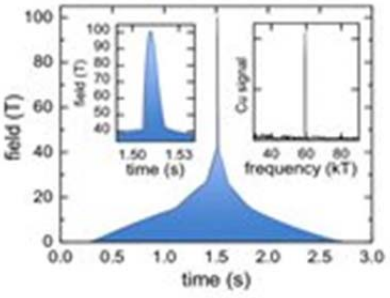
Using a simple, single-step process, engineers and scientists at the University of California at Berkeley, led by bioengineer Seung-Wuk Lee and his student and lead author Woo-Jae Chung, recently developed a technique to direct benign, filamentous viruses called M13 phages to serve as structural building blocks for materials with a wide range of properties. By controlling the physical environment alone, the researchers caused the viruses to self-assemble into hierarchically organized thin-film structures, with complexity that ranged from simple ridges, to wavy, chiral strands, to truly sophisticated patterns of overlapping strings of material. These results may also shed light on the self-assembly of biological tissues in nature. This novel, self-templating, biomaterials assembly process could be used in many other organic and inorganic materials to build hierarchical structures to tune optical, mechanical and even electrical properties from nano to macro scales. The reported approaches could be used to investigate mechanisms for diseases such as Alzheimer's, which is caused by amyloid aggregation in our brain tissues. More broadly, the breakthroughs could potentially yield scientific impacts in the area of tissue regeneration and repair.



Credit: Zina Deretsky, National Science Foundation

Super Magnet Breaks the Megagauss Barrier

Scientists and engineers at the National High Magnetic Field Laboratory (NHMFL) have successfully produced the highest nondestructive magnetic field ever – a field surpassing 100 tesla or 2 million times the Earth's magnetic field. Researchers will use this unprecedented tool to study a range of scientific activities--from unusual magnetic behaviors in materials to the quantum behavior of phase transitions in solids. The new magnet system--located at Los Alamos National Laboratory – achieved 100.75 tesla on March 22, 2012. The system is designed to pulse nondestructively in the intense 100-tesla realm on a regular basis. Magnets capable of higher field strengths have been created, but they explode after use because they cannot withstand the intense strength of the force created. The new magnet will also help researchers discover why superconductivity occurs in a newly discovered family of iron-based materials. This group of superconductors yields only to the highest magnetic fields. Superconducting magnets are used in everything from particle accelerators to magnetic resonance imaging machines. Nondestructive generation of 100 tesla magnetic fields has been a National Academy of Sciences Grand Challenge and a 15-year goal of the NHMFL. The project was jointly funded by the National Science Foundation and the Department of Energy.



Credit: Greg Boebinger, NHMFL, FSU

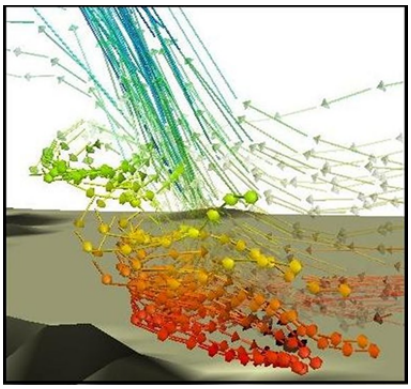
Highlights

State-of-the-Art Virtual Reality System is Key to Medical Discovery

Credit: Electronic Visualization Laboratory
University of Illinois at Chicago

A team of neurosurgeons from the College of Medicine at the University of Illinois at Chicago (UIC) recently stepped into CAVE2 – a next-generation, large-scale, virtual environment – to solve a vexing problem that presented itself in the arteries of the brain of a real patient. For years, the team had painstakingly used laptop and desktop computers to create three-dimensional, full-brain models that physiologically mirrored the brains of individual patients. These models were used for a patient whose cerebrovascular system they were trying to accurately model. But because of the limited image spatial-resolution of even today's best-quality computers, there was something the neurosurgeons couldn't see. That is, until they stepped into an automatic virtual environment, also known as a "CAVE" – a room in which images are seamlessly displayed so as to immerse an observer in a cyber-world of 3-D data. CAVE2 helped the team discover quickly that their model was “inconsistent with anatomy” – and with that revelation, their model could be corrected. The use of UIC's virtual reality system to make the discovery could help change the way surgeons are trained and greatly improve patient care – and the method could someday benefit hundreds of thousands of Americans who fall victim to brain aneurysms and strokes, the third leading cause of death in the United States. CAVE2 is funded through NSF's Major Research Instrumentation program and the Department of Energy.

Improving Tropical Cyclone Forecasts



Credit: Wallace Hogsett and Da-Lin Zhang
University of Maryland

Accurate tropical cyclone forecasts require prediction of tropical weather over vast tropical oceans; however, predicting cyclone formation is difficult due to the lack of direct observations in the formation regions and deficiencies in current models. The Weather Research and Forecasting (WRF) numerical model has captured the formation of a tropical cyclone within an area of disturbed weather associated with the Madden-Julian Oscillation (MJO) – a variable pattern of wind, rain, ocean temperature and cloudiness in the tropics. Results from the WRF research may lead the way to better modeling of tropical disturbances and improved forecasts to alert those in the tropics of potential cyclones. University of Maryland researchers have demonstrated that high-resolution models can describe slowly-evolving tropical weather patterns such as the MJO. Moreover, their results suggest that transient and small-scale weather phenomena such as tropical cyclones which develop within the disturbed weather associated with the MJO may be predictable.

SUMMARY TABLES

Total NSF Funding:

Major NSF-wide Investments:

Education:

Research Infrastructure:

National Science Foundation
Summary Table
FY 2014 Request to Congress

(Dollars in Millions)

NSF by Account	FY 2012 Actual	FY 2012[1] Enacted/ Annualized FY 2013 CR	FY 2014 Request	FY 2014 Request over: FY 2012 Actual Amount	FY 2012 Actual Percent	FY 2012 Enacted Amount	FY 2012 Enacted Percent
BIO	$712.28	$712.38	$760.58	$48.30	6.8%	$48.20	6.8%
CISE[2]	937.16	865.23	950.25	13.09	1.4%	85.02	9.8%
ENG	824.55	826.17	911.12	*86.57*	*10.5%*	*84.95*	*10.3%*
Eng Programs	*677.69*	*673.41*	*733.97*	*56.28*	*8.3%*	*60.56*	*9.0%*
SBIR/STTR	*146.86*	*152.76*	*177.15*	*30.29*	*20.6%*	*24.39*	*16.0%*
GEO[2]	1,321.37	1,321.14	1,393.86	72.49	5.5%	72.72	5.5%
MPS	1,308.70	1,308.94	1,386.12	77.42	5.9%	77.18	5.9%
SBE	254.19	254.25	272.35	18.16	7.1%	18.10	7.1%
IIA[2]	398.60	399.44	536.62	138.02	34.6%	137.18	34.3%
US ARCTIC RESEARCH COMMISSION	1.45	1.45	1.40	-0.05	-3.8%	-0.05	-3.8%
Research & Related Activities	**$5,758.30**	**$5,689.00**	**$6,212.29**	**$453.99**	**7.9%**	**$523.29**	**9.2%**
Education & Human Resources	**$830.54**	**$829.00**	**$880.29**	**$49.75**	**6.0%**	**$51.29**	**6.2%**
Major Research Equipment & Facilities Construction	**$198.08**	**$197.06**	**$210.12**	**$12.04**	**6.1%**	**$13.07**	**6.6%**
Agency Operations & Award Management	**$299.30**	**$299.40**	**$304.29**	**$4.99**	**1.7%**	**$4.89**	**1.6%**
National Science Board	**$4.37**	**$4.44**	**$4.47**	**$0.10**	**2.3%**	**$0.03**	**0.7%**
Office of Inspector General	**$14.12**	**$14.20**	**$14.32**	**$0.20**	**1.4%**	**$0.12**	**0.8%**
OIG FY 2012 ARRA Actual Obligations	$0.70						
FY 2013 Adjustment[3]		$43.04					
Total, NSF	**$7,105.41**	**$7,076.14**	**$7,625.78**	**$520.37**	**7.3%**	**$592.69**	**8.4%**

Totals may not add due to rounding.

[1] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore, these accounts were operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders based on the FY 2012 Current Plan. The Annualization of P.L. 112-175 is reflected in the FY 2013 Adjustment row.

[2] In FY 2013, a realignment of offices previously under the Office of the Director was implemented: the Office of Cyberinfrastructure (OCI) is now the Advanced Cyberinfrastructure (ACI) division in the Directorate for Computer and Information Science and Engineering (CISE); the Office of Polar Programs (OPP) is now the Division of Polar Programs (PLR) in the Directorate for Geosciences (GEO); and the Office of International Science and Engineering (OISE) has been merged with Integrative Activities (IA) to form International and Integrative Activities (IIA).

[3] This budget line is included to adjust for the 0.612 percent increase provided by the FY 2013 continuing resolution (P.L. 112-175). By account, the amounts are: R&RA - $34,816,680; EHR - $5,073,480; MREFC - $1,205,977; AOAM - $1,832,328; NSB - $27,173; and OIG - $86,904.

NSF Funding Profile

The Funding Profile presents a high level, agency-wide estimate of proposal pressure, funding rates (or proposal "success"), and award statistics. These indicators are useful in gauging the relative efficacy of different funding levels.

Statistics for Competitive Awards: Competitive awards encompass the universe of NSF new activity in a given year. Examples include research grants, cooperative agreements, equipment, fellowships, and conferences. The Number of Proposals is based on several factors, including past actual activity, planned competitions, and research trends within the various disciplinary communities. External factors, such as the state of the national economy and other sources of funding, also play a part. The Number of Awards is also based on several factors, including estimated funding and expected proposal pool. The Funding Rate is the number of competitive awards made during a year as a percentage of total proposals competitively reviewed. This indicates the probability of receiving an award when submitting proposals to NSF.

Statistics for Research Grants: Research Grants are a sub-set of competitive awards. The Number of Proposals is based on several factors, including past actual activity, planned competitions, and research trends within the various disciplinary communities. External factors, such as the state of the national economy and other sources of funding, also play a part. The Number of Awards is also based on several factors, including estimated funding and expected proposal pool. Research Grants are grants limited to research projects and exclude other categories of awards such as those for cooperative agreements, equipment, fellowships, and conferences. Annualized Award Size shows the annual level of research grants provided to awardees by dividing the total dollars of each award by the number of years over which it extends. Both the average and the median annualized award size for competitively reviewed awards are shown. Average Duration is the length of awards in years.

NSF Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate[1]	FY 2014 Estimate
Statistics for Competitive Awards			
Number of Proposals	48,600	55,100	53,200
Number of Awards	11,500	11,700	12,600
Funding Rate	24%	21%	24%
Statistics for Research Grants			
Number of Research Grant Proposals	36,900	41,400	40,000
Number of Research Grant Awards	7,900	7,800	8,800
Funding Rate	21%	19%	22%
Median Annualized Award Size	$131,200	$128,500	$133,950
Average Annualized Award Size	$164,700	$161,200	$168,600
Average Duration (years)	2.9	3.0	2.9

[1] Award estimates for FY 2013, such as numbers of awards and size/duration, are based upon the FY 2012 enacted level.

Number of People Involved in NSF Activities

NSF estimates that in FY 2014 more than 342,900 people will be directly involved in NSF programs and activities, receiving salaries, stipends, participant support, and other types of direct involvement. Beyond these figures, NSF programs indirectly impact millions of people, reaching K-12 students and teachers, the general public, and researchers through activities including workshops; informal science activities such as museums, television, videos, and journals; outreach efforts; and dissemination of improved curriculum and teaching methods.

FY 2014 Request
Number of People Involved in NSF Activities

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	56,289	52,200	57,700
Other Professionals	14,108	14,620	15,520
Postdoctoral Associates	6,025	6,420	6,420
Graduate Students	42,257	39,700	44,500
Undergraduate Students	30,637	26,500	29,300
K-12 Teachers	44,812	52,600	53,700
K-12 Students	125,469	134,500	135,800
TOTAL, PEOPLE	**319,597**	**326,540**	**342,940**

Senior Researchers include scientists, mathematicians, engineers, and educators receiving funding through NSF awards. These include both researchers who are principal or co-principal investigators on research and education projects, and researchers working at NSF-supported centers and facilities.

Other Professionals are individuals who may or may not hold a doctoral degree or its equivalent, are considered professionals but are not reported as senior researchers, postdoctoral associates, or students. Examples are technicians, systems experts, etc.

Postdoctoral Associates are individuals who have received Ph.D., M.D., D.Sc., or equivalent and are not faculty members of the performing institution. About 97 percent are supported through funds included in research projects, centers, or facilities awards. Others are recipients of postdoctoral fellowships.

Graduate Students include those compensated from NSF grant funds. About 30 percent receive support through NSF's fellowship and traineeship programs. Other graduate students are supported through research assistantships and assist senior researchers or postdoctoral associates in performing research through awards for research projects, centers, or facilities. NSF provides support for approximately 27 percent of the U.S. science and engineering graduate students receiving federal funds and about 5 percent of the science and engineering graduate students in the U.S. overall.

Undergraduate Students include students compensated from NSF grant funds who are enrolled in technical colleges or baccalaureate programs. They may be assisting senior researchers or postdoctoral associates in performing research, or participating in NSF programs aimed at undergraduate students, such as Research Experiences for Undergraduates.

K-12 Teachers include teachers at elementary, middle, and secondary schools. These individuals actively participate in intensive professional development experiences in the sciences and mathematics.

K-12 Students are those attending elementary, middle, and secondary schools. They are supported through program components that directly engage students in science and mathematics experiences.

NSF Budget Requests and Appropriations By Account: FY 1999 - FY 2014

(Millions of Current Dollars)

Click here for complete history

	Research & Related Activities (R&RA)		Education & Human Resources (EHR)		Major Research Equipment & Facilities Construction (MREFC)[1]		Agency Operations & Award Management (AOAM)[2]		Office of Inspector General (OIG)		National Science Board (NSB)		NSF, TOTAL	
Fiscal Year	Request	Appropriation	Request	Appropriation	Request	Appropriation	Request	Appropriation	Request	Appropriation	Request	Appropriation	Request	Appropriation
1999	$2,846.80	$2,774.89	$683.00	$661.84	$94.00	$90.00	$144.00	$144.11	$5.20	$5.20	-	-	$3,773.00	$3,676.05
2000	3,004.00	2,972.90	678.00	690.87	85.00	93.50	149.00	149.28	5.45	5.45	-	-	3,921.45	3,912.00
2001	3,540.68	3,356.29	729.01	785.60	138.54	121.33	157.89	161.09	6.28	6.27	-	-	4,572.40	4,430.57
2002	3,326.98	3,612.26	872.41	894.28	96.33	138.80	170.04	171.26	6.76	6.75	-	-	4,472.52	4,823.35
2003	3,783.21	4,069.29	908.08	903.17	126.28	148.54	210.16	189.43	8.06	9.19	-	3.48	5,035.79	5,323.09
2004	4,106.36	4,262.12	938.04	938.98	202.33	154.98	225.70	218.96	8.77	9.94	-	3.88	5,481.20	5,588.86
2005	4,452.31	4,229.98	771.36	841.42	213.27	173.65	294.00	223.45	10.11	10.03	3.95	3.97	5,745.00	5,482.49
2006	4,333.49	4,339.21	737.00	796.69	250.01	190.88	269.00	247.06	11.50	11.35	4.00	3.95	5,605.00	5,589.14
2007	4,665.95	4,654.24	816.22	796.59	240.45	175.61	281.82	248.50	11.86	10.97	3.91	3.97	6,020.21	5,889.87
2008	5,131.69	4,841.73	750.60	765.60	244.74	220.74	285.59	281.79	12.35	11.43	4.03	3.97	6,429.00	6,125.26
2009	*5,593.99*	*5,186.17*	*790.41*	*845.26*	*147.51*	*152.01*	*305.06*	*294.15*	*13.10*	*12.00*	*4.03*	*4.03*	*6,854.10*	*6,493.61*
2009 ARRA	-	*2,500.00*	-	*100.00*	-	*400.00*		-	-	*2.00*		-	-	*3,002.00*
2009 Total	5,593.99	7,686.17	790.41	945.26	147.51	552.01	305.06	294.15	13.10	14.00	4.03	4.03	6,854.10	9,495.61
2010	5,733.24	5,563.92	857.76	872.76	117.29	117.29	318.37	300.00	14.00	14.00	4.34	4.54	7,045.00	6,872.51
2011	6,018.83	5,509.98	892.00	861.03	165.19	117.06	329.19	299.40	14.35	13.97	4.84	4.53	7,424.40	6,805.98
2012	6,253.54	5,689.00	911.20	829.00	224.68	197.06	357.74	299.40	15.00	14.20	4.84	4.44	7,767.00	7,033.10
2013[3]	5,983.28	-	875.61	-	196.17	-	299.40	-	14.20	-	4.44	-	7,373.10	-
2014	6,212.29	-	880.29	-	210.12	-	304.29	-	14.32	-	4.47	-	7,625.78	-

Totals may not add due to rounding.

[1]The Major Research Equipment and Facilities Construction (MREFC) account was previously known as Major Research Equipment (MRE) until FY 2002.

[2]The Agency Operations and Award Management (AOAM) account was known as Salaries & Expenses (S&E) until FY 2008.

[3] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore, these accounts were operating under a continuing resolution (P.L. 112-175).

National Science Foundation
Selected Crosscutting Programs
FY 2014 Request to Congress
(Dollars in Millions)

Selected Cross-Cutting Programs[1]		FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	FY 2014 Request change over: FY 2012 Actual Amount	FY 2012 Actual Percent	FY 2012 Enacted Amount	FY 2012 Enacted Percent
ADVANCE	Research & Related Activities	16.29	16.42	15.35	-0.94	-5.8%	-1.07	-6.5%
	Education & Human Resources	1.49	1.53	1.28	-0.21	-14.1%	-0.25	-16.3%
	Total, NSF	**$17.78**	**$17.95**	**$16.63**	**-$1.15**	**-6.5%**	**-$1.32**	**-7.4%**
Catalyzing Advances in Undergraduate STEM Education - CAUSE[2]	Research & Related Activities	*37.74*	*36.20*	26.00	-11.74	-31.1%	-10.20	-28.2%
	Education & Human Resources	*77.07*	*77.26*	97.08	20.01	26.0%	19.82	25.7%
	Total, NSF	***$114.81***	***$113.46***	**$123.08**	**$8.27**	**7.2%**	**$9.62**	**8.5%**
Cyberlearning Transforming Education - CTE	Research & Related Activities	12.13	11.00	15.00	2.87	23.7%	4.00	36.4%
	Education & Human Resources	20.08	20.08	15.08	-5.00	-24.9%	-5.00	-24.9%
	Total, NSF	**$32.21**	**$31.08**	**$30.08**	**-$2.13**	**-6.6%**	**-$1.00**	**-3.2%**
Enhancing Access to the Radio Spectrum - EARS	Research & Related Activities	15.00	15.00	50.00	35.00	233.3%	35.00	233.3%
	Education & Human Resources	-	-	-	-	N/A	-	N/A
	Total, NSF	**$15.00**	**$15.00**	**$50.00**	**$35.00**	**233.3%**	**$35.00**	**233.3%**
Ethics Education in Science and Engineering - EESE	Research & Related Activities	2.99	2.45	2.44	-0.55	-18.4%	-0.01	-0.4%
	Education & Human Resources	0.07	0.30	-	-0.07	-100.0%	-0.30	-100.0%
	Total, NSF	**$3.06**	**$2.75**	**$2.44**	**-$0.62**	**-20.3%**	**-$0.31**	**-11.3%**
Faculty Early Career Development - CAREER	Research & Related Activities	232.49	206.35	223.73	-8.76	-3.8%	17.38	8.4%
	Education & Human Resources	-	-	-	-	N/A	-	N/A
	Total, NSF	**$232.49**	**$206.35**	**$223.73**	**-$8.76**	**-3.8%**	**$17.38**	**8.4%**
National Graduate Research Fellowship - NGRF	Research & Related Activities	88.70	88.50	162.57	73.87	83.3%	74.07	83.7%
	Education & Human Resources	109.24	109.64	162.57	53.33	48.8%	52.93	48.3%
	Total, NSF	**$197.93**	**$198.14**	**$325.14**	**$127.21**	**64.3%**	**$127.00**	**64.1%**
Graduate STEM Fellows in K-12 Education - GK-12	Research & Related Activities	0.01	-	-	-0.01	-100.0%	-	N/A
	Education & Human Resources	27.92	26.95	-	-27.92	-100.0%	-26.95	-100.0%
	Total, NSF	**$27.93**	**$26.95**	**-**	**-$27.93**	**-100.0%**	**-$26.95**	**-100.0%**
NSF Research Traineeships - NRT[3]	Research & Related Activities	34.42	28.62	28.74	-5.68	-16.5%	0.12	0.4%
	Education & Human Resources	31.01	31.20	26.33	-4.68	-15.1%	-4.87	-15.6%
	Total, NSF	**$65.43**	**$59.82**	**$55.07**	**-$10.36**	**-15.8%**	**-$4.75**	**-7.9%**
Total, Graduate Fellowships & Traineeships	Research & Related Activities	123.13	117.12	191.31	68.18	55.4%	74.19	63.3%
	Education & Human Resources	168.16	167.79	188.90	20.74	12.3%	21.11	12.6%
	Total, NSF	**$291.29**	**$284.91**	**$380.21**	**$88.92**	**30.5%**	**$95.30**	**33.4%**
Long-Term Ecological Research Sites - LTERs	Research & Related Activities	29.65	27.40	27.59	-2.06	-7.0%	0.19	0.7%
	Education & Human Resources	-	-	-	-	N/A	-	N/A
	Total, NSF	**$29.65**	**$27.40**	**$27.59**	**-$2.06**	**-7.0%**	**$0.19**	**0.7%**
Research Experiences for Teachers - RET	Research & Related Activities	7.87	6.98	6.95	-0.92	-11.6%	-0.03	-0.4%
	Education & Human Resources	-	-	-	-	N/A	-	N/A
	Total, NSF	**$7.87**	**$6.98**	**$6.95**	**-$0.92**	**-11.6%**	**-$0.03**	**-0.4%**
Research Experiences for Undergraduates - REU - Sites Only	Research & Related Activities	59.59	48.27	56.68	-2.91	-4.9%	8.41	17.4%
	Education & Human Resources	-	-	-	-	N/A	-	N/A
	Total, NSF	**$59.59**	**$48.27**	**$56.68**	**-$2.91**	**-4.9%**	**$8.41**	**17.4%**
Research Experiences for Undergraduates - REU - Supplements Only	Research & Related Activities	19.95	17.72	22.50	2.55	12.8%	4.78	27.0%
	Education & Human Resources	-	-	-	-	N/A	-	N/A
	Total, NSF	**$19.95**	**$17.72**	**$22.50**	**$2.55**	**12.8%**	**$4.78**	**27.0%**
Total, Research Experiences for Undergraduates - REU	Research & Related Activities	79.55	65.99	79.18	-0.37	-0.5%	13.19	20.0%
	Education & Human Resources	-	-	-	-	N/A	-	N/A
	Total, NSF	**$79.55**	**$65.99**	**$79.18**	**-$0.37**	**-0.5%**	**$13.19**	**20.0%**
Research in Undergraduate Institutions - RUI	Research & Related Activities	41.51	40.15	39.95	-1.56	-3.8%	-0.20	-0.5%
	Education & Human Resources	-	-	-	-	N/A	-	N/A
	Total, NSF	**$41.51**	**$40.15**	**$39.95**	**-$1.56**	**-3.8%**	**-$0.20**	**-0.5%**

Totals may not add due to rounding.

[1] For information related to the Selected Crosscutting Programs included in this table, see the Selected Crosscutting Programs narrative in the NSF-Wide Investments chapter.

[2] Catalyzing Advances in Undergraduate STEM Education (CAUSE) is a new program proposed for FY 2014. For comparability purposes, funding for FY 2012 Actual and FY 2012 Enacted/FY 2013 Annualized CR includes programs that have been consolidated into CAUSE. These include Climate Change Education (CCE); Engineering Education (EE); Geoscience Education; Nanotechnology Undergraduate Education in Engineering (NUE); Opportunities for Enhancing Diversity in the Geosciences (OEDG); Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP); Transforming Undergraduate Biology Education (TUBE); Transforming Undergrad Education in STEM (TUES); and Widening Implementation and Demonstration of Evidence-based Reforms (WIDER).

[3] NSF Research Traineeships is a new program in FY 2014. Included in this line are continuing grant increments for the Integrative Graduate Education Research Traineeship (IGERT) program.

National Science Foundation
NSTC Crosscuts Summary
FY 2014 Request to Congress

(Dollars in Millions)

	National Nanotechnology Initiative (NNI)						
				FY 2014 Request change over:			
				FY 2012 Actual		FY 2012 Enacted	
	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Amount	Percent	Amount	Percent
BIO	$54.07	$56.10	$57.10	$3.03	5.6%	$1.00	1.8%
CISE	13.89	17.75	14.00	0.11	0.8%	-3.75	-21.1%
ENG	183.22	166.37	174.75	-8.47	-4.6%	8.38	5.0%
GEO	0.85	0.85	0.30	-0.55	-64.7%	-0.55	-64.7%
MPS	209.99	183.16	181.56	-28.43	-13.5%	-1.60	-0.9%
SBE	1.67	1.67	0.60	-1.07	-64.1%	-1.07	-64.1%
IIA	0.10	0.10	0.10	-	-	-	-
R&RA	**$463.79**	**$426.00**	**$428.41**	**-$35.38**	**-7.6%**	**$2.41**	**0.6%**
EHR	**$2.50**	**-**	**$2.50**	**-**	**-**	**$2.50**	**N/A**
NSF Total	**$466.29**	**$426.00**	**$430.91**	**-$35.38**	**-7.6%**	**$4.91**	**1.2%**

	Networking & Information Technology R&D (NITRD)						
				FY 2014 Request change over:			
				FY 2012 Actual		FY 2012 Enacted	
	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Amount	Percent	Amount	Percent
BIO	$99.00	$99.00	$99.00	-	-	-	-
CISE	937.11	865.23	950.25	13.14	1.4%	85.02	9.8%
ENG	18.30	18.30	19.80	1.50	8.2%	1.50	8.2%
GEO	20.00	22.98	24.00	4.00	20.0%	1.02	4.4%
MPS	101.25	93.75	94.15	-7.10	-7.0%	0.40	0.4%
SBE	31.09	29.51	30.70	-0.39	-1.3%	1.19	4.0%
IIA	-	-	-	-	N/A	-	N/A
R&RA	**$1,206.75**	**$1,128.77**	**$1,217.90**	**$11.15**	**0.9%**	**$89.13**	**7.9%**
EHR	**$9.50**	**$9.50**	**$9.50**	**-**	**-**	**-**	**-**
NSF Total	**$1,216.25**	**$1,138.27**	**$1,227.40**	**$11.15**	**0.9%**	**$89.13**	**7.8%**

	U.S. Global Change Research Program (USGCRP)						
				FY 2014 Request change over:			
				FY 2012 Actual		FY 2012 Enacted	
	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Amount	Percent	Amount	Percent
BIO	$89.00	$89.00	$91.00	$2.00	2.2%	$2.00	2.2%
CISE	-	-	-	-	N/A	-	N/A
ENG	-	-	-	-	N/A	-	N/A
GEO	217.10	217.10	205.15	-11.95	-5.5%	-11.95	-5.5%
MPS	5.03	5.03	7.00	1.97	39.2%	1.97	39.2%
SBE	22.23	22.23	23.23	1.00	4.5%	1.00	4.5%
IIA	-	-	-	-	N/A	-	N/A
R&RA	**$333.36**	**$333.36**	**$326.38**	**-$6.98**	**-2.1%**	**-$6.98**	**-2.1%**
EHR	**-**	**-**	**-**	**-**	**N/A**	**-**	**N/A**
NSF Total	**$333.36**	**$333.36**	**$326.38**	**-$6.98**	**-2.1%**	**-$6.98**	**-2.1%**

Totals may not add due to rounding.

National Science Foundation
Homeland Security Activities Summary
FY 2014 Request to Congress
(Dollars in Millions)

	BIO	CISE	ENG	GEO	MPS	SBE	IIA	R&RA	EHR	AOAM	Total, NSF
FY 2012 Actual	**$15.00**	**$200.80**	**$156.00**	**$2.88**	**$3.20**	**$13.08**	**$2.67**	**$393.63**	**$45.40**	**$2.66**	**$441.69**
Protecting Critical Infrastructure & Key Assets	**-**	**$200.80**	**$156.00**	**$2.88**	**$3.20**	**$13.08**	**$2.67**	**$378.63**	**$45.40**	**$2.66**	**$426.69**
Antarctic Physical Security	-	-	-	0.30	-	-	-	**0.30**	-	-	**0.30**
Counterterrorism	-	27.00	-	-	-	-	-	**27.00**	-	-	**27.00**
Cybersecurity	-	144.50	5.00	-	0.50	7.58	-	**157.58**	-	-	**157.58**
Electronic Commerce	-	4.50	3.00	-	-	-	-	**7.50**	-	-	**7.50**
Emergency Planning & Response	-	24.80	25.00	-	2.00	-	-	**51.80**	-	-	**51.80**
Energy Supply Assurance	-	-	28.00	-	-	-	-	**28.00**	-	-	**28.00**
IT Security	-	-	-	2.58	-	-	2.67	**5.25**	0.42	2.66	**8.33**
Resilient Infrastructure	-	-	95.00	-	0.70	5.50	-	**101.20**	-	-	**101.20**
Cybercorps: Scholarship for Service	-	-	-	-	-	-	-	**-**	44.98	-	**44.98**
Defending Against Catastrophic Threats	**$15.00**	**-**	**-**	**-**	**-**	**-**	**-**	**$15.00**	**-**	**-**	**$15.00**
Research to Combat Bioterrorism - Microbial Genomics, Analysis & Modeling	15.00	-	-	-	-	-	-	**15.00**	-	-	**15.00**
FY 2012 Enacted / Annualized FY 2013 CR	**$15.00**	**$200.80**	**$156.70**	**$4.30**	**$4.80**	**$11.50**	**$2.58**	**$395.68**	**$45.38**	**$2.79**	**$443.85**
Protecting Critical Infrastructure & Key Assets	**-**	**$200.80**	**$156.70**	**$4.30**	**$4.80**	**$11.50**	**$2.58**	**$380.68**	**$45.38**	**$2.79**	**$428.85**
Antarctic Physical Security	-	-	-	0.30	-	-	-	**0.30**	-	-	**0.30**
Counterterrorism	-	27.00	-	-	-	-	-	**27.00**	-	-	**27.00**
Cybersecurity	-	144.50	5.05	-	1.00	6.00	-	**156.55**	-	-	**156.55**
Electronic Commerce	-	4.50	3.35	-	-	-	-	**7.85**	-	-	**7.85**
Emergency Planning & Response	-	24.80	25.30	-	3.10	-	-	**53.20**	-	-	**53.20**
Energy Supply Assurance	-	-	28.00	-	-	-	-	**28.00**	-	-	**28.00**
IT Security	-	-	-	4.00	-	-	2.58	**6.58**	0.38	2.79	**9.75**
Resilient Infrastructure	-	-	95.00	-	0.70	5.50	-	**101.20**	-	-	**101.20**
Cybercorps: Scholarship for Service	-	-	-	-	-	-	-	**-**	45.00	-	**45.00**
Defending Against Catastrophic Threats	**$15.00**	**-**	**-**	**-**	**-**	**-**	**-**	**$15.00**	**-**	**-**	**$15.00**
Research to Combat Bioterrorism - Microbial Genomics, Analysis & Modeling	15.00	-	-	-	-	-	-	**15.00**	-	-	**15.00**
Delta from FY 2012 Enacted	**-**	**$2.50**	**-$0.80**	**-$0.99**	**-$0.60**	**-$0.50**	**$0.02**	**-$0.37**	**-$20.02**	**-$0.45**	**-$20.84**
Protecting Critical Infrastructure & Key Assets	**-**	**$2.50**	**-$0.80**	**-$0.99**	**-$0.60**	**-$0.50**	**$0.02**	**-$0.37**	**-$20.02**	**-$0.45**	**-$20.84**
Antarctic Physical Security	-	-	-	-	-	-	-	**-**	-	-	**-**
Counterterrorism	-	-	-	-	-	-	-	**-**	-	-	**-**
Cybersecurity	-	2.50	-0.80	-	1.00	-	-	**2.70**	-	-	**2.70**
Electronic Commerce	-	-	-	-	-	-	-	**-**	-	-	**-**
Emergency Planning & Response	-	-	-	-	-1.60	-	-	**-1.60**	-	-	**-1.60**
Energy Supply Assurance	-	-	-	-	-	-	-	**-**	-	-	**-**
IT Security	-	-	-	-0.99	-	-	0.02	**-0.97**	-0.02	-0.45	**-1.44**
Resilient Infrastructure	-	-	-	-	-	-0.50	-	**-0.50**	-	-	**-0.50**
Cybercorps: Scholarship for Service	-	-	-	-	-	-	-	**-**	-20.00	-	**-20.00**
Defending Against Catastrophic Threats	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Research to Combat Bioterrorism - Microbial Genomics, Analysis & Modeling	-	-	-	-	-	-	-	**-**	-	-	**-**
FY 2014 Request	**$15.00**	**$203.30**	**$155.90**	**$3.31**	**$4.20**	**$11.00**	**$2.60**	**$395.31**	**$25.36**	**$2.34**	**$423.01**
Protecting Critical Infrastructure & Key Assets	**-**	**$203.30**	**$155.90**	**$3.31**	**$4.20**	**$11.00**	**$2.60**	**$380.31**	**$25.36**	**$2.34**	**$408.01**
Antarctic Physical Security	-	-	-	0.30	-	-	-	**0.30**	-	-	**0.30**
Counterterrorism	-	27.00	-	-	-	-	-	**27.00**	-	-	**27.00**
Cybersecurity	-	147.00	4.25	-	2.00	6.00	-	**159.25**	-	-	**159.25**
Electronic Commerce	-	4.50	3.35	-	-	-	-	**7.85**	-	-	**7.85**
Emergency Planning & Response	-	24.80	25.30	-	1.50	-	-	**51.60**	-	-	**51.60**
Energy Supply Assurance	-	-	28.00	-	-	-	-	**28.00**	-	-	**28.00**
IT Security	-	-	-	3.01	-	-	2.60	**5.61**	0.36	2.34	**8.31**
Resilient Infrastructure	-	-	95.00	-	0.70	5.00	-	**100.70**	-	-	**100.70**
Cybercorps: Scholarship for Service	-	-	-	-	-	-	-	**-**	25.00	-	**25.00**
Defending Against Catastrophic Threats	**$15.00**	**-**	**-**	**-**	**-**	**-**	**-**	**$15.00**	**-**	**-**	**$15.00**
Research to Combat Bioterrorism - Microbial Genomics, Analysis & Modeling	15.00	-	-	-	-	-	-	**15.00**	-	-	**15.00**

Totals may not add due to rounding.

National Science Foundation
Programs to Broaden Participation
FY 2014 Request to Congress

(Dollars in Millions)

Group/Program	Amount Funding Captured	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Focused Programs		**$200.51**	**$194.32**	**$183.08**	**-$11.24**	**-5.8%**
ADVANCE	100%	17.78	17.95	16.63	-1.32	-7.4%
Alliances for Graduate Education and the Professoriate (AGEP)	100%	7.84	7.84	7.84	-	-
AGEP-Graduate Research Supplements	100%	1.50	2.00	2.00	-	-
Broadening Participation Research Initiation Grants in Engineering (BRIGE)	100%	4.99	5.00	5.00	-	-
Cyberinfrastructure Training, Education, Advancement & Mentoring (CI-TEAM)[1]	100%	2.63	4.00	-	-4.00	-100.0%
Centers of Research Excellence in Science and Technology (CREST)	100%	24.21	24.24	20.24	-4.00	-16.5%
ENG Graduate Research Diversity Supplements (GRDS)	100%	2.17	1.50	1.50	-	-
Geoscience Postdoctoral Fellowships	100%	5.42	3.09	3.82	0.73	23.6%
Research on Gender in Science and Engineering (GSE)[2]	100%	10.57	10.50	10.50	-	-
Historically-Black Colleges and Universities-Undergraduate Program (HBCU-UP)	100%	31.85	31.94	31.94	-	-
Louis Stokes Alliances for Minority Participation (LSAMP)	100%	45.48	45.62	45.62	-	-
Opportunities to Enhance Diversity in the Geosciences (OEDG)[3]	100%	8.02	3.60	-	-3.60	-100.0%
Partnerships in AST & Astrophysics Research Education (PAARE)	100%	1.00	1.00	1.00	-	-
Partnerships for Research and Education in Materials (PREM)	100%	5.84	5.58	5.86	0.28	5.0%
Pre-Engineering Education Collaboratives (PEEC)	100%	1.00	1.00	1.00	-	-
Excellence Awards in Science and Engineering (EASE)[4]	100%	5.14	5.15	4.82	-0.33	-6.4%
BIO Minority Postdoctoral Fellowships	100%	3.19	2.50	2.50	-	-
Research in Disabilities Education (RDE)[2]	100%	6.50	6.50	6.50	-	-
SBE Postdoctoral Research Fellowships-Broadening Participation [formerly SBE Minority Postdoctoral Fellowships]	100%	0.99	1.00	1.50	0.50	50.0%
SBE Science of Broadening Participation	100%	1.00	1.00	1.50	0.50	50.0%
Tribal Colleges and Universities Program (TCUP)	100%	13.39	13.31	13.31	-	-
Emphasis Programs		**$560.54**	**$543.47**	**$615.96**	**$72.49**	**13.3%**
Advancing Informal STEM Learning (AISL)	60%	37.46	36.84	28.69	-8.15	-22.1%
CAREER	51%	118.57	105.24	114.10	8.86	8.4%
Centers for Ocean Sciences Education Excellence (COSEE)[5]	68%	2.88	2.88	0.59	-2.29	-79.5%
Discovery Research K-12 (DR-K12)	76%	75.67	75.41	77.92	2.51	3.3%
Geoscience Education[3]	70%	1.08	1.05	-	-1.05	-100.0%
National Graduate Research Fellowship (NGRF)	59%	116.78	116.90	191.83	74.93	64.1%
International Research Experiences for Students (IRES)	73%	0.01	2.30	1.64	-0.66	-28.6%
Innovative Technology Experiences for Students and Teachers (ITEST)[6]	65%	14.03	16.25	16.25	-	-
NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)[6]	55%	39.91	41.25	41.25	-	-
Noyce Scholarships	65%	35.68	35.68	39.58	3.90	10.9%
Research Experiences for Undergradates (REU) - Sites and Supplements	72%	57.28	47.51	57.01	9.50	20.0%
Science, Technology, Engineering and Math Talent Expansion Program (STEP)[3]	62%	15.69	15.69	-	-15.69	-100.0%
Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships)[7]	64%	45.51	46.46	47.09	0.63	1.3%
Computing Education for the 21st Century (CE21)	*51%*	*6.71*	*7.65*	-		
Math Science Partnership (MSP)	*68%*	*38.81*	*38.81*	-		
Total, Focused and Emphasis Programs		**$761.05**	**$737.79**	**$799.04**	**$61.25**	**8.3%**

Group/Program	Amount Funding Captured	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Geographic Diversity Program		**$150.85**	**$150.90**	**$163.58**	**$12.68**	**8.4%**
EPSCoR	100%	150.85	150.90	163.58	12.68	8.4%
Total, NSF		**$866.39**	**$842.23**	**$962.62**	**$120.40**	**14.3%**

Totals may not add due to rounding.

[1] The CI-TEAM program terminated and has no funding commitments in FY 2014.

[2] Research on Gender in Science and Engineering (GSE) and Research in Disabilities Education (RDE) are components of the Research on Education and Learning (REAL) program in EHR.

[3] In FY 2014, Opportunities to Enhance Diversity in the Geosciences (OEDG), Geoscience Education, and the Science, Technology, Engineering and Math Talent Expansion Program (STEP) are consolidated into the new NSF-wide program Catalyzing Advances in Undergraduate STEM Education (CAUSE). The combined program does not meet the criteria for inclusion.

[4] The Excellence Awards in Science and Engineering (EASE) program is comprised of both Presidential Awards for Excellence in Science, Math and Engineering Mentoring (PAESMEM) and Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST).

[5] The COSEE program terminates in FY 2014.

[6] NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) and Innovative Technology Experiences for Students and Teachers (ITEST) are H1B Visa funded programs.

[7] In FY 2014, Computing Education for the 21st Century (CE21) and Math Science Partnership (MSP) are merged into Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships). Prior year funding is combined for comparability.

Focused Programs have broadening participation as an explicit goal of the program and are included at 100 percent of their funding.

Emphasis Programs have broadening participation as one of several emphases but broadening participation is not an explicit goal of the program. These programs are included at a percentage of their funding level. The percentage used equals the 3-year average percentage of the programs' award portfolio that meets one the following criteria:

- At least 50 percent of the principle investigators are from an underrepresented group;
- The award was to a Minority Serving Institution (MSI); or
- At least 50 percent of the students or postdocs supported by the grant reported themselves as members of an underrepresented group on project reports.

Geographic Diversity Programs have geographic diversity as an explicit goal of the program and are included at 100 percent of their funding.

National Science Foundation
FY 2014 STEM Education Programs by Level of Education

(Dollars in Millions)

		FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
	Minority-Serving Institutions	**$45.24**	**$45.25**	**$45.25**	**-**	**-**
UG	Historically-Black Colleges and Universities Undergraduate Program (HBCU-UP)	31.85	31.94	31.94	-	-
UG	Tribal Colleges and Universities Program (TCUP)	13.39	13.31	13.31	-	-
	Fellowships/Scholarships	**$478.28**	**$473.97**	**$555.00**	**$81.03**	**17.1%**
G	East Asia & Pacific Summer Institutes for U.S. Graduate Students (EAPSI)	1.58	2.40	2.40	-	-
G	Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21)	12.97	11.77	11.50	-0.27	-2.3%
G	CyberCorps: Scholarship for Service (SFS)	44.98	45.00	25.00	-20.00	-44.4%
G	National Graduate Research Fellowship (NGRF)	197.93	198.14	325.14	127.00	64.1%
G	Graduate Teaching Fellows in K-12 Education (GK-12)[3]	27.93	26.95	-	-26.95	-100.0%
G	NSF Research Traineeships (NRT)[1]	65.43	59.82	55.07	-4.75	-7.9%
UG	NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)	72.57	75.00	75.00	-	-
UG	Robert Noyce Scholarship (Noyce) Program	54.89	54.89	60.89	6.00	10.9%
	Other Grant Programs	**$640.67**	**$634.48**	**$642.53**	**$8.05**	**1.3%**
UG	Advanced Technological Education (ATE)	64.07	64.00	64.00	-	-
G	Alliances for Graduate Education and the Professoriate (AGEP)	7.84	7.84	7.84	-	-
UG	Catalyzing Advances in Undergraduate STEM Education (CAUSE)[2]	-	-	123.08	123.08	N/A
	Climate Change Education (CCE)	*16.02*	*10.00*	-	*-10.00*	*-100.0%*
	Engineering Education (EE)	*11.88*	*11.10*	-	*-11.10*	*-100.0%*
	Geoscience Education	*1.54*	*1.50*	-	*-1.50*	*-100.0%*
	Nanotechnology Undergraduate Education in Engineering (NUE)	*1.88*	*1.50*	-	*-1.50*	*-100.0%*
	Opportunities for Enhancing Diversity in the Geosciences (OEDG)	*8.02*	*3.60*	-	*-3.60*	*-100.0%*
	Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP)	*25.30*	*25.30*	-	*-25.30*	*-100.0%*
	Transforming Undergraduate Biology Education (TUBE)	*2.90*	*13.00*	-	*-13.00*	*-100.0%*
	Transforming Undergrad Education in STEM (TUES)	*39.06*	*39.46*	-	*-39.46*	*-100.0%*
	Widening Implementation and Demonstration of Evidence-based Reforms (WIDER)	*8.21*	*8.00*	-	*-8.00*	*-100.0%*
O&I	Centers for Ocean Sciences Education Excellence (COSEE)[3]	4.23	4.24	0.87	-3.37	-79.5%
UG	Cyberinfrastructure Training, Education, Advancement & Mentoring (CI-TEAM)[3]	2.63	4.00	-	-4.00	-100.0%
K-12	Discovery Research K-12 (DR-K12)	99.57	99.23	102.53	3.30	3.3%
O&I	Excellence Awards in Science and Engineering (EASE)	5.14	5.15	4.82	-0.33	-6.4%
K-12	Geoscience Teacher Training (GEO-Teach)[3]	1.98	2.00	-	-2.00	-100.0%
K-12	Global Learning and Observations to Benefit the Environment (GLOBE)[3]	0.87	1.10	-	-1.10	-100.0%
O&I	Advancing Informal STEM Learning (AISL)	62.43	61.40	47.82	-13.58	-22.1%
K-12	Innovative Technology Experiences for Students and Teachers (ITEST)	21.59	25.00	25.00	-	-
UG	International Research Experiences for Students (IRES)	0.01	3.15	2.25	-0.90	-28.6%
UG	Louis Stokes Alliances for Minority Participation (LSAMP)	45.48	45.62	45.62	-	-
K-12	Research Experiences for Teachers (RET) in Engineering and Computer Science	6.09	5.50	5.50	-	-
UG	Research Experiences for Undergraduates (REU) - Sites and Supplements	79.55	65.99	79.18	13.19	20.0%
K-12	Research on Education and Learning (REAL)	54.16	54.72	60.44	5.72	10.5%
K-12	Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships)[4]	70.22	72.08	73.58	1.50	2.1%
	Computing Education for the 21st Century (CE21)	*13.15*	*15.00*	-		
	Math and Science Partnership (MSP)	*57.07*	*57.08*	-		
Subtotal, Above Categories		**$1,164.19**	**$1,153.70**	**$1,242.78**	**$89.08**	**7.7%**

G	**NSF Postdoctoral Programs**	**$29.97**	**$21.72**	**$26.22**	**$4.50**	**20.7%**
	BIO Postdoctoral Research Fellowships in Biology	8.12	3.80	7.80	4.00	105.3%
	GEO Postdoctoral Fellowships Programs	5.42	3.09	3.82	0.73	23.6%
	MPS Astronomy and Astrophysics Postdoctoral Fellowships	2.19	2.40	2.20	-0.20	-8.3%
	MPS Math Sciences Postdoctoral Research Fellowships	6.45	3.93	4.10	0.17	4.3%
	SBE Postdoctoral Research Fellowships-Broadening Participation [formerly SBE Minority Postdoctoral Fellowship]	0.99	1.00	1.50	0.50	50.0%
	SBE Postdoctoral Research Fellowships-Interdisc. Rsrch in Behav. & Soc. Sci. [1]	-	-	1.50	1.50	N/A
	CISE Cyberinfrastructure Postdoctoral Fellowship (CI TRaCS)	1.49	2.00	1.70	-0.30	-15.0%
	IIA International Research Fellowship program	4.56	4.50	3.60	-0.90	-20.0%
	GEO Polar Postdoctoral Fellowships [5]	0.75	1.00	-	-1.00	-100.0%
K-12 STEM Education Programs (K-12) Subtotal		**$254.48**	**$259.63**	**$267.05**	**$7.42**	**2.9%**
Undergraduate STEM Education Programs (UG) Subtotal		**$479.25**	**$471.36**	**$495.27**	**$23.91**	**5.1%**
Graduate STEM Education Programs (G) Subtotal		**$388.63**	**$373.64**	**$453.17**	**$79.53**	**21.3%**
Outreach & Informal Education STEM Education Programs (O&I) Subtotal		**$71.80**	**$70.79**	**$53.51**	**-$17.28**	**-24.4%**
TOTAL, NSF STEM Education		**$1,194.16**	**$1,175.42**	**$1,269.00**	**$93.58**	**8.0%**

Totals may not add due to rounding.

[1] NSF Research Traineeships (NRT) and SBE Postdoctoral Research Fellowships-Interdisciplinary Research in Behavioral & Social Sciences (SPRF-IBSS) are new programs proposed for FY 2014. Funding for NRT includes continuting grant increments for the Integrative Graduate Education Research Traineeship (IGERT) program.

[2] Catalyzing Advances in Undergraduate STEM Education (CAUSE) is a new program proposed for FY 2014. It is created by consolidating Climate Change Education (CCE); Engineering Education (EE); Geoscience Education; Nanotechnology Undergraduate Education in Engineering (NUE); Opportunities for Enhancing Diversity in the Geosciences (OEDG); Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP); Transforming Undergraduate Biology Education (TUBE); Transforming Undergrad Education in STEM (TUES); and Widening Implementation and Demonstration of Evidence-based Reforms (WIDER).

[3] The Graduate Teaching Fellows in K-12 Education (GK-12), Cyberinfrastructure Training, Education, Advancement & Mentoring (CI-TEAM), Geoscience Teacher Training (GEO-Teach), and Global Learning and Observations to Benefit the Environment (GLOBE) programs terminated and have no funding commitments in FY 2014. Centers for Ocean Sciences Education Excellence (COSEE) terminates in FY 2014 and funding is for continuing grant increments only.

[4] In FY 2014 Computing Education for the 21st Century (CE21) and Math Science Partnership (MSP) are merged into Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships). Prior year funding is combined for comparability.

[5] Polar Postdocs will be competed on a biannual basis beginning in FY 2015. No competition is planned for FY 2014.

National Science Foundation
Education and Human Resources (EHR) by Division and Program
FY 2014 Request to Congress

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Division of Research on Learning in Formal and Informal Settings (DRL)	**$273.23**	**$272.43**	**$277.87**	**$5.44**	**2.0%**
Learning and Learning Environments	**162.00**	**160.63**	**160.35**	**-0.28**	**-0.2%**
Core Research and Development	-	-	10.00	10.00	N/A
Discovery Research K-12 (DR-K12)	99.57	99.23	102.53	3.30	3.3%
Advancing Informal STEM Learning (AISL)	62.43	61.40	47.82	-13.58	-22.1%
Broadening Participation in STEM	**54.16**	**54.72**	**60.44**	**5.72**	**10.5%**
Research on Education and Learning (REAL)	54.16	54.72	60.44	5.72	10.5%
STEM Professional Workforce	**57.07**	**57.08**	**57.08**	**-**	**-**
Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships) [formerly Math and Science Partnership]	57.07	57.08	57.08	-	-
Division of Graduate Education (DGE)	**$237.37**	**$236.29**	**$245.15**	**$8.86**	**3.7%**
Learning and Learning Environments	**23.22**	**23.50**	**23.95**	**0.45**	**1.9%**
Climate Change Education (CCE)[1]	5.50	5.50	-	-5.50	-100.0%
Project and Program Evaluation (PPE)[2]	17.72	18.00	23.95	5.95	33.1%
STEM Professional Workforce	**214.14**	**212.79**	**221.2**	**8.41**	**4.0%**
Core Research and Development	-	-	5.00	5.00	N/A
CyberCorps: Scholarship for Service (SFS)[3,4]	44.98	45.00	25.00	-20.00	-44.4%
NSF Innovation Corps (I-Corps)	0.36	-	0.30	0.30	N/A
INSPIRE[2]	0.64	-	2.00	2.00	N/A
National Graduate Research Fellowship (NGRF)	109.24	109.64	162.57	52.93	48.3%
Graduate STEM Fellows in K-12 Education (GK-12)	27.92	26.95	-	-26.95	-100.0%
NSF Research Traineeships (NRT)[5]	31.01	31.20	26.33	-4.87	-15.6%
Division of Human Resource Development (HRD)	**$129.41**	**$129.63**	**$130.30**	**$0.67**	**0.5%**
Learning and Learning Environments	**78.79**	**78.86**	**74.86**	**-4.00**	**-5.1%**
ADVANCE	1.49	1.53	1.28	-0.25	-16.3%
ADVANCE: Career Life Balance (CLB)	-	-	0.25	0.25	N/A
Alliances for Graduate Education and the Professoriate (AGEP)	7.84	7.84	7.84	-	-
Centers for Research Excellence in Science and Technology (CREST)	24.21	24.24	20.24	-4.00	-16.5%
Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	31.85	31.94	31.94	-	-
Tribal Colleges and Universities Program (TCUP)	13.39	13.31	13.31	-	-
Broadening Participation in STEM	**45.48**	**45.62**	**50.62**	**5.00**	**11.0%**
Core Research and Development	-	-	5.00	5.00	N/A
Louis Stokes Alliances for Minority Participation (LSAMP)	45.48	45.62	45.62	-	-
STEM Professional Workforce	**5.14**	**5.15**	**4.82**	**-0.33**	**-6.4%**
Excellence Awards in Science and Engineering (EASE)	5.14	5.15	4.82	-0.33	-6.4%
Division of Undergraduate Education (DUE)	**$190.54**	**$190.65**	**$226.97**	**$36.32**	**19.1%**
Learning and Learning Environments	**71.57**	**71.76**	**102.08**	**30.32**	**42.3%**
Core Research and Development	-	-	5.00	5.00	N/A
Catalyzing Advances in Undergraduate STEM Education (CAUSE)[1]	-	-	97.08	97.08	N/A
STEM Talent Expansion Program (STEP)[1]	24.30	24.30	-	-24.30	-100.0%
Widening Implementation and Demonstration of Evidenced-based Reforms (WIDER)[1]	8.21	8.00	-	-8.00	-100.0%
Transforming Undergraduate Education in STEM (TUES)[1]	39.06	39.46	-	-39.46	-100.0%
STEM Professional Workforce	**118.96**	**118.89**	**124.89**	**6.00**	**5.0%**
Advanced Technological Education	64.07	64.00	64.00	-	-
Robert Noyce Teacher Scholarship Program (NOYCE)	54.89	54.89	60.89	6.00	10.9%
Total, EHR	**$830.54**	**$829.00**	**$880.29**	**$51.29**	**6.2%**

Totals may not add due to rounding.

Funding for the FY 2012 Actual and the FY 2012 Enacted/Annualized FY 2013 CR are shown in the FY 2014 structure for comparability.

[1] In FY 2014, Climate Change Education (CCE), STEM Talent Expansion Program (STEP), Widening Implementation and Demonstration of Evidenced-based Reforms (WIDER), and Transforming Undergraduate Education in STEM (TUES) are consolidated into the CAUSE program.

[2] In FY 2014, Project and Program Evaluation (PPE) and INSPIRE are transferred from the Division of Research on Learning in Formal and Informal Settings (DRL) to the Division of Graduate Education (DGE).

[3] In 2012, Federal Cyber Service: Scholarship for Service (SFS) was officially renamed CyberCorps: Scholarship for Service (SFS). The term CyberCorps also was registered with the U.S. trademark office for use by the federal government.

[4] In FY 2014, CyberCorps: Scholarship for Service (SFS) is transferred from the Division of Undergraduate Education (DUE) to the Division of Graduate Education (DGE).

[5] NSF Research Traineeships (NRT) is a new proposed program. Included in this line are continuing grant increments for the Integrative Graduate Education and Research Traineeship (IGERT) program.

National Science Foundation

Research Infrastructure (RI) Funding, by Account and Activity

FY 2014 Request to Congress

(Dollars in Millions)

NSF by Account	FY2012 Actual	FY 2012 Actual RI Funding	FY 2012 Enacted / Annualized FY 2013 CR	FY 2012 Enacted / Annualized FY 2013 CR RI Funding	FY 2014 Request	FY 2014 Request RI Funding	FY 2014 Request RI Change over FY 2012 Actual RI		FY 2014 Request RI Change over FY 2012 Enacted RI	
							Amount	Percent	Amount	Percent
BIO	**$712.28**	$96.62	**$712.38**	$112.89	**$760.58**	$126.46	$29.84	30.9%	$13.57	12.0%
CISE	**937.16**	242.19	**865.23**	151.16	**950.25**	162.20	-79.99	-33.0%	11.04	7.3%
ENG	**824.55**	31.37	**826.17**	31.33	**911.12**	32.83	1.46	4.7%	1.50	4.8%
GEO	**1,321.37**	678.64	**1,321.14**	660.86	**1,393.86**	705.92	27.28	4.0%	45.06	6.8%
MPS	**1,308.70**	304.59	**1,308.94**	292.71	**1,386.12**	352.35	47.76	15.7%	59.64	20.4%
SBE	**254.19**	47.49	**254.25**	43.49	**272.35**	51.70	4.21	8.9%	8.21	18.9%
IIA	**398.60**	93.24	**399.44**	93.24	**536.62**	94.99	1.75	1.9%	1.75	1.9%
U.S. Arctic Research Commission	**1.45**	-	**1.45**	-	**1.40**	-	-	N/A	-	N/A
Research & Related Activities	**$5,758.30**	$1,494.14	**$5,689.00**	$1,385.68	**$6,212.29**	$1,526.45	$32.31	2.2%	$140.77	10.2%
Education & Human Resources	**$830.54**	-	**$829.00**	-	**$880.29**	-	-	N/A	-	N/A
Major Research Equipment & Facilities Construction	**$198.08**	$198.08	**$197.06**	$197.06	**$210.12**	$210.12	$12.04	6.1%	$13.07	6.6%
Agency Operations & Award Management	**$299.30**	-	**$299.40**	-	**$304.29**	-	-	N/A	-	N/A
National Science Board	**$4.37**	-	**$4.44**	-	**$4.47**	-	-	N/A	-	N/A
Office of Inspector General	**$14.12**	-	**$14.20**	-	**$14.32**	-	-	N/A	-	N/A
Total, National Science Foundation	**$7,104.71**	**$1,692.22**	**$7,033.10**	**$1,582.74**	**$7,625.78**	**$1,736.57**	**$44.35**	**2.6%**	**$153.83**	**9.7%**

Totals may not add due to rounding.

National Science Foundation
Research Infrastructure Summary
FY 2014 Request to Congress
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	FY 2014 Request change over: FY 2012 Actual Amount	FY 2012 Actual Percent	FY 2012 Enacted Amount	FY 2012 Enacted Percent
Facilities	**$912.50**	**$897.26**	**$1,006.28**	**$93.78**	**10.3%**	**$109.02**	**12.2%**
Academic Research Fleet	92.96	78.75	86.00	-6.96	-7.5%	7.25	9.2%
Regional Class Research Vessels (RCRV)[1]	-	*2.00*	*1.00*	*1.00*	*N/A*	*-1.00*	*-50.0%*
RHOV Construction (R/V Alvin Replacement)	*5.08*	*2.40*	-	*-5.08*	*-100.0%*	*-2.40*	*-100.0%*
Ship Operations and Upgrades	*87.89*	*74.35*	*85.00*	*-2.89*	*-3.3%*	*10.65*	*14.3%*
Arecibo Observatory	9.25	8.70	8.00	-1.25	-13.6%	-0.70	-8.0%
AST Portfolio Review Implementation	-	-	10.00	10.00	N/A	10.00	N/A
Cornell High Energy Synchrotron Source (CHESS)	19.67	19.67	20.00	0.33	1.7%	0.33	1.7%
Gemini Observatory	21.57	22.07	19.59	-1.98	-9.2%	-2.48	-11.2%
Geodetic Facilities for the Advancement of Geoscience and EarthScope (GAGE)	11.92	13.18	12.70	0.78	6.6%	-0.48	-3.6%
IceCube Neutrino Observatory (IceCube)	6.90	6.90	6.90	-	-	-	-
International Ocean Discovery Program (IODP)	51.68	44.40	50.00	-1.68	-3.2%	5.60	12.6%
Large Hadron Collider (LHC)	18.00	18.00	18.00	-	-	-	-
Laser Interferometer Gravitational Wave Observatory (LIGO)	30.40	30.40	39.50	9.10	29.9%	9.10	29.9%
National High Magnetic Field Laboratory (NHMFL)	26.80	25.80	32.64	5.84	21.8%	6.84	26.5%
National Nanotechnology Infrastructure Network (NNIN)	16.00	15.86	15.46	-0.54	-3.4%	-0.40	-2.5%
National Solar Observatory (NSO)	9.10	9.10	8.00	-1.10	-12.1%	-1.10	-12.1%
National Superconducting Cyclotron Laboratory (NSCL)	21.50	21.50	22.50	1.00	4.7%	1.00	4.7%
Network for Earthquake Engineering Simulation (NEES)	20.39	20.50	22.00	1.61	7.9%	1.50	7.3%
Other Facilities[2]	2.52	2.52	2.66	0.14	5.7%	0.14	5.6%
Polar Facilities and Logistics	294.63	295.79	314.21	19.58	6.6%	18.42	6.2%
Seismological Facilities for Advancement of Geoscience & EarthScope (SAGE)	26.12	26.76	25.70	-0.42	-1.6%	-1.06	-4.0%
Other Facilities Investments							
Major Research Equipment & Facilities Construction[3]	226.88	225.86	285.92	59.04	26.0%	60.06	26.6%
Pre-construction Planning[4]	6.20	11.50	6.50	0.30	4.8%	-5.00	-43.5%
Federally Funded R&D Centers	**$204.14**	**$198.99**	**$206.80**	**$2.66**	**1.3%**	**$7.81**	**3.9%**
National Center for Atmospheric Research (NCAR)	103.00	98.60	99.00	-4.00	-3.9%	0.40	0.4%
National Optical Astronomy Observatory (NOAO)	26.25	25.50	25.50	-0.75	-2.9%	-	-
National Radio Astronomy Observatories (NRAO)[5]	71.75	71.75	77.41	5.66	7.9%	5.66	7.9%
Science and Technology Policy Institute (STPI)	3.14	3.14	4.89	1.75	55.7%	1.75	55.7%
Other Research Instrumentation and Infrastructure	**$575.58**	**$486.49**	**$523.49**	**-$52.09**	**-9.0%**	**$37.00**	**7.6%**
Major Research Instrumentation (MRI)	90.00	90.00	90.00	0.00	0.0%	-	-
National Center for Science & Engineering Statistics (NCSES)	30.64	29.65	36.31	5.67	18.5%	6.66	22.5%
NCSES Science of Science & Innovation Policy Activities	5.13	5.95	4.95	-0.18	-3.5%	-1.00	-16.8%
Networking & Computational Resources Infrastructure & Services	210.32	116.56	114.60	-95.72	-45.5%	-1.96	-1.7%
Polar Environment, Safety, and Health (PESH)	6.31	6.37	7.10	0.79	12.5%	0.73	11.5%
Research Resources[6]	233.18	237.96	270.53	37.35	16.0%	32.57	13.7%
TOTAL, RESEARCH INFRASTRUCTURE	**$1,692.22**	**$1,582.74**	**$1,736.57**	**$44.35**	**2.6%**	**$153.83**	**9.7%**

Totals may not add due to rounding.

[1] Regional Class Research Vessels are a Pre-construction Planning project for potential MREFC funding. This funding is shown here (Academic Resesarch Fleet) and is not included under Pre-construction Planning.

[2] Other Facilities includes support for other materials research facilities.

[3] Funding levels for MREFC Projects in this table include support for: a) concept and development associated with ongoing and requested MREFC projects provided through the R&RA account; b) initial support for operations and maintenance provided through the R&RA account (except for ALMA, which is included in the funding for NRAO); and c) implementation support provided through the MREFC account.

[4] Pre-construction planning includes funding for potential next generation multi-user facilities. Not included in this line are Regional Class Research Vessels, shown here under the Academic Research Fleet.

[5] Funding for the National Radio Astronomy Observatory (NRAO) includes operation and maintenance support for the Atacama Large Millimeter Array (ALMA). Construction funding for ALMA is included in the MREFC projects line above.

[6] Funding for Research Resources includes support for the operation and maintenance of minor facilities, infrastructure and instrumentation, field stations, museum collections, etc.

National Science Foundation Current Authorizations

(Dollars in Millions)

LEGISLATION	FY 2012 Actual	FY 2012 Enacted	FY 2014 Request	Authorization Levels FY 2012	FY 2013	FY 2014
National Science Foundation Act of 1950 (P.L.81-507)[1]						
Scholarships and Graduate Fellowships				*within limits of funds made available for this purpose*		
General Authority				*within the limits of available appropriations*		
Administering Provisions				*to make such expenditures as may be necessary*		
International Cooperation and Coordination with Foreign Policy				*within the limit of appropriated funds*		
Contract Arrangements				*utilize appropriations available*		
America COMPETES Reauthorization Act of 2010 (P.L.111-358)[2]	**$7,104.71**	**$7,033.10**	**$7,625.78**	**$7,800.00**	**$8,300.00**	
Account and Program Specific						
Research and Related Activities	**$5,758.30**	**$5,689.00**	**$6,212.29**	**$6,234.28**	**$6,637.85**	
Education and Human Resources	**$830.54**	**$829.00**	**$880.29**	**$978.96**	**$1,041.76**	
STEM-Training Grant Program	-	-	-	$10.00	$10.00	
Major Research Equipment and Facilities Construction	**$198.08**	**$197.06**	**$210.12**	**$225.54**	**$236.76**	
Agency Operations and Award Management	**$299.30**	**$299.40**	**$304.29**	**$341.68**	**$363.67**	
National Science Board	**$4.37**	**$4.44**	**$4.47**	**$4.81**	**$4.91**	
Office of the Inspector General	**$14.12**	**$14.20**	**$14.32**	**$14.73**	**$15.05**	
Federal Ocean Acidification Research and Monitoring Act of 2009 (P.L.111-11)	**$14.50**			**$15.00**		
SBIR and STTR reauthorized under the National Defense Authorization Act for Fiscal Year 2012,(P.L. 112-81)						
Small Business Innovation Research (SBIR) Program[3]	**$131.30**	**$134.87**	**$155.01**	*2.6% of research funds in 2012, 2.7% in 2013, 2.8% in 2014*		
Small Business Technology Transfer (STTR) Program[4]	**$15.56**	**$17.89**	**$22.14**	*0.35% of research funds in 2012 and 2013, 0.40% in 2014*		

[1] Organic language establishing NSF.

[2] Authorizes agency funding for FYs 2011-13; authorizes agency, account, and various program levels.

[3] SBIR is authorized through September 30, 2017.

[4] STTR is authorized through September 30, 2017.

RESEARCH AND RELATED ACTIVITIES (R&RA) $6,212,290,000
+$493,290,000 / 8.6%

The FY 2014 Budget Request for the Research and Related Activities (R&RA) Appropriation is $6,212.29 million, an increase of $523.29 million, or 9.2 percent, above the FY 2012 Enacted level of $5,689.00 million. Support from the R&RA Appropriation enables U.S. leadership and progress across the frontiers of scientific and engineering research and education.

In FY 2014 NSF will sustain targeted investments in fundamental science and engineering to continue fostering advances in discovery and learning that spurs innovation. Such transformational work holds great promise for meeting the myriad social, economic, and environmental challenges faced by both the Nation and the world.

In FY 2014, funding within the broad and flexible R&RA portfolio of foundational research includes strong support for cross-cutting research priorities such as advanced manufacturing, clean energy and sustainability, break-through materials, robotics, cyberinfrastructure, and cybersecurity. It also includes robust support to prepare young scientists and engineers for the high-tech jobs of the future.

R&RA Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
Biological Sciences	$712.28	$712.38	$760.58	$48.20	6.8%
Computer & Information Science & Engineering	937.16	865.23	950.25	85.02	9.8%
Engineering	824.55	826.17	911.12	84.95	10.3%
Geosciences	1,321.37	1,321.14	1,393.86	72.72	5.5%
Mathematical & Physical Sciences	1,308.70	1,308.94	1,386.12	77.18	5.9%
Social, Behavioral & Economic Sciences	254.19	254.25	272.35	18.10	7.1%
International and Integrative Activities	398.60	399.44	536.62	137.18	34.3%
U.S. Arctic Research Commission	1.45	1.45	1.40	-0.05	-3.8%
Subtotal, R&RA	**5,758.30**	**5,689.00**	**6,212.29**	**523.29**	**9.2%**
FY 2013 CR Adjustment[2]		65.00			
Total, R&RA	**$5,758.30**	**$5,754.00**	**$6,212.29**	**$493.29**	**8.6%**

Totals may not add due to rounding.

[1] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2] This budget line is included to adjust for two items specific to the FY 2013 continuing resolution: first is $35.0 million for the 0.612 percent increase provided by the continuing resolution; second is an adjustment for the $30.0 million transfer executed in FY 2012 from the Research and Related Activities account to the Major Research Equipment and Facility Construction account that is not included in the FY 2013 continuing resolution calculation.

Appropriations Language

For necessary expenses in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), and the Act to establish a National Medal of Science (42 U.S.C. 1880-1881); services as authorized by 5 U.S.C. 3109; maintenance and operation of aircraft and purchase of flight services for research support; acquisition of aircraft; and authorized travel; ~~$5,983,280,000,~~*$6,212,290,000*, to remain available until September 30, ~~2014,~~*2015*, of which not to exceed ~~$500,000,000~~*$520,000,000* shall remain available until expended for polar research and operations support, and for reimbursement to other Federal agencies for operational and science support and logistical and other related activities for the United States Antarctic program: *Provided*, That receipts for scientific support services and materials furnished by the National Research Centers and other National Science Foundation supported research facilities may be credited to this appropriation.

Research and Related Activities
FY 2014 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Carryover/ Recoveries	Adjustments to Prior Year Accounts	Transfers[1,2]	Total Resources	Obligations/ Estimates
FY 2012 Appropriation	$5,719.00	$2.38	$85.30	-$30.00	$5,776.68	$5,758.30
FY 2012 Enacted/Annualized FY 2013 CR[3, 4]	5,754.00	14.81		-	5,768.81	5,768.81
FY 2014 Request	6,212.29	-		5.00	6,217.29	6,217.29
$ Change from FY 2012 Enacted						$493.29
% Change from FY 2012 Enacted						8.6%

Totals may not add due to rounding.

[1]$30.0 million was transferred from the Research and Related Activities (R&RA) appropriation under the transfer authority provided by the Science Appropriations Act, 2012 (P.L. 112-55).

[2]In FY 2014, the Administration proposes to transfer $5.0 million from the Department of Justice to the National Science Foundation for a forensic science grant program to establish forensic science research centers.

[3]This line includes an adjustment for two items specific to the FY 2013 continuing resolution: first is $35.0 million for the 0.612 percent increase provided by the continuing resolution; second is an adjustment for the $30.0 million transfer executed in FY 2012 from the Research and Related Activities account to the Major Research Equipment and Facility Construction account that is not included in the FY 2013 continuing resolution calculation.

[4]R&RA carryover is $14.81 million; Reimbursable carryover (not shown) is $3.57 million for a total of $18.38 million.

Explanation of Carryover

Within the **Research and Related Activities (R&RA)** account, NSF carried over $14.81 million into FY 2013. Obligation of these funds is expected by the end of the third quarter of FY 2013.

- Office of Polar Programs (OPP): OPP carried over $6.04 million of no-year funds that were recovered from several awards and contracts from prior years.

- Directorate for Engineering (ENG): ENG carried over $6.0 million of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) FY 2012 funds into FY 2013.

- Office of Integrative Activities (OIA): OIA carried over $890,000 in the Science and Technology Centers (STCs) line to support the STC Summary Panel and the five strategic planning workshops related to the new STC centers cohort in FY 2013.

- National Coordination Office/Networking and Information Technology Research and Development (NCO/NITRD): NCO/NITRD carried over $120,000 of operational funds to continue government procurements and operations.

- The remaining $1.76 million was recovered from several awards and contracts from various programs throughout NSF that were not ready for obligation in FY 2012.

DIRECTORATE FOR BIOLOGICAL SCIENCES (BIO) $760,580,000
+$48,200,000 / 6.8%

BIO Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Molecular & Cellular Biosciences (MCB)	$125.63	$125.79	$136.39	$10.60	8.4%
Integrative Organismal Systems (IOS)	212.43	212.33	225.37	13.04	6.1%
Environmental Biology (DEB)	142.55	142.56	148.97	6.41	4.5%
Biological Infrastructure (DBI)	126.46	126.18	133.65	7.47	5.9%
Emerging Frontiers (EF)	105.22	105.52	116.20	10.68	10.1%
Total, BIO	**$712.28**	**$712.38**	**$760.58**	**$48.20**	**6.8%**

Totals may not add due to rounding.

About BIO

BIO's mission is to enable discoveries for understanding life. Through investments in innovative and transformative research, BIO advances the frontiers of knowledge in the life sciences by increasing our understanding of complex living systems.

Issues of national importance related to the environment, economy, agriculture, and human welfare require an understanding of how complex living systems function and interact with each other and with non-living systems. Research supported by BIO enhances this understanding. As the physical, computational, mathematical, and engineering fields increasingly use living systems to address their major questions, NSF's robust investment in the non-medical biological sciences becomes increasingly relevant to tackling these multidisciplinary challenges.

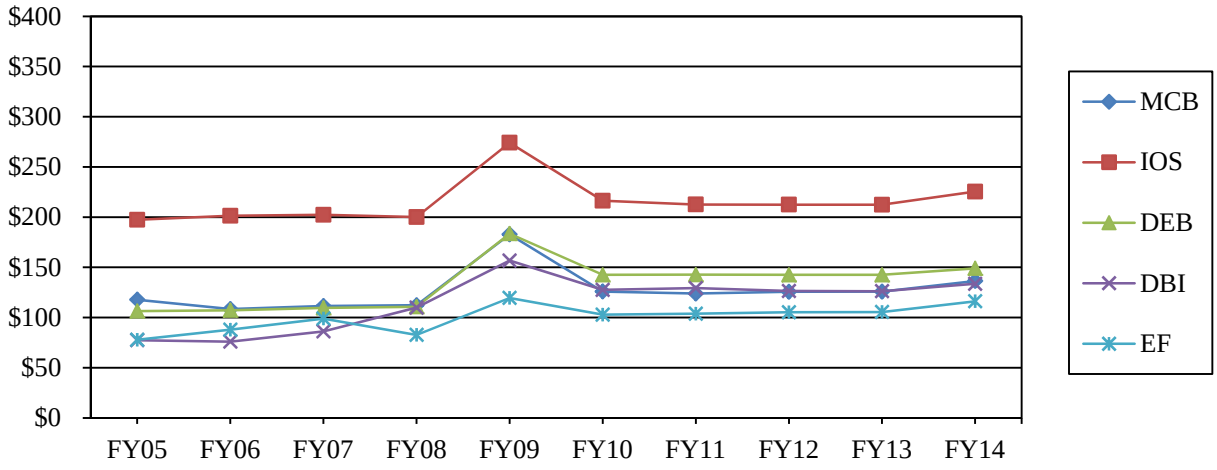
Biological concepts are integral to wide-ranging areas of science essential to human welfare and the bio-economy, including national priorities such as climate science, biotechnology, and bioengineering. Over the last 3.5 billion years, living organisms have evolved mechanisms for efficiently using energy, producing an endless array of novel compounds, and storing information in a highly compact, adaptable format. Fundamental biological research makes these innovations available to inform the next generation of nano-, bio-, and information technologies.

The FY 2014 Request includes projects on understanding the changing dynamics of the biosphere, research on the fundamental characteristics of biological energy systems, and efforts to broaden participation and develop the next generation of biological researchers. This includes research to address the five Grand Challenges in biology: synthesizing life-like systems; understanding the brain; predicting organisms' characteristics from their DNA sequences; elucidating interactions between the earth, its climate and its biosphere; and understanding biological diversity. BIO continues support for Research at the interface of Biological, Mathematical and Physical Sciences, and Engineering (BioMaPS). This interdisciplinary effort, in collaboration with the Directorates for Mathematical and Physical Sciences (MPS) and Engineering (ENG), will result in accelerated understanding of biological systems, leading to innovations in manufacturing in such areas as renewable fuels, bio-based materials, bio-imaging, and bio-inspired sensors. BIO also participates in several NSF-wide investment portfolios, including advanced

manufacturing through the Cyber-enabled Materials and Manufacturing and Smart Systems (CEMMSS) activity; Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21); Clean Energy investments; and Science, Engineering, and Education for Sustainability (SEES).

BIO provides about 64 percent of federal funding for non-medical, basic research at academic institutions in the life sciences, including environmental biology, a research area critical for addressing questions related to climate science.

BIO Subactivity Funding
(Dollars in Millions)



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2014 Summary by Division

- MCB's FY 2014 requested increase of $10.60 million, or 8.4 percent, is focused on support for fundamental research to understand the dynamics and complexity of living systems at the biochemical, molecular, and cellular level, which results in foundational knowledge at the heart of the Grand Challenges. Priority has been given to specific BIO-wide activities that emphasize maintaining robust disciplinary programs in cutting-edge areas of research and on interdisciplinary activities that build on disciplinary foundations. MCB will also fund advanced manufacturing through CEMMSS and its breakthrough materials component. MCB's contributions include research such as computational mining of the genomic data from diverse biological systems to identify inspirations for the design and synthesis of new materials with defined properties and capabilities, and predictive synthetic biology to design new nanomaterials, particularly based on photosynthesis and other biological processes.

- IOS's FY 2014 requested increase of $13.04 million, or 6.1 percent, is aimed at fundamental research on organisms as complex integrated systems and their interactions with their social and physical environments, especially as they adapt to climate variability and other environmental factors. In FY 2014, BIO will enhance support for a NSF-wide integrative activity on cognitive science and neuroscience that focuses on three thematic goals: adaptation to changing environments, mechanisms underlying dynamic decisions, and neural coding. Within IOS, a $5.0 million increase will support

research on understanding the brain, including mapping of circuits that drive behavior in a variety of organisms. IOS also maintains its commitment to the Plant Genome Research Program (PGRP), which supports genome-scale research to accelerate discoveries about basic plant biology, as well as downstream applications of societal benefit such as crop improvement, new sources of bio-based energy, and development of novel bio-based materials. Through PGRP, BIO contributes to the National Plant Genome Initiative (NPGI). In conjunction with the Department of Energy (DOE) and United States Department of Agriculture (USDA), NPGI co-sponsors postdoctoral research fellowships that allow recipients to focus their studies in plant genomics with an emphasis on quantitative genetics, modern breeding approaches, and bioinformatics.

- DEB's FY 2014 requested increase of $6.41 million, or 4.5 percent, will provide support for research on complex ecological and evolutionary dynamics to improve our ability to understand the reciprocal interactions between living systems and the environment, and inform essential considerations of environmental sustainability. DEB will sustain support for Dimensions of Biodiversity, including expanding collaborations in Indonesia. Included in this increase is $2.0 million for Strategic Integration for Biological Sciences (SIBS). SIBS planning will emphasize linking legacy and current data streams to enable novel integrative research and meta-analysis.

- DBI's FY 2014 requested increase of $7.47 million, or 5.9 percent, empowers biological discovery by supporting the development and enhancement of biological research resources, human capital, and centers. It reflects an increase in support of NSF's CIF21 investment, active research participation by undergraduate students through the Research Experiences for Undergraduates Sites (REU Sites) program, and continued investment in research to address BIO's five Grand Challenges. DBI will also partner with DEB to provide increased support for SIBS, an effort that networks the growing legacy of biological knowledge in collections with integrative biological research.

- EF's FY 2014 requested increase of $10.68 million, or 10.1 percent, provides support for developing priorities and for operations and maintenance (O&M) for the National Ecological Observatory Network (NEON). EF supports a number of limited-term activities thus allowing for repurposing of funds towards new emphases and for support for facilities. In FY 2014, EF will support: focused activities within SEES, including exploring a new program emphasis on sustainable and resilient food systems; coordination of cross-directorate innovation activities including support for Ideas Labs; and clean energy and advanced manufacturing research through continued directorate-wide support for BioMaPS. EF will also contribute to the NSF-wide framework – Catalyzing Advances in Undergraduate STEM Education (CAUSE) – that consolidates the Foundation's investments in undergraduate education. NEON O&M will increase to $21.0 million during FY 2014, its second year of operations. EF will also provide the U.S. support for the Global Biodiversity Information Facility (GBIF).

Major Investments

BIO Major Investments
(Dollars in Millions)

Area of Investment	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Advanced Manufacturing	$2.00	$2.00	$2.60	$0.60	30.0%
BioMaPS	8.95	9.00	27.07	18.07	200.8%
CAREER	35.90	31.13	33.75	2.62	8.4%
CEMMSS	3.00	3.00	5.00	2.00	66.7%
CIF21	2.00	2.00	6.50	4.50	225.0%
Clean Energy Technology	39.00	39.00	46.00	7.00	17.9%
Cognitive Science & Neuroscience	-	-	5.00	5.00	N/A
I-Corps	0.10	0.50	2.00	1.50	300.0%
INSPIRE	3.06	2.00	4.00	2.00	100.0%
SEES	27.25	27.25	35.75	8.50	31.2%

Major investments may have funding overlap and thus should not be summed.

- Advanced Manufacturing: BIO will provide $2.60 million in advanced manufacturing research through BioMaPS and CEMMSS.

- Research at the Interface of Biological, Mathematical and Physical Sciences, and Engineering (BioMaPS): seeks to discover fundamental new knowledge to enable innovation in national priorities such as clean energy, climate science, and advanced manufacturing. In FY 2014, BIO will increase support by $18.07 million for a total of $27.07 million.

- CAREER: BIO's CAREER awards support young investigators who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. In FY 2014, BIO will increase support for CAREER by $2.62 million for a total of $33.75 million.

- CEMMSS: BIO support will enable breakthrough materials through research on topics such as computational mining of genomic data from diverse biological systems to identify inspirations for design of new materials, or predictive synthetic biology to design new nanomaterials, particularly based on photosynthesis and other biological processes. BIO will increase support by $2.0 million for a total of $5.0 million for this activity.

- Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21): BIO will increase support by $4.50 million to a total of $6.50 million, and will focus on Software Infrastructure for Sustained Innovation, data-enabled science, Cyberinfrastructure in the Life Sciences (CILS) and SIBS.

- Clean Energy Technology: BIO support for clean energy technology increases by $7.0 million to $46.0 million for fundamental research in areas such as molecular biophysics, photobiology, genetic engineering, and metabolic biochemistry with relevance in areas such as fuel cells, hydrogen,

biomass, and other energy efficiency and use.

- Cognitive Science and Neuroscience: In FY 2014, BIO will enhance support for the thematic goals of a NSF-wide integrative activity on cognitive science and neuroscience: adaptation to changing environments, mechanisms underlying dynamic decisions, and neural coding. Within IOS, a $5.0 million increase will focus on mapping circuits that drive behavior in a variety of organisms.

- I-Corps: BIO will support I-Corps grants to test the feasibility of commercial prototypes developed from NSF/BIO-supported research (+$1.50 million to $2.0 million).

- INSPIRE: BIO will provide support (+$2.0 million to a total of $4.0 million) to co-fund larger cross-disciplinary grants that embody unusually creative high-risk/high-reward research.

- Science, Engineering, and Education for Sustainability (SEES): BIO will support program activities for coastal research, sustainable and resilient food systems, Dimensions of Biodiversity, Coupled Natural & Human Systems (CNH), and SEES Fellows (+$8.50 million to a total of $35.75 million).

BIO Funding for Centers Programs and Facilities

BIO Funding for Centers Programs
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Centers Programs Total	**$41.97**	**$42.22**	**$41.47**	**-$0.75**	**-1.8%**
Centers for Analysis & Synthesis (DBI)	26.09	26.12	26.30	0.18	0.7%
Nanoscale Science & Engineering Centers (DBI)	5.18	5.10	5.10	-	-
Science & Techology Centers (DBI)	9.07	9.00	8.32	-0.68	-7.6%
Science of Learning Centers (DBI)	1.63	2.00	1.75	-0.25	-12.5%

Totals may not add due to rounding.

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- Centers for Analysis and Synthesis: Funding increases by $180,000 over the FY 2012 Enacted to a total of $26.30 million. The program will support four centers in FY 2014. The increased support represents annual increments for the National Socio-Environmental Synthesis Center (SESynC) established in FY 2012.

- Nanoscale Science and Engineering Centers (NSEC): Support will be continued for the Center for Environmental Implications of Nanotechnology (CEIN).

- Science and Technology Centers (STCs): Support will decrease to $8.32 million for two STCs: the Science and Technology Center for Microbial Oceanography Research and Education (C-MORE) and Bio/computational Evolution in Action CONsortium (BEACON). FY 2014 support for C-MORE decreases (-$680,000 million to a total of $3.32 million) as this center begins a planned FY 2015 sunset.

- Science of Learning Centers: Support will be decreased by $250,000 to $1.75 million, as the center continues to ramp-down to its final year of support in FY 2015.

BIO Funding for Facilities

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Facilities Total	**$2.05**	**$0.35**	**$21.35**	**$21.00**	**6000.0%**
NNIN	0.35	0.35	0.35	-	-
National Ecological Observatory Network (NEON)	1.70	-	21.00	21.00	N/A

Totals may not add due to rounding.

For detailed information on individual facilities, please see the Facilities chapter.

BIO has increased operations and maintenance funding for facilities in order to provide support for the National Ecological Observatory Network (NEON).

- Funding for NEON operations (+$21.0 million) will support O&M for this project currently in its third year of construction. NEON is constructing a series of 106 sites over twenty domains across the United States. O&M ramps up in FY 2014, as sites are commissioned and validated for delivery of science data through a central cyberinfrastructure portal.

Summary and Funding Profile

In FY 2014, the number of full research grant proposals decreases by 32.4 percent compared to the FY 2013 Estimate due to the implementation of a new proposal submission process. Rather than two deadlines a year for full proposals, BIO instituted one deadline a year for full proposals following an extensive pre-proposal submission review process. This was implemented in two of four divisions in BIO in FY 2012. Pre-proposals are not counted in the numbers cited in the funding profile below. Numbers of total proposals, including both pre-proposals and full proposals, submitted has not appreciably changed. BIO expects to award about 1,050 research grants. Average annual award size and duration will be sustained.

In FY 2014, BIO will invest $41.47 million for centers, accounting for 5.5 percent of the BIO budget. Centers are an important modality for BIO sciences, as research in many BIO-supported disciplines have evolved to be more collaborative and interdisciplinary. In FY 2014, total centers funding decreases from FY 2012 Enacted, as the Center for Microbial Oceanography Research and Education (C-MORE) and Science of Learning Centers have begun planned sunsets.

Operations and maintenance funding for one BIO-supported user facility, NEON, comprises 2.8 percent of BIO's FY 2014 Request.

BIO Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate[1]	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	5,271	8,000	5,670
Number of New Awards	1,295	1,350	1,500
Funding Rate	25%	17%	26%
Statistics for Research Grants:			
Number of Research Grant Proposals	4,327	6,880	4,650
Number of Research Grants	921	985	1,050
Funding Rate	21%	14%	23%
Median Annualized Award Size	$176,821	$185,000	$185,000
Average Annualized Award Size	$214,157	$230,000	$230,000
Average Award Duration, in years	3.1	3.1	3.1

[1] Award Estimates for FY 2013, such as numbers of awards and size/duration, are based upon the FY 2012 Enacted level.

Note: The calculations for funding rates consist of the number of awards relative only to full proposals submitted and do not include the number of preliminary proposals that are being used with the new review systems implemented in IOS and DEB in FY 2013. If preliminary proposals were incorporated into these calculations, the actual funding rates would be approximately one third of those shown in the table above.

Program Monitoring and Evaluation

Committee of Visitors (COV):

- In FY 2012, BIO held one COV for the Environmental Biology (DEB) division. Recommendations from this COV included: continue efforts to develop new practices to complement standard panels, increase international collaboration, and expand opportunities for young investigators. BIO has addressed these recommendations through enhanced support for international collaborations in programs, such as Dimensions of Biodiversity, as well as through enhancement of programs that support young investigators, such as CAREER.
- In FY 2013, COVs will review the Plant Genome Research Program (PGRP) and the Division of Biological Infrastructure (DBI).
- In FY 2014, COVs will review the Integrative Organismal Systems (IOS) and Molecular and Cellular Biosciences (MCB) divisions.

Program Evaluations:

- In FY 2013, MCB conducted a portfolio analysis to review the geographical, gender, ethnicity, EPSCoR jurisdiction, institution, and young investigator diversity across the division. Final results from this study are expected during FY 2014.

Workshops and Reports:

- IOS funded a workshop entitled “How organisms walk the tightrope between stability and change” at the Banbury Center, Cold Spring Harbor, NY, February 28 – March 1, 2013. The workshop focused on one of the Grand Challenges in organismal biology, genomes to phenomes, and was the first time organismal biologists have considered systematically a quantitative set of approaches in their research agenda. A final report is expected in FY 2013.

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of

programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

Number of People Involved in BIO Activities

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	6,686	6,900	7,200
Other Professionals	1,746	1,800	1,900
Postdoctorates	1,560	1,600	1,600
Graduate Students	2,787	2,900	3,000
Undergraduate Students	4,660	4,600	5,000
Total Number of People	**17,439**	**17,800**	**18,700**

DIVISION OF MOLECULAR & CELLULAR BIOSCIENCES (MCB) $136,390,000 +$10,600,000 / 8.4%

MCB Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, MCB	**$125.63**	**$125.79**	**$136.39**	**$10.60**	**8.4%**
Research	**124.49**	**124.56**	**135.16**	**10.60**	**8.5%**
CAREER	12.04	12.74	13.81	1.07	8.4%
Education	**1.14**	**1.23**	**1.23**	**-**	**-**

Totals may not add due to rounding.

MCB supports fundamental research and related activities that promote quantitative, predictive, and theory-driven understanding of complex living systems at the molecular, subcellular, and cellular levels. MCB gives high priority to the research projects that integrate theory, methods, and technologies from physical sciences, mathematics, computational sciences, and engineering to address major biological questions. MCB also seeks to fund research that integrates theory and experimentation to address the emerging areas of synthetic biology, multi-scale integration, molecular and cellular evolution, and quantitative prediction of phenome from genomic information. The division also gives priority to development of methods and resources that will be used to tackle major biological questions, such as how non-living molecular systems converge to create emergent properties of living systems, or how can one predict molecular underpinnings of the impacts of environmental changes. MCB funds research that employs a range of experimental approaches – including *in vivo*, *in vitro* and *in silico* strategies – and a broad spectrum of model and non-model organisms, especially microbes and plants. MCB continues to forge partnerships to support research at the intersection of biology and other disciplines, and to provide unique educational and training opportunities for the next generation of researchers, science educators, and scientifically literate citizens.

In general, 36 percent of the MCB portfolio is available for new research grants and 64 percent is available for continuing grants.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Maintaining the health of its disciplinary knowledge base is one of BIO's top priorities. Increased support for foundational biological research in MCB will yield insights that can be used to produce the next generation of nano-, bio-, and information technologies (+$2.99 million).
- MCB will support BioMaPS in partnership with MPS and ENG (+$6.54 million to a total of $6.54 million). Support will be used to foster foundational research activities that employ interdisciplinary approaches, such as Synthetic Biology, which uses chemical and engineering principles to design and construct (or reconstruct) functional molecular and cellular systems with the goal of providing knowledge that leads to major leaps in biotechnology.
- MCB will continue to support CEMMSS research via BioMaPS and the National Nanotechnology Initiative (NNI) by supporting fundamental research on the components and processes that comprise

and control biological systems at the nano to cellular scales. Of particular interest will be research on computational design of biomaterials, as well as development of new approaches to manufacturing economically important chemicals.

- Support for early-career researchers is a BIO priority; MCB will increase investment (+$1.07 million to a total of $13.81 million) in CAREER grants.

Education

- All BIO divisions include support for Research Experiences for Undergraduates (REU) activities. In FY 2014, emphasis will be placed on research experiences for students in their first two years of college.

INTEGRATIVE ORGANISMAL SYSTEMS (IOS) $225,370,000
+$13,040,000 / 6.1%

IOS Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, IOS	**$212.43**	**$212.33**	**$225.37**	**$13.04**	**6.1%**
Research	**182.42**	**177.08**	**187.73**	**10.65**	**6.0%**
CAREER	10.07	8.22	8.92	0.70	8.5%
Education	**3.40**	**1.75**	**5.75**	**4.00**	**228.6%**
Infrastructure	**26.61**	**33.50**	**31.89**	**-1.61**	**-4.8%**
Research Resources	26.61	33.50	31.89	-1.61	-4.8%

Totals may not add due to rounding.

IOS supports research and education aimed at understanding the diversity of plants, animals, and microorganisms as complex systems interacting with their environments. Reaching a systems level understanding of organisms will require a new emphasis on interdisciplinary approaches and development of new tools. These approaches span computational, molecular, cellular, individual organism and population levels of inquiry. Many activities supported by IOS focus on biological processes that affect organismal development, structure, performance, and interactions under varying environmental conditions. IOS-supported research focuses on investigating organismal performance in an environmental context, which is significant for understanding reciprocal interactions between the biosphere and drivers of global climate change.

The activities of the Plant Genome Research Program (PGRP) support genome-scale research to accelerate basic discoveries of application to basic plant biology as well as downstream applications of potential societal benefit such as crop improvement, development of new sources of bio-based energy, development of sources of novel bio-based materials, and adaptation to global climate change. The Basic Research to Enable Agricultural Development (BREAD) Program will continue support for basic research to test innovative, early-concept approaches and technologies for sustainable, science-based solution to problems of agriculture in developing countries.

In general, 43 percent of the IOS portfolio is available for new research grants and 57 percent is available for continuing grants.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Maintaining a healthy core program is one of the top priorities for BIO, and is reflected in requested increases across all divisions. Research related to the five Grand Challenges will be supported through the IOS core programs with an emphasis on maintaining a balanced award portfolio and broadening participation (+$2.67 million).
- BioMaPS (+$2.28 million to a total of $2.28 million) is a priority area for IOS in FY 2014 and will support research on modeling multi-scale network integration and function.
- IOS supports neuroscience research directed towards the study of biological mechanisms responsible

for complex brain functions. Such mechanisms provide the basis for adaptive responses to changing environments and also drive the evolution of animal behavior. In FY 2014, as part of NSF's Cognitive Science and Neuroscience portfolio, IOS will increase its support of mapping functional neural circuitry in a wide variety of model systems (species) and developmental stages in order to facilitate tool development for functional analyses, which is essential for future technology improvement and progress in this area. Enhanced support will be provided for activities as defined by a "Dear Colleague Letter" released in FY 2013; these can include Research Collaboration Networks (RCNs) and EAGERS (+$5.0 million total).

- Broadening participation will be emphasized across all IOS activities, with an emphasis on support of networking efforts that focus on development of sustainable increases in participation and retention of underrepresented groups and women in science.
- BREAD continues to be supported by NSF ($3.0 million) and the Bill & Melinda Gates Foundation ($3.0 million), through funding provided to NSF.
- Support for early-career researchers is a BIO priority; IOS will increase investment (+$700,000 to a total of $8.92 million) in CAREER grants.

Education

- All BIO divisions include support for Research Experiences for Undergraduates (REU) activities. In FY 2014, emphasis will be placed on research experiences for students in their first two years of college.
- The Plant Genome Research Program (PGRP) provides support for the National Plant Genome Initiative (NPGI) Postdoctoral Research Fellowships Program, which is co-sponsored by NSF, the U.S. Department of Energy (DOE), and the U.S. Department of Agriculture (USDA) – Agricultural Research Service (ARS). This provides training of fellows in plant genomics, with an emphasis on quantitative genetics, modern breeding approaches, and bioinformatics (+$4.0 million).

Infrastructure

- Within infrastructure, the IOS request includes investments in research resources essential to PGRP. A slight decrease in PGRP infrastructure funding will allow for enhanced support for PGRP postdoctoral fellows (-$1.61 million).

DIVISION OF ENVIRONMENTAL BIOLOGY (DEB) $148,970,000
+$6,410,000 / 4.5%

DEB Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, DEB	**$142.55**	**$142.56**	**$148.97**	**$6.41**	**4.5%**
Research	**139.89**	**141.06**	**147.47**	**6.41**	**4.5%**
CAREER	6.01	3.34	3.72	0.38	11.4%
Education	**2.66**	**1.50**	**1.50**	**-**	**-**

Totals may not add due to rounding.

The Division of Environmental Biology supports catalytic and transformative research to inventory and document life on earth, to discover life's origins and evolutionary history, and to understand the dynamics of ecological and evolutionary systems. Ecological systems, in turn, provide goods and services upon which human health and welfare depend (e.g., breathable air, potable water, food and fiber, crop pollination, and disease control). Long-term DEB research is critical to understanding the feedbacks between natural and human systems. Scientific foci in DEB also address the processes of evolution; elucidate the integrated dimensions of biodiversity; address the spatial and temporal dynamics of species interactions that govern the assembly of functional communities; and determine the flux of energy and materials through ecosystems. This theoretical and empirical research in ecology, evolution, and biodiversity is enhanced by dynamic interactions with the fields of genomics, computer science, geoscience, engineering, and mathematics.

In general, 51 percent of the DEB portfolio is available for new research grants. The remaining 49 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Supporting research in core programs to address the five Grand Challenges at the interface of the life and physical sciences is a top priority for BIO. In DEB, support increases (+$4.03 million) for fundamental research on the genealogical relationships of all life, and on ecological and evolutionary patterns and processes in the context of changing environmental factors.
- Support for early-career researchers is a BIO priority; DEB will increase investment (+$380,000 to a total of $3.72 million) in CAREER grants.
- DEB will make an initial investment (+$2.0 million to a total of $2.0 million) in planning activities to advance our understanding of life's legacy and future on Earth. Strategic Integration for Biological Sciences (SIBS) will, for the first time, link long-term planetary biodiversity data with specimen/collections data, and with current data streams coming from biodiversity science, phylogenetics, environmental science, paleontology, and atmospheric/climate sciences. This integration will enable novel interdisciplinary research in biodiversity science.

Education

- All BIO divisions include support for Research Experiences for Undergraduates (REU) activities. In FY 2014, emphasis will be placed on research experiences for students in their first two years of college.

DIVISION OF BIOLOGICAL INFRASTRUCTURE (DBI) $133,650,000
+$7,470,000 / 5.9%

DBI Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, DBI	**$126.46**	**$126.18**	**$133.65**	**$7.47**	**5.9%**
Research	**49.54**	**47.41**	**49.41**	**2.00**	**4.2%**
CAREER	4.11	5.19	5.63	0.44	8.5%
Centers Funding (total)	41.97	42.22	41.47	-0.75	-1.8%
Centers for Analysis & Synthesis	26.09	26.12	26.30	0.18	0.7%
Nanoscale Science & Engineering Centers	5.18	5.10	5.10	-	0.0%
STC: BEACON	5.07	4.00	5.00	1.00	25.0%
STC: Center for Microbial Oceanography (C-MORE)	4.00	5.00	3.32	-1.68	-33.6%
Science of Learning Centers	1.63	2.00	1.75	-0.25	-12.5%
Education	**20.97**	**19.81**	**21.12**	**1.31**	**6.6%**
Infrastructure	**55.95**	**58.96**	**63.12**	**4.16**	**7.1%**
NNIN	0.35	0.35	0.35	-	0.0%
Research Resources	55.60	58.61	62.77	4.16	7.1%

Totals may not add due to rounding.

DBI empowers biological discovery by supporting the development and enhancement of biological research resources, human capital, and centers. In particular, DBI supports the development of, or improvements to: research infrastructure, including instruments, software, and databases; and improvements to biological research collections, living stock collections, and field stations and marine labs. In addition, DBI funds the development of human capital through support of undergraduate, graduate, and postdoctoral research experiences. Support of center and center-like activities creates opportunities to address targeted but deep biological questions that have major societal impact.

In general, 28 percent of the DBI portfolio is available for new research grants and 72 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- DBI is home to a number of Centers activities. This portfolio totals $41.47 million in FY 2014; support for the Center for Microbial Oceanography Research and Education (C-MORE) STC decreases as it begins a planned sunset with final funding in FY 2015. Support for the Science of Learning Center also decreases as this activity continues to ramp down to its final year of funding in FY 2015.
- Support for early-career researchers is a BIO priority; DBI will increase investment (+$440,000 to a total of $5.63 million) in CAREER grants.

Education

- Funding for the Research Experiences for Undergraduates (REU) Sites and Supplements program is increased $1.31 million over the FY 2012 Enacted. This additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*.

Infrastructure

- BIO will remain actively involved in CIF21 investments. DBI support for CIF21 (+$4.50 million to a total of $6.50 million) will focus on Software Infrastructure for Sustained Innovation, data-enabled science, planning activities for cyber-infrastructure for the life sciences, and Strategic Integration for Biological Sciences (SIBS).
- Funds are redirected from lower priority areas (-$340,000) to support these activities.

EMERGING FRONTIERS (EF)

$116,200,000
+$10,680,000 / 10.1%

EF Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, EF	**$105.21**	**$105.52**	**$116.20**	**$10.68**	**10.1%**
Research	**85.53**	**88.57**	**82.25**	**-6.32**	**-7.1%**
CAREER	3.67	1.64	1.67	0.03	1.8%
Education	**5.63**	**6.50**	**2.50**	**-4.00**	**-61.5%**
Infrastructure	**14.05**	**10.45**	**31.45**	**21.00**	**201.0%**
Research Resources	12.35	10.45	10.45	-	0.0%
Facilities Pre-Construction Planning (total)	1.70	-	21.00	21.00	N/A
National Ecological Observatory Network	1.70	-	21.00	21.00	N/A

Totals may not add due to rounding.

EF identifies, incubates, and supports infrastructure and research areas that transcend scientific disciplines and/or advance the conceptual foundations of biology. It is also responsible for high-risk high-profile projects, such as NEON, that require additional oversight mechanisms. Typically, developing programs and priority areas begin in EF and then shift to other BIO divisions to become part of the disciplinary knowledge base. An example includes the BioMaPS program, which is transitioning to core divisions. EF also facilitates the development and implementation of new forms of merit review and mechanisms to support transformative research and stimulate creativity. These goals are accomplished by promoting cultural change within and across scientific disciplines to increase and strengthen multidisciplinary collaborations, encourage curiosity and exploration through novel mechanisms and investments, and facilitate support of research areas relevant to all of biology by targeted co-funding throughout the directorate.

In general, 68 percent of the EF portfolio is available for new research grants. The remaining 32 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Support for early-career researchers is a BIO priority; EF will increase investment (+$30,000 to a total of $1.67 million) in CAREER grants.
- EF funding in BioMaPS (+$9.25 million to a total of $18.25 million) will produce the knowledge base for synthetic biology and the bioeconomy that is required to catalyze the emerging technologies essential to the Nation's prosperity and economic competitiveness. BioMaPS will foster research in all areas at the intersections by funding unsolicited transformative ideas in the core programs, and will provide additional stimulation for key research and training activities in emerging research fields that are ready for major growth.
- Through BioMaPS, EF contributes to both clean energy research, by supporting research on novel processes used by living organisms to capture and transduce energy, and advanced manufacturing

research, by supporting activities that aim to understand the components and processes that comprise and control biological systems from the nano to cellular scales.

- EF will support SEES (+$8.50 million to a total of $28.75 million) through, the Dimensions of Biodiversity program, Dynamics of Coupled Natural and Human Systems, coastal research, and community planning activities for a potential focus area on sustainable and resilient food systems.
- EF will provide continued support for MacroSystems Biology.
- EF will support U.S. participation in the Global Biodiversity Information Facility (GBIF).
- Funds are redirected from lower priority research areas (-$24.10 million) to support these activities along with support for infrastructure, specifically NEON O&M.

Education

- In FY 2014, NSF is adopting a comprehensive agency-wide framework – Catalyzing Advances in Undergraduate STEM Education (CAUSE) – that consolidates the Foundation's investments in undergraduate education. While the majority of funding for CAUSE is provided through the EHR Directorate, other NSF directorates contribute directly to this effort, ensuring an enduring connection to established discipline-based activities and expertise. In FY 2014, BIO's total funding of $2.50 million (formerly for the Transforming Undergraduate Biology Education (TUBE) program) will be integrated into to the CAUSE activity. Under the CAUSE framework, BIO will focus on developing (with the National Institutes for Health (NIH) and the Howard Hughes Medical Institute (HHMI)) the Partnerships for Undergraduate Life Sciences Education (PULSE).

Infrastructure

- Funding for NEON operations (+$21.0 million) will support year two of O&M for this project currently in its third year of construction. NEON is constructing a series of 106 sites over twenty domains across the United States. O&M ramps up in FY 2014, as sites are commissioned and validated for delivery of science data through a central cyberinfrastructure portal.
- Continued funding will be provided for an activity in support of digitization of scientific information associated with biological specimens held in U.S. research collections. This program began in FY 2009 with funding from the American Recovery and Reinvestment Act (ARRA). FY 2014 investments will be guided by a strategic plan developed by the community and released in FY 2010, as well as an implementation plan released in FY 2013.

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING (CISE) $950,250,000 +$85,020,000 / 9.8%

CISE Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Advanced Cyberinfrastructure (ACI)[1]	$283.84	$211.64	$221.35	$9.71	4.6%
Computing and Communication Foundations (CCF)	179.03	179.13	200.46	$21.33	11.9%
Computer and Network Systems (CNS)	212.36	212.50	238.87	$26.37	12.4%
Information and Intelligent Systems (IIS)	176.58	176.50	200.42	$23.92	13.6%
Information Technology Research (ITR)	85.35	85.46	89.15	$3.69	4.3%
Total, CISE	**$937.16**	**$865.23**	**$950.25**	**$85.02**	**9.8%**

Totals may not add due to rounding.

[1] FY 2012 Actual includes obligations $71.59 million over the enacted level for ACI (formerly OCI) due to recoveries of prior year unpaid obligations that were reobligated in FY 2012.

About CISE

CISE's mission is to promote the progress of computer and information science and engineering research and education, and advance the development and use of cyberinfrastructure; to promote understanding of the principles and uses of advanced computer, communications, and information systems in service to society; and to contribute to universal, transparent, and affordable participation in an information-based society. CISE supports ambitious long-term research and research infrastructure projects within and across the many sub-fields of computing, as well as cyberinfrastructure for all areas of science and engineering; contributes to the education and training of computing professionals; and, more broadly, informs the preparation of a U.S. workforce with computing and computational competencies essential to success in an increasingly competitive global market. CISE's FY 2014 Budget Request is shaped by the following major NSF cross-foundation investments – Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS); Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21); Secure and Trustworthy Cyberspace (SaTC); Science, Engineering, and Education for Sustainability (SEES); Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE); and NSF Innovation Corps (I-Corps) – in addition to investments in its core research, education, and infrastructure programs.

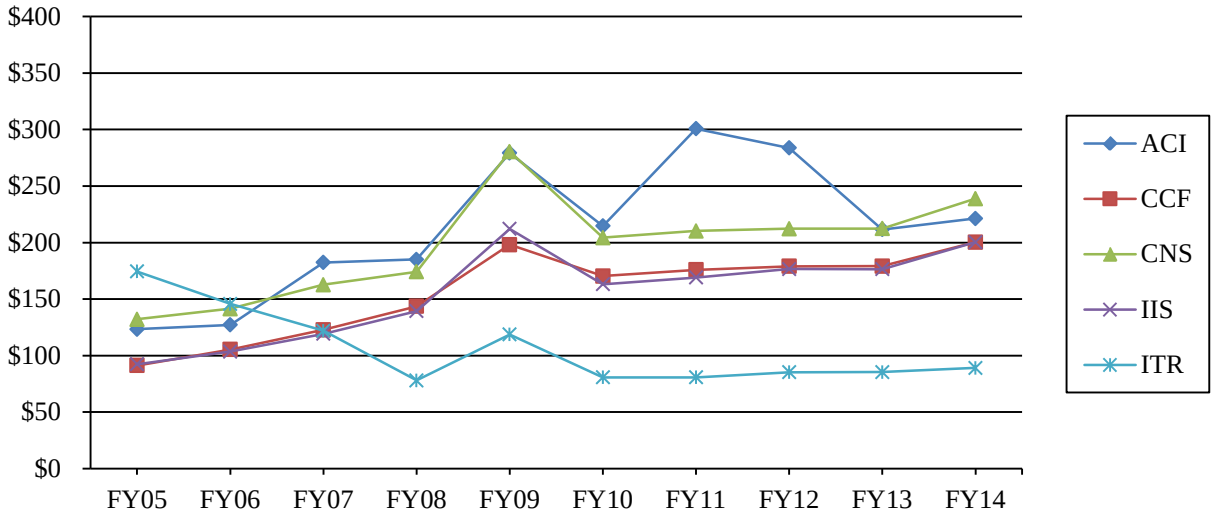
CISE continues to play a leadership role in the multi-agency Subcommittee on Networking and Information Technology Research and Development (NITRD), which is co-chaired by the CISE Assistant Director. All research, education, and research infrastructure projects supported by CISE enrich the agency's NITRD portfolio. As noted by the President's Council of Advisors on Science and Technology (PCAST) in its *Report to the President and Congress - Designing a Digital Future: Federally Funded Research and Development in Networking and Information Technology* (January 2013)[1], advances in Networking and Information Technology (NIT) are key drivers of U.S. economic competitiveness.

[1] www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-nitrd2013.pdf

Fundamental ideas and concepts derived from basic computing research have enabled innovative products and applications that now permeate all areas of modern life. IT is integral to the Nation's economy, as it drives discovery and innovation in many other areas, e.g., frontiers of scientific research, advanced manufacturing, education and workforce development, health and wellness technologies, sustainability and energy science, transportation, national and homeland security research, and public and private organizational effectiveness and efficiency. Innovation in IT will remain an essential and vital force in productivity gains and economic growth in both the manufacturing and service sectors for many years to come, positioning NSF and CISE as central and essential actors in improving the Nation's economic outlook and advancing a highly trained, technologically astute workforce.

NSF provides approximately 82 percent of the total federal support for basic research at academic institutions in computer science.

CISE Subactivity Funding
(Dollars in Millions)



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2014 Summary by Division

- ACI's FY 2014 Budget Request is focused on maintaining investments in existing programs in computational science, software, data, networking, and cybersecurity, and providing leadership in the NSF-wide CIF21 activity through increased investments in programs, such as Data Infrastructure Building Blocks (DIBBs), Software Infrastructure for Sustained Innovation (SI^2), and the cross-agency Core Techniques and Technologies to Advance Big Data Science and Engineering (BIGDATA). The goal of CIF21 is to accelerate and transform the progress of scientific discovery and innovation by providing cyberinfrastructure – including new data infrastructure and computational frameworks – that enable novel functionalities and capabilities in data-enabled, computational science and engineering. ACI continues to support other cross-disciplinary activities, including transitioning discoveries into practice in the SaTC program; leading the Computational- and Data-Intensive Science & Engineering (CDS&E) family of programs across the directorates, as well as the CIF21 track within the NSF Research Traineeships (NRT) program; and participating in INSPIRE and I-Corps.

- CCF's FY 2014 Budget Request is focused on enhancing support for its core programs and on support for NSF-wide investment areas. CCF will support the NSF-wide CIF21 program through increased investments in BIGDATA foundational research, including algorithms and software tools for managing massive amounts of heterogeneous, complex data; new functional capabilities in support of highly parallel computing, and multi-core and multi-machine data management systems. CCF, as part of the NSF-wide SEES portfolio, will increase investments in Cyber-Enabled Sustainability and Engineering (CyberSEES), focusing on the computational methods and models necessary to attain a sustainable future. CCF will increase investments in reliable wireless transmission; theoretical performance limits of spectrum sharing; technical and economic models for flexible spectrum access, real-time auctions, and on-demand spectrum services and support for the Enhancing Access to the Radio Spectrum (EARS) program. CCF will also increase its investments in eXploiting Parallelism and Scalability (XPS) as part of its core programs. CCF will support foundational research in SaTC, including new theories, models, methods, architectures, and tools that aim to achieve security-aware computing, self-healing hardware, and self-protecting software. As part of the National Nanotechnology Initiative, CCF will focus on research in nanoscale devices and systems.

- CNS's FY 2014 Budget Request is focused on enhancing support for its core programs, as well as on providing support for NSF-wide investment areas. In partnership with the other CISE divisions and the Directorates for Education and Human Resources (EHR), Engineering (ENG), Mathematical and Physical Sciences (MPS), and Social, Behavioral and Economic Sciences (SBE), CNS will continue to lead the SaTC program. CNS will maintain CISE's national leadership in developing the scientific foundations of cybersecurity as part of the Comprehensive National Cybersecurity Initiative (CNCI). Also, in partnership with other CISE divisions and NSF directorates, CNS will expand its support for CEMMSS through increased investment in research in Cyber-Physical Systems (CPS), Advanced Manufacturing (AM), and the National Robotics Initiative (NRI). CNS will increase support for research in wireless communication and mobile computing, as well as partner with ENG and MPS to support EARS research in spectrum sharing architectures and services. Additionally, CNS will support the NSF-wide CIF21 investment through BIGDATA research on pervasive computing, as well as large-scale data management systems. CISE and EHR will consolidate the Computing Education for the 21st Century (CE21) program and Math and Science Partnerships (MSP) programs into the Science, Technology, Engineering, and Mathematics, including Computing Partnerships (STEM-C Partnerships) program in FY 2014. CNS will increase its investment in the STEM-C Partnerships program. CNS will also continue its support of the Global Environment for Network Innovations (GENI) project, allowing for experimentation in future networks not possible elsewhere.

- IIS's FY 2014 Budget Request is focused on enhancing support for its core programs and on support for NSF-wide investment areas. IIS will participate in CEMMSS through leadership of NRI, in partnership with the National Institutes of Health (NIH), National Aeronautics and Space Administration (NASA), and Department of Agriculture (USDA), as well as other NSF directorates ENG, EHR, and SBE. NRI will accelerate the development and use of robots in the United States that work beside, or cooperatively with, people. IIS will participate in the NSF-wide CIF21 activity through increased investments in BIGDATA analytics and e-science, including new approaches to data mining, machine learning, knowledge extraction, visualization, predictive modeling, and automated discovery as well as in DIBBs, which will develop, implement, and support the new methods, management structures, and technologies to store and manage the diversity, size, and complexity of current and future data sets and data streams. IIS will lead a joint NSF – NIH program, Smart and Connected Health (SCH), partnering with ENG and SBE, as well as with other CISE divisions. IIS will participate in the cyberlearning and on-line education program which aims to integrate advances in technology with advances in what is known about how people learn. IIS will

increase its investments in neuroscience, building on investments in computational neuroscience and foundational research programs to revolutionize understanding of brain functions.

- ITR's FY 2014 Budget Request will provide support for emerging high-priority areas of potentially transformative research. Through I-Corps, ITR will develop and nurture a national innovation ecosystem that builds on foundational research and guides the output of scientific discoveries to the development of technologies, products, and processes that benefit society. ITR will continue to invest in the Expeditions in Computing program, which encourages researchers to come together to identify the compelling ideas that promise transformations in computing and information sciences for years to come. ITR will invest in multi-disciplinary research networks, aiming to build communities across emerging areas of research and education. ITR will increase its investments in mid-scale infrastructure, leveraging previous investments in GENI and developing new cloud testbeds. This effort will extend virtualization beyond the network to large-scale, interconnected computing resources by investing in mid-scale prototypes for an NSF Cloud research infrastructure. Through US Ignite, ITR will continue to expand and provide U.S. campuses with network testbeds that advance networking and systems research through experimentation and explorations at scale, and jumpstart public sector gigabit application development and deployment.

Major Investments

CISE Major Investments
(Dollars in Millions)

Area of Investment	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Advanced Manufacturing	$27.80	$27.80	$39.63	$11.83	42.6%
CAREER	51.26	52.24	56.64	4.40	8.4%
CEMMSS	50.50	50.50	103.00	52.50	104.0%
CIF21	47.94	35.00	90.67	55.67	159.1%
Clean Energy Technology	18.00	18.00	23.50	5.50	30.6%
CNCI	57.42	59.00	51.00	-8.00	-13.6%
EARS	7.00	7.00	24.00	17.00	242.9%
I-Corps	2.55	2.75	9.00	6.25	227.3%
INSPIRE	3.84	0.50	5.00	4.50	900.0%
NRI	13.54	12.50	21.50	9.00	72.0%
SEES	9.02	9.50	19.00	9.50	100.0%
SaTC	58.89	59.00	75.00	16.00	27.1%
STEM-C Partnerships	-	-	16.50	16.50	N/A

Major investments may have funding overlap and thus should not be summed.

- Advanced Manufacturing: As part of CEMMSS, CISE will invest in research that integrates ubiquitous sensors, computational tools, and highly connected cyber-physical systems in smart processing and advanced manufacturing systems, resulting in higher quality products with greater efficiency and sustainability produced by the factories of the future. CISE will also invest in basic research to advance robotics technology in order to enable new functionalities and provide the next-generation of products and services in various industries. In addition, CISE will support research

aimed at the development of next-generation robotics, conceived as co-robots that work alongside, or cooperatively with, people in manufacturing environments to increase their productivity, performance, and safety.

- CAREER: This program invests in the integration of research and education of early-career researchers and contributes to the development of future generations of computer and information scientists and engineers, as well as computational scientists across all areas of science and engineering.

- CEMMSS: CISE aims to establish a scientific basis for engineered systems interdependent with the physical world and social systems, synthesize multi-disciplinary knowledge to model and simulate systems in their full complexity and dynamics, and develop a smart systems technology framework. As part of CEMMSS, the CPS program, funded jointly with ENG, will be expanded through investments from MPS, SBE, and the Directorate for Biological Sciences (BIO) to accelerate advances in 21st century smart engineered systems. CEMMSS also includes CISE investments in the multi-agency NRI. As part of this research activity, CISE will also synergize investments across multiple research communities and programs in order to transform static systems, processes, and edifices into adaptive, pervasive smart systems with embedded computational intelligence that can sense, adapt, and react.

- CIF21: CISE will lead CIF21 in support of advances in the cross-agency BIGDATA research program and through investments in the DIBBS program. BIGDATA research will focus on core scientific and technological means of managing, analyzing, visualizing, and extracting useful information from large, diverse, distributed, and heterogeneous data sets. DIBBs aims to develop, implement, and support new cyberinfrastructure to store and manage the diversity, size, and complexity of current and future data sets and data streams. To advance new computational infrastructure, CISE will support SI^2, catalyzing new paradigms and practices in the development and use of software that is robust, reliable, usable, and sustainable. CIF21 researchers can now take advantage of two new significant computational resources that became available in FY 2013 – Blue Waters and Stampede.

- Clean Energy Technology: CISE will support foundational research in energy-intelligent computing; the development of new theory, algorithms, and design principles to effectively tackle energy versus computation and communication tradeoffs; and the scalability and sustainability of smart energy production software and hardware. CISE research on clean energy is partially supported via investments in SEES.

- CNCI: CISE will focus on the development of the science of cybersecurity, as well as on four game-changing research areas – designed-in security, moving target defense, tailored trustworthy spaces, and cyber economic incentives. CISE will also actively work to transition mature discoveries into a secure research infrastructure. In partnership with SBE, CISE will invest in research at the intersection of economic and computer sciences to achieve secure practices through the development of mechanisms that incentivize good behavior in cyberspace.

- EARS, including wireless and mobile computing: CISE will increase support for research in wireless communication, spectrum sharing, and mobile computing, as well as the development of wireless and spectrum testbeds. Collaborations with ENG and MPS in EARS will strengthen U.S. leadership in the global wireless technology marketplace.

- I-Corps: CISE's investment will seek to identify NSF-funded researchers who will receive additional support – in the forms of mentoring and funding – to accelerate innovation that can attract subsequent third-party investment. In FY 2013, NSF initiated two additional I-Corps subcomponents – Sites and Nodes – to further build, utilize, and sustain a national innovation ecosystem that continues to augment the development of technologies, products, and processes that benefit the Nation. I-Corps Sites are funded at academic institutions, having already existing innovation or entrepreneurial units, to enable them to nurture and support multiple, local teams to transition their ideas, devices, processes or other intellectual activities into the marketplace. The I-Corps Nodes subcomponent's goal is to establish regional nodes to provide training to I-Corps Teams; develop tools and resources that will impact and expand the benefits of the entire I-Corps program within a two to three year timeframe; and identify and pursue longer-term research and development projects.

- INSPIRE: CISE will integrate a suite of new activities with existing efforts to foster and support transformative interdisciplinary research. In FY 2014, CISE will invest in several mid-scale awards to build a new pool of potential innovators.

- NRI: The NRI is a national multi-agency research program led by NSF in partnership with NIH, NASA, and USDA that aims to accelerate the development and use of co-robots. In partnership with EHR, ENG, and SBE, NRI will support fundamental science and engineering in robotics research, and enhance understanding of the social and economic impacts of co-robots. NRI is a primary component of the smart systems research investment in CEMMSS.

- SEES: CISE will invest in CyberSEES, which aims to advance interdisciplinary research in which the science and engineering of sustainability are enabled by advances in computational- and data-intensive research and education. CISE will also invest in *Interdisciplinary Research in Hazards and Disasters* (Hazards SEES) to catalyze well-integrated interdisciplinary research efforts in hazards-related science and engineering.

- SaTC: NSF is aligning its cybersecurity investments (including investments from EHR, ENG, MPS, and SBE) with the Administration's national cybersecurity strategy, *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program*. SaTC aims to support scientific foundations, induce change, maximize research impact, and accelerate the transition to practice. This investment also includes support for CNCI. CISE will collaborate with EHR to support cyber-secure workforce development to enable a growing pipeline of researchers and educators, and to develop a citizenry that understands the security and privacy of the digital systems on which society depends.

- STEM-C Partnerships: CISE and EHR will consolidate the Computing Education for the 21st Century (CE21) program and Math and Science Partnerships (MSP) programs into the Science, Technology, Engineering, and Mathematics, including Computing Partnerships (STEM-C Partnerships) program in FY 2014. This program will enlarge the pool of K-14 students and teachers who develop and practice computational competencies in a variety of contexts, as well as the pool of early postsecondary students who are engaged and have the background in computing necessary to successfully pursue degrees in computing-related and computationally-intensive fields of study.

CISE Funding for Centers Programs and Facilities

CISE Funding for Centers Programs

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Centers Programs Total	**$11.25**	**$11.50**	**$9.69**	**-$1.82**	**-15.8%**
STC: Team for Research in Ubiquitous Secure Technology (CCF)	4.00	4.00	2.66	-1.34	-33.5%
STC: Science of Information (CCF)	5.00	5.00	5.00	-	-
SLC: Pittsburgh Science of Learning Center - LearnLab (ITR)	2.25	2.50	2.03	-0.48	-19.0%

Total may not add due to rounding.

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- CISE will provide the tenth and final year of funding, at a reduced level as the program ramps down, for the Science and Technology Center (STC) Team for Research in Ubiquitous Secure Technology (TRUST) at the University of California at Berkeley. TRUST is focused on the development of cybersecurity science and technology that will radically transform the ability of organizations to design, build, and operate trustworthy information systems for the Nation's critical infrastructure by addressing the technical, operational, legal, policy, and economic issues affecting security, privacy, and data protection, as well as the challenges of developing, deploying, and using trustworthy systems.

- CISE will provide the fourth year of funding for the STC: Center for the Science of Information at Purdue University. The goal of this center is to develop a new science of information that incorporates common features associated with data/information, such as space, time, structure, semantics, and context, that are not addressed by earlier mathematical theories, e.g., data obfuscation and hiding techniques that enhance robustness and the principles of redundancy and fault tolerance found in natural systems.

- CISE continues to support the LearnLab, formerly known as Pittsburgh Science of Learning Center (SLC) for Robust Learning, at a reduced level as the project ramps down. The Pittsburgh SLC leverages cognitive theory and cognitive modeling to identify the instructional conditions that result in robust student learning and to support field-based experimentation, data collection, and data mining in math, science, and language courses.

CISE Funding for Facilities

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Facilities Total	**$0.60**	**$0.60**	**$0.60**	-	-
National Nanotechnology Infrastructure Network (CCF)	0.60	0.60	0.60	-	-

For detailed information on individual facilities, please see the Facilities chapter.

Summary and Funding Profile

CISE supports investments in core and interdisciplinary research and education, as well as in computing research infrastructure.

In FY 2014, the number of research grant proposals is expected to increase by approximately 16 percent compared to FY 2012 Enacted Estimate. CISE expects to award approximately 1,800 research grants in FY 2014. Average annualized award size is expected to increase, while the average award duration is expected to increase slightly between the FY 2012 Enacted Estimate and FY 2014.

Funding for research infrastructure accounts for 17 percent of the CISE Request.

CISE Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate[1]	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	7,704	7,690	8,900
Number of New Awards	1,750	1,555	2,100
Funding Rate	23%	20%	24%
Statistics for Research Grants:			
Number of Research Grant Proposals	7,381	7,330	8,500
Number of Research Grants	1,495	1,335	1,800
Funding Rate	20%	18%	21%
Median Annualized Award Size	$163,352	$152,170	$175,000
Average Annualized Award Size	$210,210	$186,077	$225,000
Average Award Duration, in years	2.9	3.0	3.1

[1] Award Estimates for FY 2013, such as numbers of awards and size/duration, are based upon the FY 2012 Enacted level.

Program Monitoring and Evaluation

Committees of Visitors (COV):

- In FY 2014, CISE plans to hold a Committee of Visitors (COV) review, which will examine and assess the quality of the CISE merit review process.

Science and Technology Policy Institute (STPI) Reports and Evaluations:

- CISE management has established a contract with the Science and Technology Policy Institute (STPI) to conduct program evaluation feasibility studies for the SaTC and CEMMSS programs. These feasibility studies will examine baseline portfolio investments and identify metrics to measure progress toward program goals. The studies will be conducted to develop a plan for impact assessments of SaTC and CEMMSS investments. A contract was put into place, and a kick-off meeting was held at the end of the fourth quarter of FY 2012. The preliminary work to set out baseline evaluation metrics will be carried out in FY 2013, allowing program evaluation analyses to be deployed during FY 2014. Yearly program assessments will be carried out by the CEMMSS and SaTC working groups and presented to NSF senior management.

STEM Evaluation:

- Evaluation is a vital part of CISE's STEM education programs. Each of the STEM-C Partnerships projects managed by CISE will provide a rigorous research and/or evaluation plan designed to guide project progress and measure its impact. The plan will include a description of the instrument and metrics that will be used. Across the STEM-C Partnerships portfolio managed by CISE, a set of common metrics and a design for evaluation instruments are being developed. The expectation is that the design will be completed in FY 2013 and the first program evaluation will be completed under a new contract to be negotiated in FY 2014.

Reports:

- To better assess the long-term economic impact of CISE investments, CISE funded the National Academy of Sciences (NAS) Computer Science and Telecommunications Board (CSTB) to study the IT innovation ecosystem. The report, *Assessing the Impacts of Changes in the Information Technology R&D Ecosystem,* published in 2009, includes an in-depth articulation of the creation since 1965 of almost 20 IT industries valued at a billion dollars. To update this study, CISE funded CSTB to identify recent IT industries that have reached the billion dollar mark; develop a brief report that highlights the updated figures; and summarize results-to-date of IT research, including the nature and successes of U.S. research partnerships among government, industry, and universities, and the economic payoffs of these research investments. The report, *Continuing Innovation in Information Technology,* was published in 2012.
- In FY 2011-2012, the CISE Directorate supported several community activities to assess future research and infrastructure needs. A workshop organized by the CISE-funded Computing Community Consortium (CCC) resulted in a report – *Science, Engineering, and Education of Sustainability: The Role of Information Sciences and Engineering* – that defines a vision for fundamental research at the intersection of sustainability and IT.[2] A subsequent study by the CSTB, *Computing Research for Sustainability*, specifies a framework for how innovation in computing will be essential to finding real world solutions to sustainability challenges, such as electricity production and delivery, global food production, and environmental adaptation.[3] Separately, a CSTB study, *The Future of Computing Performance: Game Over or Next Level?*,[4] together with a CCC white paper, *21st Century Computer Architecture,* outline the need for advances in computer architecture research.[5]

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external COV and directorate Advisory Committees. Please see this chapter for additional information.

Number of People Involved in CISE Activities

	FY 2012 Actual	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	8,706	7,800	9,500
Other Professionals	1,108	900	1,200
Postdoctorates	415	500	500
Graduate Students	6,099	5,400	6,700
Undergraduate Students	2,639	2,000	2,900
Total Number of People	**18,967**	**16,600**	**20,800**

[2] http://cra.org/ccc/docs/RISES_Workshop_Final_Report-5-10-2011.pdf
[3] www.nap.edu/catalog.php?record_id=13415
[4] www.nap.edu/openbook.php?record_id=12980
[5] http://cra.org/ccc/docs/init/21stcenturyarchitecturewhitepaper.pdf

DIVISION OF ADVANCED CYBERINFRASTRUCTURE (ACI) $221,350,000
+$9,710,000 / 4.6%

ACI Funding
(Dollars in Millions)

	FY 2012 Actual[1]	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, ACI	**$283.84**	**$211.64**	**$221.35**	**9.71**	**4.6%**
Research	**66.30**	**87.48**	**98.80**	**11.32**	**12.9%**
CAREER	4.08	3.97	4.54	0.57	14.4%
Education	**7.23**	**7.60**	**7.95**	**0.35**	**4.6%**
Infrastructure	**210.32**	**116.56**	**114.60**	**-1.96**	**-1.7%**
Networking and Computational Resources Infrastructure and Services	210.32	116.56	114.60	-1.96	-1.7%

Totals may not add due to rounding.

[1] FY 2012 Actual includes obligations $71.59 million over the enacted level for ACI (formerly OCI) due to recoveries of prior year unpaid obligations that were reobligated in FY 2012.

ACI enables science and engineering research and education by developing, creating, and supporting secure, advanced, global cyberinfrastructure (CI). ACI partners with NSF directorates and offices to support research and development across the entire range of cyberinfrastructure activities, including acquisition, integration, coordination, and operations associated with data, networking, computation, software, and the development of CDS&E tools and expertise. ACI focuses on the development of these resources and capabilities, as well as on the expertise to conduct next generation science and engineering, in order to better address complex and multidisciplinary discovery, prediction, and innovation. ACI also supports international activities in networking, data, and computation, including connectivity to major international resources and scientific instruments, and computational support to more than 8,000 faculty and researchers.

In general, about 31 percent of the ACI research and infrastructure portfolio is available for new research grants. The remaining 69 percent is used primarily to fund continuing grants made in previous years.

Approximately 60 percent of ACI's budget is used to support individuals and small groups of researchers, while about 40 percent of the budget goes to support larger cyberinfrastructure consortia and facilities, including the eXtreme Digital (XD) services program, the Blue Waters Petascale Computing Program, and mid-scale pilots and prototypes toward an integrated data infrastructure.

FY 2014 Summary
All funding decreases/increases represent change over the FY 2012 Enacted level.

Research
- ACI will continue support for early-career researchers through increased investments (+$570,000 to a total of $4.54 million) in the CAREER program.
- ACI will provide leadership for the NSF-wide CIF21 portfolio and increase its investments (+$43.17 million to a total of $66.17 million) in the portfolio of activities that provide integrated cyber resources, enabling multidisciplinary research opportunities in all areas of science and engineering. It

will leverage ongoing cyberinfrastructure investments across NSF by coordinating and deploying common approaches and components to manage data, provide computational support, and develop new multidisciplinary research communities. ACI's data investments include the Data Infrastructure Building Blocks (DIBBs) and BIGDATA programs, as well as development of mid-scale pilots and prototypes toward a national data infrastructure. DIBBs, a program initiated in FY 2012 to support data conceptualization and data pilot awards, will be added to the CIF21 portfolio in FY 2014 and represents $33.17 million of the funding increase to CIF21 in FY 2014. ACI continues to support and invest in software innovation, development, and sustainability with additional investments in multi-directorate community building, and computational infrastructure activities.

- ACI will support the NSF-wide SEES portfolio (+$1.50 million to a total of $3.0 million) through cyberinfrastructure-enabled sustainability research, including the development of advanced and high-performance simulations and models.
- ACI will continue to support INSPIRE (+$500,000 to a total of $1.0 million), addressing some of the most complicated and pressing scientific problems that lie at the intersection of traditional disciplines.
- ACI will continue support of the I-Corps program (+$750,000 to a total of $1.0 million), which aims to guide the output of scientific discoveries closer to the development of technologies, products, and processes that benefit society. Additional investments will be put into I-Corps Sites and Nodes, which are designed to build and support a national innovation ecosystem that continues the development of technologies, products and processes that benefit the Nation.

Education

- With all CISE divisions, ACI will continue support for Research Experiences for Undergraduates (REU) sites and supplements (+$150,000 to a total of $1.25 million).
- ACI is home to the Cyberinfrastructure Postdoctoral Fellowship program (CI TRaCS). It is also a significant contributor to the CIF21 track within the Foundation-wide NSF Research Traineeships (NRT) program; it supports the Expeditions in Training, Research, and Education for Mathematics and Statistics through Quantitative Explorations of Data (EXTREEMS-QED) program with MPS; and it invests in the STEM-C Partnerships activity. This portion of the ACI Education portfolio totals to $6.70 million (+$200,000) in FY 2014.

Infrastructure

- The ACI Networking programs will increase investments (+$2.35 million to a total of $26.60 million) in improvements and re-engineering at the campus level to leverage dynamic network services to support a range of scientific data transfers and movement. The program also supports network integration activities tied to achieving higher levels of performance, reliability, security and predictability for science applications and distributed research projects.
- ACI will invest in the NSF-wide SaTC program (+$2.0 million to a total of $6.0 million) through support of efforts to transition cybersecurity research into practice, including more participation with campuses. The focus is on applied research, development, prototyping, testing, and experimental deployment, resulting in fielded capabilities and innovations of direct benefit to networks, systems, and environments supporting NSF science and engineering research and education.
- The High Performance Computing (HPC) program (-$6.31 million to a total of $82.0 million) will provide ongoing support for the eXtreme Digital (XD) services program, an advanced nationally distributed open cyberinfrastructure comprised of shared user and management services; the operation and maintenance of the Blue Waters Petascale Computing program; and ongoing support for experimental/innovative HPC. There are no HPC acquisitions planned for FY 2014. Refer to Appendix A in this chapter for more information on the HPC portfolio.

DIVISION OF COMPUTING AND COMMUNICATION FOUNDATIONS (CCF) **$200,460,000**
+$21,330,000 / 11.9%

CCF Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, CCF	**$179.03**	**$179.13**	**$200.46**	**$21.33**	**11.9%**
Research	**171.13**	**171.03**	**192.11**	**21.08**	**12.3%**
CAREER	15.24	15.37	16.97	1.60	10.4%
Centers Funding (total)	9.00	9.00	7.66	-1.34	-14.9%
STC: Team for Research in Ubiquitous Secure Technology	4.00	4.00	2.66	-1.34	-33.5%
STC: Science of Information	5.00	5.00	5.00	0.00	-
Education	**7.30**	**7.50**	**7.75**	**0.25**	**3.3%**
Infrastructure	**0.60**	**0.60**	**0.60**	0.00	-
Nat'l Nanotechnology Infrastructure Network	0.60	0.60	0.60	0.00	-

Totals may not add due to rounding.

CCF supports research and education activities that explore the foundations and limits of computation, communication, and information; advance algorithmic knowledge for research areas both within and outside computer science; and advance software, hardware, and computer system design. CCF's research investments support advances in the design and analysis of algorithms, computational complexity, theoretical and experimental studies of algorithms and their resource requirements, and formal models of computation, including models for parallel, distributed, and heterogeneous multi-core machines. CCF invests in research that addresses the theoretical underpinnings and enabling technologies for information acquisition, transmission, and processing in communication and information networks, such as sensor networks, wireless and multimedia networks, biological networks, and networks of quantum devices. CCF investments advance the design, verification, evaluation, and utilization of computing hardware and software through new theories and high-leverage tools that focus on performance, correctness, usability, dependability, reliability, and scalability. CCF also invests in research that explores the potential impact of emerging technologies on computation and communication, including nanotechnology, biotechnology, and quantum systems.

In general, about 74 percent of the CCF portfolio is available for new research grants. The remaining 26 percent is used primarily to fund continuing grants.

FY 2014 Summary
All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CCF continues support for early-career researchers through increased investments in the CAREER program (+$1.60 million to a total of $16.97 million).
- CCF will support the NSF-wide CIF21 portfolio (+$5.50 million to a total of $9.50 million) through BIGDATA foundational research, including algorithms and software tools for managing massive amounts of heterogeneous, complex data; models and theories for massive data sets; streaming, sub-

linear, space-limited, and probabilistic algorithms; methods to validate and verify data; and tools and algorithms to extract knowledge from massive data sets and enable new discoveries.

- CCF will support the NSF-wide SEES portfolio (+$4.77 million to a total of $8.27 million) through research on cyber-enabled sustainability, which includes new approaches based on optimization, modeling, simulation, and inference; large-scale data management and analytics; and smart management of engineered systems. In CyberSEES, CCF will support research that addresses holistic, integrative approaches to sustainable computing and information technologies across the lifecycle of design, use, and reuse with the associated consumption of energy, materials, and other resources. In Hazards SEES, CCF will support computational research in the areas of decision-making under extreme conditions, increasing knowledge about natural and technological hazards.
- CCF will invest in wireless communication research ($8.0 million) as part of EARS-related research, with a focus on reliable transmission in the presence of channel impairments; the theoretical performance limits for communication systems using spectrum sharing; and the management of spectrum sharing based on the principles of cognitive networking, game-theoretic and economic models, and computationally-efficient algorithms.
- CCF will invest in XPS at a funding level of $6.50 million through foundational research advancing parallel and scalable computing; challenging the validity of the traditional computer hardware and software stack for today's heterogeneous parallel systems; and focusing on new foundational principles and cross-layer approaches that integrate both software and hardware through new programming languages, models, algorithms, compilers, runtime systems, and architectures. The goal is to achieve scalable performance and energy efficiency in systems while also addressing programmability, reliability, and domain-specific design.
- CCF will support the NSF-wide SaTC program (+$3.0 million to a total of $14.50 million) through research on the foundations of secure and trustworthy computing, including theories, models, algorithms, architectures, languages, tools, and cryptography.
- CCF will participate in the NSF-wide CEMMSS portfolio through NRI (+$1.0 million to a total of $3.0 million) and CPS (+$2.0 million to a total of $6.0 million). Focusing on the development of smart systems, research will emphasize new formal and semi-formal methods for specification, development, and verification of software, hardware, and embedded systems for various sectors, including advanced manufacturing.
- CCF will support INSPIRE at a funding level of $1.0 million, addressing some of the most complicated and pressing scientific problems that lie at the intersection of traditional disciplines.
- As part of the National Nanotechnology Initiative, CCF will maintain its investment in the Nanotechnology Signature Initiatives ($3.83 million).
- CCF will participate in the cross-cutting SCH program ($3.0 million, level with FY 2012 Enacted).
- CCF will continue to support the STC, Science of Information, at Purdue University at the $5.0 million level; and the TRUST STC at the University of California at Berkeley at a reduced level of funding as the project ramps down (-$1.34 million to a total of $2.66 million).

Education

- CCF will provide support for the STEM-C Partnerships activity ($4.0 million, level with FY 2012 Enacted) with the other CISE divisions and EHR.
- Along with the other CISE divisions, CCF will continue support for REU sites and supplements ($3.0 million, level with the FY 2012 Enacted).

Infrastructure

- CCF co-funds the National Nanotechnology Infrastructure Network, supported primarily by ENG, at a level of $600,000.

DIVISION OF COMPUTER AND NETWORK SYSTEMS (CNS) $238,870,000
$26,370,000 / 12.4%

CNS Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, CNS	**$212.36**	**$212.50**	**$238.87**	**$26.37**	**12.4%**
Research	**166.99**	**166.60**	**191.98**	**25.38**	**15.2%**
CAREER	14.68	15.15	16.35	1.20	7.9%
Education	**17.29**	**15.90**	**16.89**	**0.99**	**6.2%**
Infrastructure	**28.08**	**30.00**	**30.00**	**-**	**-**
Research Resources	28.08	30.00	30.00	-	-

Totals may not add due to rounding.

CNS supports research and education activities that advance understanding of the fundamental properties of computer systems and networks; explore new ways to address the limitations of existing computer and networked systems to make better use of these technologies; and develop novel paradigms, abstractions, and tools for designing, analyzing, and building next generation computer and networked systems that are robust, secure, and trustworthy. CNS investments in computer systems research focus on: distributed, mobile, and embedded systems; sensing and control systems; dynamically configured, multiple-component systems; and parallel systems. CNS investments in fundamental network research create new insights into the dynamics of complex networks and explore new architectures for future-generation networks and services. CNS provides scientific leadership in cybersecurity, supporting research and education activities that will ensure society's ubiquitous and distributed computing and communications systems deliver the quality of service they are designed to achieve, without disruption, while enabling and preserving privacy, security, and trust. CNS also plays a leadership role in coordinating CISE investments in research infrastructure resources and in the development of the computing workforce of the future.

In general, about 62 percent of the CNS portfolio is available for new research grants. The remaining 38 percent is used primarily to fund continuing grants.

FY 2014 Summary
All funding decreases/increases represent change over the FY 2012 Enacted level.

Research
- CNS continues support for early-career researchers through increased investments in the CAREER program (+$1.20 million to a total of $16.35 million).
- In partnership with EHR, ENG, MPS, SBE, and the other CISE divisions, CNS will continue to lead the SaTC program (+$8.0 million to a total of $44.0 million), which aligns with the Administration's national cybersecurity strategy, *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program*. SaTC will invest in game-changing research in support of CNCI, develop scientific foundations, maximize research impact, and accelerate transitions to practice, in addition to addressing education and workforce issues. CNS will invest in large-scale collaborations requiring multi-disciplinary teams to focus on cybersecurity grand challenges.

- In partnership with ENG, MPS, and the other CISE divisions, CNS will expand on the portfolio that has been developed under the CEMMSS initiative. As part of the CPS program under CEMMSS (+$13.0 million to a total of $31.0 million), CNS will support the foundational interdisciplinary research and education necessary to transform static systems, processes, and edifices into adaptive, pervasive smart systems, as well as to further the understanding of fundamentals arising from grand challenge applications, ranging from advanced manufacturing and transportation to critical infrastructure, such as the Smart Grid, medical devices, and disaster response. As part of the CEMMSS portfolio, CNS will invest in NRI (+$1.50 million to a total of $5.0 million).
- CNS will expand support for research in wireless communication, spectrum sharing, and mobile computing and the development of wireless testbeds (+$7.0 million to a total of $10.0 million). CNS will also collaborate with ENG, MPS, and other CISE divisions in EARS, including research in advancing spectrum sensing techniques; exploring machine learning and game theory for dynamic spectrum management; understanding incentive mechanisms; and developing mid-scale experimental infrastructure to test theoretical innovations, wireless devices, protocols, and algorithms.
- CNS will support XPS at a funding level of $3.50 million, which invests in new approaches to the traditional computer hardware and software stack in multi-core, multi-machine, cloud, data-intensive, and highly concurrent systems.
- CNS will participate in the CIF21 investment (+$1.0 million to a total of $4.0 million) through the BIGDATA program. This includes research in pervasive computing, combining distributed sensing with data analytics and distributed response, as well as work on large-scale data management systems.
- CNS will support the NSF-wide SEES investment (+$1.0 million to a total of $3.50 million) through research in large-scale, intelligent data management and analysis; widespread, heterogeneous sensing and control; new methods for addressing power, thermal, and sustainability issues in the design and operation of computing systems at all scales; and disaster avoidance through advanced sensing.
- CNS will support INSPIRE at a funding level of $1.0 million, addressing some of the most complicated and pressing scientific problems that lie at the intersection of traditional disciplines.
- CNS will participate in other cross-cutting research programs, including SCH ($3.0 million, level with the FY 2012 Enacted) and the cyberlearning and on-line education program ($2.0 million, level with the FY 2012 Enacted).

Education

- CNS will increase its investments in the joint CISE/EHR STEM-C Partnerships activity, which seeks to enhance computational competencies for all students (+$4.0 million to a total of $8.0 million). This program will enlarge the pool of K-14 students and teachers who develop and practice computational competencies in a variety of contexts, as well as the pool of early postsecondary students who are engaged and have the background in computing necessary to successfully pursue degrees in computing-related and computationally-intensive fields of study.
- Along with the other CISE divisions, CNS will continue support for REU sites and supplements ($3.50 million, level with the FY 2012 Enacted).
- CNS maintains support for the ADVANCE program at a funding level of $2.95 million, which endeavors to increase the participation and advancement of women in academic science and engineering careers.

Infrastructure

- Through the Computing Research Infrastructure program ($18.0 million), CNS supports acquisition, enhancement, and operation of state-of-the-art infrastructure that enables high-quality computing research and education in a diverse range of institutions and projects.
- CNS will maintain its support for the development of world-class, mid-scale computing research infrastructure through GENI and cloud testbeds ($12.0 million) by investing in a suite of wireline and wireless interconnected testbeds, campuses, cities, research backbones, and regional optical networks.

DIVISION OF INFORMATION AND INTELLIGENT SYSTEMS (IIS) **$200,420,000**
+$23,920,000 / 13.6%

IIS Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
Total, IIS	**$176.58**	**$176.50**	**$200.42**	**$23.92**	**13.6%**
Research	**167.41**	**168.50**	**191.17**	**22.67**	**13.5%**
CAREER	16.86	17.75	18.78	1.03	5.8%
Education	**9.17**	**8.00**	**9.25**	**1.25**	**15.6%**

Totals may not add due to rounding.

IIS supports research and education that develop and apply new IT to enhance the capabilities of people and machines to create, discover, and reason by advancing their ability to represent, collect, store, organize, visualize, and communicate data and information; develop new knowledge to support people in the design and use of IT; and advance knowledge about how computational systems can perform tasks autonomously, robustly, and flexibly.

IIS research investments support the exploration of novel theories and innovative technologies that advance our understanding of the complex and increasingly coupled relationships between people and computing, promising to enhance quality of life. Investments in information integration and informatics focus on the processes and technologies involved in creating, managing, visualizing, and fusing diverse data, information, and knowledge from disparate and uncoordinated sources within a changing landscape of computing platforms, from personal devices to globally-distributed networks. IIS also invests in research on artificial intelligence, computer vision, natural language, robotics, machine learning, computational neuroscience, cognitive science, and areas leading to the computational understanding and modeling of intelligence in complex, realistic contexts, including investments to revolutionize understanding of brain functions.

In general, about 70 percent of the IIS portfolio is available for new research grants. The remaining 30 percent is used primarily to fund continuing grants.

FY 2014 Summary
All funding decreases/increases represent change over the FY 2012 Enacted level.

Research
- IIS continues support for early-career researchers through increased investments in the CAREER program (+$1.03 million to a total of $18.78 million).
- In partnership with three other federal agencies (NASA, NIH, and USDA), three other NSF directorates (ENG, SBE, and EHR), and two other CISE divisions (CCF and CNS), IIS will continue to lead the NRI program (+$6.5 million to a total of $13.50 million). IIS will focus on fundamental research in robotics as a critical underpinning of the NSF-wide CEMMSS investment, which includes advanced sensing, control, and power sources; integrated problem-solving architectures and decision algorithms; and safe and soft structures. NRI will focus on human-centered research in developing service robots, requiring significant advances in human-robot interaction, including safety standards for robots touching humans and recovery from errors in robot interpretation and action. Application

domains include robots as co-workers in advanced manufacturing environments, aides supporting emergency responders in the field, and service robots assisting the elderly and infirm to live independently.

- IIS will support the NSF-wide CIF21 investment (+$6.0 million to a total of $11.0 million), advancing BIGDATA core techniques and technologies to propel novel discoveries and capabilities, and through participation in DIBBs, developing the associated data infrastructure required to collect, store, manage, and scale large data sets. Research includes cloud-database architectures, trusted and secure data, data mining methods, and data- and information-fusion techniques. CIF21 advances machine learning, predictive modeling, and automated discovery of phenomena and causality in data.
- The IIS division will lead the cyberlearning and on-line education program jointly with EHR and SBE, through an evolution of the Cyberlearning Transforming Education (CTE) program (+$4.0 million to a total of $12.0 million). Research will integrate advances in technology with advances in the ways people learn; resolve how to more effectively use technology for promoting learning; and design new technologies for integration in learning environments and evaluate their use. Interdisciplinary researchers will study the deluge of data potentially produced from new on-line teaching paradigms, such as from implementations of massive open on-line courses, to better understand learning mechanisms and enable productive, personalized, and customized education.
- In partnership with NIH, two other NSF directorates (ENG and SBE), and two other CISE divisions (CCF and CNS), IIS will lead the SCH program ($9.0 million, level with FY 2012 Enacted). IIS will pursue improvements in safe, effective, efficient, and patient-centered proactive and predictive health and wellness technologies through innovations in computer and information science and engineering. The program addresses changing age demographics with investments in assistive cyber-physical engineered systems that are embedded in the local environment and are easily accessed and used.
- As part of its CEMMSS investment, IIS will support the CPS program (+$2.0 million to a total of $5.0 million). IIS will support basic research in smart systems with embedded computational intelligence that can sense, adapt, and react and that will enable new functionalities and provide the next-generation of products and services in various sectors, including advanced manufacturing.
- IIS will support the NSF-wide SaTC program (+$3.00 million to a total of $10.50 million) through research in secure and privacy-protecting mechanisms for multi-sourced aggregated data and for visualizing complex levels of access to personal information.
- IIS will support the NSF-wide SEES portfolio (+$2.23 million to a total of $4.23 million). CyberSEES investments will focus on the information processing dimensions of energy utilization and pursue breakthroughs needed in optimization, modeling, simulation, and inference. IIS will also support investments in Hazards SEES, an interdisciplinary research program in disaster prevention, mitigation, and recovery that will improve the ability to prepare for, mitigate, respond to, and recover from natural and technological hazards.
- IIS will invest in innovative wireline and wireless applications in areas of societal and economic benefit ($2.0 million) as part of EARS-related research.
- IIS will support INSPIRE at a funding level of $2.0 million, addressing some of the most complicated and pressing scientific problems that lie at the intersection of traditional disciplines.

Education

- IIS will invest in the STEM-C Partnerships activity ($4.0 million, level with FY 2012 Enacted) partnering with the other CISE divisions and EHR.
- With all CISE Divisions, IIS will continue support for REU sites and supplements ($3.50 million, level with FY 2012 Enacted).

DIVISION OF INFORMATION TECHNOLOGY RESEARCH (ITR) $89,150,000
+$3,690,000 / 4.3%

ITR Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, ITR	**$85.35**	**$85.46**	**$89.15**	**$3.69**	**4.3%**
Research	**81.85**	**81.46**	**69.82**	**-11.64**	**-14.3%**
CAREER	0.39	-	-	0.00	N/A
SLC: Pittsburgh Science of Learning Center -- LearnLab	2.25	2.50	2.03	-0.48	-19.0%
Education	**0.30**	**-**	**2.33**	**2.33**	**N/A**
Infrastructure	**3.19**	**4.00**	**17.00**	**13.00**	**325.0%**
Research Resources	3.19	4.00	17.00	13.00	325.0%

Totals may not add due to rounding.

ITR provides support for transformative explorations in computer and information science and engineering research, infrastructure, and related education activities, emphasizing the funding of high-risk, multi-investigator, and multidisciplinary projects.

In general, about 51 percent of the ITR portfolio is available for new research grants. The remaining 49 percent is used primarily to fund continuing grants.

FY 2014 Summary
All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Through I-Corps (+$5.50 million to a total of $8.0 million), ITR will invest in NSF-funded researchers who will receive additional support – in the form of mentoring and funding – to accelerate innovation and transfer of knowledge from lab to practice. ITR will also invest in two additional I-Corps subcomponents that were initiated in FY 2013 – Sites and Nodes – to further build, utilize, and sustain a national innovation ecosystem that continues to augment the development of technologies, products, and processes that benefit the Nation.
- Leveraging previous investments in GENI, ITR will invest in US Ignite ($3.0 million), an effort to promote U.S. leadership in developing gigabit public sector applications and services for ultra-fast broadband and software-defined networks. As part of US Ignite, ITR will invest in foundational wireline, wireless, cloud computing, security, and distributed systems research and experimentation, as well as gigabit application development.
- In collaboration with ENG, CISE will continue to support innovative partnerships and collaborations between universities and industries, in part through the Industry/University Cooperative Research (I/UCRC) program which will continue to establish centers that partner industry with university research efforts (+$1.0 million to a total of $8.0 million).
- ITR will maintain its investments in the Expeditions in Computing program ($12.0 million, level with FY 2012 Enacted). This program identifies projects with transformative research agendas that promise to accelerate discovery at the frontiers of computing and communication. It will also

continue to encourage researchers to come together within or across departments and/or institutions to identify the compelling ideas that promise transformations in computing and information sciences for many years to come.

- ITR will continue to support development and deployment of wireless testbeds ($4.0 million, level with the FY 2012 Enacted).
- ITR will invest in multi-disciplinary research networks, including the Science Across Virtual Institutes (SAVI) activity ($2.0 million, level with FY 2012 Enacted). These research networks will provide opportunities to develop collaborations in areas of emerging interest to computer and information science and engineering, including international partnerships.
- ITR will continue to provide support for emerging and urgent high-priority areas of potentially transformative research through various award mechanisms, such as Early-concept Grants for Exploratory Research (EAGERs) and Grants for Rapid Response Research (RAPIDs), and through co-funding of awards with other NSF directorates to pursue important emerging areas.
- CISE will continue its support of the SLC: LearnLab, formerly known as Pittsburgh SLC for Robust Learning (-$470,000 to a total of $2.03 million). Support is at a reduced level in FY 2014 as the project ramps down.

Education

- With the other CISE Divisions, ITR will support REU supplements (+$1.63 million to a total of $1.63 million). This additional funding will support enhanced research experiences for students in their first two years of college as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*

Infrastructure

- As part of US Ignite, ITR will expand the current mid-scale infrastructure investment in GENI, at a funding level of $7.0 million, to a national scale by research-enabling and/or integrating additional U.S. campuses, regional and research backbone networks, commercial equipment, and cities across the Nation to create a unique at-scale infrastructure available for future network research and infrastructure experimentation that is not possible elsewhere.
- Building on the success of GENI, ITR will extend virtualization beyond the network to large-scale, interconnected computing resources by developing mid-scale prototypes for an NSF Cloud research infrastructure, enabling future cloud and distributed computing experimentation not possible elsewhere ($6.0 million).

APPENDIX A – HIGH PERFORMANCE COMPUTING PORTFOLIO

ACI High Performance Computing Funding
(Dollars in Millions)

	Prior Years[1]	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Petascale (Track 1)[2]	$140.97	$128.55	$39.41	$30.00
Innovative HPC Program	176.49	24.57	48.90	25.00
Teragrid - Phase III (XD)	233.19	22.52	-	27.00
Total	**$550.65**	**$175.64**	**$88.31**	**$82.00**

Totals may not add due to rounding.

[1] The following adjustments have been made to Prior Years:
- Petascale decreased by $49.5 million and XD increased by the same amount to reflect a coding error correction made in the NSF financial system. In FY 2011, an award was miscoded to Petascale, rather than to XD.
- Petascale decreased by $90.5 million and XD decreased by $71.59 million to reflect deobligations of prior year funds that were later reobligated. See footnote 2.
- Petascale decreased by $140.61 million and XD increased by the same to reflect that the TeraGrid program is a predecessor to the XD program. TeraGrid transitioned to XD in FY 2010.

[2] FY 2012 Actual includes obligations over the enacted level for ACI (formerly OCI) due to recoveries of prior year unpaid obligations that were reobligated in FY 2012.

NSF has been a leader in High Performance Computing (HPC) for almost four decades. Due to the continuing rapid change in computing and related technologies, coupled with the exponential growth and complexity of data, NSF has created a new vision and strategy towards advanced computing infrastructure, which will expand NSF's leadership role in the science, engineering, and education enterprise. This coordinated NSF-wide strategy, which is a key component of the CIF21 framework, seeks to position and support the entire spectrum of NSF-funded communities at the cutting edge of advanced computing technologies, hardware, and software. It also aims to promote a more complementary, comprehensive, and balanced portfolio of advanced computing infrastructure and programs for research and education to support multidisciplinary computational and data-enabled science and engineering that supports the entire scientific, engineering, and education community. This shift away from a focus on procurement is consistent with the recommendations of a 2010 review and 2012 follow-up review[6] of the Federal Networking and Information Technology R&D (NITRD) program by the President's Council of Advisors on Science and Technology.

PETASCALE COMPUTING (TRACK 1) – BLUE WATERS

Description

The National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign (UIUC) has provided the capability for researchers to tackle much larger and more complex research challenges than previously possible, by acquiring, deploying, and operating a sustained petascale leadership class high-performance computational resource known as Blue Waters. This investment complements the Department of Energy (DOE) Office of Science's program on computing hardware, which focuses on peak petascale performance, with Blue Waters providing sustained petascale performance. Blue Waters will be in full production in mid-FY 2013. It is operated by NCSA and its

[6] *Designing a Digital Future: Federally Funded Research and Development Networking and Information Technology,* President's Council of Advisors on Science and Technology, January 2013.

partners in the Great Lakes Consortium for Petascale Computing (GLC).

The Blue Waters project also includes education and outreach programs that target pre-college, undergraduate, graduate, and post-graduate levels. A virtual school of computational science and engineering has been established to create courses that focus on petascale computing and petascale-enabled science and engineering. The virtual school explores new instructional technologies and creates courses, curricula, and certificate programs tailored to science and engineering students. It also sponsors workshops, conferences, summer schools, and seminars.

The project includes an annual series of workshops targeted at the developers of simulation packages and aspiring application developers. In addition, the project includes two industrial partnership activities: the Industry Partners in Petascale Engagement (IPIPE) program provides industrial partners with a first look at the technological and scientific developments that flow from the petascale program; and the Independent Software Vendor Application Scalability Forum promotes collaborations among consortium members, independent software vendors, and the industrial end-user community.

The broader impacts of this award include: provisioning of unique infrastructure for research and education; extensive efforts accelerating education and training in the use of high-performance computation in science; training in petascale computing techniques; promoting an exchange of information between academia and industry about the applications of petascale computing; and broadening participation in computational science through NCSA's Girls Engaged in Mathematics and Science (GEMS) program. GEMS is designed to encourage middle-school girls to consider mathematics-oriented and science-oriented careers.

Current Status

In late September 2011, UIUC selected a new vendor, Cray, for the Blue Waters project. By March 2012, a Blue Waters Early Science System, representing about 15 percent of the overall capacity of the system, became operational. In November/December 2012, the acceptance milestone was approved by NSF, and the entire system became available to 33 NSF-approved science and engineering teams (called friendly users) to help test and evaluate the system. It is currently in friendly user mode while UIUC completes the final stages of testing of the archival storage environment. It is expected to be in full production in mid-2013 and will then enter a five-year operations phase.

The Blue Waters education and outreach projects are ongoing, with components on undergraduate education, graduate education, training workshops, and outreach. A December 2011 workshop provided scientists and engineers with knowledge and expertise to develop applications for Blue Waters and other petascale computers. The Blue Waters team hosts summer workshops and has created and offered courses through the virtual school of computational science and engineering. The Blue Waters project partners with the Shodor Foundation to provide undergraduate course materials and internships. With the change in vendor to Cray, which was approved by NSF following external panel review in September 2011, some of the funds originally designated for hardware funding were designated for extending and expanding the outreach, education, and parallel algorithm development aspects of the project.

Science and engineering research and education activities enabled by Blue Waters

When Blue Waters is in full production, it will permit investigators across the country to conduct innovative research demanding petascale capabilities. Allocations of time on Blue Waters have been requested for research on: complex biological behavior in fluctuating environments; the electronic properties of strongly correlated systems; the properties of hydrogen and hydrogen-helium mixtures in astrophysically relevant conditions; the electronic and magnetic structures of transition metal compounds; the molecular dynamics responsible for the properties of liquid water; and the propagation of seismic energy through a detailed structural model of Southern California, together with the predicting of ground

motion and the modeling of the response of buildings and other structures. Other allocations address testing hypotheses about the role of cloud processes and ocean mesoscale eddy mixing in the dynamics of climate and improving climate models; the formation of the first galaxies; turbulent stellar hydrodynamics; binary black hole and neutron star systems as sources of gamma ray bursts; and other intense radiation phenomena, contagion, and particle physics.

Management and Oversight

NSF Structure: The project is managed and overseen by ACI program staff and a grants officer from the Division of Grants and Agreements. These NSF staff members receive strategic advice from NSF's CIF21 Cyberinfrastructure Leadership group which includes representatives from the various directorates and offices. Advice from the Office of General Counsel is sought as necessary.

External Structure: During the development and acquisition phase of this project, UIUC oversaw work by a number of sub-awardees, conducted software development, and assisted competitively selected research groups to prepare to use the Blue Waters system. The primary sub-awardee, Cray, was responsible for implementation of the hardware, system software, and main program development tools. Other sub-awardees worked on performance modeling, the evaluation of an astrophysical modeling framework, the engagement of applications groups, scalable performance tools, undergraduate training, and broadening the participation of underrepresented groups in high-performance computing. The project team is advised by a Petascale Executive Advisory Committee composed of senior personnel with technical and management expertise in high-performance scientific computing, the management of acquisition contracts for leading-edge computing systems, and the operation of large computing centers.

Risks: Any activity of this nature, and at this scale, comes with a certain element of risk. The extensive review process, conducted prior to award included reviewing and analyzing the risks as presented in the proposal and identifying any additional risk that should be considered. The Petascale Computing (Track 1) award required that risks be identified and analyzed, and that a mitigation plan be created and followed. One of the activities of the periodic NSF external reviews, by a panel of experts, is to revisit and assess the risk situation and make recommendations as deemed necessary. Risks that are no longer applicable are retired. New risks may be added, or degree of risk promoted or demoted as necessary, all of which is documented in a risk register. In addition to the discussion of risks that occurs between UIUC and NSF, periodic closed session updates to the National Science Board (NSB) identify any major changes in risk assessment.

Reviews: The project was selected through a competitive review in 2007. An external panel of experts, selected by NSF, periodically reviews the progress of the project including project management, risk management, hardware and software development, and the provision of advanced user support to research groups receiving provisional resource allocations on the Blue Waters system. One of the important roles of this external review panel is to analyze the awardee's assessments of the deliverables from its sub-awardees, together with the awardee's and sub-awardees' plans for remedial action when necessary, and to provide NSF with advice on whether these assessments and plans are reasonable. These external reviews have been conducted in February 2008, April 2008, October 2008, April 2009, July 2009, December 2009, April 2010, September 2010, December 2010, February 2011, May 2011, September 2011, March 2012, August 2012, and December 2012.

INNOVATIVE HPC PROGRAM

Description

Using lessons learned during the execution of the HPC Track 2 program and informed by the NSF Advisory Committee for Cyberinfrastructure's (ACCI) High Performance Computing task force, the HPC Track 2 program was renamed Innovative HPC in 2011. Innovative HPC awards are made in the context of the eXtreme Digital (XD) services program (described below). While the Petascale Computing (Track 1) system is targeted to provide sustained petascale performance, the Innovative HPC systems provide, at most, petascale peak performance. Each system is capable of supporting hundreds to thousands of researchers (over the course of a year) engaged in leading-edge science and engineering across a broad array of disciplines.

There is a direct relationship between the Innovative HPC awards and the XD activity. Several systems are currently serving as allocatable resources within XD. Initially, Innovative HPC awards were generally made as two parts: a) an acquisition component and associated funding, and b) an operations and maintenance component and associated funding. More recent awards in the Innovative HPC program (including FutureGrid, Gordon, and Keeneland) did not separate these components due to the experimental nature of the systems. When an award was made, funding was provided to the institution, which issued sub-awards to vendors for acquisitions as necessary. Once the system has passed the acceptance process, vendors receive final payment for the system. After the system has been fully tested, it becomes an XD resource and the institution becomes an XD resource provider and has access to the operations and maintenance funding component of the award.

Beginning with the FY 2011 solicitation, *High Performance System Acquisition: Enhancing the Petascale Computing Environment for Science and Engineering*, based on feedback from the scientific and engineering community, a more sustained approach to core HPC services was initiated. This provides a longer time horizon for funding of HPC providers in recognition of the value and time required for building and retaining staff skilled in interdisciplinary computational science. Thus, an eight to ten year horizon is envisioned for a core HPC provider. This timeline begins with an acquisition award, which allows for the possibility of a renewal acquisition award four years after the original award. In addition to the acquisition awards, accompanying operations and maintenance (O&M) awards are planned.

Current Status

Machines and facilities that are currently operational in the Innovative HPC program include Keeneland, Blacklight, FutureGrid, Gordon, Kraken, Lonestar, Longhorn, Ranger, Stampede, and Trestles. Keeneland is a new, highly innovative experimental system that became fully operational in FY 2013. Stampede, at the University of Texas at Austin, is a comprehensive computing, data analysis, and visualization system. It went online in January 2013 and is the most powerful system in the NSF XD environment.

The largest resource in the NSF portfolio designed for capacity computing, Kraken, located at the National Institute for Computational Sciences at the University of Tennessee, has reached the end of its useful lifetime. An additional year of funding was provided to Kraken in FY 2012, while a new solicitation was issued in FY 2012, and a review process was conducted during late FY 2012 through early FY 2013. New award(s) are expected in FY 2013 to provide the capacity level computational needs of the open science community.

NSF issued a new solicitation in FY 2013, High Performance System Acquisition: Building a More Inclusive Computing Environment for Science and Engineering, for a total of $30,000,000 to fund up to three new resources, both computational and data related. The solicitation encourages the community to think broadly about resources which would: 1) complement existing XD resources; and 2) enlarge the

horizon to include research communities that are not users of traditional HPC systems, but who would benefit from advanced computational capabilities at the national level. The solicitation explicitly mentioned the use of virtual machines, efficient cloud computing capabilities, expanding the range of data-intensive computing, and high throughput applications among others. The proposal submission deadline is April 15, 2013.

Science and engineering research and education activities enabled by Innovative HPC

- The complete spectrum of scientific research is supported, including: climate and weather modeling, economics, cosmology and astrophysics, geosciences, physics, chemistry, biology and medicine, earthquake engineering, and mechanical engineering.
- Innovative HPC will enable world-leading transformative advances in science and engineering research, in the integration of research and education, and in broadening participation in science and engineering by underrepresented groups; by providing researchers and educators with usable access to computational resources, beyond those typically available on most campuses, together with the interfaces, consulting support, and training necessary to facilitate their use.
- Through the unifying XD framework and services, Innovative HPC will enable researchers to manipulate extremely large amounts of digital information from simulation, sensors, and experiments, and add needed capabilities in remote visualization, an increasingly important analysis tool for modern science and engineering.
- Outreach and training critical to reducing the barriers to the use of HPC systems by the research and education community will be provided by engaging research universities and foundations. Innovative HPC will incorporate new computational technologies and new approaches to software and data management, together with the expertise to enable researchers and students to complement theory and experiment with an equal emphasis in computation.

Management and Oversight

NSF Structure: The Division of Advanced Cyberinfrastructure's program officers provide direct oversight during both the acquisition and operations phase. Formal reporting consists of quarterly and annual reports, which are reviewed by the program officer. There are also bi-weekly teleconferences with NSF program officers.

External Structure: Each Innovative HPC award is managed under a cooperative agreement. Each awardee is responsible for the satisfactory completion of milestones in order for the spending authorization to be raised. Progress is evaluated by the review process and the NSF program officer.

Each project has a detailed management plan in place. Each cooperative agreement includes the management structure, milestones, spending authorization levels, and review schedule.

Risks: Any activity of this nature, and at this scale, comes with a certain element of risk. The review process, conducted prior to award, reviews and analyzes the risks as presented in the proposal and identifies any additional risk that should be considered. The awards are experimental, by nature, and therefore encompass high-risk, high-reward scenarios. The award process requires that risks be identified and analyzed, and that a mitigation plan be created and followed. One of the activities of the periodic NSF external reviews, conducted by a panel of experts, is to revisit and assess the risk situation and make recommendations as necessary. Risks that are no longer applicable are retired. New risks may be added, or degree of risk promoted or demoted as necessary, all of which is documented in a risk register.

Reviews: Annual reviews are performed as part of the XD review. Semi-annual reviews are performed as part of the acquisition phase. The reviews are arranged by the NSF program officer. The reviewers' backgrounds include scientific research, project management, and large-scale systems acquisitions and

operations, and include familiarity with projects funded by NSF, as well as other federal agencies. To the extent possible, continuity through the series of reviews is provided by using the same set of reviewers.

FutureGrid Experimental High Performance Grid Testbed at Indiana University (IU)

Description

- An Indiana University-led project team has provided a significant new experimental computing grid and cloud test-bed, named FutureGrid. FutureGrid enables research communities to tackle complex research challenges in computer science related to the use and security of grids and clouds.
- The test-bed includes a geographically distributed set of heterogeneous computing systems, a data management system that will hold both metadata and a growing library of software images, and a dedicated network allowing isolatable, secure experiments.
- The test-bed supports virtual machine-based environments, as well as native operating systems for experiments aimed at minimizing overhead and maximizing performance.
- The project partners integrate existing open-source software packages to create an easy-to-use software environment that supports the instantiation, execution, and recording of grid and cloud computing experiments.
- The FutureGrid project team is part of the Service Providers Forum and participates in the discussions every week. While FutureGrid does not allocate cycles, it is available to the research community as a testbed and continues to be used internally by the eXtreme Science and Engineering Discovery Environment (XSEDE), part of the XD program as described below, as a testbed for systems that may become integrated into mainstream XSEDE activities. FutureGrid is being used to test cloud and virtualization capabilities; advanced digital services the user community is expected to request.

Gordon Data-Intensive Computing at San Diego Supercomputer Center (SDSC)

Description

- In FY 2012, Gordon became fully operational as an allocatable resource within the XSEDE environment. The University of California at San Diego (UCSD) provided this ground-breaking new computing facility, which is available to the research community together with advanced user support for researchers with data-intensive problems that may not parallelize well or will require access to very large amounts of memory.
- The distinguishing features are the integration of solid state disks (SSDs) and very large shared memory. This system is optimized to support research with very large data-sets or very large input-output requirements. It provides a step-up in capability for data-intensive applications that scale poorly on current large-scale architectures, providing a resource that will enable transformative research in many research domains.

Keeneland Experimental High Performance Computing at Georgia Institute of Technology

Description

- Keeneland, provided by the Georgia Tech Research Corporation (GTRC), is a new, experimental high-performance computing facility with unconventional computing architectures. The system allows scientific and engineering researchers to evaluate the relative merit of these new architectures. Keeneland became fully operational in January 2013.
- The distinguishing feature of Keeneland is the inclusion of General-Purpose computation on Graphics Processing Units processors (GPGPU) as a general purpose technique for computational acceleration in large systems. The goal is to address computational problems that are challenging to more conventional supercomputing architectures. Productivity is of particular interest in using Open Computing Language (OpenCL) as a mechanism to program the GPGPUs.

- Applications will require additional development and testing to be appropriately prepared to effectively use this new type of architecture.

Stampede – Enabling, Enhancing and Extending Petascale Computing for Science and Engineering at University of Texas at Austin

Description
- The Stampede project at the University of Texas at Austin adds a new system to NSF XD cyberinfrastructure services.
- The new resource and accompanying services target science and engineering researchers using both advanced computational methods and emerging data-intensive approaches.
- The new system will boost XD resources to nearly twice their current capacity. It provides researchers with early access to a potentially transformative new approach to performance via Intel Many Integrated Core (MIC) processors. An addition of the second generation of the MIC processors is planned in late FY 2015.

Current Status
Consideration for system acceptance was reviewed by an external panel at the end of January 2013. NSF approved the acceptance milestone in February 2013.

TERAGRID PHASE III: EXTREME DIGITAL (XD)

Description
- XD, successor to the TeraGrid program, is an advanced, nationally distributed, open cyberinfrastructure comprised of shared user and management services, supercomputing, storage, analysis, visualization systems, data services, and science gateways connected by high-bandwidth networks, integrated by coordinated policies and operations, and supported by computing and technology experts.
- XD enables and supports leading-edge scientific discovery and promotes science and technology education.
- XD has taken a significant step forward by encouraging innovation in the design and implementation of an effective, efficient, increasingly virtualized approach to the provision of high-end digital services – extreme digital services – while ensuring that the infrastructure continues to deliver high-quality access for the many researchers and educators that use it in their work.

Current Status
Two planning grants, one to UCSD ($1.60 million) and one to UIUC ($1.62 million), were made in FY 2009 to obtain community input and engagement in order to develop the ideas and expanded horizons that will be required to deploy the advanced infrastructure required for XD. The planning grants were reviewed in February 2010 and the two teams submitted their full proposals in July 2010. The full proposals were reviewed by an external panel of experts in the fourth quarter of FY 2010. A recommendation for a $121.0 million, five-year award to UIUC, entitled XSEDE, was approved by the NSB and awarded July 1, 2011. XSEDE had its first annual review in June 2012 at NSF. Progress in Year 1 and plans for Year 2 were evaluated. The review committee found that the project had made extraordinary progress over its first year and identified issues for consideration moving forward.

XSEDE, which manages the XD shared user and management services, is the final component of the XD program. XSEDE is a partnership of 17 institutions that links computers, data and people around the world to establish a single, virtual system that scientists can interactively use to conduct research.

Initially, XSEDE will support 16 supercomputers across the country. It also will include other specialized digital resources and services to complement these computers. These resources will be expanded throughout the lifetime of the project.

Science and engineering research and education activities enabled by XD

- XD services enable transformative advances in science and engineering research, in the integration of research and education, and in broadening participation in science and engineering to under-represented groups, by providing researchers and educators with coherent and highly usable access to extreme-scale digital resources beyond those typically available on most campuses, together with the interfaces, consulting, advanced user support, and training necessary to facilitate their use.
- XD provides high-performance computing services, enables researchers to manipulate extremely large amounts of digital information from simulations, sensors, and experiments, and adds needed capabilities in remote visualization, an increasingly important analysis tool for modern science and engineering.
- XD is developing tools and services that not only link users to national facilities, but enables scientific collaborations within and across university campuses, government laboratories, and experimental facilities.
- The project includes outreach and training critical to reducing the barriers to the use of advanced digital systems by the research and education communities. XD incorporates new ideas and technologies to enable researchers and students to move transparently between local and national resources, substantially lowering the barriers to effective use of cyberinfrastructure and promoting enhanced productivity.

Management and Oversight

NSF Structure:

- XD is managed by ACI, informed by the ACCI and its task forces, with ongoing strategic guidance from the NSF cross-directorate CIF21 Leadership Group. The project has an external advisory board, a user board, and a service provider board to ensure that all stakeholders can provide project input. These boards provide substantial ongoing community input to the XD project. ACI participates in the management of XSEDE via weekly teleconferences with the senior XSEDE personnel.
- XD shared services consist of several inter-related parts – High-Performance Remote Visualization Service (HPRVS); Technology Audit Service (TAS); Technology Insertion Service (TIS); Coordination and Management Service (CMS); Advanced User Support Service (AUSS); and Training, Education and Outreach Service (TEOS). The last three elements constitute the XSEDE project that manages shared services in the XD program.

These elements are designed and implemented in a way that is consistent with sound system engineering principles, clearly tied to the user requirements of the science and engineering research community using a flexible methodology that permits the architecture to evolve in response to changing user needs and presents the individual user with a common user environment regardless of where the resource or user is located.

- The HPRVS was reviewed in FY 2009 and two awards were made, one to the University of Texas at Austin ($7.0 million) and one to the University of Tennessee-Knoxville ($10.0 million).
- The TAS and TIS components of XD were reviewed in FY 2010 and two awards were made; one award to the University of Buffalo for the TAS ($7.75 million) and one award to the University of Illinois at Urbana-Champaign for the TIS ($9.0 million). These two awards have facilitated the TeraGrid to XD transition and are already functioning successfully in the new environment.
- XSEDE, the final component of XD, which includes CMS, AUSS, and TEOS, was awarded to the University of Illinois Urbana-Champaign (UIUC) in July 2011. This is a five-year award for $121.0

million and involves four other major partners. They are the University of Pittsburgh, University of Texas at Austin, University of California San Diego (UCSD) and the University of Tennessee at Knoxville. XSEDE also involves twelve other institutions.

External Structure: The final configuration of XD consists of an access and accompanying services component, and compute, visualization, and storage resources at a number of sites. The sites contain a range of high-performance computing platforms, large disk storage devices, computational platforms specifically tailored for remote visualization, high-bandwidth networks, a broad set of user services and an education, outreach, and training component designed to fulfill the needs of current users of high-performance computing, as well as to broaden participation to new communities and under-represented groups in science and engineering. The composition of these sites will change in time as new resources become part of the XD family and other resources are retired. University partners may be part of XSEDE services either by providing and receiving services to the project or by simply using the digital products being developed by XSEDE in their own local environment.

DIRECTORATE FOR ENGINEERING (ENG) $911,120,000
+$84,950,000 / 10.3%

ENG Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Chemical, Bioengineering, Environmental, and Transport Systems (CBET)	$171.51	$171.45	$185.30	$13.85	8.1%
Civil, Mechanical, and Manufacturing Innovation (CMMI)	203.59	203.58	224.02	20.44	10.0%
Electrical, Communications, and Cyber Systems (ECCS)	106.74	106.73	117.90	11.17	10.5%
Engineering Education and Centers (EEC)	123.93	120.00	126.25	6.25	5.2%
Industrial Innovation and Partnerships (IIP)	187.79	193.41	225.45	32.04	16.6%
SBIR/STTR	*146.86*	*152.76*	*177.15*	*24.39*	*16.0%*
Emerging Frontiers in Research and Innovation (EFRI)	30.99	31.00	32.20	1.20	3.9%
Total, ENG	**$824.55**	**$826.17**	**$911.12**	**$84.95**	**10.3%**

Totals may not add due to rounding.

About ENG

ENG is a global leader in identifying and catalyzing fundamental engineering research, innovation, and education. To achieve this vision, the directorate leads in frontier engineering research, cultivates an innovation ecosystem, develops the next-generation engineer, and demonstrates organizational excellence.

Since its inception, ENG has provided substantial support for frontier research and education across all fields of engineering. ENG-funded basic and use-inspired research, combined with the creativity of well-educated engineers and the resources of state-of-the-art facilities, have fueled many important innovations that in turn have stimulated economic growth and improved the health and quality of life for all Americans.

Many ENG programs and activities support national priorities and contribute to solutions to grand challenges. ENG is central to several cross-Foundation investments designed to create the knowledge and innovations required for these areas. These investments include Cyber-Enabled Materials, Manufacturing, and Smart-Systems (CEMMSS); Innovation Corps (I-Corps); Science, Engineering, and Education for Sustainability (SEES); and the Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21).

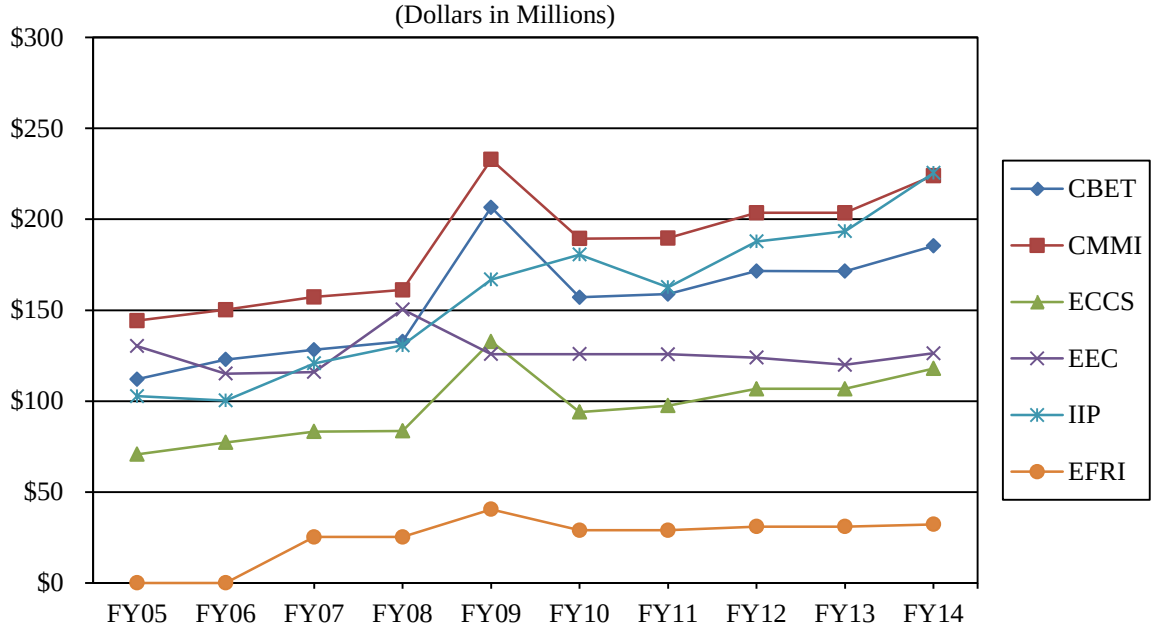
- ENG will be a major contributor in the CEMMSS investment through interdisciplinary research in breakthrough materials and materials design, advanced manufacturing techniques and processes, and smart systems research, including robotics.
- The ENG role in SEES will continue with significant emphasis on Sustainable Research Networks and Sustainable Energy Pathways, in addition to engineering research related to sustainable synthesis, use, and reuse of chemicals and materials as part of the Sustainable Chemistry, Engineering, and

Materials (SusChEM) component. ENG investment in Hazards SEES will help catalyze well-integrated interdisciplinary research efforts in hazards-related engineering in order to improve the understanding of natural hazards and technological hazards linked to natural phenomena, mitigate their effects, and to better prepare for, respond to, and recover from disasters.

- ENG will build on its significant contributions to innovation programs in growing the evolving I-Corps program to the next phase of establishing a platform for innovation, thus joining other established innovation programs such as Partnerships for Innovation (PFI), Engineering Research Centers (ERC), Industry/University Cooperative Research Centers (I/UCRC), and others that are managed by ENG.
- ENG leads the Foundation in strategic research investments focusing on research and education in manufacturing in all its dimensions (advanced manufacturing, nanomanufacturing, and transformative technologies for traditional manufacturing).
- The ENG investment in CIF21 will build upon the directorate's support of groundbreaking work in cyber–physical systems, engineering modeling and simulation, smart networks, and sensors.

ENG provides about 32 percent of the federal funding for basic research in engineering at academic institutions.

ENG Subactivity Funding
(Dollars in Millions)



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2014 Summary by Division

- The FY 2014 Request for CBET will promote research and education for sustainability in the areas of water, climate, clean energy, and sustainable chemistry by contributing to the NSF-wide SEES investment. CBET's request will bolster CEMMSS support through investment in robotics research to assist those with physical disabilities or cognitive impairment. CBET will also enhance support for early-career researchers and support a Science and Technology Center (STC) from the Class of 2010.

- The FY 2014 Request for the CMMI will enable contributions to the CEMMSS investment through research and education in advanced manufacturing, interdisciplinary research in advanced materials and manufacturing processes, as well as materials design, robotics, and cyber–physical system approaches to capitalize on interdisciplinary research opportunities arising in cyber-enabled smart manufacturing systems. CIF21 support will focus on research and education on computational-based approaches for engineering design, analysis, and predictive modeling, particularly under high degrees of uncertainty. CMMI's contribution to SEES will include research for resilient and sustainable buildings and infrastructure, disaster-resilient systems, energy systems manufacturing, and energy-efficient materials and processes.

- The FY 2014 Request for ECCS will enable contributions to the CIF21 investment through support for research and education in advanced devices and systems directed towards computing, data storage, networking, and data management. The ECCS investment in the Enhanced Access to the Radio Spectrum (EARS) activity will support research on more efficient radio spectrum use and greatly improved low power energy-conserving device technologies. The division will also provide support for CEMMSS-related work in the areas of robotics, smart health research, and cyber-physical systems in the area of integration of intelligent decision-making algorithms and hardware into physical systems. ECCS will also enhance support for early-career researchers and support an STC.

- The FY 2014 Request for EEC will provide funding for a combination of three new ERCs or Nanosystems Engineering Research Centers (NERCs) and provide planned growth supplements to the first class of NERCs established in FY 2012. EEC will work closely with the Directorate for Education and Human Resources (EHR) in integrating the ENG-led engineering education research into the comprehensive agency-wide framework – Catalyzing Advances in Undergraduate STEM Education (CAUSE) – that consolidates the Foundation's investments in undergraduate education. EEC will enhance support for early-career researchers and for activities that facilitate alternative pathways to engineering careers, especially for non-traditional engineering students such as veterans. Support for the Research Experiences for Undergraduates (REU) program will be increased, with a particular focus on first and second year students.

- The FY 2014 Request for IIP reflects its commitment to enhancing the Nation's innovation ecosystem. Through programs for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR), IIP will continue to support technological breakthroughs that benefit society. Through I-Corps, PFI, I/UCRC, and other activities, the division will enable academic researchers to begin translation of fundamental research discoveries, encourage academia and industry to collaborate (especially regionally), and prepare students to be entrepreneurial leaders in innovation.

- The FY 2014 Request for EFRI will provide support for 15 interdisciplinary teams to pursue cutting-edge research with the potential for transformative impacts on national needs and grand challenges.

Major Investments

ENG Major Investments
(Dollars in Millions)

Area of Investment	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Advanced Manufacturing	$55.44	$48.42	$77.50	$29.08	60.1%
BioMaPS	3.31	3.31	7.00	3.69	111.5%
CAREER	50.89	50.34	54.58	4.24	8.4%
CEMMSS	56.00	56.00	126.42	70.42	125.8%
CIF21	3.70	5.00	12.00	7.00	140.0%
Clean Energy Technology	122.00	121.80	130.00	8.20	6.7%
EARS	4.00	4.00	14.00	10.00	250.0%
I-Corps	2.72	2.50	8.00	5.50	220.0%
INSPIRE	2.99	-	6.00	6.00	N/A
NNI	183.22	166.37	174.75	8.38	5.0%
NRI	8.33	8.33	10.00	1.67	20.0%
SEES	19.77	19.25	26.76	7.51	39.0%
SaTC	5.00	3.25	4.25	1.00	30.8%

Major investments may have funding overlap and thus should not be summed.

- ENG will strategically invest additional funds across the directorate in advanced manufacturing to support innovations in multi-scale modeling for simulation-based design and manufacturing across the supply chain, nanomanufacturing, innovative materials and manufacturing processes, energy systems manufacturing, and complex engineering systems design and manufacturing. In addition to working across all directorates, ENG will maintain close connections with efforts by other agencies to raise U.S. manufacturing capacity by ensuring an appropriate link with the NSF investments in fundamental research and education in manufacturing. ENG's FY 2014 Request for Advanced Manufacturing is $77.50 million.

- ENG will invest $7.0 million in Research at the Interface of the Biological, Mathematical, Physical Sciences, and Engineering (BioMaPS) through the clean energy and advanced manufacturing activities as well as ENG core programs. Funding for this activity will be directed to the CBET, CMMI, and ECCS divisions.

- ENG's CAREER funding of $54.58 million supports young investigators who exemplify the role of teacher–scholar through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations.

- ENG support of $126.42 million for CEMMSS will build upon existing frontier research and advance connections between robotics and manufacturing; materials and manufacturing; cyber–physical systems and robotics; robotics and the biological aspects of engineering.

- ENG funding of $12.0 million in the CIF21 investment will focus on computational and data-enabled science and engineering research, infrastructure and community building, and access and connections to cyberinfrastructure facilities. Funding will be directed to CBET, CMMI, and ECCS.

- ENG support of $130.0 million for clean energy-related activities will enhance research and innovations in smart grid technologies, solar energy technologies, biofuels and bioenergy, wind energy generation, and renewable energy storage. The ENG clean energy investment will be strategically divided among all divisions.

- EARS support of $14.0 million represents an increase of $10.0 million over the FY 2012 Enacted level. The National Science and Technology Council (NSTC) report, *Enhanced Access to the Radio Spectrum: A Path Forward*, outlines the need for research on new and innovative ways to use the spectrum more efficiently. In partnership with the Directorates for Computer and Information Science and Engineering (CISE) and Mathematical and Physical Sciences (MPS), ENG's ECCS division will initiate support for the basic research that underpins this effort.

- ENG investment in the NSF I-Corps program of $8.0 million will seek to identify NSF-funded researchers who will receive additional support – in the forms of mentoring and funding — to accelerate innovation that can attract subsequent third-party investment. In FY 2013 NSF initiated two additional I-Corps competitions – Sites and Nodes – to further build, utilize, and sustain a national innovation ecosystem that continues to augment the development of technologies, products, and processes that benefit the Nation. These investments will continue in FY 2014. I-Corps Sites are funded at academic institutions, having already existing innovation or entrepreneurial units, to enable them to nurture and support multiple, local teams to transition their ideas, devices, processes or other intellectual activities into the marketplace. The I-Corps Nodes subcomponent's goal is to establish regional nodes to provide training to I-Corps Teams; develop tools and resources that will impact and expand the benefits of the entire I-Corps program within a two to three year timeframe, and identify and pursue longer-term (five+ year) research projects based on the knowledge gained in the growth of the program.

- ENG participation in Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) will continue to strengthen ENG's long-standing support for interdisciplinary, potentially transformative research by complementing existing efforts, such as EFRI, with a suite of highly creative Foundation-wide activities and funding opportunities. ENG's FY 2014 Request for INSPIRE is $6.0 million.

- The directorate will continue supporting the National Nanotechnology Initiative (NNI), with additional funding directed towards the NNI Signature Initiatives: Nanoelectronics for 2020 and Beyond; Sustainable Nanomanufacturing — Creating the Industries of the Future; Nanotechnology for Solar Energy Collection and Conversion; Nanotechnology for Sensors and Sensors for Nanotechnology; and Nanotechnology Knowledge Infrastructure. ENG's FY 2014 Request for NNI is $174.75 million.

- ENG support for the National Robotics Initiative (NRI) will fund research on assistive mechanisms for those with physical disabilities and cognitive impairment as well as the elderly; on systems integration that enables ubiquitous, advanced robotics to be realized; and on next-generation robotics for manufacturing, healthcare and rehabilitation, surveillance and security, education and training, and transportation. This $10.0 million investment will be directed to CBET, CMMI, and ECCS. NRI is a cross-agency initiative involving NSF's CISE and ENG directorates along with external partners, including the National Aeronautics and Space Administration (NASA), the National Institutes of

Health (NIH), and the U.S. Department of Agriculture (USDA).

- ENG will support the NSF-wide SEES investment by funding activities across the directorate that will lay the foundation for technologies to mitigate, and adapt to, environmental change that threatens sustainability. The greatest share of funding will be directed to CBET, CMMI, and ECCS, for investments in Sustainability Research Networks and Sustainable Chemistry research. ENG's FY 2014 Request for SEES is $26.76 million.

- ENG support of $4.25 million for the Secure and Trustworthy Cyberspace (SaTC) activity will focus on the engineering aspects of the Administration's *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program* (released December 2011). The program's research thrusts cover a set of interrelated priorities for U.S. government agencies that conduct or sponsor research and development in cybersecurity.

ENG Funding for Centers Programs and Facilities

ENG Funding for Centers Programs
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2013 Request Amount	Change Over FY 2013 Request Percent
Centers Programs Total	**$99.95**	**$99.82**	**$87.87**	**-$11.95**	**-12.0%**
Engineering Research Centers (EEC)	70.06	70.00	70.50	0.50	0.7%
Nanoscale Science & Engineering Centers (Multiple)	17.87	17.62	5.75	-11.87	-67.4%
Science & Technology Centers (Multiple)	10.12	10.00	10.00	-	-
Science of Learning Centers (EEC)	1.90	2.20	1.62	-0.58	-26.4%

Totals may not add due to rounding.

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- Support for the ERC program will increase by $500,000 to a total of $70.50 million. Building on the long-standing ERC program model, ENG will provide funding for a combination of three new ERC or NERCs and provide planned growth supplements to the first class of NERCs established in FY 2012.

- NSEC support will be reduced by $11.87 million, to a total of $5.75 million as two centers receive final funding in FY 2013. It is anticipated core programs in ENG will increase support to nano science and engineering offsetting the reduction.

- ENG will continue to fund two STCs in FY 2014. CBET will support the Center on Emergent Behaviors of Integrated Cellular Systems, and ECCS will support the Center for Energy Efficient Electronics Science.

- ENG decreases investments in the directorate-supported SLC by $580,000, to a total of $1.62 million in FY 2014, as the center continues a planned ramp down.

ENG Funding for Facilities

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Facilities (Total)	**$31.37**	**$31.33**	**$32.83**	**$1.50**	**4.8%**
NEES (CMMI)	20.39	20.50	22.00	1.50	7.3%
NNIN (Multiple)	10.98	10.83	10.83	-	-

Totals may not add due to rounding.

For detailed information on individual facilities, please see the Facilities chapter.

ENG will increase operations and maintenance budgets for facilities by $1.50 million at the FY 2014 Request level. Notable items include:

- Support for the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) operations in FY 2014 increases by $1.50 million to a total of $22.0 million, in line with the terms of the cooperative agreement. ENG will leverage investment in CIF21 to support NEES connections and foster data-enabled research within the earthquake engineering community.
- ENG continues support for infrastructure through investment in the Next Generation National Nanotechnology Infrastructure Network (NG NNIN) of user facilities at the FY 2012 Enacted level of $10.83 million. FY 2014 represents year one of this planned ten-year investment.

Summary and Funding Profile

ENG supports investments in core research and education as well as research infrastructure such as facilities.

In FY 2014 the number of research grant proposals is expected to be 9,200. ENG expects to award approximately 1,600 research grants in FY 2014. Average annualized award size and duration are estimated to be $128,000 and three years, respectively, in FY 2014.

In FY 2014, funding for centers accounts for nearly 12 percent of ENG's non-SBIR/STTR Request.

Funding for facilities accounts for less than 5 percent of ENG's non-SBIR/STTR FY 2014 Request.

ENG Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate[1]	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	11,340	12,850	12,300
Number of New Awards	2,067	2,220	2,260
Funding Rate	18%	17%	18%
Statistics for Research Grants:			
Number of Research Grant Proposals	8,684	9,600	9,200
Number of Research Grants	1,440	1,450	1,600
Funding Rate	17%	15%	17%
Median Annualized Award Size	$106,764	$102,000	$107,000
Average Annualized Award Size	$125,891	$122,000	$128,000
Average Award Duration, in years	2.9	3.0	3.0

[1] Award estimates for FY 2013, such as numbers of awards and size/duration, are based upon the FY 2012 enacted level.

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- In FY 2011–2012, ENG funded Manhattan Strategies, Inc. to evaluate the Nanotechnology Undergraduate Education (NUE) program. The final report was received September 30, 2012. This external evaluation of the 155 projects funded to date is being conducted to determine the outputs and outcomes resulting from NUE funding, the collaborating departments and colleges, the impact of the program on engineering education as reported by the funded projects, whether program outcomes have been disseminated throughout the academic community, and the level of K-12 outreach. Major recommendations included:
  - Development and integration of a theory of action or logic model into the FY 2013 solicitation and beyond, to define and direct Principal Investigator (PI) efforts toward the achievement of articulated program goals and objectives.
  - Implementation of a structured reporting process to improve data collection from PIs allowing portfolio-wide reporting capabilities to describe the outputs and impacts associated with NUE funding.
  - Articulation of clear expectations for dissemination of NUE program outputs and outcomes, particularly those that leverage existing funded and successful tools such as NanoHUB. The FY 2013 NUE solicitation requires that NUE awardees publish all educational content, assessment instruments, and learning results of their programs on nanoHUB.org. In addition, NUE awardees are required to host their entire NUE program web page on nanoHUB.
  - Consideration of PI lessons learned, best practices, recommendations, and articulated needs detailed within completed NUE annual reports.

  ENG will take these recommendations into account as it develops its contributions to the CAUSE program.

- In late FY 2013, EEC will initiate a survey of university faculty and administrators who have participated in or "housed" ERCs to ascertain the impact of an ERC on the broader culture of its lead and partner institutions, in terms of: spreading a culture of interdisciplinary collaboration, partnerships in innovation with industry, expanding the role of universities in innovation, the integration of research and education, and promoting the involvement of faculty and students in bringing engineering concepts to pre-college classrooms. The results of this survey are expected in FY 2014 and will inform the direction of future ERC solicitations.

Science and Technology Policy Institute (STPI) Reports:

- The CMMI division is currently using STPI for a retrospective assessment of solid freeform fabrication/additive manufacturing (SFF). This project will research and identify how SFF-related fundamental research sponsored by the agency originated and evolved since its initiation. Analytical input will be provided regarding major research directions, the outcomes from NSF support (major discoveries, new technologies and affected industries, and development of a SFF community), factors affecting innovation, and lessons learned that can be used to help design future initiatives similar to NSF's Strategic Manufacturing (STRATMAN) initiative that, in part, helped launch and mature SFF technologies, and to inform NSF's participation in the Additive Manufacturing Innovation Institute.
- In FY 2010–2011, ENG utilized STPI to perform a formative assessment and evaluation of the processes by which topic areas and potentially transformative projects are selected by EFRI, and to design a protocol for future outcome evaluation of EFRI research projects. In response to this report and 2011 Committee of Visitors (COV) recommendations, the directorate substantially revised the research topic selection process and instituted several internal process innovations in FY 2011–2012. The topic selection process frequency has been modified to every other year and external experts are being engaged in evaluating candidate topics. In order to enhance participation of underrepresented groups, the office launched a new opportunity to provide support to active EFRI projects for establishing summer institutes for mentored research experiences with groups including undergraduates, community college students, high school students, teachers, professors at minority serving institutions, and veterans.
- In FY 2011–2012, the directorate supported two studies to assess future earthquake engineering research and research infrastructure needs. A National Research Council (NRC) committee prepared a workshop report on research grand challenges for networked earthquake engineering experimental facilities and cyberinfrastructure. To build on this work, STPI developed potential scenarios for the future of NSF-supported earthquake engineering facilities. The Foundation used the results and recommendations of these studies to craft the research solicitations and facility operations competition for the next generation NEES facility.

Workshops and Reports:

- Nanotechnology Infrastructure Workshop – April 3-4, 2012. Arlington, VA. The intent of this workshop was to develop a vision of the needs and appropriate future investments for a national infrastructure for nanotechnology. NSF is currently soliciting proposals for NG NNIN. www.acpt.nsf.gov/eng/eccs/nanotechnology_infrastructure_workshop_report.pdf
- NSF/Air Force Office of Scientific Research (AFOSR) Workshop – 2D Materials and Devices Beyond Graphene – May 30-31, 2012. Owing to the results of graphene research, the question of whether 2D atomic layers from other materials can be isolated and exploited for fundamental study and applications has become very relevant. The workshop on 2D layered materials and devices beyond graphene sought to define an emerging field that has sprouted at the heels of the large body of graphene work. The high level of interest shown by the large spectrum of scientists points to the acceptance of this theme as the next big thing in materials after graphene. Connections to the Administration's Materials Genome Initiative and the NNI Signature Initiative *Nanotechnology*

Knowledge Infrastructure (NKI): Enabling National Leadership in Sustainable Design were identified. http://nsf2dworkshop.rice.edu/final-report/

Committees of Visitors:

- In 2012, COVs reviewed CBET and CMMI. The COVs presented their reports to the ENG Advisory Committee, which convened in April and October of 2012.
  - Main findings from the CBET COV were: The percent success rate in proposal funding has fallen to historically low levels; the number of submissions has grown disproportionately large; and "Awards have become, too frequently, inadequate to cover the minimum costs of a project." According to the COV, CBET is a remarkable program due to both the excellence of the program topics, the quality of the staff, and the success of the program despite having one of the largest numbers of proposals relative to available funds and staff. However, these challenges related to the large number of proposal submissions could in the future create both staffing problems and affect the quality of submitted proposals. The COV conveyed concern that researchers with exceptional ideas may not pursue their research through NSF due to the low probability of success.
  - Main findings from the CMMI report were: CMMI is doing a great job under difficult and challenging circumstances – particularly under the budget constraints and restrictions on travel. Due to the importance of face-to-face panels (can be blended with some virtual participation, but face to face should be the core of the review process), travel is necessary for program management, enhancing collaboration, project oversight, and global STEM cooperation and participation.
- In 2013, COVs will review EEC and IIP. In 2014, COVs will review ECCS and EFRI.

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external COV and directorate Advisory Committees. Please see this chapter for additional information.

In addition to continuous ongoing evaluation within the ERC and I/UCRC programs, the directorate has additional evaluations in development. ENG has hired a program director for evaluation and assessment who is leading a group charged with developing an overarching strategy for the directorate, which includes developing and ratifying logic models for the different engineering programs. The program director is working on a pilot evaluation with selected fundamental engineering research and engineering education programs. Using a "Logic Model" approach, the engineering evaluation and assessment plan will focus on immediate-, intermediate-, and long-term impact of engineering investments on society. In addition, ENG is working with the Science of Science and Innovation Policy (SciSIP) program within the Social, Behavioral and Economic Sciences Directorate (SBE) on a National Academies study to evaluate the quality of research output and impact on society.

Number of People Involved in ENG Activities

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	11,050	10,800	12,000
Other Professionals	1,732	1,800	1,900
Postdoctorates	468	500	500
Graduate Students	6,895	7,300	7,400
Undergraduate Students	3,808	3,500	4,100
Total Number of People	**23,953**	**23,900**	**25,900**

DIVISION OF CHEMICAL, BIOENGINEERING, ENVIRONMENTAL, AND TRANSPORT SYSTEMS (CBET)

$185,300,000
+$13,850,000 / 8.1%

CBET Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, CBET	**$171.51**	**$171.45**	**$185.30**	**$13.85**	**8.1%**
Research	**164.13**	**165.16**	**178.26**	**13.10**	**7.9%**
CAREER	21.90	21.55	23.29	1.74	8.1%
Centers Funding (total)	11.21	11.08	6.88	-4.20	-37.9%
NSEC	6.15	6.08	1.88	-4.20	-69.1%
STC for Emergent Behavior	5.06	5.00	5.00	-	-
Education	**3.65**	**2.60**	**3.35**	**0.75**	**28.8%**
Infrastructure	**3.73**	**3.69**	**3.69**	**-**	**-**
NNIN	3.73	3.69	3.69	-	-

CBET supports research to enhance and protect U.S. national health, energy, environment, process manufacturing, and security. Through CBET, the physical, chemical, life, and social sciences are integrated in engineering research and education, resulting in advances in the rapidly evolving fields of bioengineering, advanced materials, environmental engineering, and in areas that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. CBET investments contribute significantly to the knowledge base and to the development of the workforce for major components of the U.S. economy, including chemicals, pharmaceuticals, medical devices, specialty chemicals and materials for advanced manufacturing, forest products, metals, natural gas and petroleum production, food, textiles, utilities, and microelectronics.

CBET supports research in biotechnology and the chemical, environmental, biomedical, mechanical, civil, and aerospace engineering disciplines. To serve these communities and achieve its goals, CBET has been organized into four thematic clusters: Chemical, Biochemical, and Biotechnology Systems; Biomedical Engineering and Engineering Healthcare; Environmental Engineering and Sustainability; and Transport and Thermal Fluids Phenomena.

In general, 67 percent of the CBET portfolio is available for new research grants and 33 percent supports continuing increments for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER funding increases by $1.74 million to a total of $23.29 million in FY 2014. This increase is consistent with CBET's emphasis on supporting early-career researchers.
- CBET investment in SEES increases $1.50 million to a total of $12.25 million in FY 2014 and will support the areas of water sustainability and climate change mitigation and adaptation research with an emphasis in the energy area, to be supplemented by core investments in the areas of sustainable chemistry, water, energy, and the environment.

- Investments for CIF21 increase by $1.0 million, to a total of $2.0 million, and will contribute to developing a cyberinfrastructure of "Sustainable Computation" that allows the use of "expert algorithms" by multiple groups (including undergraduates and industrial practitioners), less experienced than experts, to perform calculations after minimal instruction. Existing resources (envelopes, clouds, open source modules, etc.) will be used to create this environment of learning and discovery.
- CBET funding of the National Robotics Initiative (NRI), part of the ENG CEMMSS portfolio, increases $1.0 million to a total of $2.0 million and will include research on assistive mechanisms for those with physical disabilities and cognitive impairment, as well as the aging population, especially through the Biosensing program and the General and Age-Related Disabilities Engineering (GARDE) program.
- The division will also provide $3.0 million in support of the national Materials Genome Initiative (MGI), through a collaborative effort with MPS in Designing Materials to Revolutionize and Engineer our Future (DMREF) under the NSF-wide CEMMSS investment area.
- Support for BioMaPS is requested at $4.0 million in FY 2014 and will include research on nanoscale biosensing, neuro-engineering, and cellular biomechanics, as well as metabolic engineering and engineering aspects of synthetic biology.
- In the FY 2014 request, CBET will invest $750,000 in collaborative research in support of the proposed cross-foundation activity in Cognitive Science and Neuroscience.
- STC funding remains at $5.0 million, equivalent with the FY 2012 Enacted level, to continue support for the STC on Emergent Behavior of Integrated Cellular Systems, led by the Massachusetts Institute of Technology.
- CBET support for the NSEC program will be reduced by $4.20 million, to a total of $1.88 million, as two centers supported by the division will receive final funding in FY 2013.

Education

- CBET contributes to a number of education and diversity activities, including ADVANCE, REU, and NSF's Career Life Balance activity. Total CBET funding for these activities in the FY 2014 Request is $3.35 million.

Infrastructure

- ENG continues support for infrastructure through investment in the NG NNIN of user facilities at the FY 2012 Enacted level. FY 2014 represents year one of this planned ten-year investment.

DIVISION OF CIVIL, MECHANICAL, AND MANUFACTURING INNOVATION (CMMI) $224,020,000 +$20,440,000 / 10.0%

CMMI Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, CMMI	**$203.59**	**$203.58**	**$224.02**	**$20.44**	**10.0%**
Research	**177.66**	**177.63**	**196.07**	**18.44**	**10.4%**
CAREER	17.45	16.76	18.28	1.52	9.1%
Centers Funding (total)	5.49	5.48	1.61	-3.87	-70.6%
NSEC	5.49	5.48	1.61	-3.87	-70.6%
Education	**3.62**	**3.55**	**4.05**	**0.50**	**14.1%**
Infrastructure	**22.31**	**22.40**	**23.90**	**1.50**	**6.7%**
NNIN	1.92	1.90	1.90	-	-
NEES	20.39	20.50	22.00	1.50	7.3%

CMMI funds fundamental research in support of the Foundation's strategic goals directed at advances in the disciplines of civil, mechanical, industrial, systems, manufacturing engineering, and materials design. In addition, the division has a focus on the reduction of risks and damage resulting from earthquakes and other hazards and disasters. CMMI encourages discovery enabled by the use of cross-cutting technologies such as adaptive systems, nanotechnology, and high-performance computational modeling and simulation. The division promotes cross-disciplinary research partnerships at the intersections of traditional research disciplines to advance transformative research results that promote innovative manufacturing technology; enable the design and analysis of complex engineering systems; enhance the sustainability and resiliency of U.S. infrastructure (for example, buildings, transportation, and communication networks); help protect the Nation from extreme events; and apply engineering principles to improve the Nation's service enterprise systems, such as healthcare.

In general, 76 percent of the CMMI portfolio is available for new research grants and 24 percent supports continuing increments for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER funding increases by $1.52 million, to a total of $18.28 million, in FY 2014. This increase is consistent with CMMI's emphasis on supporting early-career researchers.
- Fundamental core research in support of advanced manufacturing will be $57.0 million in FY 2014 as part of the NSF-wide CEMMSS activity. Areas of continued emphasis include nanomanufacturing, manufacturing enterprise systems and operations research, smart manufacturing, and design and manufacturing of complex engineered systems.
- Research to support the NRI will be funded at $5.0 million with advances helping to ensure continued U.S. leadership in the robotics field.

- The division will also provide $12.0 million in support of the national MGI through the DMREF effort under the NSF-wide CEMMSS investment area.
- Investments in SEES, requested at $6.0 million in FY 2014, will continue to support research for resilient and sustainable infrastructure, disaster-resilient systems, energy manufacturing, and energy-efficient materials and processes.
- Support for CIF21 totals $7.0 million in FY 2014. CMMI will contribute to this NSF-wide investment by supporting research on computational-based approaches for engineering design, analysis, and predictive modeling particularly under high degrees of uncertainty. Efforts will support research in the areas of data-enabled science and engineering, with emphasis on complex systems design and analysis and methods to utilize disparate and distributed data sets for CMMI-relevant research. Linkages between these CEMMSS-related research programs and elements of the CIF21 activity will be strengthened, as researchers make greater use of modeling and simulation and data enabled capabilities made possible by CIF21 investments.
- CMMI support for the NSEC program will be reduced by $3.87 million, to a total of $1.61 million, as two centers supported by the division will receive final funding in FY 2013.

Education

- CMMI contributes to a number of education and diversity activities, including ADVANCE, REU, and NSF's Career Life Balance activity in FY 2014. Total CMMI funding for these activities in the FY 2014 Request is $4.05 million.

Infrastructure

- Support for NEES operations in FY 2014 will increase $1.50 million to a total of $22.0 million. ENG will leverage investment in CIF21 to support NEES connections and foster data-enabled research within the earthquake engineering community.
- ENG continues support for infrastructure through investment NG NNIN facility at the FY 2012 Enacted level. FY 2014 represents year one of this planned ten-year investment.

DIVISION OF ELECTRICAL, COMMUNICATIONS, AND CYBER SYSTEMS (ECCS) **$117,900,000**
+$11,170,000 / 10.5%

ECCS Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, ECCS	**$106.74**	**$106.73**	**$117.90**	**$11.17**	**10.5%**
Research	**99.53**	**99.63**	**110.21**	**10.58**	**10.6%**
CAREER	11.53	12.03	13.01	0.98	8.1%
Centers Funding (total)	8.59	8.54	5.96	-2.58	-30.2%
NSEC	3.53	3.54	0.96	-2.58	-72.9%
STC for Efficient Electronics	5.06	5.00	5.00	-	-
Education	**1.88**	**1.86**	**2.45**	**0.59**	**31.7%**
Infrastructure	**5.33**	**5.24**	**5.24**	**-**	**-**
NNIN	5.33	5.24	5.24	-	-

ECCS addresses fundamental research issues underlying electronic and photonic devices and component technologies, radio frequency through terahertz (THz) circuit integration, nanoelectronics, bioelectronics, energy (including alternate energy sources), power, smart-grid, controls, computation, networking, communications, control, sensing, robotics, and cyber–physical technologies. The division supports fundamental research of novel electronic and photonic devices, the integration of these devices into circuit and system environments, and the networking of intelligent systems at multiple scales for applications in energy, healthcare, disaster mitigation, telecommunications, environment, manufacturing, and other systems-related areas. ECCS research and education investments emphasize interdisciplinary collaboration and the convergence of technologies to take on major technological challenges for the next generation of innovative devices and systems.

In general, 67 percent of the ECCS portfolio is available for new research grants and 33 percent supports continuing increments for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER funding increases by $980,000, to a total of $13.01 million in FY 2014. This increase is consistent with ECCS's emphasis on supporting early-career researchers.
- ECCS will increase support for the NSF-wide CIF21 activity at a level of $3.0 million through support for research in advanced devices and systems directed towards computing, data storage, networking, and data management.
- The division's investment in the NRI ($3.0 million) is part of the NSF-wide CEMMSS portfolio and will support the integration of electronic, mechanical, computing, sensing devices and systems, controls, and intelligent systems that enable ubiquitous, advanced robotics to be realized.
- In an ongoing collaboration with CISE, the division will increase support for research on cyber–physical systems (CPS) by $4.0 million, to a total of $8.0 million. The ECCS investment is part of

the NSF-wide CEMMSS portfolio and will be directed towards the integration of intelligent decision-making algorithms and hardware into physical systems.

- The ECCS investment in EARS will increase by $10.0 million, to a total of $14.0 million, and will support research on more efficient radio spectrum use and greatly improved low power, energy-conserving device technologies. Increased emphasis will be directed towards research of novel high linearity transistors, devices and circuits that will permit more efficient spectrum use, as well as research into new modulation techniques, circuits, and communications systems. Extension of the radio spectrum to bandwidth-rich higher frequencies will be enabled with research of new types of transistors, electronic devices, and circuits that can operate at these higher frequencies with enhanced efficiency. Research on novel integrated antenna technologies and investigations of electromagnetic propagation in lossy media will be increased.
- ECCS funding of $5.0 million in FY 2014 supports the STC for Energy Efficient Electronics Science, led by the University of California at Berkeley and awarded in FY 2010.
- ECCS support for the NSEC program will be reduced by $2.58 million, to a total of $960,000, as two centers supported by the division receive final funding in FY 2013.

Education

- ECCS contributes to a number of education and diversity activities, including ADVANCE, REU, and NSF's Career Life Balance activity in FY 2014. Total ECCS funding for these activities in the FY 2014 Request is $2.45 million.

Infrastructure

- ENG continues support for infrastructure through investment in the NG NNIN user facility at the FY 2012 Enacted level. FY 2014 represents year one of this planned ten-year investment.

DIVISION OF ENGINEERING EDUCATION AND CENTERS (EEC) **$126,250,000**
+$6,250,000 / 5.2%

EEC Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, EEC	**$123.93**	**$120.00**	**$126.25**	**$6.25**	**5.2%**
Research	**86.27**	**87.15**	**94.16**	**7.01**	**8.0%**
Centers Funding (total)	74.66	74.72	73.42	-1.30	-1.7%
ERC	70.06	70.00	70.50	0.50	0.7%
NSEC	2.70	2.52	1.30	-1.22	-48.4%
SLC	1.90	2.20	1.62	-0.58	-26.4%
Education	**37.66**	**32.85**	**32.09**	**-0.76**	**-2.3%**

EEC integrates disciplinary basic research and education conducted in other divisions of ENG and across NSF, into strategic frameworks critical for addressing societal grand challenges and promoting innovation. Research included in the EEC portfolio spans both the physical and life sciences and engineering, from nanostructured materials to new device concepts, subsystems, and systems. Applications range across a wide spectrum, including energy, medicine, telecommunications, nanoelectronics, manufacturing, civil infrastructure, the environment, computer networks, cyber security, and others. Also included are formal scholarly studies in engineering education and on how people learn.

The complex, integrative role of EEC requires a comprehensive infrastructure of people, equipment, and centers. Fresh, creative approaches to developing the engineering workforce are vital, as a lack of properly prepared engineers is a critical barrier to a healthy U.S. economy. EEC invests in faculty, graduate and undergraduate students, post-doctoral scholars, and K–12 teachers. As nontraditional students – e.g. part-time, delayed enrollment, veteran, etc. – comprise more than 70 percent of the general undergraduate population, EEC is defining unique alternative pathways for these students, especially veterans, to successfully earn degrees in engineering.

The programs in EEC are administratively managed within three categories: (1) Major Centers and Facilities; (2) Engineering Education Research; and (3) Engineering Career Development. The Major Centers and Facilities category is comprised of the signature ERC program, NSECs, and a Science of Learning Center (SLC). They provide the framework for interdisciplinary research and education, development, and technology transfer in partnership with academia, industry, and government. The Engineering Education Research category advances new productive engineering pedagogy and learning strategies in traditional and non-traditional environments. The Engineering Education Research Category also includes NSF's comprehensive agency-wide framework – Catalyzing Advances in Undergraduate STEM Education (CAUSE), which consolidates the Foundation's investments in undergraduate education. The Engineering Career Development category includes programs such as Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET).

In general, 15 percent of the EEC portfolio is available for new research grants. The remaining 85 percent funds continuing grants and cooperative agreements made in previous years. This high fraction of multi-year commitments is primarily a consequence of the center funding vehicle, which includes awards made as five-year cooperative agreements.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Support for the ERC program increases by $500,000, to a total of $70.50 million. Building on the long-standing ERC program model, ENG will provide funding for a combination of three new ERC or NERCs and provide planned growth supplements to the first class of (NERCs) established in FY 2012.
- Funding of $1.62 million will provide continued support for an SLC — the Center of Excellence for Learning in Education, Science, and Technology (CELEST) led by Boston University. FY 2014 is the final year of funding for this SLC based on its scheduled ramp-down of support.

Education

- In FY 2014, NSF is adopting a comprehensive agency-wide framework –CAUSE – that consolidates the Foundation's investments in undergraduate education. While the majority of funding for CAUSE is provided through EHR, other NSF directorates contribute directly to this effort, ensuring an enduring connection to established discipline-based activities and expertise. In FY 2014, ENG's total funding of $12.60 million (formerly for the Engineering Education Research and NUE programs) will be integrated into to the CAUSE activity.
- Funding for the REU Sites program is increased $1.75 million over the FY 2012 Enacted level to $11.0 million. The additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, "Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics."
- Funding for the RET totals $4.0 million. Over the past 10 years, the RET in Engineering sites program has provided K-12 teachers and community college faculty the opportunity to gain research experience in university laboratories. The professional development gained by the participants through this unique experience has enriched their performance in the classroom and their guidance of students toward engineering, thus impacting the current anemic engineering pipeline. The increase will support these participants in areas of national need such as sustainability, energy, manufacturing, robotics, and others.
- EEC will also provide $1.0 million to support the SEES Fellows program.

DIVISION OF INDUSTRIAL INNOVATION AND PARTNERSHIPS (IIP) **$225,450,000 +$32,040,000 / 16.6%**

IIP Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, IIP	**$187.79**	**$193.41**	**$225.45**	**$32.04**	**16.6%**
Research	**187.79**	**193.41**	**225.45**	**32.04**	**16.6%**
SBIR/STTR	146.86	152.76	177.15	24.39	16.0%

IIP contributes to the NSF innovation ecosystem by: (1) supporting innovation research that builds on fundamental research discoveries that exhibit potential for societal and economic impact; (2) encouraging research partnerships between academia and industry; and (3) offering hands-on experience in the innovation process to entrepreneurs and future innovators.

IIP is home to two federal small business research programs, the Small Business Innovation Research (SBIR) program and the Small Business Technology Transfer (STTR) program. These programs support innovation research that leverages academic research findings and builds partnerships among small businesses, academia, large companies, and other stakeholders with the goal of achieving technology commercialization and enabling new products, processes, or services. Technology topics draw upon the breadth of NSF scientific and engineering research disciplines and are aligned along national and societal priorities.

IIP supports academic research through three research programs: the I/UCRC program, the PFI program, and the Grant Opportunities for Academic Liaison with Industry (GOALI) program. These programs aim to stimulate academia-industry partnerships, leverage industrial support, accelerate technology transfer and commercialization, and empower future generations in science and engineering. University grantees in these programs collaborate with industry to create enabling technologies that meet national needs, such as managing the electrical power system, improving manufacturing and biological processing, and supporting new healthcare information and telecommunications technologies.

The division also manages the grant-making process, and is a strong intellectual contributor to the I-Corps investment. The NSF I-Corps' purpose is to identify NSF-funded researchers who will receive additional support — in the forms of mentoring and funding — to accelerate the translation of knowledge derived from fundamental research into emerging products and services that can attract subsequent third-party funding.

In general, 92 percent of the IIP portfolio is available for new research grants. The remaining 8 percent funds continuing grants made in previous years, primarily due to the long-duration of I/UCRC awards. All other IIP programs are managed with standard grants.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Funding for SBIR/STTR increases by $24.39 million, to a total of $177.15 million, which is consistent with the levels specified in the SBIR/STTR Reauthorization Act of 2011 (P.L 112-81), which stipulates 2.8 percent and 0.4 percent of NSF's FY 2014 extramural research funding be allocated to the SBIR and STTR programs, respectively. Increased support for SBIR/STTR will (1) provide more resources to the small business community to carry on cutting-edge, high-risk and high-impact research projects; and (2) provide an opportunity for greater collaboration with the disciplinary divisions across NSF in the spirit of catalyzing technology commercialization of discovery research.
- Funding for the PFI program totals $22.45 million. The PFI program is an umbrella for two complementary components. The Accelerating Innovation Research (AIR) component is designed to strengthen the U.S. innovation ecosystem. AIR will support projects that accelerate the translation of technologically-promising research discoveries toward a path of commercialization, and foster synergistic collaborations between an existing NSF-funded innovation research alliance and other public and private entities. The Building Innovation Capacity (BIC) component will fund projects to stimulate partnerships and research collaborations between academic researchers and small business practitioners to further basic research toward market-accepted innovations.
- Funding for I-Corps increases by $5.50 million, to a total of $8.0 million, to provide more resources that will help determine the readiness to commercialize technologies built on previously or currently NSF-funded basic research projects.
- The I/UCRC program totals $11.20 million. The increased support will emphasize topics related to advanced manufacturing, clean energy, and cyberinfrastructure in line with NSF investments in CEMMSS and CIF21. The increased funding will also support Research Experiences for Undergraduates (REU), which will further enhance educational impact of I/UCRC program and prepare students for innovation leadership in a globally competitive marketplace through opportunities to work closely with industry.
- IIP's support for the GOALI program totals $6.65 million. The program promotes university-industry partnerships by making project funds or fellowships/traineeships available to support an eclectic mix of industry-university linkages across the Foundation. ENG's total FY 2014 Request for GOALI is $17.0 million.

OFFICE OF EMERGING FRONTIERS IN RESEARCH AND INNOVATION (EFRI) **$32,200,000**
+$1,200,000 / 3.9%

EFRI Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, EFRI	**$30.99**	**$31.00**	**$32.20**	**$1.20**	**3.9%**
Research	**30.99**	**31.00**	**32.20**	**1.20**	**3.9%**

EFRI strategically pursues and funds projects in important emerging areas in a timely manner. Each year EFRI recommends, prioritizes, and funds interdisciplinary topics at the frontiers of engineering research and education that have the potential for transformative impacts on national needs and/or grand challenges.

Technological innovations have given rise to new industries, expanded access to quality healthcare, and fueled national prosperity even as global competition has grown. To help ensure the Nation's continued success, EFRI will provide critical, strategic support of fundamental discovery, particularly in areas that may lead to breakthrough technologies and strengthen the economy's technical underpinnings. EFRI will have the necessary flexibility to target long-term challenges, while retaining the ability and agility to adapt as new challenges demand.

EFRI encourages the engineering community to come forward with new and paradigm-shifting proposals at the interface of disciplines and fields in important emerging areas. Their ideas and discoveries may potentially lead to new research areas for NSF and other agencies, new industries or capabilities that result in a leadership position for the country, and/or significant progress on a recognized national need or grand challenge.

Recent EFRI topics have included areas such as: sustainable energy sources; integrated systems designed to make U.S. infrastructures more resilient to disasters; advances in robotics; manufacturing healthcare; and regeneration of some of the body's most complex tissues. In FY 2011, EFRI invested in two topic areas to use insights from the biological world to inspire new engineering capabilities. These two topical areas were Engineering New Technologies Based on Multicellular and Inter-kingdom Signaling (MIKS), and Mind, Machines, and Motor Control (M3C) and were developed in close collaboration with the Directorate for Biological Sciences, CISE, and SBE. The results from these investigations will enable new biological energy sources and better protection for the environment, and human health, including new bionic prosthetics for amputees. In FY 2012 and FY 2013, EFRI is investing in three topic areas: Flexible Bioelectronics Systems (BioFlex); Origami Design for the Integration of Self-assembling Systems for Engineering Innovation (ODISSEI); and Photosynthesis Biorefineries (PSBR).

The Department of Energy (DOE) and the Environmental Protection Agency (EPA) have co-funded some of the current EFRI projects in sustainable energy and environmental design. AFOSR entered into a five-year Memorandum of Understanding (MOU) with NSF in FY 2012 to help support projects of mutual interest related to FY 2014, as well as future EFRI topics.

In general, 92 percent of the EFRI portfolio is available for new research grants and 8 percent supports continuing increments for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted Level.

Research

- FY 2014 funding will provide support for up to 15 interdisciplinary team projects aimed at addressing national challenges such as renewable energy or advanced manufacturing.

DIRECTORATE FOR GEOSCIENCES (GEO) $1,393,860,000
+$72,720,000 / 5.5%

GEO Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Atmospheric & Geospace Sciences (AGS)	$258.65	$258.66	$266.61	$7.95	3.1%
Earth Sciences (EAR)	183.43	183.50	191.20	7.70	4.2%
Integrative & Collaborative Education & Research (ICER)	91.30	91.21	93.71	2.50	2.7%
Ocean Sciences (OCE)	351.79	351.90	377.44	25.54	7.3%
Polar Programs (PLR)	436.20	435.87	464.90	29.03	6.7%
U.S. Antarctic Logistical Support	[67.52]	[67.52]	[67.52]	-	-
Total, GEO	**$1,321.37**	**$1,321.14**	**$1,393.86**	**$72.72**	**5.5%**

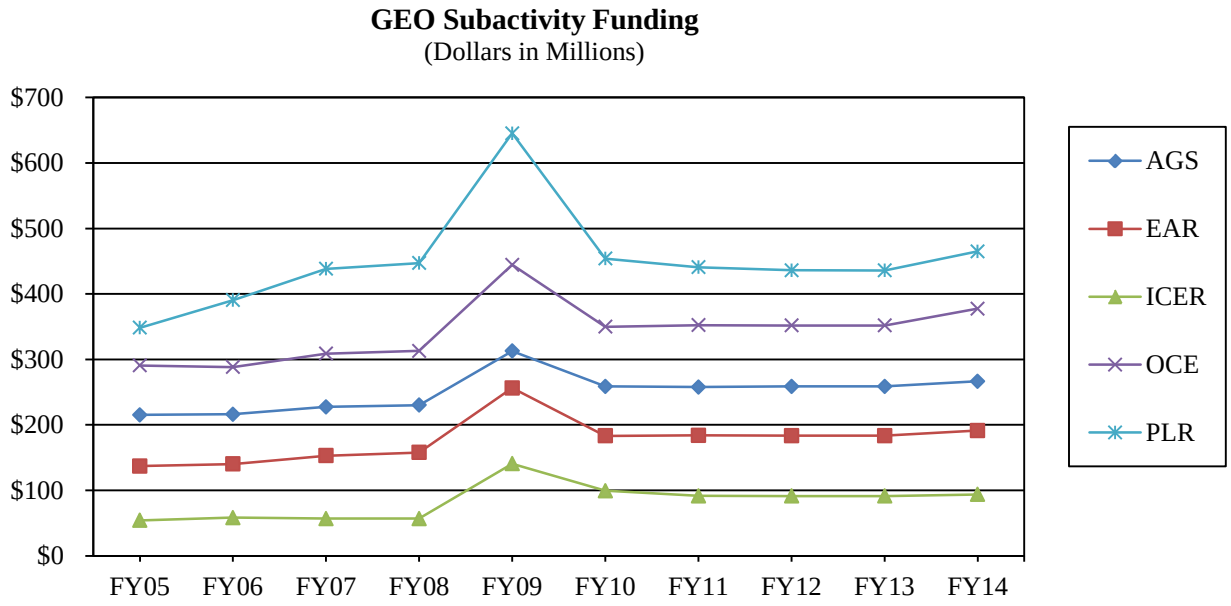
Totals may not add due to rounding.

About GEO

GEO supports basic research that advances the frontiers of knowledge and drives technological innovation while improving our understanding of the many processes that affect the global environment. These processes include the role of the atmosphere and oceans in climate, the planetary water cycle, and ocean acidification. Support is provided for interdisciplinary studies that contribute directly to national research priorities such as: understanding, adapting to, and mitigating the impacts of global change; developing and deploying integrated ocean observing capabilities to support ecosystem-based management; and understanding future availability of fresh water. Lives are saved and property is preserved through better prediction and understanding of natural environmental hazards, such as earthquakes, tornados, hurricanes, tsunamis, drought, and solar storms. Basic research supported by GEO enables preparation for and subsequent mitigation of, or adaptation to, the effects of these and other disruptive natural events.

GEO supports research spanning the Atmospheric, Earth, Ocean, and Polar sciences. As the primary U.S. supporter of fundamental research in the polar regions, GEO provides interagency leadership for U.S. polar activities. In the Arctic, NSF helps coordinate research planning as directed by the Arctic Research Policy Act of 1984. The NSF Director chairs the Interagency Arctic Research Policy Committee created for this purpose, which is now a component of the President's National Science and Technology Council. In the Antarctic, per Presidential Memorandum 6646, GEO manages all U.S. activities as a single, integrated program, making Antarctic research possible for scientists supported by NSF and by other U.S. agencies. The latter include the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), the Smithsonian Institution, and the Department of Energy. The U.S. Antarctic Program research activity supported by NSF also supports leadership by the U.S. Department of State in the governance of the continent and Southern Ocean under the aegis of the Antarctic Treaty.

GEO provides about 61 percent of the federal funding for basic research at academic institutions in the geosciences.



Note: FY 2009 includes ARRA funding. U.S. Antarctic Logistical Support is included in PLR funding data.

FY 2014 Summary by Division

- AGS's FY 2014 Budget Request is focused on enhancing support of the NSF-wide Science, Engineering, and Education for Sustainability (SEES) investment, maintaining support for disciplinary and interdisciplinary research activities, and support of the observational infrastructure required to conduct modern research, including overseeing operation of the NCAR-Wyoming supercomputer center.

- EAR's FY 2014 Budget Request is focused on enhancing support of the NSF-wide SEES investment, maintaining support for disciplinary and interdisciplinary research activities, and support of the observational infrastructure required to conduct modern research. A realignment of infrastructure support within EAR begins in FY 2013, and while overall support levels remain relatively steady, previously-existing facilities are being integrated into new activities.

- ICER's FY 2014 Budget Request will support emerging priority areas, such as Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21), while enhancing support of the NSF-wide SEES investment. Significant shifts in GEO's undergraduate education portfolio will occur, with investments moving toward the consolidated NSF-wide activity, Catalyzing Advances in Undergraduate STEM Education (CAUSE), which is led by the Directorate for Education and Human Resources.

- OCE's FY 2014 Budget Request will enhance support of the NSF-wide SEES investments where emphasis will be on understanding coastal systems and mitigating the impacts of disasters. OCE is strongly supporting the President's Executive Order establishing a National Ocean Policy (NOP) [1] through enablement of research, education, and infrastructure. OCE will continue to invest in research infrastructure, as well as develop and evaluate plans for potential new Regional Class

[1] www.whitehouse.gov/administration/eop/oceans/implementationplan

Research Vessels. Support for the Ocean Observatories Initiative (OOI) increases as operations ramp up.

- PLR's FY 2014 Budget Request is focused on maintaining strong disciplinary programs, targeted basic research in cross-foundation and interagency priorities, and supporting and improving the efficiency of critical facilities that enable research in both polar regions, most notably support for implementing recommendations of the U.S. Antarctic Program Blue Ribbon Panel (BRP).[2]

Major Investments

GEO Major Investments
(Dollars in Millions)

Area of Investment	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
CAREER	$15.60	$13.08	$14.18	$1.10	8.4%
CIF21	4.49	8.00	16.50	8.50	106.3%
I-Corps	0.19	0.25	1.75	1.50	600.0%
INSPIRE	0.86	2.00	6.00	4.00	200.0%
SEES	58.75	58.75	86.27	27.52	46.8%

Major investments may have funding overlap and thus should not be summed.

- Faculty Early Career Development Program (CAREER): This Foundation-wide activity offers the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. Approximately 30 awards will be made in FY 2014.

- CIF21: GEO support for the NSF-wide CIF21 investment ($16.50 million) will predominantly support development of EarthCube. A partnership with the Directorate for Computer and Information Science and Engineering (CISE), EarthCube seeks transformative concepts and approaches to create an integrated data management infrastructure across the geosciences. In addition, proposals submitted to CIF21 competitions will be considered for support along with other CIF21 activities across GEO.

- NSF Innovation Corps (I-Corps): GEO support of I-Corps gives project teams access to resources to help determine the readiness of technology developed by previously-funded or currently-funded NSF projects to transition from idea to product.

- Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE): Intended to encourage cross-disciplinary science, INSPIRE helps to break down disciplinary barriers and encourages program managers to use new tools, collaboration modes, and techniques in the merit-review process to widen the pool of prospective discoveries that may be hidden from or circumvented by traditional means. Leveraged by centralized support, scientists will utilize INSPIRE to pursue novel interdisciplinary research at the forefront of the geosciences.

[2] www.nsf.gov/od/opp/usap_special_review/usap_brp/rpt/index.jsp

- SEES: GEO supports a portfolio of activities that highlight NSF's unique role in helping society address the challenges of achieving sustainability. In FY 2014, existing areas, especially coastal and hazards-related research, will be strengthened and a thrust on sustainable materials will be supported by GEO.

GEO Funding for Centers Programs and Facilities

GEO Funding for Centers Programs
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Centers Programs Total	**$17.66**	**$17.70**	**$16.11**	**-$1.59**	**-9.0%**
Nanoscale Science & Engineering Centers (ICER)	0.25	0.25	-	-0.25	-100.0%
Science & Technology Centers (AGS, OCE, PLR)	17.41	17.45	16.11	-1.34	-7.7%

Totals may not add due to rounding.

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- Nanoscale Science and Engineering Centers (NSEC): NSEC support will decrease by $250,000 as the award to the single center partially supported by GEO concludes.

- Science and Technology Centers (STCs): GEO supports a total of four Science and Technology Centers through funding from three divisions. FY 2014 completes the planned sunsetting of the Center for the Remote Sensing of Ice Sheets (CRESIS) as the center enters its final year of support.

GEO Funding for Facilities
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Facilities Total	**$614.79**	**$591.53**	**$647.66**	**$56.13**	**9.5%**
Academic Research Fleet (OCE)	92.96	78.75	86.00	7.25	9.2%
Arctic Research Support & Logistics (PLR)	42.08	43.54	44.00	0.46	1.1%
Arecibo Observatory (AGS)	3.63	3.20	3.50	0.30	9.4%
Geodesy for the Advancement of Geoscience & EarthScope (EAR)	11.92	13.18	12.70	-0.48	-3.6%
IceCube Neutrino Observatory (PLR)	3.45	3.45	3.45	-	-
International Ocean Discovery Program (OCE)	51.68	44.40	50.00	5.60	12.6%
National Nanotechnology Infrastructure Network (ICER	0.60	0.60	0.30	-0.30	-50.0%
National Center for Atmospheric Research (AGS)	103.00	98.60	99.00	0.40	0.4%
Ocean Observatories Initiative (OCE)	26.80	26.80	52.80	26.00	97.0%
Seismological Facilities for the Advancement of Geosciences & EarthScope (EAR)	26.12	26.76	25.70	-1.06	-4.0%
U.S. Antarctic Facilities & Logistics (PLR)	185.02	184.73	202.69	17.96	9.7%
U.S. Antarctic Logistical Support (PLR)	67.52	67.52	67.52	-	-

Totals may not add due to rounding.

For detailed information on individual facilities, please see the Facilities chapter.

GEO has increased operations and maintenance budgets for facilities in order to provide the infrastructure needed by the broad geoscience research community and address BRP recommendations related to Antarctic infrastructure. Notable items include:

- Support for the Academic Research Fleet increase reflects the start of operation of the R/V *SIKULIAQ* and increased fuel costs.
- The International Ocean Discovery program funds increase enables a longer operational schedule for the vessel.
- Operational support for the Ocean Observatories Initiative (OOI) increases as the observatory procures spare parts and operations ramp up.
- U.S. Antarctic Facilities and Logistics, responding to BRP recommendations, will provide a significant increase to improve operational efficiency, reduce future operations costs, and increase safety of researchers and contractors working in Antarctica.

Summary and Funding Profile

In FY 2014, the number of research grant proposals is expected to be about 5,000 and GEO expects to award about 1,400 research grants. Average annual award size and duration are not expected to materially fluctuate in FY 2012 through FY 2014.

Operations and maintenance (O&M) funding for GEO-supported user facilities totals $646.36 million, and comprises 46 percent of GEO's FY 2014 Request. GEO has increased operations budgets for facilities to maintain current operational capacity, keep pace with needed increases for OOI O&M, and respond to BRP recommendations to increase efficiency of activities in Antarctica.

GEO Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate[1]	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	5,246	5,774	5,500
Number of New Awards	1,640	1,788	1,700
Funding Rate	31%	31%	31%
Statistics for Research Grants:			
Number of Research Grant Proposals	4,716	5,140	5,000
Number of Research Grants	1,361	1,560	1,400
Funding Rate	29%	30%	28%
Median Annualized Award Size	$129,866	$132,750	$136,000
Average Annualized Award Size	$170,566	$167,867	$171,000
Average Award Duration, in years	2.6	2.8	2.8

[1] Award estimates shown for FY 2013, such as numbers of awards and size/duration, are based upon the FY 2012 Enacted level.

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- In FY 2012, NSF and the Office of Science and Technology Policy received the report of the U.S. Antarctic Blue Ribbon Panel, *More and Better Science in Antarctica Through Increased Logistical Effectiveness*.[3] The FY 2014 Request allocates funding to begin implementing the recommendations of this group.
- Two reports from the National Research Council were received in 2012: *New Research Opportunities in the Earth Sciences*,[4] which identifies emerging research directions for consideration by NSF; and *Challenges and Opportunities in Hydrologic Sciences*,[5] which highlights research opportunities to help us better understand the role of water in the Earth system.

Workshops and Reports:

- Many workshops are convened each year to allow the research communities supported by GEO to articulate priorities. Of particular note in 2012 was an opportunity for considerable community planning around GEO's EarthCube activity. This ambitious program seeks to develop the cyberinfrastructure to knit together geoscience data from a variety of disciplines, and is GEO's contribution to NSF's CIF21 investment, and is central to GEO's strategy to capitalize on Big Data.

Committees of Visitors (COV):

- In 2012, COVs reviewed the NCAR and Facilities Section within AGS,[6] and Ocean Research and Education programs in OCE.[7] The COVs' reports were presented to the GEO Advisory Committee, which convened in April and October of 2012.
- In 2014, COVs will be held to review the Atmosphere Section within AGS and Instrumentation and Facilities programs in EAR.

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

Number of People Involved in GEO Activities

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	6,924	7,700	7,300
Other Professionals	3,288	3,700	3,500
Postdoctorates	675	800	700
Graduate Students	2,947	3,100	3,100
Undergraduate Students	2,531	2,300	2,700
Total Number of People	**16,364**	**17,600**	**17,300**

[3] www.nsf.gov/od/opp/usap_special_review/usap_brp/rpt/index.jsp
[4] www.nap.edu/catalog.php?record_id=13236
[5] www.nap.edu/catalog.php?record_id=13293
[6] www.nsf.gov/geo/adgeo/advcomm/fy2012_cov/ags-geo-ncar-facilities-report-2012.pdf
[7] www.nsf.gov/geo/adgeo/advcomm/fy2012_cov/oce-geo-ocean-sciences-edu-report-2012.pdf

DIVISION OF ATMOSPHERIC AND GEOSPACE SCIENCES (AGS) — $266,610,000 +$7,950,000 / 3.1%

AGS Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, AGS	**$258.65**	**$258.66**	**$266.61**	**$7.95**	**3.1%**
Research	**121.11**	**124.28**	**139.65**	**15.37**	**12.4%**
CAREER	6.45	5.48	5.90	0.42	7.7%
Centers Funding (total)	4.00	4.00	4.00	-	-
STC: Multi-Scale Modeling of Atmospheric Processes	4.00	4.00	4.00	-	-
Education	**3.78**	**1.96**	**1.70**	**-0.26**	**-13.3%**
Infrastructure	**133.76**	**132.42**	**125.26**	**-7.16**	**-5.4%**
Arecibo Observatory	3.63	3.20	3.50	0.30	9.4%
National Center for Atmospheric Research (NCAR)	103.00	98.60	99.00	0.40	0.4%
Research Resources	27.13	30.62	22.76	-7.86	-25.7%

Totals may not add due to rounding.

The mission of AGS is to extend the intellectual frontiers in atmospheric and geospace sciences by making investments in fundamental research, technology development, and education that enable discoveries, nurture a vibrant, diverse scientific workforce, and help attain a prosperous and sustainable future. AGS supports activities to further our understanding of the physics, chemistry, and dynamics of Earth's atmosphere, from the Earth's surface to the Sun, on timescales ranging from minutes to millennia. AGS provides support for: 1) basic science projects and 2) the acquisition, maintenance, and operation of observational and cyberinfrastructure facilities and services that enable modern-day atmospheric and geospace science research activities. Although the majority of AGS support is through individual investigator merit-reviewed multi-year grants, the division also supports small-scale, limited-duration exploratory research projects; collaborative or multi-investigator group projects focusing on a particular problem, subject, or activity; large center or center-like projects; and funding for the research conducted at facilities provided by the NSF-supported National Center for Atmospheric Research (NCAR), which extends and enhances research at universities. More information on NCAR is available in the Facilities chapter. The division will increase support in key areas of fundamental atmospheric and geospace science, including dynamics and predictability of high-impact atmospheric and space weather hazards, and support for research concerning the complex and dynamic interactions among natural and human-driven processes in coastal areas through its contributions to NSF's Science, Engineering, and Education for Sustainability (SEES) activities of Hazards SEES and Coastal SEES.

Recognizing the close interplay between the division's support for science and the provision of facilities to support that science, AGS seeks a balance between its support for science and facilities. Approximately 50 percent of the annual budget of AGS is used to support observational and computational facilities, as well as the Arecibo Observatory and the Federally Funded Research and Development Center, NCAR. The Arecibo Observatory is also supported by Division of Astronomical Sciences in the Directorate for Mathematical and Physical Sciences. The remaining 50 percent of the

AGS budget is for individual, small group, and center-like research grants. In general, of the 50 percent of the AGS budget available for research grants, about 50 percent (or 25 percent of the total AGS portfolio) is available for new research grants; the remaining 50 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Support for early-career researchers is an AGS priority. The division increases its support for CAREER grants by $420,000 to a total of $5.90 million.
- The Space Weather Research program supports the development of integrative space science models, extending network observing capabilities, with the goal of meeting societal needs for improved monitoring and advancement of predictions of space weather phenomena and effects. Support for this program is increased by $1.0 million, to a total of $7.23 million.
- In FY 2014 AGS will contribute $19.40 million in support of the cross-directorate research opportunities within the Science, Engineering, and Education for Sustainability (SEES) portfolio. AGS will support Hazards SEES at $5.40 million and Coastal SEES at $3.0 million. For AGS, the overarching goal of Hazards SEES is to catalyze basic research in hazard-related science to support a broad spectrum of research into the improved understanding and prediction of atmospheric and space weather hazards. Among the goals of Coastal SEES are enabling place-based, system-level understanding of vulnerable coastal systems; yielding outcomes with quantitative predictive value; and identifying pathways to enhance coastal resilience. AGS support of SEES activities Decadal and Regional Climate Prediction using Earth System Models (EaSM) will continue at $10.0 million, while support for Water Sustainability and Climate will be supported at a level of $1.0 million.
- The Center for Multi-scale Modeling of Atmospheric Processes, an NSF Science and Technology Center (STC) initiated in FY 2006, will be maintained at $4.0 million.

Education

- AGS funding for the Research Experiences for Undergraduates (REU) Sites and Supplements program decreases $250,000 below the FY 2012 Enacted level to $1.0 million, reflecting increased support for CAREER. $180,000 of FY 2014 funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*.
- AGS supports other education activities including AGS Postdoctoral Fellows. The total AGS education portfolio is $1.70 million in FY 2014.

Infrastructure

- Funding for the Arecibo Observatory will increase to $3.50 million (+$300,000).
- Support for the National Center for Atmospheric Research (NCAR) is increased by $400,000, to a total of $99.0 million. This level of support maintains key community research infrastructure operated by NCAR.
- Support for Research Resources is reduced by $7.86 million, to a total of $22.76 million. This level of support represents an increased focus on research using existing instrumentation rather than instrumentation development.

DIVISION OF EARTH SCIENCES (EAR)

$191,200,000
+$7,700,000 / 4.2%

EAR Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, EAR	**$183.43**	**$183.50**	**$191.20**	**$7.70**	**4.2%**
Research	**119.45**	**117.09**	**125.75**	**8.66**	**7.4%**
CAREER	6.18	4.80	5.07	0.27	5.6%
Education	**4.42**	**4.93**	**5.48**	**0.55**	**11.2%**
Infrastructure	**59.57**	**61.48**	**59.97**	**-1.51**	**-2.5%**
Geodesy for the Advancement of Geoscience & EarthScope (GAGE)	11.92	13.18	12.70	-0.48	-3.6%
Seismological Facilities for the Advancement of Geosciences & EarthScope (SAGE)	26.12	26.76	25.70	-1.06	-4.0%
Research Resources	21.54	21.54	21.57	0.03	0.1%

Totals may not add due to rounding.

EAR supports fundamental research into the structure, composition, and evolution of the Earth, and the life it has sustained over the four and a half billion years of Earth history. The results of this research will lead to a better understanding of Earth's changing environment (past, present, and future); the natural distribution of its mineral, water, biota, and energy resources; and provide methods for predicting and mitigating the effects of geologic hazards, such as earthquakes, volcanic eruptions, floods, and landslides.

Through its Surface Earth Processes Section, EAR supports research in geomorphology and land use, hydrologic science, geobiology and low temperature geochemistry, and sedimentary geology and paleobiology. The division's Deep Earth Processes Section maintains programs in geophysics, tectonics, petrology and geochemistry, and integrated earth systems. In addition to these fundamental research programs, EAR has an Instrumentation and Facilities program that supports community-based, shared-use facilities; and the acquisition and development of instrumentation by individual investigators; EarthScope, a $200.0 million facility and science program focused on studying the structure and tectonics of the North American continent; and an education program that funds a number of activities to attract and support students and young investigators to the field of Earth Science.

Approximately 68 percent of EAR's budget is used to support individuals and small groups of researchers, while about 32 percent of the budget goes to instrumentation and facilities. In general, 36 percent of EAR's portfolio is available for new research grants. The remaining 64 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- EAR will continue its participation in SEES with $8.90 million for Water Sustainability and Climate, an increase of $1.90 million. In FY 2014, EAR will also participate in SEES SusCHEM - Sustainable Chemistry, Engineering, and Materials at $1.50 million, Hazards SEES at $4.50 million, and Coastal SEES at $3.50 million.
- In FY 2014 EAR's support for NSF's INSPIRE Track 1 investment will be $1.0 million.
- CAREER funding will be increased by $270,000 to a total of $5.07 million, reflecting EAR's continued commitment to supporting early career investigators.

Education

- EAR funding for the Research Experiences for Undergraduates (REU) Sites and Supplements program increases $250,000 over the FY 2012 Enacted level to $1.34 million. $180,000 of the increased FY 2014 funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*
- Support for EAR Postdoctoral Fellowships will increase by $300,000 to $1.70 million reflecting EAR's commitment to workforce development.

Infrastructure

- Beginning in FY 2014, the separate seismic and geodetic facilities operated by the Incorporated Research Institutions for Seismology (IRIS), UNAVCO and EarthScope will be integrated into two facilities: (1) Seismological Facilities for the Advancement of Geosciences and EarthScope (SAGE), operated by IRIS, will be funded at $25.70 million; and (2) Geodetic Facilities for the Advancement of Geoscience and EarthScope (GAGE), operated by UNAVCO, will be funded at $12.70 million.

DIVISION OF INTEGRATIVE AND COLLABORATIVE EDUCATION AND RESEARCH (ICER)

$93,710,000
+$2,500,000 / 2.7%

ICER Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, ICER	**$91.30**	**$91.21**	**$93.71**	**$2.50**	**2.7%**
Research	**60.91**	**72.04**	**77.35**	**5.31**	**7.4%**
Centers Funding (total)	0.25	0.25	-	-0.25	-100.0%
Nanoscale Science & Engineering Centers	0.25	0.25	-	-0.25	-100.0%
Education	**29.79**	**18.57**	**16.06**	**-2.51**	**-13.5%**
Infrastructure	**0.60**	**0.60**	**0.30**	**-0.30**	**-50.0%**
National Nanotechnology Infrastructure Network (NNIN)	0.60	0.60	0.30	-0.30	-50.0%

Totals may not add due to rounding.

ICER supports novel, complex, or partnership projects in both research and education. These investments cut across traditional boundaries within the geosciences, encouraging interdisciplinary activities and responding directly to critical needs of the entire geoscience community. ICER's principal goals are to develop innovative means to initiate and support geoscience education, attract underrepresented groups to careers in the geosciences, foster the interchange of scientific information nationally and internationally, and to join with other parts of NSF in major integrative research and education efforts. In FY 2014, the division will make strategic investments in climate research, international activities, education, diversity, and human resource development.

In general, 38 percent of the ICER portfolio is available for new research grants. The remaining 62 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- ICER will support SEES activities totaling $17.25 million in FY 2014. Supported activities will lay the foundation for technologies to mitigate, and adapt to, environmental change that threatens sustainability, with an emphasis in FY 2014 on vulnerable regions in the Arctic and along coasts. ICER will participate in activities to establish a robust suite of Sustainability Research Networks, and in a program to identify clean energy sources and the impact of using those sources on the environment and society.
- ICER supports a varied portfolio of international collaborative activities. In FY 2014, this will total $6.50 million, and emphasize collaborative research across the Americas and specific research activities sponsored by the International Group of Funding Agencies for Global Change Research.

Education

- In FY 2014, GEO is consolidating geoscience education and diversity support into the NSF-wide CAUSE initiative. ICER houses GEO's support for the CAUSE activity, which totals $10.90 million in FY 2014. No other education efforts are supported by ICER in FY 2014.

Infrastructure

- ICER provides GEO's contribution to the National Nanotechnology Infrastructure Network. In FY 2014, this support decreases by $300,000, to a total of $300,000, as a previously supported center refocuses its emphasis upon renewal.

DIVISION OF OCEAN SCIENCES (OCE) $377,440,000
+$25,540,000 / 7.3%

OCE Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, OCE	**$351.79**	**$351.90**	**$377.44**	**$25.54**	**7.3%**
Research	**162.47**	**183.21**	**175.69**	**-7.52**	**-4.1%**
CAREER	1.64	2.80	3.21	0.41	14.6%
Centers Funding (total)	8.96	9.00	9.00	-	-
STC: Coastal Margin Observation & Prediction	4.00	4.00	4.00	-	-
STC: Dark Energy Biosphere Investigations	4.96	5.00	5.00	-	-
Education	**9.00**	**7.94**	**6.12**	**-1.82**	**-22.9%**
Infrastructure	**180.32**	**160.75**	**195.63**	**34.88**	**21.7%**
Academic Research Fleet	92.96	76.75	85.00	8.25	10.7%
International Ocean Discovery Program (IODP)	51.68	44.40	50.00	5.60	12.6%
Ocean Observatories Initiative (OOI)	26.80	26.80	52.80	26.00	97.0%
Research Resources	8.87	10.80	6.83	-3.97	-36.8%
Facilities Pre-Construction Planning (total)	-	2.00	1.00	-1.00	-50.0%
Regional Class Research Vessels (RCRV)	-	2.00	1.00	-1.00	-50.0%

Totals may not add due to rounding.

Research, education, and infrastructure funded by OCE address the central role of the oceans in a changing Earth and as a national strategic resource, as recognized in the President's 2010 Executive Order establishing a National Ocean Policy (NOP) and creating a National Ocean Council (NOC) to implement the policy. OCE supports interdisciplinary research to better understand changing ocean circulation and other physical parameters, biodiversity and the dynamics of marine organisms and ecosystems, and changing ocean chemistry as exemplified by ocean acidification. OCE also supports research on the geology of the ocean margins and sub-seafloor to investigate past ocean and climate conditions, stability of methane hydrates, natural hazards associated with earthquakes and volcanic eruptions, and microbial life deep below the seafloor. Ocean education emphasizes undergraduate REU programs and the interdisciplinary nature of ocean sciences. Since ocean science requires access to the sea, OCE supports research vessels, deep submergence capability including submersibles and autonomous vehicles, and technologically advanced sensors and instrumentation. In FY 2014, research emphases in OCE will be guided by the recently issued report "*Science for an Ocean Nation: An Update of the Ocean Research Priorities Plan*".[8] This report identifies national research priorities in key areas of interaction between society and the ocean. These priorities include improved understanding of marine ecosystems, marine biodiversity, the impact of increased atmospheric carbon dioxide on ocean acidification, the

[8] www.whitehouse.gov/sites/default/files/microsites/ostp/ocean_research_plan_2013.pdf

ocean's role in climate change, ocean observing, changing conditions in the Arctic, hazards and extreme events, and the enhancement of infrastructure to support ocean and coastal research.

In general, 30 percent of the OCE portfolio is available for new research grants. The remaining 70 percent funds continuing grants made in previous years. Approximately 52 percent of the overall budget supports facilities and infrastructure.

FY 2014 Summary

Research

- OCE's research funding decreases by $7.52 million from the FY 2012 Enacted level, primarily due to increased infrastructure funding. Included here are a $2.0 million investment in INSPIRE and a $1.60 million increase in CAREER. OCE will continue support for two STCs and the Long Term Ecological Research program at previous levels. OCE will give high priority to research themes that emerge from both the NOP and the Ocean Research Priorities Plan.
- OCE will invest $19.50 million in SEES activities. This includes $8.50 million in Coastal SEES, $2.50 million in Hazards SEES, $6.0 million in Ocean Acidification, and $2.50 million in Dimensions of Biodiversity.
- OCE will also continue its partnership on the theme of Oceans and Human Health with the National Institute of Environmental Health Sciences (NIEHS).

Education

- Funding for educational activities will decrease by $1.82 million, reflecting the close-out of the Centers for Ocean Science Education Excellence (COSEE) program during FY 2014.
- OCE support for REU will increase by $1.12 million over the FY 2012 Enacted level. $220,000 of the increased FY 2014 funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*.
- Funding will continue for a program initiated in FY 2012, the OCE Postdoctoral Fellowship Program. This program aims to broaden participation in the ocean sciences through fellowships to enhance opportunities for women and minority scientists.

Infrastructure

- Continuation of investment ($1.0 million) in planning and design for fleet renewal with construction of up to three Regional Class Research Vessels (RCRVs), as a candidate Major Research Equipment and Facilities Construction (MREFC) project.
- A $26.0 million increase for continued implementation of the Ocean Observatories Initiative (OOI), bringing the total for operations and maintenance to $52.80 million in FY 2014. These increased funds support the transition from the design/build phase to deployment and testing of the network leading to full commissioning and operation in FY 2015.
- Continued support ($50.0 million) is requested for FY 2014 operations of the drilling vessel, *JOIDES Resolution* as part of the U.S. contribution to the International Ocean Discovery Program (IODP). This level is $5.60 million above the FY 2012 Enacted level. In FY 2012, the National Science Board approved a one-year extension of the current program into FY 2014 to allow time for a competition, currently underway, to award a new cooperative agreement to continue operations of the *JOIDES Resolution*. In FY 2013, NSF investments in IODP have been leveraged by support from international partners and allowing sub-leasing of the vessel to industry by the current contractor. Such leveraging is expected to continue in FY 2014 and beyond.
- The cost of Academic Research Fleet operations will increase, reflecting the general upward trend in fuel costs and other expenses.

DIVISION OF POLAR PROGRAMS (PLR) $464,900,000
+$29,030,000 / 6.7%

PLR Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, PLR	**$436.20**	**$435.87**	**$464.90**	**$29.03**	**6.7%**
Research	**129.36**	**127.71**	**139.34**	**11.63**	**9.1%**
CAREER	1.34	-	-	-	N/A
Centers Funding (total)	4.45	3.77	3.11	-0.66	-17.5%
STC: Center for Remote Sensing of Ice Sheets	4.45	3.77	3.11	-0.66	-17.5%
Education	**2.45**	**2.55**	**0.80**	**-1.75**	**-68.6%**
Infrastructure	**304.39**	**305.61**	**324.76**	**19.15**	**6.3%**
Arctic Research Support & Logistics	42.08	43.54	44.00	0.46	1.1%
IceCube Neutrino Observatory (IceCube)	3.45	3.45	3.45	-	-
U.S. Antarctic Facilities & Logistics	185.02	184.73	202.69	17.96	9.7%
U.S. Antarctic Logistical Support	67.52	67.52	67.52	-	-
Polar Environment, Safety, and Health	6.31	6.37	7.10	0.73	11.5%

Totals may not add due to rounding.

The Division of Polar Programs (PLR) is the primary U.S. supporter of, and serves NSF interagency leadership responsibilities for, fundamental research in the polar regions. The Arctic Sciences section supports research in social, earth systems, and a broad range of natural sciences; its Research Support & Logistics program is driven by and responds to research by assisting researchers with access to the Arctic and for engagement in planning and sharing of results with local Arctic communities. Antarctic Sciences funds research for which access to Antarctica is essential to advancing the scientific frontiers, including research in a broad array of geo- and bio-sciences, such as earth system science, as well as space and astrophysical sciences that can only be achieved or are best achieved with work performed in Antarctica and the Southern Ocean. Antarctic Infrastructure and Logistics enables research in Antarctica on behalf of the U.S. Government through a network of stations, labs, equipment, and logistical resources. The Environment, Safety, and Health section provides oversight for the environmental, safety, and health aspects of research and operations conducted in polar regions.

PLR's FY 2014 Request reflects three key priorities: (1) maintaining strong disciplinary programs that provide a base for investments in cross-disciplinary science programs; (2) focusing basic research on cross-foundation (e.g., Science, Engineering, and Education for Sustainability (SEES), Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21), GEOTRACES), and interagency priorities; and (3) supporting and improving the efficiency of critical facilities that enable research in both polar regions. For Antarctica, the primary objective is to initiate a concerted multi-year commitment toward more effective and lower-cost science support as recommended by the U.S. Antarctic Program (USAP) Blue Ribbon Panel (BRP) report, *More and Better Science in Antarctica through Increased Logistical Effectiveness*.[9] NSF issued a formal response to this report in

[9] www.nsf.gov/od/opp/usap_special_review/usap_brp/rpt/index.jsp

March 2013.[10] This entails coordinated commitments by the Antarctic Sciences and Antarctic Infrastructure and Logistics sections, as well as the Environment, Safety, and Health section. Emphases include safety and health improvements, investments with positive net present value, and facilities renewal at McMurdo and Palmer stations. Additionally, the Antarctic science community will be asked to plan and execute more effective observational approaches as outlined in the 2011 National Research Council (NRC) report, *Future Science Opportunities in Antarctica and the Southern Ocean*,[11] and reaffirmed by the BRP. For the Arctic, shared cross-directorate basic research objectives, the recently released Interagency Arctic Research Policy Committee's (IARPC) *Arctic Research Plan FY 2013-2017* (Five-Year Plan)[12] and the *National Ocean Policy (NOP) Implementation Strategy*[13] inform science investment priorities.

In general, 40 percent of the PLR research portfolio is available for new grants and 60 percent for continuing grants. Approximately 70 percent of the overall budget supports facilities and logistics.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Funding increases to develop mechanisms to coordinate with Alaska Native organizations to build partnerships and broaden participation in scientific research, and to strengthen PLR's long-standing commitment to engaging Alaska Native students and communities. (+$200,000, to a total of $300,000)
- PLR will collaborate with OCE to support the U.S. components of several marine expeditions under the GEOTRACES program to measure trace elements and isotopes across the Arctic Ocean and the connecting passages between the Arctic, Atlantic, and Pacific Oceans. (+$2.0 million, to a total of $2.0 million)
- Core Arctic research will be prioritized to support reinvestment in sustained synthesis of modeling and observational data at the system level and for research on the Chukchi and Beaufort Seas, also taking an integrative system-level approach. These will complement the more focused research supported by mission agencies, such as the Bureau of Ocean Energy Management (BOEM) and the National Oceanic and Atmospheric Administration (NOAA), and contribute to the coordinated activity under IARPC. ($6.0 million)
- Core Antarctic research investments will include prioritizing investments in remotely deployed observation instruments and improved climate modeling techniques and capabilities, as recommended in the NRC and BRP reports. ($4.0 million)
- Funding for the Center for the Remote Sensing of Ice Sheets (CReSIS) (-$660,000, to a total $3.11 million) reflects the planned sunsetting of the center in FY 2015.

Education

- Funding for the Research Experiences for Undergraduates (REU) Sites and Supplements program increases $300,000 over the FY 2012 Enacted level. The increased funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*

[10] www.nsf.gov/news/news_summ.jsp?cntn_id=127345&org=NSF&from=news
[11] www.nap.edu/catalog.php?record_id=13169
[12] www.nsf.gov/od/opp/arctic/iarpc/arc_res_plan_index.jsp
[13] www.whitehouse.gov/administration/eop/oceans/implementationplan

Infrastructure

- Arctic Research Support and Logistics: The Arctic Research Support and Logistics program provides support for Arctic researchers, including airplanes, helicopters, access to icebreakers and field camps for researchers participating in approximately 150 projects in remote sites in Alaska, Canada, Arctic Scandinavia, Russia, and the Arctic Ocean. Summit Station on the Greenland icecap operates as a year-round international site for a variety of atmospheric and geophysical measurements. Increased funding will support anticipated ship-time on the new UNOLS vessel *SIKULIAQ*. (+$460,000, to a total of $460,000)
- IceCube Neutrino Observatory: PLR continues to match the Directorate for Mathematical and Physical Science's contribution of $3.45 million for operations and maintenance of the IceCube Observatory.
- U.S. Antarctic Facilities and Logistics:
  - Funding provides all necessary infrastructure, instrumentation, and logistics for scientists from all disciplines performing research in Antarctica. This support includes forward staging facilities in New Zealand and South America; operation of three year-round stations in Antarctica; DoD fixed-wing aircraft, contracted rotary- and fixed-wing aircraft; two leased research vessels, and a leased icebreaker.
  - The NSF FY 2014 Budget Request for Antarctic Facilities and Logistics also focuses on implementing recommendations from the USAP BRP. NSF issued a formal response to the BRP in March 2013,[14] and this Budget Request incorporates investments outlined in that document, totaling $18.0 million. These include:
    - Address resupply issues at Palmer Station by improving the condition of the pier and mitigating the underwater rock ledge that currently prevents larger vessels from docking at the station ($8.0 million). The small boating range will also be increased through the purchase of rigid hull inflatable boats ($1.0 million), which will allow for better access to areas of scientific interest and provide a more robust platform for the recovery of remote sensing systems, such as gliders and robotic underwater vehicles;
    - Improve fire suppression engineering through a study of fire suppression requirements and existing capabilities in order to target any areas needing improvement ($1.0 million);
    - Roboticize the overland traverse to increase productivity by increasing the number of trips each swing of the traverse can make in a single season to the South Pole or other interior scientific locations ($2.0 million). New tractors will be purchased for the heavy traverse ($4.0 million) to provide a standardized tractor fleet on which to build the robotics system; and
    - Consolidate warehousing activities to enable reductions in physical and personnel footprint. The first phase of the new McMurdo long-range plan involves construction of a single logistics and warehousing facility, as well as a consolidated trade shop and warehousing complex. Design work will begin on these facilities so that materials and equipment can be purchased for delivery to Antarctica on the 2015 resupply vessel. ($2.00 million)
- Polar Environment, Safety, and Health: The Environment, Safety, and Health section provides oversight for these aspects of conducting and supporting research in the polar regions. Funds are invested in development of an electronic medical records system that will serve both polar regions. (+$180,000 to a total of $180,000)

[14] www.nsf.gov/news/news_summ.jsp?cntn_id=127345&org=NSF&from=news

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES (MPS)

$1,386,120,000
+$77,180,000 / 5.9%

MPS Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Division of Astronomical Sciences (AST)	$234.72	$234.55	$243.64	$9.09	3.9%
Division of Chemistry (CHE)	234.03	234.06	253.65	19.59	8.4%
Division of Materials Research (DMR)	294.40	294.55	314.63	20.08	6.8%
Division of Mathematical Sciences (DMS)	237.72	237.77	244.54	6.77	2.8%
Division of Physics (PHY)	277.44	277.37	289.02	11.65	4.2%
Office of Multidisciplinary Activities (OMA)	30.37	30.64	40.64	10.00	32.6%
Total, MPS	**$1,308.70**	**$1,308.94**	**$1,386.12**	**$77.18**	**5.9%**

Totals may not add due to rounding.

About MPS

The MPS request of $1,386.12 million is a balance of strategic investments in the core research programs of each of the five MPS divisions, initiation of programs that address directorate-specific priorities, and continuing participation in Foundation-wide programs. The support for robust core programs in MPS provides the healthy foundation of basic research in astronomical sciences, chemistry, materials research, mathematical sciences, and physics that transforms the frontiers of science. Closely related aspects of this request are the initiation of a midscale instrumentation program and the continued support for major multi-user facilities, clean energy research, CAREER, and Research Experiences for Undergraduates (REU). The directorate will also use its core research funding to seed new efforts in grand challenge communities, food and water security, and neuroscience. MPS will continue to be a major participant in NSF-wide efforts such as Science, Engineering, and Education for Sustainability (SEES), under which it will launch a new effort in critical elements, minerals, and materials.

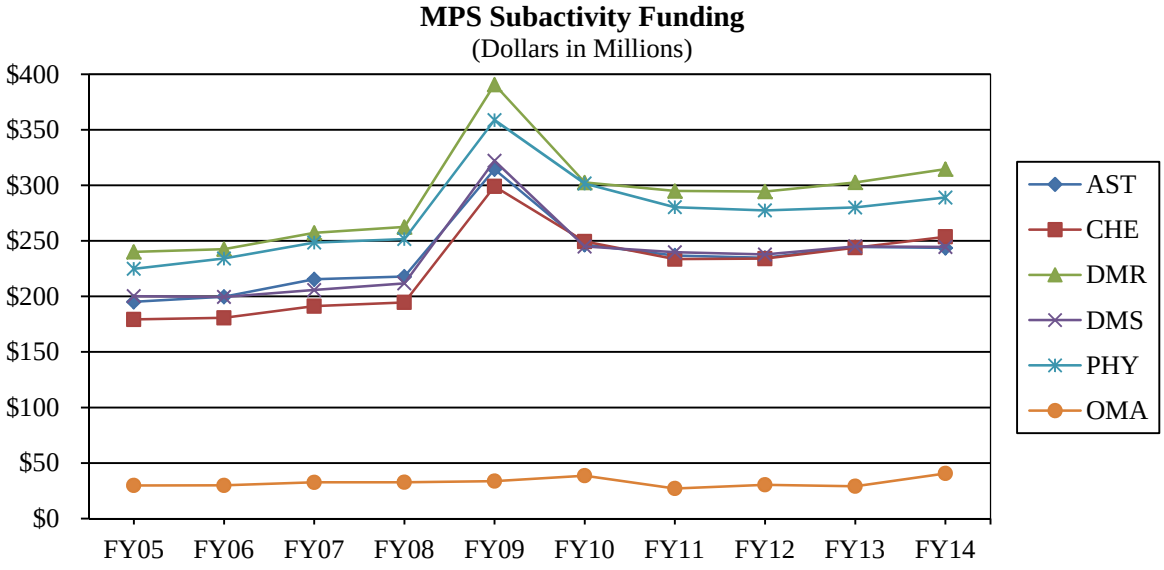
All MPS divisions will continue to invest substantially in their core research programs to drive new discoveries that strengthen the building blocks of innovation. This funding will be used to initiate a midscale instrumentation program in AST and PHY, begin exploratory activities in food and water security, and augment clean energy research investments. PHY will launch a new effort in accelerator and detector science. DMR and DMS will invest in complex problem solving to support strategic investments in cyberinfrastructure, instrumentation, and fundamental science to enable development of grand challenge communities; DMR will develop Materials Innovation Platforms (MIP) as the first exemplar of this investment.

Facilities are a priority in the MPS request. Within the facilities portfolio, AST support design and development for the Large Synoptic Survey Telescope (LSST) as it transitions into its construction stage, and begin the ramp down for the University Radio Observatories while increasing operations funding for the Atacama Large Millimeter Array (ALMA), as planned. As part of the ramp up to full operations, PHY expects to increase support for operations of the Advanced Laser Interferometer Gravitational Wave Observatory (AdvLIGO). The request also increases Office of Multidisciplinary Activities (OMA) funding to enable MPS to make responsible decisions regarding its facilities portfolio components by

means of appropriate studies of possible environmental issues, stewardship transition costs, or partnership start-up costs.

The directorate continues to participate vigorously in Foundation-wide activities. MPS increases its investment in SEES/Sustainable Chemistry, Engineering and Materials (SusChEM) within CHE and DMR to launch a critical materials activity. Through AST, MPS continues to partner with the Directorates for Engineering (ENG) and Computer and Information Science and Engineering (CISE) in Enhancing Access to the Radio Spectrum (EARS). MPS grows or maintains investments in other cross-Foundational priorities such as Research at the Interface of Biological, Mathematical and Physical Sciences, and Engineering (BioMaPS); Secure and Trustworthy Cyberspace (SaTC); Innovation Corps (I-Corps); and Cyber-Enabled Materials Manufacturing and Smart Systems (CEMMSS), which includes Designing Materials to Revolutionize and Engineer our Future (DMREF).

MPS provides about 48 percent of the federal funding for basic research at academic institutions in the Mathematical and Physical Sciences.



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2014 Summary by Division

- AST's FY 2014 Budget Request will support individual investigator awards, astronomical observatories, and increased investment in EARS and the major MPS priority of mid-scale instrumentation. Funding for individual research is balanced against funding for facilities, and among facilities, increased support over FY 2012 levels for ALMA and LSST is requested.

- CHE's FY 2014 Budget Request is for enhancing support for core programs, and features a focus on SusChEM as an important component in the NSF-wide SEES investment. SusChEM will fund research in sustainable chemistry, and increased funding for Centers for Chemical Innovation (CCI) will continue the SusChEM focus within this program. CHE will continue strong commitment to research in the area of clean energy technologies, advanced manufacturing, and DMREF.

- DMR's FY 2014 Budget Request includes plans to increase its portfolio of individual investigator awards, specifically in NSF focus areas where advanced materials are essential, such as SEES through SusChEM, including a new effort in critical elements, minerals, and materials; CEMMSS through DMREF; and BioMaPS. DMR will also continue a strong commitment to research in clean energy technologies. Centers and facilities receive enhanced funding as well.

- DMS's FY 2014 Budget Request focuses on enhancing support for frontier research, training a diverse group of researchers in mathematical and statistical sciences with computational skills, investing in mathematical sciences institutes and network structures, and providing support through efficient mechanisms to foster multidisciplinary research activities in, but not limited to, Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21); SEES; BioMaPS; CEMMSS; and SaTC.

- PHY's FY 2014 Request includes continued support for individual investigator awards, particularly in NSF-wide priority areas such as CIF21 and BioMaPS. PHY also requests sufficient funding for investigators using its major facilities, and for operations and maintenance of these facilities. In FY 2014, PHY will support mid-scale instrumentation and new approaches to accelerator science.

- OMA in FY 2014 will continue its tradition of providing assistance for multidisciplinary research and activities in education and broadening participation. OMA will emphasize research relevant to NSF priorities such as SEES, CIF21, BioMaPS, and CEMMSS. OMA will coordinate MPS activities related to I-Corps and INSPIRE. In addition, OMA will support responsible decisions regarding the MPS facilities portfolio, including studies of possible environmental issues, stewardship transition costs, or partnership start-up costs.

Major Investments

MPS Major Investments

(Dollars in Millions)

Area of Investment	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Advanced Manufacturing	$27.15	$32.15	$40.00	$7.85	24.4%
BioMaPS	14.29	7.69	16.60	8.91	115.9%
CAREER	70.11	54.02	58.57	4.55	8.4%
CEMMSS	34.82	32.15	66.00	33.85	105.3%
CIF21	27.60	11.50	22.30	10.80	93.9%
Clean Energy Technology	135.81	137.31	153.95	16.64	12.1%
EARS	3.00	3.00	12.00	9.00	300.0%
I-Corps	0.65	1.00	3.30	2.30	230.0%
INSPIRE	1.97	3.00	7.00	4.00	133.3%
SEES	17.03	16.50	35.26	18.76	113.7%
SaTC	0.50	0.50	2.00	1.50	300.0%

Major investments may have funding overlap and thus should not be summed.

- Advanced Manufacturing ($40.0 million, +$7.85 million over FY 2012 Enacted): Investments will be made in nanomanufacturing, industry/university partnerships, BioMaPS, DMREF, and Centers

programs. Advanced manufacturing is an area of continued growth, especially in light of the heightened emphasis on sustainability (via SusChEM).

- BioMaPS ($16.60 million, +$8.91 million over FY 2012 Enacted). The study of biological complexity necessitates new developments in mathematical and physical sciences, leading to new theoretical and experimental approaches. Interdisciplinary efforts in partnership with the Directorate for Biological Sciences (BIO) and ENG will result in accelerated understanding of biological systems, as well as uncovering of new mathematical and physical concepts, leading to innovations in such areas as renewable fuels, bio-based materials, bioimaging, and bio-inspired sensors.

- CAREER ($58.57 million, +$4.55 million over FY 2012 Enacted): MPS continues its strong commitment to early career faculty development. CAREER awards support young investigators who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. MPS expects to make about 130 CAREER awards in FY 2014. The purpose and scope of the CAREER program varies across the cultures of the five MPS divisions. In some disciplinary communities a CAREER award is a widely accepted mechanism for developing new faculty, while in others it is an honor reserved for a few exceptionally meritorious young scientists.

- CEMMSS ($66.0 million, +$33.85 million over FY 2012 Enacted): In partnership with ENG and CISE, MPS investments in CEMMSS will focus on DMREF, in support of the national Materials Genome Initiative. This is a major effort to design and synthesize materials with specific and desired functions or properties through synergistic integration of theory and computation, experiment, and data mining.

- CIF21 ($22.30 million, +$10.80 million over FY 2012 Enacted): All MPS divisions and OMA will contribute to computational and data-enabled science and engineering activities, including fundamental mathematical algorithms, software, data services, and network infrastructure needed to serve scientists wherever they are located. The CIF21 emphasis within the new NSF Research Traineeships (NRT) is part of this investment as well.

- Clean Energy Technology ($153.95 million, +$16.64 million over FY 2012 Enacted): Investment is focused in core program research in fuel cells, solar research and development, hydrocarbon conversion, and energy storage.

- EARS ($12.0 million, +$9.0 million over FY 2012 Enacted): Support will be for basic research that underpins this ongoing partnership with ENG and CISE. The MPS investment will concentrate on materials science, radio frequency interference mitigation, advanced receiver design, and mathematical foundations of radio spectrum access and hardware design, as well as key national and international regulatory and public policy foundations for radio spectrum management.

- I-Corps ($3.30 million, +$2.30 million over FY 2012 Enacted): MPS increases investment in the NSF-wide I-Corps program to stimulate innovative industrial partnerships.

- INSPIRE ($7.0 million, +$4.0 million over FY 2012 Enacted): All MPS divisions will contribute to this NSF-wide activity, which supports transformative, high risk, interdisciplinary research. OMA provides the largest share of MPS support, at $3.0 million in FY 2014.

- SEES ($35.26 million, +$18.76 million over FY 2012 Enacted): Funding will focus most strongly on the SusChEM activity and a secondary effort in critical elements, minerals, and materials. Existing

programs, including centers as well as core programs, will be re-focused to support sustainable chemistry, engineering, and materials.

- SaTC ($2.0 million, +$1.50 million over FY 2012 Enacted): In partnership with CISE, funding will support frontier research needed to keep the Nation's data confidential and transactions secure.

MPS Funding for Centers Programs and Facilities

MPS Funding for Centers Programs
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Centers Programs Total	**$87.36**	**$78.72**	**$93.62**	**$14.90**	**18.9%**
Centers for Analysis & Synthesis (DMS, OMA)	0.20	0.20	0.10	-0.10	-50.0%
Centers for Chemical Innovation (CHE)	26.03	24.00	33.25	9.25	38.5%
Materials Centers (DMR)	49.56	44.35	56.00	11.65	26.3%
Nanoscale Science & Engineering Centers (CHE, DMR, DMS, PHY)	7.57	6.17	0.95	-5.22	-84.6%
Science & Technology Centers (DMR)	4.00	4.00	3.32	-0.68	-17.0%

Totals may not add due to rounding.

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- Centers for Analysis and Synthesis ($100,000, -$100,000 below FY 2012 Enacted): Funding will extend support for a sixth year to the National Institute for Mathematical and Biological Synthesis, a Center for Analysis and Synthesis primarily managed by BIO.

- Centers for Chemical Innovation (CCI) ($33.25 million, +$9.25 million over FY 2012 Enacted): This program inspires research on strategic, transformative "grand challenges" in chemical research. CCI awards are strengthened by direct links to chemical industry and governmental laboratories, which encourage successful transitions from the lab to innovation to societal applications.

- Materials Centers ($56.0 million, +$11.65 million over FY 2012 Enacted): The request will support 18 Materials Research Science and Engineering Centers (MRSECs). Materials Centers advance materials research through collaborations of groups of principal investigators, and provide students with a rich, interdisciplinary education. The Centers address fundamental research problems of intellectual and strategic importance that will advance U. S. competitiveness. A competition in FY 2014 will reduce the number of centers from 23 to 18 but increase funding to each center, in keeping with the recommendation of the 2007 National Research Council report on MRSECs.

- Nanoscale Science & Engineering Centers (NSEC) ($950,000, -$5.22 million below FY 2012 Enacted): As planned, support for the Center for Probing the Nanoscale will end in FY 2013.

- Science and Engineering Centers ($3.32 million, -$680,000 below FY 2012 Enacted): Funding for the Center for Layered Polymeric Systems ramps down as planned in FY 2014 in preparation for the sunset of this Science and Technology Center (STC) in FY 2015.

MPS Funding for Facilities
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Facilities Total	**$266.11**	**$264.99**	**$285.38**	**$20.39**	**7.7%**
Advanced Technology Solar Telescope (ATST)	2.00	2.00	2.00	-	-
Arecibo Observatory	5.63	5.50	4.50	-1.00	-18.2%
Atacama Large Millimeter Array (ALMA)	28.61	28.61	36.41	7.80	27.3%
Cornell High Energy Synchrotron Source (CHESS)	19.67	19.67	20.00	0.33	1.7%
Gemini Observatory	21.57	22.07	19.59	-2.48	-11.2%
IceCube Neutrino Observatory (IceCube)	3.45	3.45	3.45	-	-
Large Hadron Collider (LHC)	18.00	18.00	18.00	-	-
Large Synoptic Survey Telescope (LSST)	4.50	4.50	6.50	2.00	44.4%
Laser-Interferometer Gravity-wave Observatory (LIGO)	30.40	30.40	39.50	9.10	29.9%
National High-Magnetic Field Laboratory (NHMFL)	26.80	25.80	32.64	6.84	26.5%
National Nanotechnology Infrastructure Network (NNIN)	2.98	2.98	2.88	-0.10	-3.4%
National Optical Astronomy Observatory (NOAO)	26.25	25.50	25.50	-	-
National Radio Astronomy Observatory (NRAO)	43.14	43.14	41.00	-2.14	-5.0%
National Solar Observatory (NSO)	9.10	9.10	8.00	-1.10	-12.1%
National Superconducting Cyclotron Laboratory (NSCL) (MSU Cyclotron)	21.50	21.50	22.50	1.00	4.7%
Other MPS Facilities[1]	2.52	2.77	2.91	0.14	5.1%

Totals may not add due to rounding.

[1] Other MPS Facilities is the Center for High Resolution Neutron Scattering (CHRNS) for all years and the Giant Segmented Mirror Telescope (GSMT) for FY 2012 Enacted/Annualized FY 2013 CR and FY 2014 Request.

For detailed information on individual facilities, please see the Facilities chapter.

MPS has increased operations and maintenance budgets for several facilities in order to enhance operations. A few facilities will see lowered budgets as explained below and in the Facilities chapter.

- Arecibo ($4.50 million, -$1.0 million below FY 2012 Enacted): AST funding plus added support from the Directorate for Geosciences of $3.50 million (+$300,000 over FY 2012 Enacted) will provide total NSF support of $8.0 million (-$700,000 below FY 2012 Enacted). NASA is also expected to provide support at about $2.0 million.

- ALMA ($36.41 million, +$7.80 million over FY 2012 Enacted): Funding is consistent with a planned ramp-up of operations as this facility comes on line and continues early science activities.

- CHESS ($20.0 million, +$330,000 over FY 2012 Enacted): The actual award amount will depend on the outcome of the review of a renewal proposal. The CHESS user program supports work in cancer research, new materials for electronics, aircraft, biotechnology, batteries, fuel cells, solar cells, and other energy applications.

- Gemini ($19.59 million, -$2.48 million below FY 2012 Enacted): Funding is primarily for observatory operations and maintenance, reflecting the international partner agreement, with a decreased contribution to the long-term instrumentation fund.

- LHC ($18.0 million, flat with FY 2012 Enacted): Funding will support operations of the ATLAS and CMS detectors.

- LIGO ($39.50 million, +$9.10 million over FY 2012 Enacted): Support is increased as the Advanced LIGO construction project is completed and commissioning of the upgraded interferometer begins. See the MREFC chapter for more details on Advanced LIGO.

- NHMFL ($32.64 million, +$6.84 million over FY 2012 Enacted): Funds will allow the continuation of transformational research using high magnetic fields. This facility serves researchers in fields ranging from biology to materials and condensed matter physics. The requested budget reflects a new cooperative agreement that started in FY 2013.

- NRAO ($41.0 million, -$2.14 million below FY 2012 Enacted): Reduced support reflects the planned budget realignment to support ALMA operations as it transitions from construction to full operations.

- NSO ($8.0 million, -$1.10 million below FY 2012 Enacted): Funding assumes that closure of one or more current facilities is concluded in FY 2014, as planned for a long-term transition to the Advanced Technology Solar Telescope (ATST).

- NSCL ($22.50 million, +$1.0 million over FY 2012 Enacted): Increased support will promote enhanced operations.

Summary and Funding Profile

MPS supports investment in core research and education as well as research infrastructure such as centers and facilities.

In FY 2014, MPS will dedicate $93.62 million for Centers, accounting for 6.8 percent of the MPS Request. This total is up from FY 2012 Enacted by $14.90 million, as MPS increases investments in the Centers for Chemical Innovation and Materials Centers. Centers are an important modality for MPS sciences as research in many MPS-supported disciplines has evolved to be more collaborative and interdisciplinary.

Operations and maintenance funding for MPS-supported user facilities constitutes 20.6 percent of MPS's FY 2014 Request. MPS has increased operations budgets for facilities to maintain current operational capacity, with several facilities seeing large increases for enhanced operations. Where increases were not possible, MPS has maintained operations budgets as close to constant as possible.

MPS Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	9,007	9,200	9,750
Number of New Awards	2,524	2,355	2,700
Funding Rate	28%	26%	28%
Statistics for Research Grants:			
Number of Research Grant Proposals	7,892	7,650	8,200
Number of Research Grants	2,006	1,813	2,100
Funding Rate	25%	24%	26%
Median Annualized Award Size	$116,985	$110,000	$117,000
Average Annualized Award Size	$143,321	$139,000	$145,000
Average Award Duration, in years	3.1	3.1	3.1

[1] Award Estimates shown for FY 2013, such as numbers of awards and size/duration, are based on the FY 2012 Enacted level.

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- A Subcommittee of the MPS Advisory Committee (MPS A/C) conducted an Astronomical Sciences Portfolio Review, "Advancing Astronomy in the Coming Decade: Opportunities and Challenges," which was completed in August of 2012.
- A Subcommittee of the MPS A/C conducted a review of the DMR portfolio balance of facilities and instrumentation, which was completed in August of 2012.
- The Astronomy and Astrophysics Advisory Committee (AAAC) completed their annual report on interagency activities by DOE, NASA, and NSF in March 2012. The next annual report is expected in summer of 2013.
- The National Academy of Sciences, National Research Council, conducted a study on underground science, completed in February of 2012. NAS is conducting additional studies on Nuclear Physics (expected 2013) and Undergraduate Physics Education (expected late 2013 or early 2014). NAS has conducted several surveys of MPS fields as well, but these are not program evaluations.

Science and Technology Policy Institute (STPI) Reports:

- STPI is working with DMS on a pilot study of the Mathematical Institutes.

Workshops and Reports:

- CHE sponsored a workshop entitled "Strengthening Forensics Science through Connections with the Analytical Sciences" in December 2012. Attendees included a range of scientists from the measurement, informatics, and forensics communities in universities and government agencies (Office of Science and Technology Policy (OSTP), National Institute for Standards and Technology (NIST), Department of Justice (DOJ), Department of Homeland Security (DHS), National Institute of Justice (NIJ), Naval Research Laboratory (NRL), Food and Drug Administration (FDA)) as well as one individual from industry. Representatives from parallel organizations in the Netherlands also

attended the workshop. NSF sponsored this workshop in response to the recent NAS report "Strengthening Forensic Science in the US." A workshop report is expected in April 2013 and additional workshops are planned for the future.

- CHE and the NASA Astrobiology Program co-sponsored an international workshop on "Alternative Chemistries of Life" in Washington, DC. The workshop was led by two chemists and a prominent marine microbiologist. The highly interdisciplinary nature of the workshop produced suggestions for future areas/lines of research, and a report is due in the next few months.
- CHE and ENG partners, along with American Chemical Society (ACS) and the American Institute of Chemical Engineers (AIChE), co-sponsored a 1-day "Presidential Event" ACS symposium, titled "Ensuring the Sustainability of Critical Materials and Alternatives: Addressing the Fundamental Challenges in Separation Science and Engineering (SSE)" at the fall ACS annual meeting in 2012. Issues discussed related to stresses in the global market and the key and enabling role of SSE in ensuring a sustainable supply and use of critical materials, and brought into focus crosscutting research needs and Scientific Grand Challenges in SSE associated with the sustainable extraction, recovery, recycling, and purification of critical materials. A website for permanent dissemination of symposium materials has been created, and a comprehensive report will be provided by late spring of 2013.
- DMR sponsored a workshop in December 2012 entitled "Workshop on Ethnic Diversity in Materials Science and Engineering." The goal was to bring department chairs and key stakeholders together for the purpose of discussing and recommending practices that can broaden participation in the field, particularly among ethnic and racial minority groups. A report will be disseminated to the community.
- DMR sponsored a workshop in December 2012 entitled the "Materials Genome Initiative Workshop." The goal was to elicit input from the community about the scientific opportunities and next steps needed for integrating calculations, experiments, and data-enabled science for the purpose of discovering and developing advanced materials.
- The DMR-sponsored Biomaterials Workshop examined the scientific opportunities and role of agencies in supporting the rapidly growing biomaterials field, both in research and education. The three leaders rolled out recommendations at a webcast at NSF in December 2012, and a report will be widely disseminated by mid-June 2013.
- DMS funded a forward-looking study on trends in the mathematical sciences. The report, released in January 2013, is entitled "The Mathematical Sciences in 2025." The study was conducted by the Board on Mathematical Sciences and their Applications of the National Academy. There are two components to this study. The brochure "Fueling Innovation and Discovery: The Mathematical Sciences in the 21st Century" is available at www.nap.edu/catalog.php?record_id=13373. The full report is available at www.nap.edu/catalog.php?record_id=15269.
- PHY funded a two-day conference to focus national attention on current issues facing graduate education in physics. The American Physical Society (APS) and the American Association of Physics Teachers (AAPT) jointly organized the conference. The conference took place at the American Center for Physics in College Park, MD in fall 2012 and brought together about 100 participants who provided informed recommendations for change and, as Directors of Graduate Studies on their respective campuses, were able to implement those changes. The topics included curriculum; exam/exam structure; climate and diversity; admissions; advising and mentoring; non-academic careers; developing "soft" skills including oral and written communication; team building and leadership; multi-disciplinary coursework and degrees; outcome assessment of graduate programs; and shaping a holistic and effective graduate education experience. The conference provided a forum to learn about the progress made in various graduate programs since the first conference and find ways to identify, adapt, and implement best practices within local constraints.
- PHY also funded five simultaneous conferences on women in physics, aimed at attracting and retaining undergraduate women in physics. Each conference was attended by 50 to 100

undergraduate women. The conferences were coordinated and had a common keynote speaker (available by video-conferencing) as well as some common events on mentoring, application to graduate school, etc. The five universities involved were chosen to allow coverage of a wide geographical area so that as many undergraduate women as possible would be able to attend one of the conferences.

Committees of Visitors (COV):

- In 2012, a COV reviewed PHY. The division is responding to and implementing recommendations from this review, as presented to the MPS A/C.
- In 2013, COVs will review CHE and DMS. The results of those COVs will be reported out in April 2013 to the MPS A/C.
- In 2014, COVs will review DMR and AST.

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

Number of People Involved in MPS Activities

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	11,281	9,100	11,400
Other Professionals	3,173	2,800	3,300
Postdoctorates	2,246	2,400	2,300
Graduate Students	8,887	9,100	9,000
Undergraduate Students	6,949	6,800	7,200
Total Number of People	**32,536**	**30,200**	**33,200**

Totals may not add due to rounding.

DIVISION OF ASTRONOMICAL SCIENCES (AST) $243,640,000 +$9,090,000 / 3.9%

AST Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, AST	**$234.72**	**$234.55**	**$243.64**	**$9.09**	**3.9%**
Research	**66.30**	**73.23**	**74.71**	**1.48**	**2.0%**
CAREER	4.30	4.30	4.75	0.45	10.5%
Education	**6.65**	**6.65**	**5.83**	**-0.82**	**-12.3%**
Infrastructure	**161.77**	**154.67**	**163.10**	**8.43**	**5.5%**
Adv. Technology Solar Tel. (ATST)	2.00	2.00	2.00	-	-
Arecibo Observatory	5.63	5.50	4.50	-1.00	-18.2%
Atacama Large Millimeter Array (ALMA)	28.61	28.61	36.41	7.80	27.3%
Gemini Observatory	21.57	22.07	19.59	-2.48	-11.2%
Nat'l Optical Astron. Obs. (NOAO)	26.25	25.50	25.50	-	-
Nat'l Radio Astron. Obs. (NRAO)	43.14	43.14	41.00	-2.14	-5.0%
Nat'l Solar Observatory (NSO)	9.10	9.10	8.00	-1.10	-12.1%
Research Resources	20.98	14.00	19.35	5.35	38.2%
Pre-Construction Planning (total)	4.50	4.75	6.75	2.00	42.1%
Large Synoptic Survey Telescope (LSST)	4.50	4.50	6.50	2.00	44.4%
Giant Segmented Mirror Telescope (GSMT)[1]	-	0.25	0.25	-	-

Totals may not add due to rounding.

[1] Pursuant to solicitation NSF 12-526, published in December 2011, AST has selected the Thirty Meter Telescope (TMS) for the further development and improvement of the partnership model for a GSMT project. It is expected that NSF construction funding would not be available before FY 2020.

AST is the federal steward for ground-based astronomy in the United States. Through awards to individual investigators, small groups, and national facilities, AST funding covers research to understand the origins and characteristics of planets, stars, and galaxies, as well as the structure and origin of the Universe. AST also supports the development of advanced technologies and instrumentation, the planning and design of future astronomical research facilities, and management of the electromagnetic spectrum for scientific use. Working in partnership with private institutions to enhance the Nation's overall astronomical observing capacity and capabilities, AST funds the operations and maintenance of several world-class national and international facilities. These facilities provide access to a wide range of observational resources on a competitive basis and serve thousands of users each year.

In 2010, the National Academy of Sciences released a decadal survey report recommending a comprehensive ground-based astronomy program for the coming decade. In anticipation of funding that is more constrained than assumed in that report, AST carried out a community-based review of its entire portfolio in order to maximize the delivery of the recommended science. The AST Portfolio Review was completed in FY 2012. In light of the more constrained budget outlook, the review recommended re-balancing the AST portfolio by FY 2017. In order to maintain the balance of large facilities, mid-scale projects, and individual investigator grants that is needed to make progress on key decadal survey science goals, the recommendations included divestment of some components of major research facilities, as described in the Facilities chapter. AST is presently engaged in exploring partnership and scope options for the various facilities given lower priority in the Portfolio Review, and no decisions on divestment

have been made. Funding to support NSF-wide efforts on its facilities portfolio are provided through OMA.

Approximately 59 percent of AST's budget is used to support current operations and future development of large multi-user astronomy facilities, while 32 percent supports individual investigator grants and 8 percent supports the development and operation of advanced instrumentation and experiments based on such instrumentation. In general, about 16 percent of the AST budget is available for new research grants, while the remainder funds long-term facilities and continuing awards for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Changes in NSF-wide investments are accommodated through strategic investments through AST core programs, accompanied by small reductions to programs not receiving proposals in these areas. These NSF-wide investments include:
  - CIF21 (+$1.98 million to a total of $3.68 million): This includes $1.50 million to implement the Theoretical and Computational Astrophysics Networks recommendation of the decadal survey, in collaboration with NASA.
  - EARS (+$9.0 million to a total of $12.0 million): This investment will concentrate on the radio-frequency-interference mitigation, advanced receiver design, propagation studies, and other foundations of radio spectrum access and hardware design, as well as key regulatory and public policy foundations for radio spectrum management.
- Other grants programs, including the Astronomy and Astrophysics Research Grants (AAG), remain approximately constant in the FY 2014 Request. AAG supports foundational research in all areas of astronomy, such as extra-solar planets, near-Earth objects, and cosmology. The stable level of AAG is enabled by reductions to select areas within AST facility infrastructure (see below) and is made to support the AST commitment to maintaining individual research that is critical to advancement of the field.

Education

- Research Experiences for Undergraduates Site and Supplements program (+$230,000 to a total of $2.63 million): This additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*
- AST eliminates funding for ADVANCE (-$850,000 to a total of zero) in order to continue support for other activities, including REU (above), Astronomy and Astrophysics Postdoctoral Fellowship (-$200,000 to a total of $2.20 million), and Partnerships in Astronomy and Astrophysics Research and Education (constant at $1.0 million).

Infrastructure

AST oversees an array of infrastructure projects and programs. Reductions in facility support reflect the maintenance of funding balance between facilities and individual research. Future trends for these facilities will consider the recommendations of the AST Portfolio Review. For detailed information on individual AST facilities, please see the Facilities chapter.

- ATST operations: Funding is constant at $2.0 million, to mitigate the cultural impacts of construction in Hawaii as agreed to in the permitting process.

- Arecibo: AST funding decreases (-$1.0 million to a total of $4.50 million); additional funding is provided by GEO ($3.50 million) and NASA ($2.0 million).
- ALMA: Support (+$7.80 million to a total of $36.41 million) is consistent with a planned ramp-up of operations as this observatory comes online and continues early science activities.
- Gemini: Support (-$2.48 million to $19.59 million) is primarily for observatory operations and maintenance, reflecting the international partner agreement, with a decreased contribution to the long-term instrumentation fund.
- NRAO: Funding is reduced (-$2.14 million to a total of $41.0 million) as part of the budget realignment plan to support ALMA operations.
- NSO: Funding (-$1.1 million to $8.0 million) assumes that closure of one or more current facilities is concluded in FY 2014, as planned for a long-term transition to the Advanced Technology Solar Telescope (ATST), currently under construction (see the MREFC chapter for more details).
- Research resources: Funding growth (+$5.35 million to a total of $19.35 million) reflects the initiation of a competed Mid-Scale Innovations Program (MSIP) at $7.0 million, together with a decrease (-$2.0 million to $8.50 million) for the Advanced Technologies and Instrumentation program. A vigorous MSIP was recommended by the 2010 decadal survey, which cited "many highly promising projects for achieving diverse and timely science." MSIP will support a variety of astronomical activities within the $4.0 to $40.0 million range and will emphasize both strong scientific merit and a well-developed plan for student training in instrumentation, facility development, community telescope access, and/or provision of data to the community.
- LSST: Design and development (D&D) funding increases (+$2.0 million to $6.50 million) following the successful NSF Preliminary Design Review and coordinated DOE camera review, for this top-ranked ground-based large-scale project in the decadal survey. Support covers enhanced systems management, continued work on data management issues, and improved project management and quality assurance, which were recommended by the reviews, and other D&D that will reduce risk before a construction start. Funds to support an FY 2014 construction start for LSST are separately requested in the MREFC chapter.
- GSMT: Funding maintained at $250,000 to support the Thirty Meter Telescope (TMT) project to define and develop a model by which the federal government could potentially become a partner in this GSMT candidate after 2020.

DIVISION OF CHEMISTRY (CHE) $253,650,000
+$19,590,000 / 8.4%

CHE Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, CHE	**$234.03**	**$234.06**	**$253.65**	**$19.59**	**8.4%**
Research	**218.94**	**224.07**	**235.95**	**11.88**	**5.3%**
CAREER	24.33	21.38	23.00	1.62	7.6%
Centers Funding (total)	27.58	24.15	33.40	9.25	38.3%
Centers for Chemical Innovation	26.03	24.00	33.25	9.25	38.5%
Nanoscale Science & Engineering Centers	1.55	0.15	0.15	-	-
Education	**10.30**	**6.95**	**6.65**	**-0.30**	**-4.3%**
Infrastructure	**4.79**	**3.04**	**11.05**	**8.01**	**263.5%**
NHMFL	1.50	1.50	1.75	0.25	16.7%
NNIN	0.40	0.40	0.30	-0.10	-25.0%
Research Resources	2.89	1.14	9.00	7.86	689.5%

Totals may not add due to rounding.

CHE supports a large and vibrant research community engaged in fundamental research linked to key national priorities. Basic research supported by CHE will enable research in sustainability in general, and sustainable chemistry in particular, providing new molecules that are essential to our economy and well-being. CHE strongly supports research at the interface of biology and chemistry. CHE's programs invite research in catalysis for energy capture and storage as well as to enable the formation of new chemical bonds, appreciation of and insight into the chemistry of life processes, new nanochemistry advances that will revolutionize electronics and photonics, and better awareness of how nanosized aerosols and particles impact our environment. In addition, CHE supports curiosity-driven research that leads to increased understanding of molecules and their chemical transformations and the development of new instrumentation to study and detect molecules.

Approximately 87 percent of CHE's budget is used to support individuals and small groups of researchers, while about 13 percent of the budget goes to centers and facilities. There are currently eight Phase I and six Phase II Centers supported in the Centers for Chemical Innovation (CCI) program. In general, 60 percent of CHE's portfolio is available for new research grants. The remaining 40 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER (+$1.62 million to a total of $23.0 million): At this level, funding rates for CAREER proposals are increased (>20 percent) consistent with CHE objectives for CAREER support.
- Chemistry Centers (+$9.25 million to a total of $33.25 million): Center co-funding by NASA has ended, so resources from CHE are increasing in FY 2014. (See the Centers narrative in the NSF-Wide Investments chapter for more details).
- Cognitive Science and Neuroscience ($400,000): Funding supports cross-Foundation fundamental research relevant to cognitive science and neuroscience.

- Changes in NSF-wide investments are accommodated through strategic investments through CHE core programs, accompanied by small reductions to programs not receiving proposals in these areas. These NSF-wide investments include:
  - BioMaPS (+$2.23 million to a total of $4.15 million): Support will strengthen research in advanced spectroscopic and imaging techniques for biomolecules and biosystems, metal speciation, coordination and function, chemical studies of enzyme and ribozyme catalysis, and other studies at the chemistry-biology frontier.
  - CEMMSS (+$15.80 million to a total of $29.0 million): CEMMSS is comprised of two components in MPS:
    - Advanced Manufacturing (+$6.80 million to a total of $20.0 million): This is closely entwined with the chemical enterprise for new and more efficient chemical production.
    - DMREF (+$9.0 million to a total of $9.0 million): This contributes to the Administration's Materials Genome Initiative (MGI).
  - CIF21 (+$1.73 million to a total of $3.48 million): Investment in CIF21 is targeted at Scientific Software Elements (SSE) and Scientific Software Integration (SSI).
  - Clean Energy (+$20.20 million to a total of $81.70 million). The CHE portfolio includes chemical research in Clean Energy Technology such as solar energy conversion, biomass conversion, energy storage, and photocatalysis.
  - SEES (+$11.83 million to a total of $19.33 million): Funding for programs supporting SEES, including activities in Sustainable Chemistry, Engineering, and Materials (SusChEM), will be achieved by refocusing existing programs, such as Centers for Chemical Innovation (CCI), International Collaboration in Chemistry (ICC), and individual investigator awards. Under the SEES umbrella, CHE is also investing in a postdoctoral fellows program and Sustainable Energy Pathways (SEP). CHE will also use a small amount of core funding plus some SEES funding to initiate community-building activities such as workshops, research coordination networks, and exploration of alternative programs to advance fundamental research in food and water security.

Education

- Research Experiences for Undergraduates Site and Supplements program (+$1.28 million to a total of $5.78 million): $640,000 of this additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.* The remaining $640,000 million will support REU Site proposals with a specific focus on broadening participation.
- Integrative Graduate Education and Research Traineeship program (IGERT) (-$1.58 million to zero): All final funding increments in this program are consolidated into OMA. IGERT will sunset in FY 2014 with the initiation of the NSF Research Traineeships (NRT) program.

Infrastructure

- NHFML (+$250,000 to a total of $1.75 million): Funding supports the Fourier Transform Ion Cyclotron Resonance (FTICR) Laboratory at NHMFL. This request will allow the facility to continue operations, focus on magnet development, and strengthen education, training, user support, and in-house research, consistent with prior levels for this activity.
- NNIN (-$100,000 to a total of $300,000): Support decreases because the research needs of the chemistry community are better served by the chemistry infrastructure programs. CHE supports a growing fraction of the nanoscience community research through the macromolecular, supramolecular, and nanochemistry (MSN) program.
- Research Resources (+$7.86 million up to a total of $9.0 million): Added funding is for the Chemistry Research Instrumentation and Facilities (CRIF) program, suspended in FY 2012.

DIVISION OF MATERIALS RESEARCH (DMR) $314,630,000
+$20,080,000 / 6.8%

DMR Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, DMR	**$294.40**	**$294.55**	**$314.63**	**$20.08**	**6.8%**
Research	**229.27**	**231.84**	**243.92**	**12.08**	**5.2%**
CAREER	23.79	18.00	19.35	1.35	7.5%
Centers Funding (total)	58.22	53.23	60.12	6.89	12.9%
Materials Centers	49.56	44.35	56.00	11.65	26.3%
Nanoscale Science & Engineering Centers	4.66	4.88	0.80	-4.08	-83.6%
STC: Center for Layered Polymeric Systems	4.00	4.00	3.32	-0.68	-17.0%
Education	**9.20**	**9.06**	**7.96**	**-1.10**	**-12.1%**
Infrastructure	**55.93**	**53.65**	**62.75**	**9.10**	**17.0%**
CHESS	19.67	19.67	20.00	0.33	1.7%
NHMFL	25.30	24.30	30.89	6.59	27.1%
NNIN	2.58	2.58	2.58	-	-
Other MPS Facilities[1]	2.52	2.52	2.66	0.14	5.6%
Research Resources	5.87	4.58	6.62	2.04	44.5%

Totals may not add due to rounding.

[1] Other MPS Facilities is the Center for High Resolution Neutron Scattering (CHRNS) for all years.

DMR focuses on research aimed at advancing materials discovery and characterization, including condensed matter physics, solid-state chemistry, and the science of materials that are multifunctional, hybrid, electronic, photonic, metallic, superconducting, ceramic, polymeric, biological and nanostructured. DMR awards enable the community to advance understanding of electronic, atomic, and molecular mechanisms and processes that govern macroscale properties so that we can learn how to manipulate and control them, to discover new synthesis and processing strategies that lead to new materials with unique and novel properties, and to discover and to understand emerging phenomena. The discoveries and advancements transcend traditional scientific and engineering disciplines, and can result in elimination of roadblocks to enabling new technology including those with the goal of sustainability. A key and critical enabler to these scientific advances is the investment in development and support of the materials workforce, in cyberinfrastructure and in next generation instruments and facilities.

In general, 29 percent of the DMR portfolio is available for new research grants and 71 percent funds continuing grants.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER (+$1.35 million for a total of $19.35 million): These awards are a high priority and are used to develop a pipeline of new faculty in materials research that will form the community of the future.
- Centers:
  - Materials Centers (+$11.65 million to a total of $56.0 million): Funding will support 18 Materials Research Science and Engineering Centers (MRSECs). A competition in FY 2014 will reduce the number of centers from 23 to 18 but increase funds to each center, in keeping with the recommendation of the 2007 NRC report on MRSECs. (For more information, see the Centers narrative in the NSF-Wide Investments section).
  - Nanoscale Science and Engineering Centers (-$4.08 million for a total of $800,000) are sunsetting as planned, but DMR will continue to fund those projects that advance environmental health and safety and societal impacts of nanotechnology.
  - Science and Technology Centers (-$680,000 for a total of $3.32 million): This decrease reflects the planned sunsetting of the Center for Layered Polymeric Systems.
- Cognitive Science and Neuroscience ($400,000): Funding supports cross-Foundation fundamental research relevant to cognitive science and neuroscience.
- Changes in NSF-wide investments are accommodated through strategic investments through DMR core programs, accompanied by small reductions to programs not receiving proposals in these areas. These NSF-wide investments include:
  - BioMaPS (+$2.23 million for a total of $4.15 million): DMR supports a large and growing amount of research at the intersection of the life and physical sciences, not only in its Biomaterials program, but throughout its portfolio, including the centers and facilities.
  - Clean Energy (-$4.55 million to a total of $66.83 million): Funding in the DMR portfolio supports research in clean energy, including hydrogen, fuel cells, biomass, solar energy, hydrocarbon conversion, and energy storage.
  - CEMMSS (+$22.80 million to a total of $35.0 million): CEMMSS is comprised of two components in MPS:
    - Advanced Manufacturing (+$7.80 million for a total of $20.0 million): This addresses nanomanufacturing.
    - DMREF (+$15.0 million for a total of $15.0 million): DMR leads the DMREF activity, which is based on the national Materials Genome Initiative (MGI). The DMREF competition is run in partnership with CHE and DMS, as well as with the Directorates for Engineering and Computer and Information Science and Engineering. DMREF is a major effort to accelerate the discovery and deployment of new materials with a specific and desired function or property through integration of theory and computation, experiments and systematic use of materials data.
  - CIF21 (+$1.73 million for a total of $3.48 million): Funding will accelerate research, especially related to DMREF/CEMMSS, by investing in new functional capabilities in computational methods, algorithms, tools and data core methods, and technologies.
  - SEES (+$6.43 million for a total of $11.93 million). DMR is a major contributor to SEES. In the Sustainable Chemistry, Engineering and Materials (SusChEM) program, DMR focuses work to enable the capture and use of CO_2, discover new materials that can withstand extreme conditions, use new (non-petroleum based) raw materials as feedstocks for society's materials, and synthesize and process materials to optimize the use of raw materials, water, chemicals, and energy in an environmentally benign way. In FY 2014, DMR will lead the initiation of a new component of the SusChEM program to address critical elements, minerals, and materials.

Education

- Research Experiences for Undergraduates Sites and Supplements program (REU) (+$800,000 to a

total of $6.27 million.): $400,000 of this additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.* The remaining $400,000 will support efforts to broaden participation to groups including veterans and others that are under-represented in science, technology, engineering, and mathematics.

- IGERT (-$1.90 million to zero): All final funding increments in this program are consolidated into OMA. IGERT will sunset in FY 2014 with the initiation of the NSF Research Traineeships (NRT) program.

Infrastructure

- NHMFL (+$6.59 million to a total of $30.89 million): Funds will continue to support transformational research using high magnetic fields. This facility serves researchers in disciplines ranging from biology to materials and condensed matter physics. The requested level reflects a new cooperative agreement for operations that started in FY 2013.
- CHESS (+$330,000 to an estimated total of $20.0 million): The CHESS user program supports work in cancer research, new materials for electronics, aircraft, biotechnology, batteries, fuel cells, solar cells and other energy applications. The current cooperative agreement with CHESS ends in FY 2014 and a renewal is currently being reviewed.
- Research Resources (+$2.04 million to a total of $6.62 million): This includes support to pilot activities associated with the Material Innovation Platforms (MIPs) (+$3.0 million to a total of $3.0 million). In addition, decreased funding for Coherent Light Source development (CLS) reflects the planned end, in April 2014, of the current cooperative agreement (-$960,000 to a total of $3.62 million).

DIVISION OF MATHEMATICAL SCIENCES (DMS) $244,540,000
+$6,770,000 / 2.8%

DMS Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, DMS	**$237.72**	**$237.77**	**$244.54**	**$6.77**	**2.8%**
Research	**212.04**	**219.11**	**227.05**	**7.94**	**3.6%**
CAREER	9.61	3.33	4.13	0.80	24.0%
Centers Funding (total)	0.10	0.10	0.10	-	-
Centers for Analysis & Synthesis	0.10	0.10	0.10	-	-
Education	**25.68**	**18.66**	**17.49**	**-1.17**	**-6.3%**

Totals may not add due to rounding.

NSF plays a critical role in the mathematical and statistical sciences, as it provides more than sixty percent of all federal support for basic research for these fields in the Nation's colleges and universities. In certain core areas of the mathematical sciences this percentage is much higher, since NSF funds a broader range of fundamental and multidisciplinary research topics than do other federal agencies.

DMS supports research at the frontiers of fundamental, applied, and computational mathematics and statistics, and also enables discovery and innovation in other fields of science, engineering, and education. In turn, advances in science, engineering, and education, especially those that generate big and complex data sets, or that are driven by powerful computing environments, require development of ever more sophisticated mathematical and statistical methodology, theory, and tools. DMS plays a key role in these developments, in training future researchers in the mathematical and statistical sciences, and in training the Nation's scientific and engineering workforce.

DMS supports core research programs in algebra and number theory; analysis; applied mathematics; computational mathematics; geometrical analysis and topology; mathematical biology; probability, combinatorics, and foundations; and various areas within statistics. In addition, DMS funds national mathematical and statistical sciences research institutes; training and mentoring of a diverse group of postdoctoral, graduate, and undergraduate students; and infrastructure, such as workshops, conferences, and equipment.

Approximately 53 percent of the DMS portfolio is available for new research grants. The remaining 47 percent is used primarily to fund continuing grants made in previous years. DMS receives approximately 2,500 research proposals annually, of which less than a third receive awards.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER (+$800,000 to a total of $4.13 million): This increase reflects a continued emphasis on fostering career development of junior mathematical scientists.
- Mathematical and Statistical Sciences Institutes (level at $29.50 million): Eight domestic DMS-supported institutes will continue to catalyze frontier research through an array of varied scientific

programs.

- Cognitive Science and Neuroscience ($400,000): Funding supports cross-Foundation fundamental research relevant to cognitive science and neuroscience.
- Changes in NSF-wide investments are accommodated through strategic investments through DMS core programs. These NSF-wide investments include:
  - BioMaPS (+$2.23 million to a total of $4.15 million): Funding supports innovative research at the intersection of the mathematical and physical sciences and the biological sciences in a comprehensive new approach to acquire insight into and inspiration from the living world.
  - CIF21 (+$4.36 million to a total of $7.66 million): DMS research will focus on mathematical, statistical, and computational sciences, supporting theoretical and methodological developments in mathematics and statistics, the development of new models and algorithms, and visualization methods and computational tools that help solve complex scientific problems involving large and complex data sets and that enable scientific discovery and innovation. This investment expands upon some existing programs supporting research in the analysis of large data sets, development of novel algorithms, and new computational methods in mathematics and statistics. It will also support training and working activities and help develop new theoretical foundations in mathematics and statistics related to CIF21.
  - Clean Energy (+$440,000 to a total of $4.92 million): Increased funding will support efforts in solar energy conversion, energy storage, and smart grid technology.
  - SaTC (+$2.0 million to a total of $2.0 million): Addressing the challenges of cybersecurity requires multi-disciplinary expertise in human, statistical, mathematical, computational, and computer sciences. DMS invests in fundamental research in cryptographic methods, new algorithms, risk assessments, and mathematical and statistical methods for cybersecurity.
  - SEES (+$1.0 million to a total of $3.50 million): This investment addresses challenges in climate, hazards, sustainability, and energy research and education through data analysis, modeling, and simulation. DMS investment in SEES will also support effective training and networking opportunities for collaborations among mathematical and statistical scientists and with domain scientists.

Education

- Education for Mathematics and Statistics through Quantitative Explorations of Data (EXTREEMS-QED (+$2.0 million to a total of $2.0 million): This investment supports enhanced training in computational and data-enabled science for the next generation of mathematical and statistical scientists.
- Research Experiences for Undergraduates Sites and Supplements program (REU) (+$430,000 to a total of $3.39 million.): All of this increased funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*
- Other education and diversity activities (-$1.17 million to a total of $17.49 million): DMS invests in a number of education and diversity activities, including the Mathematical Sciences Postdoctoral Research Fellowships (MSPRF), Research Training Groups (RTG), and Mentoring through Critical Transition Points (MCTP) programs. Decreased funding here is offset by greater use of core research program awards to support graduate students and postdoctoral researchers.

DIVISION OF PHYSICS (PHY)

$289,020,000
+$11,650,000 / 4.2%

PHY Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, PHY	**$277.44**	**$277.37**	**$289.02**	**$11.65**	**4.2%**
Research	**192.73**	**193.68**	**177.48**	**-16.20**	**-8.4%**
CAREER	8.03	7.01	7.34	0.33	4.7%
Centers Funding (total)	1.16	1.14	-	-1.14	-100.0%
Nanoscale Science & Engineering Centers	1.16	1.14	-	-1.14	-100.0%
Education	**5.61**	**5.34**	**6.09**	**0.75**	**14.0%**
Infrastructure	**79.10**	**78.35**	**105.45**	**27.10**	**34.6%**
IceCube	3.45	3.45	3.45	-	-
Large Hadron Collider (LHC)	18.00	18.00	18.00	-	-
Laser Interferometer Grav. Wave Obs. (LIGO)	30.40	30.40	39.50	9.10	29.9%
Nat'l Superconoducting Cyclotron Lab. (NSCL)	21.50	21.50	22.50	1.00	4.7%
Research Resources	5.75	5.00	22.00	17.00	340.0%

Totals may not add due to rounding.

PHY supports fundamental research addressing frontier areas of physics that lead to the understanding of the make-up of the Universe, from the formation of stars and galaxies to the principles of life processes on Earth. This research covers a range of physics subfields: atomic, molecular, optical and plasma physics, elementary particle physics, gravitational physics, nuclear physics, particle and nuclear astrophysics, physics of living systems, physics at the information frontier, and theoretical physics. PHY is the primary supporter of all U.S. research in gravitational physics and the leading supporter of fundamental research in atomic, molecular, and optical physics in the U.S. PHY is a major partner with the Department of Energy (DOE) in support of elementary particle physics, nuclear physics, and plasma physics. PHY also has the only U.S. program designed for the support of physics research in living systems. The development of the most advanced cutting-edge computational resources, innovative technology, and new instrumentation is a key part of physics research, and tools developed by the physics community continuously have major impact in other scientific and engineering fields.

In general, 26 percent of the PHY portfolio is available for new research grants. The remaining 74 percent is used primarily to fund continuing grants made in previous years (49 percent) and to support operations and maintenance for four facilities that are a key part of the division portfolio (29 percent).

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research
A decrease of $16.20 million to a total of $177.48 million for Research Grants will be redirected to increased support of major facilities. Changes in disciplinary research support that reflect priorities include:

- CAREER (+$330,000 to a total of $7.34 million): This increase shows a continued emphasis on fostering career development of junior scientists.

- Center for Probing the Nanoscale, a Nanoscale Science and Engineering Center (-$1.14 million to a total of zero): As planned, support for this center will end in FY 2014.
- Cognitive Science and Neuroscience ($400,000): Funding supports cross-Foundation fundamental research relevant to cognitive science and neuroscience.
- Changes in NSF-wide investments are accommodated through strategic investments through PHY core programs. These NSF-wide investments include:
  - BioMaPS (+$2.22 million to a total of $4.15 million): This provides for programs that support research at the interface between the mathematical and physical sciences and the life sciences.
  - CIF21: (+$750,000 to a total of $3.75 million): This funds programs that support CIF21.

Education

- Research Experiences for Undergraduates Sites and Supplements program (REU) (+$750,000 to a total of $5.89 million): $100,000 of this additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.* The remaining $650,000 will support efforts to broaden participation by groups traditionally underrepresented in the physical sciences.

Infrastructure

- IceCube (level at $3.45 million): Funding reflects the NSB-approved post-construction ramp up in operations.
- LHC (level at $18.0 million): This supports operations of the ATLAS and CMS detectors at LHC.
- LIGO (+$9.10 million to a total of $39.50 million): Funding for LIGO increases as the Advanced LIGO (AdvLIGO) construction project is completed and commissioning of the upgraded interferometer begins. (See the MREFC chapter for more details on AdvLIGO).
- NSCL (+$1.0 million to a total of $22.50 million): This investment increases in order to promote enhanced operations.
- Research Resources (+$17.0 million to a total of $22.0 million): This funding covers support for mid-scale instrumentation and a new program in accelerator science.

OFFICE OF MULTIDISCIPLINARY ACTIVITIES (OMA) $40,640,000
+$10,000,000 / 32.6%

OMA Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, OMA	**$30.37**	**$30.64**	**$40.64**	**$10.00**	**32.6%**
Research	**27.05**	**27.44**	**26.75**	**-0.69**	**-2.5%**
CAREER	0.05	-	-	-	N/A
Centers Funding (total)	0.10	0.10	-	-0.10	-100.0%
Centers for Analysis & Synthesis	0.1	0.10	-	-0.10	-100.0%
Education	**0.32**	**0.20**	**3.89**	**3.69**	**1845.0%**
Infrastructure	**3.00**	**3.00**	**10.00**	**7.00**	**233.3%**
Research Resources	3.00	3.00	-	-3.00	-100.0%
Portfolio Analysis	-	-	10.00	10.00	N/A

Totals may not add due to rounding.

OMA enables and facilitates MPS support of novel, challenging, or complex projects of varying scale, in both research and education, which are not readily accommodated by traditional organizational structures and procedures. This is done primarily in partnership with MPS disciplinary divisions and is especially directed at activities by multi-investigator, multidisciplinary teams, as well as cross-NSF and interagency activities.

In general, approximately 54 percent of the OMA portfolio is available for new research grants and 46 percent is available for continuing grants.

In FY 2014, OMA will focus on research that emphasizes the mathematical and physical scientific foundations of sustainability, including issues that affect food and water security; fundamental science critical to the understanding, design, and development of new materials; basic research at the interface between the mathematical and physical sciences and the life sciences to provide insight into the molecular basis of life processes; computational and data-enabled science across the MPS divisions; multidisciplinary explorations into the control and manipulation of the behavior of quantum matter and the limitations of quantum information processing; basic research in optics and photonics; and team efforts aimed at the development of next-generation instrumentation to enable fundamental advances across a wide spectrum of disciplines. OMA also will provide leadership and support for MPS activities related to agency-wide efforts in INSPIRE and I-Corps.

MPS divisions have undertaken, or are engaged in, wide ranging reviews of their facilities portfolios. Of particular note are the AST Portfolio Review carried out by the MPS Advisory Committee (A/C), the on-going MPS A/C study of the role of the Division of Materials Research in synchrotron science, and the National Research Council study of high magnetic field science, all of which are addressed under the Program Monitoring and Evaluation section previously described. OMA will invest $10.0 million to enable responsible decisions regarding the components of the MPS facilities portfolio. This investment will support studies of possible environmental issues, stewardship transition costs, or partnership start-up costs.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- In FY 2014, OMA will focus on multidisciplinary research that addresses the key MPS and NSF-wide priorities of I-Corps, INSPIRE, SEES, CIF21, CEMMS, BioMaPS, clean energy, and optics and photonics, and neuroscience
- I-Corps (+$2.30 million to a total of $3.30 million): OMA will increase its funding for this cross-agency effort.
- INSPIRE (level at $3.0 million): OMA will maintain its investment in this cross-agency effort.
- CIF21 (+$250,000 to a total of $250,000). OMA will continue to coordinate MPS' participation with BIO, CISE, and ENG, providing funding for Software Infrastructure for Sustained Innovation and Scientific Software Innovation Institutes.

Education

- Alliances for Graduate Education and the Professoriate (AGEP) research supplements (level at $2.0 million): This is consistent with support that began in FY 2012.
- IGERT (+$3.44 million to a total of $3.44 million): All final funding increments for MPS awards in this program are being consolidated into OMA. IGERT will sunset in FY 2014 with the initiation of the NSF Research Traineeships (NRT) program.

Infrastructure

- Portfolio analysis (+$10.0 million to a total of $10.0 million): OMA will support responsible decision making regarding portfolio composition, including studies of possible environmental issues, stewardship transition costs, and partnership start-up costs.

SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES (SBE) $272,350,000
+$18,100,000 / 7.1%

SBE Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Social and Economic Sciences (SES)	$97.26	$97.18	$102.51	$5.33	5.5%
Behavioral and Cognitive Sciences (BCS)	92.47	92.69	97.43	4.74	5.1%
SBE Office of Multidisciplinary Activities (SMA)	28.22	28.23	30.65	2.42	8.6%
National Center for Science and Engineering Statistics (NCSES)	36.23	36.15	41.76	5.61	15.5%
Total, SBE	**$254.19**	**$254.25**	**$272.35**	**$18.10**	**7.1%**

Totals may not add due to rounding.

About SBE

SBE's mission is to promote the understanding of people and their lives by supporting research that reveals basic facets of human behavior; to encourage research that addresses important societal questions and problems; to work with other scientific disciplines to ensure that basic research and solutions to problems build upon the best multidisciplinary science; and to provide mission-critical statistical information about science and engineering (S&E) in the U.S. and the world through the National Center for Science and Engineering Statistics (NCSES). SBE supports long-term research across a diverse range of sciences that includes economics, psychology, sociology, geography, neuroscience, anthropology, archaeology, statistics, linguistics, and political science. SBE combines these sciences in a dynamic suite of interdisciplinary activities that link these fields to each other and to other science and engineering fields. Thus, SBE is a significant partner in cross-directorate programs that connect the social and behavioral sciences to priority investments across the agency.

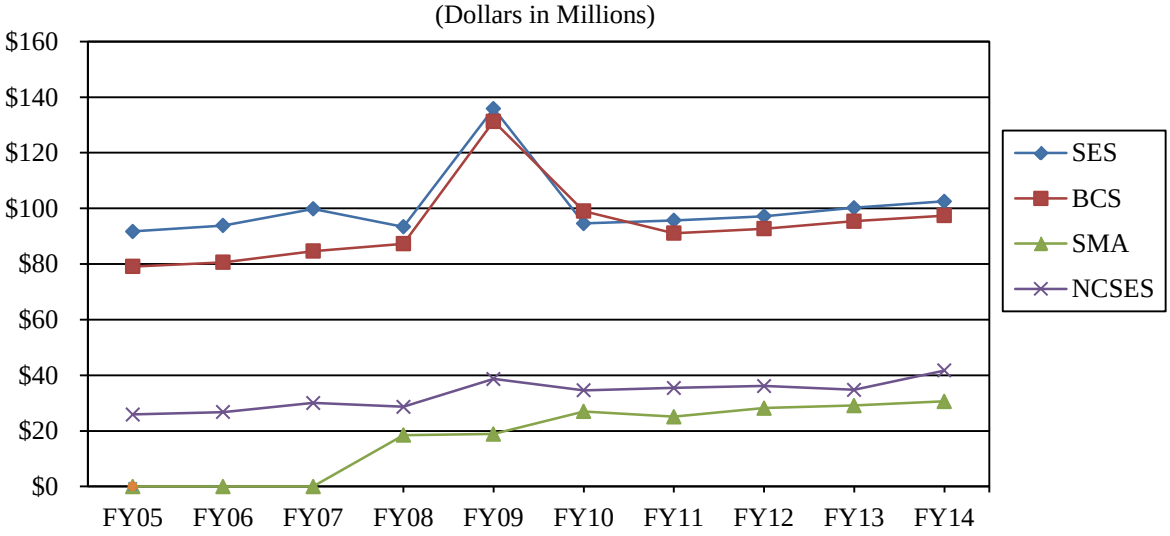
SBE's FY 2014 Request is informed by three key priorities: (1) participate in cross-directorate programs that integrate the social and behavioral sciences into priority NSF investments such as Science, Engineering, and Education for Sustainability (SEES); Comprehensive National Cybersecurity Initiative (CNCI) (via the Secure and Trustworthy Cyberspace (SaTC) investment); Cyberinfrastructure for 21st Century Science, Engineering, and Education (CIF21)/Big Data; and Innovation Corps (I-Corps); (2) sustain the directorate's ongoing strategic transformation through support for interdisciplinary research and training (via INSPIRE and SBE's own SBE 2020) and the emerging investment in cognitive science and neuroscience; and (3) protecting and enhancing core research programs and the commitment to the National Center for Science and Engineering Statistics (NCSES). These investments reflect both newly requested funds and a redeployment of resources previously committed to other areas.

SBE continues to strategically transform its scientific direction. These changes build on NSF's strategic plan, *Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years 2011-2016;* and on the directorate's SBE 2020 visioning activity, which led to a report entitled *Rebuilding the Mosaic*, which was published by NSF in November 2011.

The SBE portfolio also includes major surveys that provide broad-based infrastructure for the research community while providing policy makers with needed information. NCSES is the designated federal statistical entity with responsibility for statistics about the S&E enterprise, and its data collections and analyses are important for evaluating overall U.S. competitiveness in science and engineering.

SBE provides 56 percent of the federal funding for basic research at academic institutions in the SBE sciences.

SBE Subactivity Funding
(Dollars in Millions)



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2014 Summary by Division

- SES's FY 2014 request reflects its strong contribution to the unifying themes in the FY 2014 NSF Budget Request. This includes SEES, through investments in the Hazards, SEES Fellows, Water Sustainability and Climate, and Sustainability Research Networks activities; Secure and Trustworthy Cyberspace (SaTC) through the Cyber Economic Incentives theme within CNCI; and CIF21 through community research networks and research on virtual organizations and with an initial investment in CIF21's Big Data emphasis area. SES will continue efforts to build the scientific foundation and research evidence base needed for future programmatic efforts in broadening the participation in science and engineering (S&E) of women, underrepresented minorities, and people with disabilities (via SBE's Science of Broadening Participation (SBP)). SES will also maintain its commitment to existing programs and continue support for surveys that provide unique insights into U.S. social, economic, and political life, while providing funding for new research that has the potential to transform the social and economic sciences and contribute to effective policy development. SES will also enhance funding for the CAREER program. To further transform SBE by increasing interdisciplinary research, training, and integration with other parts of NSF, SES will sustain its investment in SBE 2020, funding more SBE Fellows. To enhance interdisciplinary research and training, SES will participate in the Interdisciplinary Behavioral and Social Science Research (IBSS) program and continue its role in international activities with increased investments in the European Open Research Area (ORA) and Science Across Virtual Institutes (SAVI) programs. SES will maintain investment in the National Nanotechnology Infrastructure Network (NNIN).

- In FY 2014, BCS will be a major partner in NSF-wide interdisciplinary activities such as SEES, CIF21, cognitive and neuroscience research, and CNCI. BCS will expand support for behavioral and cognitive research that informs our understanding of critical issues facing the Nation such as terrorism, pandemics, and sustainability. Increased SEES funding will focus on research with SBE-specific emphases, such as investments in understanding human behavior and decision making about energy use, interactions among natural and human systems, vulnerability and resilience, and participation in Hazards and Sustainability Research Networks. In its ongoing programs, BCS will operate in an interdisciplinary context; providing additional support for research on the complex ways people interact with climate and other natural systems; and research and methodological development on learning and adaptive systems. BCS support for CNCI will enable research on cognitive and behavioral aspects of threats to cybersecurity. BCS will contribute to broadening participation in S&E of women, underrepresented minorities, and people with disabilities in STEM (via SBP). Increased funding for the SBE 2020 activity will enable BCS to partner with other NSF directorates, increasing interdisciplinary research and training for behavioral and cognitive scientists. BCS will uphold its role in international activities by participating in SAVI, ORA, and other international partnerships. It will also support the Science of Learning Centers (SLC) program and continue investments in integrative interdisciplinary approaches to the understanding of human cultural and biological evolution over long time scales. BCS will also continue to fund basic research that advances understanding of the brain, cognition, and behavior through various research mechanisms.

- SMA provides a focal point for programmatic activities that cut across NSF and SBE boundaries. In addition, SMA assists with seeding interdisciplinary activities for the future. In FY 2014, SMA will continue to play an important role in the expansion of interdisciplinary training as part of SBE 2020, by expanding the SBE Postdoctoral Research Fellowship (SPRF) program to include interdisciplinary postdoctoral fellowships; SMA will provide overall management for the program. Support for enhancing the research experience for students will continue via investments in the Research Experiences for Undergraduates (REU) Sites and Supplements programs. SMA will fund interdisciplinary activities associated with CIF21; the Science of Science and Innovation Policy program (SciSIP); the interagency STAR METRICS pilot project; cognitive science and neuroscience; and SEES, including Hazards, Sustainability Research Networks, and SEES Fellows. SMA will participate in I-Corps, INSPIRE, and SaTC (through the Cyber Economic Incentives theme within CNCI, a multi-agency priority). SMA will continue to manage the agency-wide Science of Learning Centers program.

- For FY 2014, NCSES will close a growing gap in its national estimates for research and development funding and performance by developing and implementing a survey of nonprofit organizations. It will also expand the scope of administrative records sources being considered to augment the full suite of its existing surveys and proceed with a pilot project establishing collaboration between several federal agencies to assess the feasibility of using agencies' administrative records to measure research and development activity. NCSES will test new measures in the Survey of Doctorate Recipients (SDR) that address data gaps related to understanding the relationship between federal support for graduate education and outcomes, such as employment; increase the frequency of the Survey of State Government Research and Development; and develop and test effective data collection strategies for the nascent Microbusiness Innovation Science and Technology Survey (MIST).

Major Investments

SBE Major Investments
(Dollars in Millions)

Area of Investment	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
CAREER	8.58	5.54	6.01	0.47	8.5%
Cognitive Science and Neuroscience	1.00	1.00	3.00	2.00	200.0%
CIF21	5.50	5.50	7.50	2.00	36.4%
CTE	1.00	1.00	1.00	-	-
CNCI	7.58	6.00	6.00	-	-
I-Corps	0.20	0.50	0.50	-	-
INSPIRE	3.32	0.50	1.00	0.50	100.0%
Research Experiences for Undergraduate (REU) Sites and Supps	3.99	3.32	3.89	0.57	17.2%
SaTC	4.00	4.00	4.00	-	-
SEES	7.75	7.75	9.25	1.50	19.4%
SciSIP	12.80	13.50	11.05	-2.45	-18.1%

Major investments may have funding overlap and thus should not be summed.

- CAREER: SBE supports CAREER (an increase of $470,000 over FY 2012 Enacted, to a total of $6.01 million) with awards to young investigators in social and behavioral sciences who exemplify the role of teacher-scholar through the integration of education and research.

- Cognitive Science and Neuroscience: Support for this cross-foundation activity ($3.0 million total, $2.0 million above the FY 2012 Enacted level) will contribute to NSF's participation in the Office of the Science and Technology Policy's effort to coordinate federal research in this area. SBE and other NSF directorates work together informally through co-review of interdisciplinary proposals and formally through special solicitations, such as Collaborative Research in Computational Neuroscience. A Dear Colleague Letter (DCL) was issued in FY 2013 supporting research on neuroscience and cognitive science. In FY 2014, SBE, in conjunction with the Directorates for Computer and Information Science and Engineering (CISE); Engineering (ENG); Biological Sciences (BIO); and Mathematical and Physical Sciences (MPS), will continue to leverage existing investments in neuroscience, informed by the results of the DCL activity, and come together to call for a broad-based focus on understanding the brain and learning how to deploy that understanding.

- CIF21: Support for this NSF-wide investment ($7.50 million total, $2.0 million above FY 2012 Enacted) will support awards for data and cyberinfrastructure investments that create new opportunities for SBE researchers to understand human behavior and cognition and the effectiveness of virtual organizations in the context of the 21st century networked society. Also, SBE will make an initial investment in CIF21's Big Data emphasis area for research that advances the core scientific and technological means of managing, analyzing, visualizing, and extracting information from large, diverse, data sets, especially related to neuroscience, economics, and the integration of the human, social, and natural worlds.

- CTE: SBE's participation in Cyberlearning Transforming Education (CTE) remains at $1.0 million in FY 2014 for research on the development of technologies for cyberlearning, and for studying the impact of technologies on learning.

- Comprehensive National Cybersecurity Initiative (CNCI): In partnership with CISE, SBE will support multidisciplinary research in the science of cybersecurity, moving target defense, tailored trustworthy spaces, and cyber economic incentives. SBE's investment in this national priority is maintained at $6.0 million in FY 2014. SBE will devote resources to Secure and Trustworthy Computing (SaTC) through support for the Cyber Economic Incentives theme within CNCI. In addition, SBE's broad scientific base in the behavioral, social, and decision making sciences provides a wealth of opportunities to contribute to this national priority.

- I-Corps: With a sustained investment of $500,000, SBE will continue a multi-year effort to strengthen collaboration between social scientists and practitioners and improve social science students' understanding of innovation.

- INSPIRE: SBE support for this NSF priority is aligned with SBE Transformed Portfolio, SBE 2020. This support increases in FY 2014 (+$500,000 over FY 2012 Enacted, to a total of $1.0 million) to support interdisciplinary research and training.

- Funding for the Research Experiences for Undergraduates (REU) Sites and Supplements program is increased $570,000 over the FY 2012 Enacted. This additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*

- SEES: In FY 2014 SBE will continue its commitment to sustainability research by making significant investments across a variety of SEES activities, such as Water Sustainability and Climate (WSC), Coupled-Natural and Human Systems (CNH), SEES Fellows, Sustainability Research Networks (SRN), and Hazards. These investments further integrate the SBE sciences into research on energy and sustainability, while strengthening SBE's existing investments, and making new investments in decision making, coastal communities, and vulnerability and resilience. Funding increases by $1.50 million over FY 2012 Enacted (to a total of $9.25 million).

- Science of Science and Innovation Policy (SciSIP): decreases in FY 2014 (-$2.45 million below FY 2012 Enacted to a total of $11.05 million). SciSIP will continue to support research and data collections related to innovation and R&D spending.

SBE Funding for Centers Programs and Facilities

SBE Funding for Centers Programs

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Centers Programs Total	**$17.32**	**$14.27**	**$14.20**	**-$0.07**	**-0.5%**
Nanoscale Science & Engineering Centers (SES & BCS)	1.16	0.60	0.60	-	-
Science of Learning Centers (SMA & BCS)	16.16	13.67	13.60	-0.07	-0.5%

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- Funding for the Nanoscale Science & Engineering Centers will continue at $600,000 in FY 2014.

- The Science of Learning Centers (SLC) program funding decreases (-$70,000) below the FY 2012 Enacted to a total of $13.60 million. Support includes annual increments to all six centers: the Center of Excellence for Learning in Education, Science, and Technology (CELEST); the Center for Learning in Informal and Formal Environments (LIFE); the Pittsburgh Science of Learning Center for Robust Learning (PSLC); the Spatial Intelligence and Learning Center (SILC); the Temporal Dynamics of Learning Center (TDLC); and the Visual Language and Visual Learning Center (VL2). Support is also included for SLC evaluation activities in FY 2014. Funding for Cohort 1 centers will end in FY 2014, and funding for Cohort 2 centers, approved for an additional five-year renewal by the National Science Board in February 2011, will end in FY 2015.

SBE Funding for Facilities

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Facilities Total	**$0.40**	**$0.40**	**$0.40**	-	-
National Nanotechnology Infrastructure Network (NNIN)	0.40	0.40	0.40	-	-

For detailed information on individual facilities, please see the Facilities chapter.

The current NNIN ten-year cooperative agreement will close at the end of FY 2013. SBE's support for this activity will continue beyond this end point. The Directorate for Engineering (ENG) is currently evaluating the scope for future nanotechnology user facility support and working to identify a replacement program. NNIN is funded through the SES division and the funding level ($400,000) is sustained.

Summary and Funding Profile

SBE supports investment in core research and education as well as research infrastructure. In FY 2014, the number of research grant proposals is expected to be held constant with the FY 2013 Estimate level. SBE expects to award approximately 590 research grants in FY 2014. Average annualized award size will increase over the FY 2012 Enacted and duration will be held constant at the FY 2012 Enacted estimate level.

In FY 2014, funding for the centers accounts for 5 percent of SBE's Request. Center funding decreases $70,000 from the FY 2012 Enacted level, and includes the SLC program supporting six centers and support to the Centers for Nanotechnology in Society.

SBE Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate[1]	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	4,775	5,500	5,500
Number of New Awards	1,018	1,190	1,220
Funding Rate	21%	22%	22%
Statistics for Research Grants:			
Number of Research Grant Proposals	3,209	3,700	3,700
Number of Research Grants	576	570	590
Funding Rate	18%	15%	16%
Median Annualized Award Size	$98,247	$100,350	$100,350
Average Annualized Award Size	$120,052	$115,450	$116,429
Average Award Duration, in years	2.5	2.6	2.6

[1]Award Estimates for FY 2013, such as numbers of awards and size/duration, are based upon the FY 2012 Enacted level.

Program Monitoring and Evaluation

Committees of Visitors (COV):

- No SBE COVs will convene in FY 2014.
- A COV to review the SES division will convene on June 3-5, 2013.
- In FY 2013, one COV convened on October 10-12, 2012 and reviewed programs under the Behavioral and Cognitive Sciences (BCS) division: Archaeology/Archaeometry; Biological Anthropology; Cultural Anthropology; Geography and Spatial Sciences; Linguistics; Documenting Endangered Languages; Perception, Action and Cognition; Cognitive Neuroscience; Developmental and Learning Sciences; and Social Psychology. The BCS COV recommended that: BCS experiment with new review cycles (inclusive of a mechanism for evaluating the effectiveness of the new cycle compared with the old); further development of transdisciplinary research across BCS disciplines; increase publicity of BCS-funded research (across NSF, and to the public and scientific community); further exploration of virtual conferencing; clearer definition of reviewer role in determining "broader impacts" and "intellectual merit" criteria for funding decisions; encourage BCS proposers to make better use of "broader impacts" to frame description of their research questions; and provide clearer

guidance on NSF's use of data management plans. The Chair of the BCS COV will present the report and response to the SBE Advisory Committee on May 20-21, 2013.

- In FY 2012, one COV convened on December 15-16, 2011 and reviewed programs under the Office of Multidisciplinary Activities (SMA): Research Experiences for Undergraduates (REU) Sites, SBE Minority Postdoctoral Research Fellowships (MPRF), and the Science of Science and Innovation Policy (SciSIP). The SMA COV recommended SBE management review the current placement of the multidisciplinary programs in the directorate, as well as the question of how many submissions a year are appropriate. The COV also recommended taking actions to broaden participation and increase capacity for research related to the Science of Science and Innovation Policy (SciSIP) program. The SMA COV report and response to the report were presented and approved before the SBE Advisory Committee (AC) on May 17-18, 2012.
- All SBE divisions are responding to and implementing recommendations from recent COVs.

Workshops and Reports:

- A recent report by the SBE directorate, *Rebuilding the Mosaic; Fostering Research in Social, Behavioral, and Economic Sciences at the National Science Foundation in the Next Decade* (issued November, 2011), sets forth a next generation model of research that is collaborative, data-intensive, and multi- or interdisciplinary. Based on 252 white papers from more than 500 individuals, together with consultation with professional associations, societies, and campus visits, the report explores the programmatic implications of this model of research for the directorate's programs and has been influential in setting priorities and framing discussions within the directorate, across the Foundation, and with other public and private agencies and organizations. Key areas of interest are interdisciplinary training and support for graduate students and young faculty; programs to foster interdisciplinary investigations; and efforts, within the directorate and in cooperation with CISE and other entities, to catalyze research communities around new data and computational infrastructures.
- Two recent workshops were convened by the SBE Advisory Committee's Subcommittee on the Science of Learning that have implications for programmatic portfolio development. The first was held October 4-5, 2012 and focused on the scientific achievements in the science of learning over the past decade; the results were reported at the SBE AC meeting on November 15, 2012. The second workshop was held February 28 and March 1, 2013 and focused on strategies and objectives to advance the science of learning into the future. The results will be discussed at the May 2013 SBE AC meeting with emphasis on future strategic and budget planning in SBE's investment in the Science of Learning.

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

Number of People Involved in SBE Activities

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	3,646	3,100	3,200
Other Professionals	519	700	700
Postdoctorates	330	300	400
Graduate Students	2,097	2,300	2,300
Undergraduate Students	789	800	800
Total Number of People	**7,381**	**7,200**	**7,400**

DIVISION OF SOCIAL AND ECONOMIC SCIENCES (SES) $102,510,000
+$5,330,000 / 5.5%

SES Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, SES	**$97.26**	**$97.18**	**$102.51**	**$5.33**	**5.5%**
Research	**85.23**	**87.83**	**91.94**	**4.11**	**4.7%**
CAREER	2.38	2.82	3.11	0.29	10.3%
Centers Funding (total)	0.98	0.42	0.42	-	-
Nanoscale Science & Engineering Centers	0.98	0.42	0.42	-	-
Education	**3.73**	**3.79**	**3.17**	**-0.62**	**-16.4%**
Infrastructure	**8.30**	**5.56**	**7.40**	**1.84**	**33.1%**
Nat'l Nanotechnology Infrastructure Network (NNIN)	0.40	0.40	0.40	-	-
Research Resources	7.90	5.16	7.00	1.84	35.7%

Totals may not add due to rounding.

SES supports research and related activities, conducted within the U.S. and globally, that improve our understanding of economic, political, and social institutions and how individuals and organizations behave within them. SES also funds activities investigating risk assessment and decision-making by individuals and groups; the nature and development of science and technology and their impact on society; methods and statistics applicable across the social, economic, and behavioral sciences; scholarly career development; and broadening participation in the social, behavioral, and economic sciences. Its discipline-based programs include sociology, economics, and political science, while interdisciplinary programs support fields such as decision-making and risk; methods, measurement, and statistics; science of organizations; law and social science; and science and technology studies. In many of its programs, SES is the major, if not only, source of federal funding for fundamental research, making important investments in the data resources and methodological advances that produce transformative research.

SES also coordinates the Ethics Education in Science and Engineering program, supporting (with other NSF directorates) the Online Ethics Center for Engineering and Science, and manages the Centers for Nanotechnology in Society. SES is a participant in a number of Nanoscale Science and Engineering Centers. In addition, SES plays a major role in managing the Decision Making Under Uncertainty collaborative projects.

In general, 60 percent of the total SES portfolio is available for new research grants. The remaining 40 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

Overall, support for SES disciplinary and interdisciplinary research increases (+$4.11 million to a total of $91.94 million).

- Continued support ($7.10 million total) for interdisciplinary research, training, and integration opportunities through SBE's own SBE 2020 (via SBE's Interdisciplinary Behavioral and Social Science IBSS) program. Funding in this investment will require a reduction in core disciplinary research programs.
- CAREER funding in FY 2014 increases by $290,000, to a total of $3.11 million. This investment is consistent with SES's emphasis on supporting early career researchers.
- An increase of $1.97 million will expand SBE's international leadership role through participation in SAVI, the European Open Research Area program, and other international partnerships.
- SES continues its investments of $400,000 to the Ethics Education in Science and Engineering (EESE) cross-directorate program.
- CIF21: funding of $4.40 million (an increase of $1.75 million) will provide support for a Big Data ($1.50 million) emphasis area with research that aims to advance the core scientific and technological means of managing, analyzing, and visualizing, and extracting information from large, diverse, data sets. An additional $250,000 will further SES' investment in planning awards for the future data cyberinfrastructure investments that create new opportunities for SBE researchers in the context of the 21st century networked society.
- Increased funding (+$350,000, to a total of $4.0 million) for SEES will support research in expanded SEES activities through SBE-specific emphases, such as investments in understanding energy use and in decision making, coastal communities, and vulnerability and resilience, through the enhancement of existing programs and new solicitations; funding will also support Hazards, Sustainability Research Networks, SEES Fellows, and Water Sustainability and Climate.
- Continued support of $2.0 million for SaTC is provided through support for the Cyber Economic Incentives and other themes within CNCI.
- Funding for SES' Science of Broadening Participation investment increases by $250,000 to a total of $750,000. SES' SBP investment supports efforts to build the scientific foundation and research evidence base needed for future broadening participation efforts. Investing in research that informs the science of broadening participation spans education and the SBE sciences, and engages all of NSF.
- Support for the Coupled Natural and Human Systems program decreases by $250,000, to $2.25 million total.
- Permanent termination of SES' investment in the Enhancing Access to the Radio Spectrum (EARS) program, a partnership with ENG, MPS, and CISE (-$500,000). Funding is redeployed to establish or increase funding for NSF and SBE priorities.

Education

- FY 2014 support for ADVANCE ($790,000) and REU supplements ($500,000) remain constant with the FY 2012 Enacted level.
- In an effort to establish a better balance between the responsibilities and demands of work lives and family lives for social and behavioral scientists, an investment of $130,000 provides support to the Career-Life Balance (CLB) Initiative.
- SBE will invest $1.75 million in graduate traineeships as IGERT evolves into a new program, NSF Research Traineeships (NRT), which will encourage strong, well-documented efforts at innovation and design of graduate programs to support growth within specific disciplines and solid preparation of the trainees.

Infrastructure

- The existing National Nanotechnology Infrastructure Network (NNIN) comes to a close at the end of FY 2013 at the completion of its ten-year cooperative agreement. ENG is currently evaluating the scope for future nanotechnology user facility support and working to identify a replacement program, and SBE expects to sustain its investment of $400,000 in NNIN beyond the end point of the current cooperative agreement.
- Funding for other Research Resources activities increases (+$1.84 million, to a total of $5.16 million). Funding supports multi-million dollar survey awards such as the American National Election Studies (ANES), the Panel Study of Income Dynamics (PSID), and the General Social Survey (GSS). These surveys are national resources for research, teaching, and decision-making and have become models for similar undertakings in other fields. Funding supports SES' CIF21 investment inclusive of support for the Building Community and Capacity for Data-Intensive Research in the Social, Behavioral, and Economic Sciences and in Education and Human Resources (BCC-SBE/EHR) initiative (in partnership with EHR and CISE). This investment seeks to enable research communities to develop visions, teams, and capabilities dedicated to creating new large-scale, next-generation data resources and relevant analytic techniques to advance fundamental research for SBE and EHR sciences.

DIVISION OF BEHAVIORAL AND COGNITIVE SCIENCE (BCS) $97,430,000
+$4,740,000 / 5.1%

BCS Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, BCS	**$92.47**	**$92.69**	**$97.43**	**$4.74**	**5.1%**
Research	**87.78**	**89.73**	**93.77**	**4.04**	**4.5%**
CAREER	5.54	2.82	3.11	0.29	10.3%
Centers Funding (total)	5.05	5.78	5.78	-	-
Nanoscale Science & Engineering Centers	0.18	0.18	0.18	-	-
Science of Learning Centers	4.87	5.60	5.60	-	-
Education	**3.56**	**2.92**	**2.52**	**-0.40**	**-13.7%**
Infrastructure	**1.14**	**0.04**	**1.14**	**1.10**	**2750.0%**
Research Resources	1.14	0.04	1.14	1.10	2750.0%

Totals may not add due to rounding.

BCS supports research and related activities that advance fundamental understanding in the behavioral, cognitive, anthropological, and geographic sciences. Strong core programs are complemented by active involvement in competitions that support collaborative and cross-disciplinary projects. The division seeks to advance scientific knowledge and methods focusing on human cognition and behavior, including perception, thought processes, language, learning, and social behavior across neural, individual, family, and group levels. BCS also supports activities focusing on human variation at the scales of society, culture, and biology, and how these variations and related patterns develop and change across time and space. The division aims to increase basic understanding of geographic distributions and relationships as well as the capabilities to explore them, with an emphasis on interactions among human and natural systems on the Earth's surface. BCS research is helping us prepare for and mitigate the effects of natural and human-initiated disasters, predict and address how people respond to stressors, improve methods for effective learning, enhance the quality of social interaction, and respond to issues such as globalization, terrorism, and climate change. BCS investments in SEES advance our understanding of sustainability and contribute to energy research.

In general, 59 percent of the BCS portfolio is available for new research grants. The remaining 41 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted. In the FY 2014 Request there is a general reduction for core programs to provide resources for enhancement and implementation of other programs related to directorate priorities.

Research
Overall, support for BCS disciplinary and interdisciplinary research increases (+$4.04 million to a total of $93.77 million).

- Support increases (+$2.28 million, to a total of $5.40 million) for SBE 2020 (via SBE's IBSS initiative and Dear Colleague Letter (DCL)) to support interdisciplinary research, training, and integration opportunities for behavioral and cognitive scientists.
- CAREER funding will increase by $180,000, to a total of $2.90 million. This investment is consistent with BCS' emphasis on supporting early-career researchers.
- Cognitive Science and Neuroscience: BCS support for this cross-foundation activity totals approximately $2.0 million in FY 2014 (+$1.0 million). BCS funding will support NSF's commitment to making targeted investments in collaborative science and innovative technologies for understanding the brain.
- An increase of $1.0 million will expand SBE's international leadership role through participation in SAVI, the European Open Research Area program, and other international partnerships.
- Increased funding (+$80,000, to a total of $3.33 million) for SEES to support research with SBE-specific emphases, such as investments in understanding human behavior and decision making about energy use, interactions among natural and human systems, vulnerability and resilience, and to participate in Hazards, Sustainability Research Networks, SEES Fellows, and Water Sustainability and Climate (WSC).
- Increased support (+$250,000, to a total of $2.10 million) for CIF21 will create new opportunities for BCS researchers to understand human behavior and cognition.
- $1.20 million will be used for SaTC to support the Cyber Economic Incentives theme within CNCI. An additional $1.0 million is provided for multidisciplinary research in other CNCI activities.
- Support for the Enhancing Access to the Radio Spectrum (EARS) program is permanently terminated (-$500,000) at the FY 2014 Request level as a result of SBE's redeployment of funding to establish or increase investments in NSF and SBE priorities.
- Centers Funding: As planned, support for the SLC program ($5.60 million total) and the Nanotechnology Centers ($180,000) remains constant with the FY 2012 Enacted level.
- Funding for BCS' Science of Broadening Participation (SBP) investment increases by $250,000 to a total of $750,000. BCS's SBP investment supports efforts to build the scientific foundation and research evidence base needed for future broadening participation efforts. Investing in research that informs the science of broadening participation spans education and the SBE sciences, and engages all of NSF.
- Continued investment in support of integrative and interdisciplinary approaches to the understanding of human cultural and biological evolution over long time scales.

Education

- BCS support for ADVANCE will remain at the FY 2012 Enacted level ($680,000).
- With an initial investment of $120,000, BCS will support NSF's Career-Life Balance activity.
- BCS will invest $1.28 million in graduate traineeships as IGERT evolves into a new program, NSF Research Traineeships (NRT), which will encourage strong, well-documented efforts at innovation and design of graduate programs to support growth within specific disciplines and solid preparation of the trainees.
- Support for Research Experiences for Undergraduates (REU) Supplements ($440,000) is sustained.

Infrastructure

- FY 2014 support for infrastructure activities increases by $1.10 million (to a total of $1.14 million). Funding supports BCS' CIF21 investment inclusive of support for the Building Community and Capacity for Data-Intensive Research in the Social, Behavioral, and Economic Sciences and in Education and Human Resources (BCC-SBE/EHR) initiative (in partnership with EHR and CISE) which seeks to enable research communities to develop visions, teams, and capabilities dedicated to creating new large-scale, next-generation data resources and relevant analytic techniques to advance fundamental research for SBE and EHR sciences.

SBE OFFICE OF MULTIDISCIPLINARY ACTIVITIES (SMA) **$30,650,000**
+$2,420,000 / 8.6%

SMA Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, SMA	**$28.22**	**$28.23**	**$30.65**	**$2.42**	**8.6%**
Research	**22.47**	**22.56**	**22.80**	**0.24**	**1.1%**
CAREER	0.66	-	-	-	N/A
Centers Funding (total)	11.29	8.07	8.00	-0.07	-0.9%
Science of Learning Centers	11.29	8.07	8.00	-0.07	-0.9%
Education	**3.47**	**3.38**	**5.95**	**2.57**	**76.0%**
Infrastructure	**2.28**	**2.29**	**1.90**	-0.39	**-17.0%**
Research Resources	2.28	2.29	1.90	-0.39	-17.0%

Totals may not add due to rounding.

SMA provides a focal point for programmatic activities that cut across SBE disciplinary boundaries, including the agency-wide Science of Learning Centers (SLCs). SMA also funds the Science of Science and Innovation Policy (SciSIP) program, Research Experiences for Undergraduates (REU) Sites, and SBE Postdoctoral Research Fellowships (SPRF). SMA will play a critical role in several NSF areas of emphasis for FY 2014, such as clean energy and sustainability (via the SEES investment); cyberinfrastructure and computer science (via the CIF21 investment); national security (via the CNCI investment); international leadership and interaction (via support to the Open Research Area (ORA) activity); innovation (via the Innovation Corps (I-Corps) investment); interdisciplinary research and training (via the INSPIRE investment and full implementation of the SBE Transformed Portfolio, SBE 2020 through the Interdisciplinary Behavioral and Social Science Research (IBSS) solicitation); and the developing investment in cognitive science and neuroscience. These investments reflect both newly requested funds and a significant redeployment of resources previously committed to other social, behavioral and economics science disciplines within SBE. Co-funding with other divisions in SBE and with other directorates is typical for SMA, as is participation in interagency activities. While all SBE divisions pursue interdisciplinary work, SMA assists with seeding multidisciplinary activities for the future. All areas of SBE sciences are represented in the SMA portfolio.

In general, 39 percent of the SMA portfolio is available for new research grants. The remaining 61 percent funds continuing awards made in previous years, including funding for the SLCs.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted. In the FY 2014 Request there is a general reduction for core programs to provide resources for enhancement and implementation of other programs related to directorate priorities.

Research
Overall, support increases for basic research activities (+$240,000 to a total of $22.80 million).

- $1.0 million (an increase of $500,000) supports INSPIRE, an NSF priority aligned with SBE 2020.

- $500,000 (to a total of $500,000) supports the I-Corps investment, strengthening collaboration between social scientists and academe and improving social science students' understanding of innovation.
- In FY 2014, SMA will continue to support six active Science of Learning Centers and funding decreases by $70,000 (to a total of $8.0 million). A gradual phase down of the program continues as centers reach their endpoints in FY 2014 and FY 2015.
- Funding for the SciSIP disciplinary research activities decreases by $2.45 million, to a total of $5.10 million. Funding is redeployed to establish or increase funding for NSF and SBE priorities.
- $1.0 million of resources from SMA SciSIP funding will be redirected to initiate an investment in cognitive science and neuroscience research. At this level SMA, in partnership with SBE's BCS division and other NSF directorates (ENG, BIO, MPS, and EHR), will further its efforts toward defining a broad-based focus on understanding the brain and learning how to deploy that understanding through community building activities such as; workshops, Dear Colleague Letters, and research coordination networks.
- SEES funding, $1.92 million total (+$1.07 million) supports research with SBE-specific emphases, such as investments in understanding human behavior and decision making about energy use, interactions among natural and human systems, and vulnerability and resilience. SMA will participate in Hazards, Sustainability Research Networks, and SEES Fellows.
- SMA provides continued support of $1.0 million for Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21). Of particular interest to SMA are new opportunities for SBE researchers to understand the 21st century networked society.
- With a continued investment of $800,000, SMA will partner with CISE in devoting resources to the Secure and Trustworthy Cyberspace (SaTC) initiative through support for the Cyber Economic Incentives theme within CNCI. This investment will support research at the interstices of the economic and computer sciences to achieve secure practices through the development of market forces that incentivize good behavior.

Education

Overall, support for Education activities in SMA increases by $2.57 million, to a total of $5.95 million.

- Support for Research Experiences for Undergraduates (REU) Sites increases by $570,000, to a total of $2.89 million. This additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*
- In FY 2012, NSF/SBE expanded an existing postdoctoral fellowship program to include interdisciplinary post-doctoral fellows. It is called the SBE Postdoctoral Research Fellowship (SPRF) program, and has two tracks – broadening participation (SPRF-BP), which replaces the former SBE Minority Postdoctoral Fellowships; and interdisciplinary research (SPRF-IBSS) which aligns with SBE 2020 activities. At the FY 2014 Request level, funding for SPRF-BP increases by $500,000, to a total of $1.50 million. An investment of $1.50 million will support the SPRF-IBSS activity.

Infrastructure

- Support for infrastructure activities decreases (-$390,000 to a total of $1.90 million). Funding is primarily for data and tool development. Data development includes such databases as: the National Bureau of Economic Research/Harvard patent database; the University of California, Davis database on initial public offerings; and two surveys, "Management and Organizational Practices Across the U.S.", and the "Division of Innovative Labor." Tool developments include such projects as Open Researcher and Contributor ID (ORCID) unique researcher identifiers and Publication Harvester: An Open-Source Software Tool for Science Policy Research.

NATIONAL CENTER FOR SCIENCE AND ENGINEERING STATISTICS (NCSES) — $41,760,000 / +$5,610,000 / +15.5%

NCSES Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, NCSES	**$36.23**	**$36.15**	**$41.76**	**$5.61**	**15.5%**
Research	**0.46**	**0.55**	**0.50**	**-0.05**	**-9.1%**
Infrastructure	**35.77**	**35.60**	**41.26**	**5.66**	**15.9%**

Totals may not add due to rounding.

The National Center for Science and Engineering Statistics (NCSES) was established within the National Science Foundation by Section 505 of the America COMPETES Reauthorization Act of 2010 (P.L. 111-358). The Act provides NCSES with the legislative mission to "…serve as the central federal clearinghouse for the collection, interpretation, analysis, and dissemination of objective data on science, engineering, technology, and research and development." NCSES is called on to support the collection of statistical data on research and development trends, the science and engineering workforce, U.S. competitiveness, and the condition and progress of the Nation's STEM education; to support research using the data it collects and on methodologies in areas related to the work of the Center; and to support the education and training of researchers in the use of its own and other large-scale, nationally representative data sets.

As one of the thirteen principal federal statistical agencies, NCSES has broad responsibility for statistics about the science and engineering enterprise. NCSES designs, supports, and directs a coordinated collection of periodic national surveys and performs a variety of other data collections and research, providing policymakers, researchers, and other decision makers with high quality data and analysis on R&D, innovation, the education of scientists and engineers, and the science and engineering workforce. The work of NCSES involves survey development, methodological and quality improvement efforts, data collection, analysis, information compilation, dissemination, web access, and customer service to meet the statistical and analytical needs of a diverse user community. It also prepares two congressionally mandated biennial reports — *Science and Engineering Indicators (SEI)* and *Women, Minorities, and Persons with Disabilities in Science and Engineering*. The data collected by NCSES also serve as an important resource for researchers in SBE's Science of Science and Innovation Policy (SciSIP) program.

The funding portfolio for NCSES includes ongoing, cyclical surveys; reports and other products; and projects accomplished primarily through contracts and grants.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted.

Infrastructure

FY 2014 support for core NCSES infrastructure activities increases by $5.61 million to an overall total of $41.76 million. The additional funds support targeted improvements in NCSES' statistical programs and are as follows:

- $2.0 million to plan and conduct a survey of research and development funding and performance by nonprofit organizations. NCSES has not conducted such a survey in more than 15 years, though the level and importance of R&D activity in this sector is thought have grown significantly.
- $500,000 to increase the frequency of the Survey of State Government Research and Development
- $500,000 to develop and test effective data collection strategies for the Microbusiness Innovation Science and Technology Survey, to fill a void in our knowledge of the smallest employers, often the very businesses believed to fuel innovation in the U.S.
- $500,000 for the Survey of Doctorate Recipients to develop and test new measures that address data gaps related to understanding the relationship between Federal support for graduate education and outcomes, such as employment.
- $1.50 million to expand the scope of administrative records sources that NCSES is exploring to augment the full suite of its existing surveys. NCSES will proceed with a pilot project establishing collaboration between several federal agencies to test the feasibility of using agencies' administrative records to measure research and development activity. NCSES will explore approaches to improving other agencies' data sets, closely coordinating such activities with relevant offices in OMB. This work will also include outcome data for STEM graduates whose education is funded in whole or in part via federal research grants and improved innovation measures for the Business R&D and Innovation Survey (BRDIS) and NCSES' other R&D surveys.
- $610,000 to plan and design program modifications to respond to recommendations received from the National Academy's Committee on National Statistics Panel on Developing Science, Technology and Innovation Indicators for the Future.
- Funding for NCSES SciSIP activities will decrease to $4.95 million total ($1.0 million below the FY 2012 Enacted level). Current SciSIP funding is used to support the Business R&D and Innovation Survey, the federal statistical system's primary survey on business domestic and global R&D expenditures and workforce; and the National Survey of Recent College Graduates (NSRCG), the federal statistical system's primary survey of the nation's science and engineering workforce. This reduction will be offset primarily with savings from the termination of the NSRCG.

INTERNATIONAL AND INTEGRATIVE ACTIVITIES (IIA) $536,620,000
+$137,180,000 / 34.3%

IIA Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Communicating Science Broadly	$2.00	$2.00	-	-$2.00	-100.0%
EPSCoR	150.85	150.90	163.58	$12.68	8.4%
INSPIRE[1]	12.35	12.35	31.00	18.65	151.0%
International Science and Engineering	49.95	49.85	51.88	2.03	4.1%
Major Research Instrumentation	90.00	90.00	90.00	-	-
National Graduate Research Fellowships	88.50	88.50	162.57	74.07	83.7%
NSF Research Traineeships	-	-	5.00	5.00	N/A
Science and Technology Centers Class of 2013	-	-	25.00	25.00	N/A
Science and Technology Centers Administration	0.43	1.30	1.30	-	-
Science and Technology Policy Institute	3.14	3.14	4.89	1.75	55.7%
STAR METRICS	1.38	1.40	1.40	-	-
Total, IIA	**$398.60**	**$399.44**	**$536.62**	**$137.18**	**34.3%**

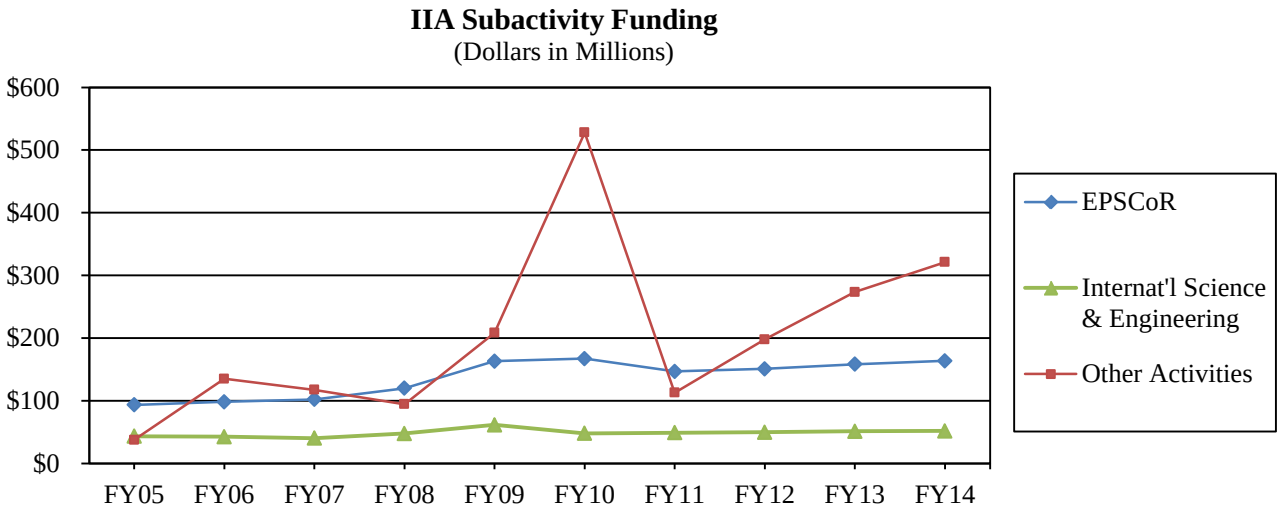
Totals may not add due to rounding.

As part of the approved realignment of four offices within the Office of the Director, the Office of International Science and Engineering was combined with the Office of Integrative Activities and renamed the Office of International and Integrative Activities (OIIA). The Integrative Activities budget line is now International and Integrative Activities (IIA).

[1] This line shows centralized funding for INSPIRE. Other IIA budget lines, notably International Science and Engineering, also provide funding for INSPIRE.

About IIA

IIA includes a diverse array of Foundation-wide activities. Through IIA, funding is provided for high priority, well-established activities such as administration of the Science and Technology Centers (STCs), Experimental Program to Stimulate Competitive Research (EPSCoR), Major Research Instrumentation (MRI), National Graduate Research Fellowship (NGRF) programs, and International Science and Engineering (ISE). IIA also invests in new activities, such as Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE), that will have a significant impact on the way NSF supports novel science and engineering research at the intersection of traditional disciplines. IIA also facilitates NSF-wide activities such as Career Life Balance that assure an excellent U.S. science, technology, engineering, and mathematics (STEM) workforce by creating a coherent set of career-life policies and program opportunities that take into account the career-family life course and reduce the rate of departure of women from the STEM pathway.



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5). FY 2010 includes ARRA carryover.

FY 2014 Summary

All funding changes are over the FY 2012 Enacted level.

- Communicating Science Broadly (CSB): CSB is proposed for termination. Peer-reviewed research and model-building activities to better understand effective means and innovative models for engaging the public in learning science outside of school settings will continue to be supported through the Advancing Informal STEM Learning (AISL) program – formerly known as the Informal Science Education program – in the Directorate for Education and Human Resources (EHR).

- The Experimental Program to Stimulate Competitive Research (EPSCoR): EPSCoR assists NSF in its mandate to promote scientific progress nationwide. EPSCoR investments enable lasting improvements in the research capacity of institutions in participating states and promote broader engagement at the frontiers of discovery and innovation in science and engineering. EPSCoR's FY 2014 Request of $163.58 million is an increase of $12.68 million over the FY 2012 Enacted level of $150.90 million.

- Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE): This program was established in FY 2012 to address some of the most complicated and pressing scientific problems that lie at the intersections of traditional disciplines, in keeping with NSF's strategic goal of *Transform the Frontiers*. INSPIRE will continue to strengthen NSF's support of interdisciplinary, potentially transformative research by complementing existing efforts with a suite of highly innovative Foundation-wide activities and funding opportunities. In FY 2014, IIA will invest $31.0 million in INSPIRE, which is $18.65 million above FY 2012 Enacted.

- International Science and Engineering (ISE): IIA will emphasize support of internationally-focused activities that augment and further integrate international engagement of research and education programs across NSF. This will be accomplished by co-funding with directorates and offices through activities including Science Across Virtual Institutes (SAVI) the Global Venture Fund (GVF), and the international postdoctoral support programs. In addition to co-funding collaborations with NSF disciplinary units, the following OIIA-managed programs enhance U.S. international research and education interests: Partnerships for International Research and Education (PIRE); International

Research Experience for Students (IRES); East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI); and Catalyzing New International Collaborations (CNIC). These programs support U.S. scientists, engineers, and students engaged in international research and education activities in all NSF-supported disciplines involving any region of the world. IIA also contributes to U.S. participation in global organizations, and manages overseas offices to facilitate U.S. engagement with foreign researchers and educators. The FY 2014 Request includes $51.88 million in funding for international activities within IIA an increase of $2.03 million over FY 2012 Enacted.

- Major Research Instrumentation (MRI): Advanced research instrumentation is essential for breakthrough discoveries. In addition, state-of-the-art research instrumentation motivates and enables researchers at all career levels. In FY 2014, MRI investments will support awards that strengthen the Nation's research instrumentation capacity and modern research infrastructure. Funding for MRI in FY 2014 is $90.0 million, which is unchanged from FY 2012 Enacted.

- In FY 2014, National Graduate Research Fellowship (NGRF) program (formerly Graduate Research Fellowship program), will represent an enhancement of NSF's signature graduate fellowship program to become a flagship STEM fellowship program for the federal government. A $74.07 million increase over the FY 2012 Enacted is requested for a total IIA investment of $162.57 million. An equivalent investment ($162.57 million) is provided through the Directorate for Education and Human Resources (EHR) for total NGRF funding of $325.14 million. With the additional resources, NSF will award approximately 700 additional fellows bringing the total estimated number of new fellowships awarded in FY 2014 to 2,700.

- In collaboration with EHR, a new program, NSF Research Traineeships (NRT) will be initiated with an IIA investment of $5.0 million in FY 2014. NRT will encourage strong, well-documented efforts at innovation and design of graduate programs to support growth within emphasis areas (e.g. cyberinfrastructure) and solid preparation of the trainees. For more information see the Major Investments in Science, Technology, Engineering, and Mathematics (STEM) Graduate Education narrative in the NSF-Wide Investments chapter.

- The Science and Technology Policy Institute (STPI): This Federally Funded Research and Development Center (FFRDC), sponsored by NSF on behalf of the White House Office of Science and Technology Policy (OSTP), provides analysis on significant domestic and international science and technology policies and developments for OSTP and other federal agencies. In FY 2014, NSF requests $4.89 million, an increase of $1.75 million above FY 2012 Enacted. Of this increase, $1.50 million will support OSTP in leading a new, interagency Big Earth Data initiative to improve coordination and management of federal Earth system observations, data, and information. This is in coordination with the U.S. Group on Earth Observations Subcommittee of the National Science and Technology Council. The remaining $250,000 increase will support additional studies and analyses for OSTP.

- Science and Technology for America's Reinvestment (STAR METRICS): This is an interagency pilot activity that is a new approach to developing information on how NSF and other federal research and development investments affect the innovation ecosystem. The FY 2014 Request of $1.40 million will enable NSF to meet commitments to the interagency STAR METRICS partnership, promote the integration of elements of STAR METRICS into an assessment and evaluation information system linked to NSF management information systems, and support assessment and evaluation pilots in NSF programs using STAR METRICS tools. This project supports the assessment and evaluation plans described in *Empowering the Nation Through Discovery and Innovation - NSF Strategic Plan for Fiscal Years (FY) 2011-2016.*

Major Investments

IIA Major Investments

(Dollars in Millions)

Area of Investment	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Clean Energy Technology	$23.98	$25.21	$19.00	-$6.21	-24.6%
INSPIRE[1]	12.43	12.35	32.00	19.65	159.1%
SEES	11.98	12.00	10.00	-2.00	-16.7%

Major investments may have funding overlap and thus should not be summed.

[1] Includes funding for INSPIRE captured in IIA's International Science and Engineering line for the FY 2012 Actual ($75,000) and FY 2014 Request ($1.0 million).

- Clean Energy Technology: Support of $19.0 million will enhance research and innovations in such areas as solar energy technologies, biofuels and bioenergy, wind energy generation, sustainability, and renewable energy storage. The IIA Clean Energy Technology investment includes its support of the Science, Engineering, and Education for Sustainability (SEES) activity.

- INSPIRE: Funding of $32.0 million will strengthen NSF's support of interdisciplinary, potentially transformative research. Included in this total is $1.0 million of ISE support for INSPIRE.

- SEES: An investment of $10.0 million will fund international collaborations that focus on research and technologies to mitigate and adapt to, environmental change that threatens sustainability. IIA's SEES support primarily consists of its funding for the existing, SEES-focused 2012-2016 PIRE cohort.

IIA Funding for Centers Programs and Facilities

IIA Funding for Centers Programs

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Centers Programs Total	**$0.43**	**$1.30**	**$26.30**	**$25.00**	**1923.1%**
Science & Techology Centers Administration	0.43	1.30	1.30	-	-
Science & Techology Centers Class of 2013	-	-	25.00	25.00	N/A

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- NSF's investments in Science and Technology Centers (STCs) create platforms to support interdisciplinary discovery. The STC Integrative Partnerships program — which in FY 2014 will fund 16 centers (11 existing and up to five new from the Class of 2013) nationwide — supports innovative, potentially transformative, complex research and education projects that require large-scale, long-term efforts. STCs engage the Nation's intellectual talent through partnerships between academia and other sectors including industry, national laboratories, and government. In FY 2014,

$25.0 million will be transferred from IIA to the managing directorates for the Class of 2013 STCs. The remaining $1.30 million will support administrative costs associated with post-award management for the existing 11 centers.

IIA Funding for Facilities

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Facilities Total	**$0.10**	**$0.10**	**$0.10**	**-**	**-**
National Nanotechnology Infrastructure Network (NNIN)	0.10	0.10	0.10	-	-

For detailed information on individual facilities, please see the Facilities chapter.

- In FY 2014, IIA will continue support of the NNIN to leverage connections and collaborations with foreign institutions.

Program Monitoring and Evaluation

Science and Technology Policy Institute (STPI) Reports and Evaluations:

- In FY 2011, EPSCoR supported a contract to STPI to perform an in-depth, life-of-program assessment of NSF EPSCoR activities and their outputs and outcomes. This evaluation is focusing on progress in research competitiveness, infrastructure development, broadening participation in science and engineering, and STEM workforce development within EPSCoR jurisdictions. This assessment will provide recommendations for better targeting funds to those jurisdictions for which the EPSCoR investment can result in the largest incremental benefit to their research capacities. The expected completion date is early FY 2014.
- In FY 2012, ISE supported a contract to STPI to perform an in-depth review and assessment of NSF's three overseas offices (Paris, Tokyo, and Beijing). The purpose is to identify ways to optimize the services provided by the offices, as well as to examine options to achieve an effective NSF presence in different regions of the world. The expected completion date is May 2013.

Program Evaluations:

- In FY 2011, the National Academy of Science (NAS) was charged with conducting a study of EPSCoR and EPSCoR-like programs as called for in the America COMPETES Reauthorization Act of 2010 (P.L. 111-358). Agencies with active programs are Department of Energy (DOE), National Aeronautics and Space Administration (NASA), National Institute of Health (NIH), NSF, and United States Department of Agriculture (USDA). NSF will take into account the results of this study in implementing its EPSCoR program. The expected completion date is early FY 2014.
- An evaluation of the PIRE program was initiated during FY 2012 and is expected to be completed in FY 2014. The FY 2012 PIRE competition will be the fourth competition and an evaluation and assessment is timely and appropriate.
- In FY 2014, baseline data and feasibility study from FY 2013 will inform an outcome evaluation and impact assessment of the first two years of INSPIRE Track 1. The Track 1 outcome evaluation will be modified as needed for INSPIRE Track 2 and Director's INSPIRE Awards. In consultation with other internal organizations, NSF will begin a review to determine improvements to eBusiness systems to facilitate interdisciplinary research by allowing for interdisciplinary classification of

proposals and awards, and will develop an implementation plan.

Committees of Visitors (COV):

- In 2012, a COV reviewed EPSCoR. The COV presented their reports to the Office Head of the Office of International and Integrative Activities in August 2012. Recommendations were to:
  - Continue the implementation of the recommendations of COVs past and present, in particular with respect to the improved training of reviewers and future COV members and to the continue appointment of at least one member from previous COVs to future COVs to maintain an "institutional memory" and continuity.
  - Continue Research Infrastructure Improvement (RII) Track-2 awards with the incorporation of collaboration across jurisdictions that are beyond the establishment and use of cyberinfrastructure (CI); and endorse the efforts of the EPSCoR program in directing the jurisdictions to seek cyberinfrastructure support from other sources outside of NSF and inside, across other directorates and offices.
  - Continue EPSCoR's efforts focused on broadening participation and maintenance of language in EPSCoR solicitations that emphasize the importance of broadening participation and expanded participation of minority serving institutions (MSIs) in EPSCoR programs and projects, including in leadership and full partner roles.
  - Increase the pool of CI reviewers and the increased use of CI expertise as reviewers across EPSCoR funding mechanisms and encourage the participation of more early-career reviewers.
  - Encourage project leadership to engage new investigators as part of the team that implements the project.
  - Develop an on-line data collection system readily accessible to EPSCoR grantees to facilitate collection and accuracy of data required by NSF EPSCoR and amenable to data mining by the EPSCoR staff.

Workshops and Reports:

- A workshop aimed at developing and implementing strategic initiatives to strengthen the STEM skills in students, particularly those from underrepresented groups, was held in FY 2012. A group of faculty and staff from three organizations were engaged in student development activities as the starting event for the year-long project. The three organizations that led the project's activities were: (1) EPSCoR jurisdictions, (2) Campus Compact, a network of college and university presidents who focus on civic purposes of higher education, and (3) SENCER, Science Engagement for New Civic Engagements and Responsibilities - an organization that committed to connecting science learning to critical civic questions. Hawaii, Montana, Iowa, Oklahoma, West Virginia, Tennessee, Maine, and New Hampshire were the initial cohort of EPSCoR jurisdictions that participated in this activity.
- In FY 2013, a two-and-a-half day workshop on Bioinformatics was held in Little Rock, Arkansas. This workshop brought life and computational scientists together to address the need for cross-fertilization among different domains of bioinformatics. The workshop enabled effective collaborations among EPSCoR jurisdictions in bioinformatics research and education. The workshop also informed the participants of the interdisciplinary, computational and data- enabled science, cyberinfrastructure resources, and EPSCoR-related opportunities at NSF.
- In FY 2012, The Living on Earth III (LOE III) workshop addressed the need for effective integration of processes linking scientific knowledge and analytical approaches in social-ecological systems research. This workshop continued the work of the two previous workshops in building science and research capacity in sustainability science and coupled human-natural/socio-ecological systems science (SES) across EPSCoR jurisdictions and facilitated the formalization of a LOE-SES scientific network promoting cutting-edge and transformative science ideas. LOE III focused on conceptualizing SES science in the context of small, yet critical, ecosystems with challenging human dimensions.

Specific outcomes from the workshop were to: (1) formalize and structure a new LOE-SES EPSCoR scientific network building upon previous informal network approaches from LOE I and II, (2) generate thematic sub-network groups with specific aims and goals, and (3) develop a LOE-SES network toolkit for building within-EPSCoR jurisdictional capacity.

Please see the Performance chapter for details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees.

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCoR) **$163,580,000**
+$12,680,000 / 8.4%

EPSCoR Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, EPSCoR	**$150.85**	**$150.90**	**$163.58**	**$12.68**	**8.40%**
Research Infrastructure Improvement (RII)	110.60	110.00	121.58	11.58	10.5%
Co-Funding	38.83	39.40	40.00	0.60	1.5%
Outreach and Workshops	1.43	1.50	2.00	0.50	33.3%

Totals may not add due to rounding.

EPSCoR assists NSF in its statutory function, provided by the NSF Act, "to strengthen research and education in science and engineering throughout the United States and to avoid undue concentration of such research and education." EPSCoR goals are: 1) to provide strategic programs and opportunities for EPSCoR participants that stimulate sustainable improvements in their R&D capacity competitiveness; and 2) to advance science and engineering capabilities in EPSCoR jurisdictions for discovery, innovation, and overall knowledge-based prosperity.

The FY 2014 Request of $163.58 million will support three strategic investment tools: Research Infrastructure Improvement (RII) awards, co-funding, and outreach. RII awards support development of physical, human, and cyber-based research infrastructure in EPSCoR jurisdictions with an emphasis on collaborations among academic researchers, the private sector, and state and local governments to effect sustainable improvements in research infrastructure.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research Infrastructure Improvement (RII)
RII awards are designed to improve the research competitiveness of jurisdictions by strengthening their academic research infrastructure in areas of science and engineering supported by NSF and critical to the particular jurisdiction's science and technology initiative or plan. These areas are identified by the jurisdiction's EPSCoR governing committee as having the best potential to improve the jurisdiction's future research and development competitiveness. RII awards also enable broader regional and topical collaborations and enhance discovery, learning, and economic development of EPSCoR jurisdictions. The FY 2014 Request for this activity is $121.58 million, an increase of $11.58 million.

Co-Funding
EPSCoR co-invests (co-funds) with NSF directorates and offices meritorious proposals from individual investigators, groups, and centers in EPSCoR jurisdictions that are submitted to the Foundation's research and education programs and crosscutting initiatives. These proposals are merit reviewed in NSF disciplinary programs and recommended for award, and the combined, leveraged support of EPSCoR ensures that sufficient funding is provided. The FY 2014 Request for this activity is $40.0 million, an increase of $600,000.

Outreach and Workshops

EPSCoR Outreach and Workshop activities support workshops, conferences, and other community-based activities designed to explore opportunities in emerging areas of science and engineering and to share best practices in strategic planning, diversity, communication, cyberinfrastructure, evaluation, and other capacity-building areas of importance to EPSCoR jurisdictions. The FY 2014 Request for this activity is $2.0 million, an increase of $500,000.

Number of People Involved in EPSCoR Activities

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	314	400	400
Other Professionals	224	300	300
Postdoctorates	44	100	100
Graduate Students	390	500	500
Undergraduate Students	553	700	700
K-12 Teachers	4,753	5,000	5,400
K-12 Students	43,517	50,000	49,500
Total Number of People	**49,795**	**57,000**	**56,900**

INTERNATIONAL SCIENCE AND ENGINEERING (ISE) $51,880,000
+$2,030,000 / 4.1%

International Science and Engineering Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, ISE	**$49.95**	**$49.85**	**$51.88**	**$2.03**	**4.1%**
Research	43.25	38.70	43.53	4.83	12.5%
Education	6.61	11.05	8.25	-2.80	-25.3%
Infrastructure	0.10	0.10	0.10	-	-

Totals may not add due to rounding.

The objectives of ISE programs are to support U.S. scientists, engineers, and students engaged in international research and education activities in all NSF-supported disciplines involving any region of the world. In FY 2014, ISE will emphasize support of internationally-focused activities that enhance and further integrate international engagement of research and education programs across NSF. This will be accomplished by co-funding with directorates and offices through NSF-wide activities such as Science Across Virtual Institutes (SAVI), the Global Venture Fund (GVF), INSPIRE, International Research Experiences for Undergraduates (iREU), and International Postdoctoral Support programs. In addition, the following ISE-managed programs will continue to enhance U.S. international research and education interests: Partnerships for International Research and Education (PIRE); East Asia and Pacific Summer Institutes for U.S. graduate students (EAPSI); and Catalyzing New International Collaborations (CNIC). ISE also contributes to U.S. participation in global organizations and manages overseas offices to facilitate U.S. research engagement, leveraging NSF funding with that of counterpart funding agencies. The FY 2014 Request of $51.88 million is $2.03 million over FY 2012 Enacted.

FY 2014 Summary

ISE support for international engagement involves linking research and education activities as an integral part of their educational experience. The level of emphasis between research and education varies by program.

ISE will use a variety of approaches to coordinate and collaborate across NSF, including program officer exchanges with NSF research divisions, joint review of solicitations and proposals, and interactions with an internal cross-directorate NSF International Coordinating Committee.

All funding decreases/increases represent the change over the FY 2012 Enacted level.

Research

- ISE will support international research interactions through two major mechanisms: co-funding of awards with programs managed by other NSF organizational units and direct funding of awards through programs managed by ISE.
- ISE works actively with NSF disciplinary programs to provide incentives for funding international components in new proposals and as supplements to existing grants. The specific allocation of funding resources among programs is dependent on proposal pressure from the community and NSF program initiative to encourage international engagements.

- Although NSF programs are encouraged to involve an international component, where appropriate, the following NSF programs are specifically designed to facilitate international research partnerships: Science Across Virtual Institutes (SAVI), Partnerships for International Research and Education (PIRE), Catalyzing New International Collaborations (CNIC), and Global Venture Fund (GVF).
- ISE will continue to provide support for U.S. participation in domestic and foreign organizations that facilitate international activities for U.S. researchers and educators.
- The FY 2014 Request for activities with a research emphasis is $43.53 million, an increase of $4.83 million.

Education

- International interactions will be closely integrated into NSF's disciplinary and interdisciplinary programs to expose U.S. student to the mutual benefits of international research partnerships in their careers. Recent evaluations of ISE-managed programs have documented the long-term value of such program investments.
- In FY 2014, ISE will continue to manage several programs that support students and early career researchers engaging in international activities: East Asia and Pacific Summer Institutes (EAPSI) funded by ISE; Pan-American Advanced Studies Institutes (PASI) funded by NSF directorates; International Research Fellowships (IRFP) through ISE co-funding with directorate post doctorate programs; and International Research Experiences for Students with ISE funding. The FY 2014 Request for activities with an education emphasis is $8.25 million.

Infrastructure

- The FY 2014 Request for support of the Next-Generation National Nanotechnology Infrastructure Network (NG NNIN) at $100,000, level with funding for the former NNIN program, which will reach its ten year award life at the end of FY 2013.

Summary and Funding Profile

ISE is placing increased emphasis on support for activities that augment and integrate the international engagement of research and education programs across NSF by using a co-funding model. In FY 2014, ISE direct management of awards and the resulting estimated award statistics will decrease as this data is reported by NSF directorate and offices that manage the individual awards.

Number of People Involved in ISE

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	436	200	200
Other Professionals	56	20	20
Postdoctorates	102	20	20
Graduate Students	151	500	500
Undergraduate Students	60	300	300
Total Number of People	**805**	**1,040**	**1,040**

ISE Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate[1]	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	952	1,270	800
Number of New Awards	334	410	255
Funding Rate	35%	32%	32%
Statistics for Research Grants:			
Number of Research Grant Proposals	686	940	750
Number of Research Grants	73	105	255
Funding Rate	11%	11%	34%
Median Annualized Award Size	$50,000	$70,000	$10,000
Average Annualized Award Size	$199,444	$270,000	$72,800
Average Award Duration, in years	1.9	2.4	0.5

PIRE competitions are held biennially. The next competition is planned for FY 2014.

1 Award Estimates for FY 2013, such as numbers of awards and size/duration, are based upon the FY 2012 Enacted level.

UNITED STATES ARCTIC RESEARCH COMMISSION (USARC)

$1,400,000
-$50,000 / -3.8%

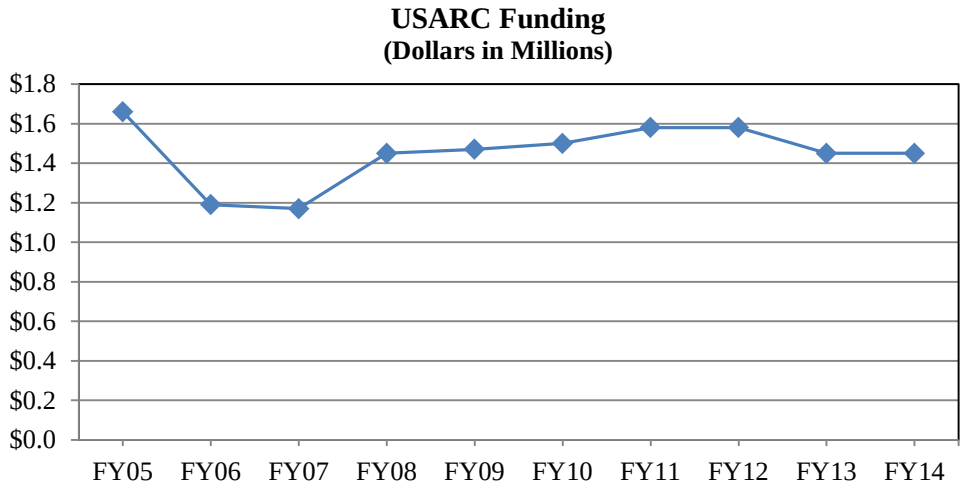
USARC Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
USARC	**$1.45**	**$1.45**	**$1.40**	**-$0.05**	**-3.8%**

About USARC

USARC was created by the Arctic Research and Policy Act of 1984, (as amended, P. L. 101-609), to establish the national policy, priorities, and goals necessary to construct a federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences. This request provides funds to promote Arctic research, to recommend Arctic research policy, and to communicate research and policy recommendations to the Administration and the Congress, as well as supporting close collaboration with the National Science Foundation (NSF) as the lead agency responsible for implementing Arctic research policy and supporting cooperation and collaboration throughout the federal government. In addition, USARC gives guidance to the Interagency Arctic Research Policy Committee (IARPC) to develop national Arctic research projects and a five-year plan to implement those projects. USARC also supports interaction with Arctic residents, international Arctic research programs and organizations, and local institutions, including regional governments, in order to obtain the broadest possible view of Arctic research needs. USARC is an independent federal agency, funded through NSF's appropriations, specifically as an activity in the Research and Related Activities account.

The USARC is requesting $1.40 million, a decrease of $50,000 below the FY 2012 Enacted level. The FY 2014 Request will support an estimate of 3 FTE at the USARC along with 1 additional IPA. In addition, two full-time contractors will be supported by FY 2014 Request level funds. A total of seven compensated personnel are authorized in P.L. 101-609.



EDUCATION AND HUMAN RESOURCES (EHR)

$880,290,000
+$51,290,000 / 6.2%

EHR Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Division of Research on Learning in Formal and Informal Settings (DRL)	$273.23	$272.43	$277.87	$5.44	2.0%
Division of Graduate Education (DGE)	237.36	236.29	245.15	8.86	3.7%
Division of Human Resource Development (HRD)	129.41	129.63	130.30	0.67	0.5%
Division of Undergraduate Education (DUE)	190.54	190.65	226.97	36.32	19.1%
Total, EHR	**$830.54**	**$829.00**	**$880.29**	**$51.29**	**6.2%**

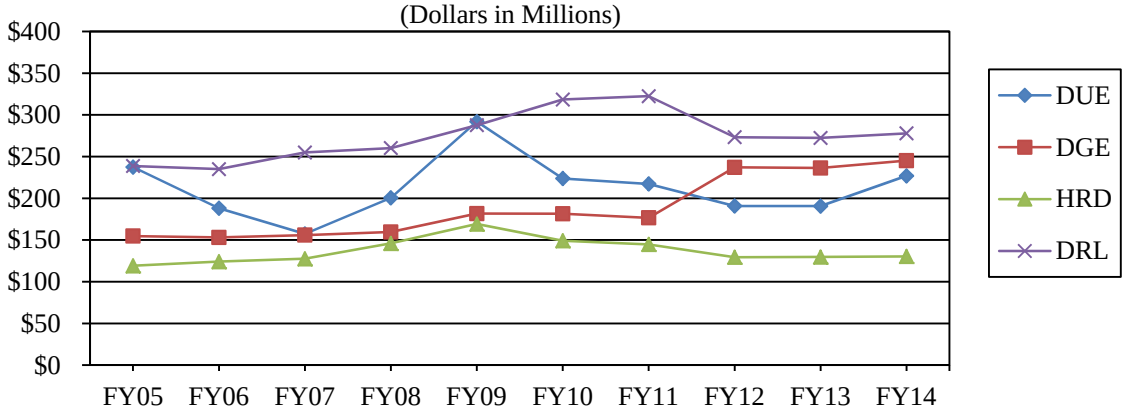
Totals may not add due to rounding.
Funding for the FY 2012 Actual and the FY 2012 Enacted/Annualized FY 2013 CR are shown in the FY 2014 structure for comparability.

About EHR

The Directorate for Education and Human Resources (EHR) makes investments toward a vision of a healthy and vital national science, technology, engineering, and mathematics (STEM) enterprise. The directorate works toward that vision through its mission, which is to support the preparation of a diverse, globally competent STEM workforce and a STEM-literate citizenry through investment in research and development on STEM education and learning.

Opportunities to learn STEM effectively – for people of all ages, from all corners of the Nation, and in many venues (e.g. classrooms and living rooms; science centers and virtual centers) – are the foundation for that scientifically literate society and strong scientific workforce. These in turn are the basis for keeping our Nation globally competitive, prosperous, and secure. EHR provides the focus for NSF's investments to advance STEM learning, scientific literacy, and a globally competitive science and engineering workforce.

EHR Subactivity Funding
(Dollars in Millions)



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

Appropriations Language

For necessary expenses in carrying out science, mathematics and engineering education and human resources programs and activities pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services as authorized by 5 U.S.C. 3109, authorized travel, and rental of conference rooms in the District of Columbia, ~~$875,000,000~~*$880,290,000,* to remain available until September 30, ~~2014.~~*2015*.

Education and Human Resources
FY 2014 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Carryover/ Recoveries	Adjustments to Prior Year Accounts	Total Resources	Obligations/ Estimates
FY 2012 Appropriation	$829.00	$0.22	$6.49	$835.71	$830.54
FY 2012 Enacted/ Annualized FY 2013 CR[1, 2]	834.07	0.96		835.03	835.03
FY 2013 Request	880.29			880.29	880.29
$ Change from FY 2012 Enacted					$51.29
% Change from FY 2012 Enacted					6.2%

Totals may not add due to rounding.

[1]This budget line includes an adjustment for an item specific to the FY 2013 continuing resolution: $5.07 million for the 0.612 percent increase provided by the continuing resolution.

[2]Congressional EHR carryover is $0.96 million; Reimbursable carryover (not shown) is $4.20 million for a total of $5.17 million.

Explanation of Carryover

Within the **Education and Human Resources (EHR)** account, NSF carried over $960,000 (2-year: $330,000 and no-year: $630,000) into FY 2013 for awards and contracts that were not ready for obligation in FY 2012. Obligation of these funds is expected by the end of the third quarter of FY 2013.

FY 2014 EHR Summary

The FY 2014 Request concentrates EHR investments into three categories that form a strategic framework for the directorate's mission. Within each of these categories, EHR will continue to build and emphasize its research and development activities and prioritize other activities such as the National Science and Technology Council's Committee on STEM Education (CoSTEM); collaborations with other U.S. Departments, including the U.S. Department of Education; and partnerships with federal science mission agencies to address national priorities in STEM education.

- **Learning and learning environments:** Investments in this category seek to develop understanding of the cognitive, affective, and non-cognitive foundations of STEM learning; to study emerging contexts and tools for learning STEM concepts and skills; and to build environments that promote new, high-impact learning opportunities for tomorrow's scientists and engineers, as well as citizens and students living in an increasingly technology-oriented society.

- **Broadening participation in STEM:** Programs in this category capitalize on the Nation's diversity in order to increase the scientific workforce by engaging and building capacity in *all* people in STEM

learning and professional training, particularly those from groups that have been traditionally underrepresented in STEM fields – Blacks, Hispanics, Native Americans, women, and people with disabilities, English-language learners, and veterans.

- **STEM professional workforce:** Workforce investments are intended to improve the education and preparation of a STEM professional workforce that will be ready to capitalize on unprecedented advances in technology and science, and to address global, social, and economic challenges yet to be imagined.

Investment in these strategic categories will balance and bring additional coherence to the EHR portfolio with an eye toward impact and improved evidence. This framework positions the directorate to more readily respond to emerging opportunities created by new technologies, improvements in the STEM-education evidence base, Administration priorities, and other national or societal needs.

As part of its strategic improvement process, NSF is collaborating with the White House Office of Science and Technology Policy to address national priorities in STEM education through a coordinated STEM education investment strategy. In the past year, significant progress has been made on the National Science and Technology Council's Committee on STEM Education (CoSTEM) 5-year strategic plan. The coordination strategies and the priorities introduced in the update to Congress in February 2012[1] are reflected in this request. In particular, the CoSTEM emphasis on using, amassing, and improving evidence in education research and development, the priority to transform undergraduate education, and the commitment to strengthen the STEM workforce through graduate education, have shaped EHR's FY 2014 Budget Request.

FY 2014 Summary by Division

EHR's Core Research and Development (R&D) activity will continue in FY 2014, through an EHR-wide program. Each division will have intellectual and program leadership for separate components of the core R&D activity.

In FY 2014, three EHR programs will be assigned to divisions different from their current placement to ensure better alignment with division missions. The Project and Program Evaluation (PPE) and Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) programs will be transferred from the Division of Research on Learning in Formal and Informal Settings (DRL) to the Division of Graduate Education (DGE). The CyberCorps: Scholarship for Service (SFS) program will be based in DGE, transferring from the Division of Undergraduate Education (DUE).

- The Division of Research on Learning in Formal and Informal Settings (DRL) will continue to support the development of innovative resources, models, and tools for K-12 STEM education; fundamental research on STEM learning; experiences that enable lifelong STEM learning inside and outside of school; teacher learning; research on national STEM education priorities; and evaluation studies and activities. In FY 2014, the Discovery Research (DR-K12) program will invest $15 million to further support early research, development, validation, and scale-up of evidence-based approaches to improve student learning of mathematics at the K-16 levels. This will take the form of a collaboration jointly administered by the Department of Education (ED) and EHR. Lead by DRL, a formal collaboration with the Computer and Information Science and Engineering (CISE) directorate will consolidate the former Math and Science Partnership (MSP) and Computing Education for the

[1] *Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education Investments: Progress Report.* A Report from the Federal Coordination in STEM Education Task Force Committee on STEM Education National Science and Technology Council, February 2012. http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc_federal_stem_education_coordination_report.pdf

21st Century (CE21) programs into the Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships) program in FY 2014. For core R&D, DRL will lead the focus on STEM learning.

- The Division of Graduate Education (DGE) invests in U.S. graduate students and innovative graduate programs to prepare tomorrow's leaders in STEM. The FY 2014 DGE budget includes a reorganization that incorporates graduate fellowship and traineeship priorities and emphases with strong ties to national priorities. The NSF Graduate Research Fellowship (GRF) program will be expanded into a National Graduate Research Fellowship program (NGRF) to incorporate features and opportunities that allow fellows to gain specialized experiences and training in key STEM areas. The proposed new NSF Research Traineeships program (NRT), which draws upon the fifteen–year old Integrative Graduate Education and Research Traineeship Program (IGERT) program, will allow for institutional traineeship program applications that focus on areas of need for both the federal government and the science and engineering enterprise, and that incorporate plans for transforming aspects of graduate programs and experiences at those institutions. For more information see the Major Investments in Science, Technology, Engineering, and Mathematics (STEM) Graduate Education narrative within the NSF-Wide Investments chapter. For core R&D, DGE will lead the focus on STEM professional workforce development.

- The Division of Undergraduate Education (DUE) provides NSF-wide leadership and expertise for transforming undergraduate STEM education to meet the needs of the 21st century through the use of evidence to improve undergraduate education. In FY 2014, DUE places a strong focus on supporting the Administration's goal of generating 100,000 new effective STEM teachers and one million more STEM graduates. In order to improve STEM education through the use and generation of evidence, the FY 2014 Budget Request includes a bold reorganization of STEM undergraduate education programs that will use existing resources more effectively through a streamlined and consolidated approach. A new NSF-wide activity, Catalyzing Advances in Undergraduate STEM Education (CAUSE), will consolidate several current DUE programs and undergraduate programs from NSF's Research and Related Activities (R&RA) account (see the CAUSE narrative in the NSF-wide Investments chapter for more detailed information). For core R&D, DUE will lead the focus on STEM learning environments.

- The Division of Human Resources Development (HRD) continues to build a diverse and well-qualified STEM workforce through broadening participation. HRD investments in Historically Black Colleges and Universities (HBCUs), Tribal Colleges and Universities (TCUs), and other minority-serving institutions remain critically important. The goal of the ADVANCE program is to develop systemic approaches to increase the representation and advancement of women in academic STEM careers, thereby contributing to the development of a more diverse science and engineering workforce. ADVANCE also has as its goal to contribute to and inform the general knowledge base on gender equity in the academic STEM disciplines. In FY 2014, HRD, through the ADVANCE program, supports the NSF Career Life Balance activity. HRD will lead the core R&D focus on broadening participation and capacity.

Major Investments

EHR Major Investments
(Dollars in Millions)

Area of Investment	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
CAUSE	[$71.93]	[$97.96]	$97.08	-$0.88	-0.9%
I-Corps	0.36	-	0.30	0.30	N/A
INSPIRE	0.64	-	2.00	2.00	N/A
NGRF	109.24	109.64	162.57	52.93	48.3%
SaTC	44.98	45.00	25.00	-20.00	-44.4%
SEES	6.00	6.00	0.50	-5.50	-91.7%

Major investments may have funding overlap and thus should not be summed.

- Catalyzing Advances in Undergraduate STEM Education (CAUSE): DUE will lead and support the CAUSE program, for which funding will be retained in individual directorates and offices. For more information see the CAUSE narrative within the NSF-Wide Investments chapter.
- NSF Innovation Corps (I-Corps): In FY 2014, DGE will continue to lead and support EHR's participation in this activity at a level of $300,000.
- Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE): In FY 2014 with DGE as the lead division, EHR will invest $2.0 million to support the development of STEM professionals in INSPIRE-supported research areas.
- National Graduate Research Fellowship (NGRF): Administered by DGE, the current Graduate Research Fellowship (GRF) program will become the NGRF program. It will operate under the same general framework and principles currently used in GRF, and will include consultation with other agencies to help ensure the most effective practices are used and suitable targeted opportunities are provided. The stipend, duration, and cost-of-education allowance will be same as the current GRF. A $52.93 million increase is requested in FY 2014 for a total investment of $162.57 million within EHR. An equivalent investment ($162.57 million) is provided through International and Integrative Activities (IIA) for a total NGRF investment of $325.14 million. Through this expanded program, NSF will be able to award approximately 700 additional fellows bringing the total estimated number of new fellowships awarded in FY 2014 to 2,700. For more information see the Major Investments in Science, Technology, Engineering, and Mathematics (STEM) Graduate Education narrative within the NSF-Wide Investments chapter.
- Secure and Trustworthy Cyberspace (SaTC): Through the CyberCorps: Scholarship for Service (SFS) program, the DGE will support SaTC at a level of $25.0 million.
- Science, Engineering and Education for Sustainability (SEES): In FY 2014, EHR will decrease its SEES support by $5.50 million to a level of $500,000 as Climate Change Education (CCE) program funding is shifted to CAUSE. The Division of Human Resources (HRD) will be responsible for EHR's SEES investments through the Centers of Research Excellence in Science and Technology (CREST) program.

Program Monitoring and Evaluation

STEM Education Program Evaluation:
EHR has implemented robust processes and structures for high-quality, appropriately rigorous program evaluation and affiliated monitoring systems for programs based in the directorate. An EHR-wide Evaluation Working Group has been established and enhanced expertise in evaluation, statistics, and/or assessment has been added to each division. In FY 2013, DGE assumed leadership for the EHR-wide Evaluation Working Group. In FY 2014, the group will expand its scope and will be prepared to offer assistance and resources to NSF Research and Related Activities (R&RA) programs engaged in STEM education, especially graduate education and human capital investments, as well as collaborate with the centralized NSF Evaluation Capability. In partnership with other groups within EHR and across NSF, DGE will continue an evaluation of the current mechanisms for supporting graduate students (e.g., research assistantships, fellowships, traineeships, centers, research training groups) to develop a comprehensive strategy to increase the impact of NSF's support for graduate students and graduate education.

An EHR Evaluation 5-year Strategic Plan that will address the following goals is being implemented in FY 2013:

1. Demonstrate leadership in evaluation by building and strengthening EHR's own evaluation capacity and becoming a leading resource on STEM-education evaluation across NSF and other federal agencies.
2. Use evidence frameworks to gather and apply evidence to evaluate and continuously improve EHR programs and policies.
3. Draw on NSF, federal, and field expertise to build, use, and disseminate a research base of best practices in education evaluation and the use of evidence in educational decision making.
4. Use best practices in education evaluation to institute consistent and coherent processes and policies for gathering and using performance data.
5. Develop state-of-the-art information systems for documenting, visualizing, analyzing, synthesizing and communicating EHR's research and development portfolio.

Emphases for FY 2014 will include collaboration with the NSF Evaluation Capability in evaluation of NSF human capital investments such as NSF's investment in graduate education and in research experiences for undergraduates. Given the CoSTEM's strong emphasis on the importance of building and using evidence, the evaluation group will also collaborate as appropriate with other Federal agencies engaged in STEM-education program evaluation as a means of sharing best practices, working toward the use of common metrics and instruments, and building collaborative expertise for STEM-education evaluation across agencies.

Committees of Visitors (COV) tentatively scheduled in FY 2013 and FY 2014:

- In FY2013, COVs will review Alliances for Graduate Education and the Professoriate (AGEP), Centers for Research Excellence in Science and Technology (CREST), Historically Black Colleges and Universities–Undergraduate Program (HBCU-UP), Louis Stokes Alliances for Minority Participation (LSAMP), and Tribal Colleges and Universities Program (TCUP) in HRD; and STEM Talent Expansion Program (STEP) and Transforming Undergraduate Education in STEM (TUES) in DUE.

- In FY2014, the following programs are scheduled to be reviewed by COVs: Advancing Informal STEM Learning (AISL), Innovative Technology Experiences for Students and Teachers (ITEST), and STEM-C Partnerships in DRL; NSF Scholarships in STEM (S-STEM) and CyberCorps: Scholarship for Service (SFS) in DUE; IGERT in DGE; and ADVANCE in HRD.

Workshops and Reports:
Following the 2011 National Research Council report *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*, NSF supported regional workshops on K-12 STEM education in Philadelphia, Las Vegas, Seattle, Chicago, and Baltimore. All of these were oversubscribed, and community response to these opportunities to engage with NSF-funded principal investigators in K-12 STEM education to discuss promising practices was very positive. Congress requested that NSF identify models for tracking progress toward achieving the report's recommendations. In response, the NRC convened the Committee on an Evaluation Framework for Successful K-12 STEM Education, which released a report in November 2012, *Monitoring Progress Toward Successful K-12 STEM Education: A Nation Advancing?* EHR's senior leadership has reviewed that report's recommendations and is engaging in discussions with key stakeholders to launch an implementation plan in FY 2013. (www.nap.edu/catalog.php?record_id=13509)

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see that chapter for additional information.

Number of People Involved in EHR Activities

	FY 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	7,246	6,200	6,500
Other Professionals	2,262	2,600	2,700
Postdoctorates	185	200	300
Graduate Students	12,004	8,600	12,000
Undergraduate Students	8,648	5,500	5,600
K-12 teachers	40,059	47,600	48,300
K-12 Students	81,952	84,500	85,800
Total Number of People	152,356	155,200	161,200

DIVISION OF RESEARCH ON LEARNING IN FORMAL AND INFORMAL SETTINGS (DRL) — $277,870,000 / +$5,440,000 / 2.0%

DRL Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, DRL	**$273.23**	**$272.43**	**$277.87**	**$5.44**	**2.0%**
Learning and Learning Environments	**162.00**	**160.63**	**160.35**	**-0.28**	**-0.2%**
Core Research and Development	-	-	10.00	10.00	N/A
Discovery Research K-12 (DR-K12)	99.57	99.23	102.53	3.30	3.3%
Advancing Informal STEM Learning (AISL)	62.43	61.40	47.82	-13.58	-22.1%
Broadening Participation in STEM	**54.16**	**54.72**	**60.44**	**5.72**	**10.5%**
Research on Education and Learning (REAL)	54.16	54.72	60.44	5.72	10.5%
STEM Professional Workforce	**57.07**	**57.08**	**57.08**	**-**	**-**
Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships) [formerly Math and Science Partnership (MSP)]	57.07	57.08	57.08	-	-

Totals may not add due to rounding.

Funding for the FY 2012 Actual and the FY 2012 Enacted/Annualized FY 2013 CR are shown in the FY 2014 structure for comparability.

The Division of Research on Learning in Formal and Informal Settings (DRL) will lead the directorate in research and development on STEM learning through investments in several programs: DR-K12, AISL, STEM-C Partnerships, and REAL. DRL will also engage with the other EHR divisions through the Core Research and Development (R&D) activity, focusing its expertise primarily in the areas of learning and the related aspects of learning environments. While DRL-funded research is likely to be situated in institutional and social settings and may involve development of learning resources, tools, and model learning environments, the principal goal is to characterize the STEM learning process in all its forms, by the full range of learners, in a full range of settings. This includes development of innovative and effective approaches and instruments for promoting and assessing learning. A particular focus is on understanding how to improve STEM learning and education opportunities for all learners, including those from groups traditionally underrepresented in STEM – especially women, minorities, persons with disabilities, English-language learners, and veterans.

DRL will invest in new areas of research and development driven by recent changes in modalities of schooling, which include open online courses, data-driven decision making using massive heterogeneous data sets, new STEM curricula using scientific big data, new cyberlearning capabilities, and new data and video analysis capabilities.

DRL will collaborate across the directorate in FY 2014 to emphasize:

- Understanding STEM learning in the context of emerging cyberinfrastructure, which is transforming STEM practices, STEM learning, and assessment;
- Understanding learning by learners traditionally underrepresented in STEM, including women and persons with disabilities;
- Understanding STEM learning in a variety of settings (e.g., homes, formal institutions, informal institutions), including learning that cuts across multiple settings and studies that involve the development and implementation of innovations in learning;

- Advancing assessment of STEM learning using a variety of approaches and resources, especially with the advent of common core state standards in K-12 education; and
- Understanding STEM learning at the undergraduate level by building on the knowledge base generated by the REAL program, the National Academies report on discipline-based education research[2], the PCAST report[3] on undergraduate education, and numerous activities underway within and outside of NSF, including funded synthesis projects, workshops, and seminars.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Learning and Learning Environments

- DRL will provide strategic direction and program guidance for the STEM Learning component of EHR's Core R&D activity and is working with the other EHR divisions to release a single Core R&D solicitation. DRL will invest $10.0 million in this activity in FY 2014.
- Requested funding for DR-K12 is slightly above the FY 2012 Enacted level (+$3.30 million to a total of $102.53 million).
- AISL (-$13.58 million to a total of $47.82 million) will focus on research, model-building, and development activities to better understand effective means and innovative models for engaging today's young people and adults in learning science outside of school settings, including museums, science centers, and other informal learning venues.

Broadening Participation in STEM

- REAL is increased $5.72 million to a total of $60.44 million. The requested increase will allow greater emphasis on investments in research and development on STEM learning. Cyberlearning and the use of big data will be a priority as will projects that focus on issues related to broadening participation in STEM, particularly for women and persons with disabilities.

STEM Professional Workforce

- In FY 2014, DRL will formalize a collaboration with the Computer and Information Science and Engineering (CISE) directorate to combine the former Math and Science Partnership (MSP) program and the Computing Education for the 21st Century (CE21) program into the Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships) program. DRL's investment remains at the FY12 Enacted level of $57.08 million and with CISE's investment of $16.50 million, the total funding for STEM-C Partnerships is $73.58 million in FY 2014. Through STEM-C Partnerships, EHR will continue investing in activities that are designed to further understanding of the preparation and continuing education of STEM teachers and will build upon opportunities provided by new technologies that enable innovative STEM teaching and learning. In collaboration with CISE, investments will also be made with the joint goal of increasing the pool of K-16 students and teachers who develop and practice computational competencies in a variety of contexts, and increasing the pool of early postsecondary students who are engaged and have the background in computing necessary to successfully pursue degrees in computing-related and computationally-intensive fields of study.

[2] National Research Council. *A Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering*. Washington, D.C.: The National Academies Press, 2012.

[3] President's Council of Advisors on Science and Technology (February 2012). *Engage to Excel, Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.* Washington, DC.

DIVISION OF GRADUATE EDUCATION (DGE) $245,150,000
+$8,860,000 / 3.7%

DGE Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, DGE	**$237.37**	**$236.29**	**$245.15**	**$8.86**	**3.7%**
Learning and Learning Environments	**23.22**	**23.50**	**23.95**	**0.45**	**1.9%**
Climate Change Education (CCE)	5.50	5.50	-	-5.50	-100.0%
Project and Program Evaluation (PPE)[1]	17.72	18.00	23.95	5.95	33.1%
STEM Professional Workforce	**214.14**	**212.79**	**221.2**	**8.41**	**4.0%**
Core Research and Development	-	-	5.00	5.00	N/A
CyberCorps: Scholarship for Service (SFS)[2,3]	44.98	45.00	25.00	-20.00	-44.4%
NSF Innovation Corps (I-Corps)	0.36	-	0.30	0.30	N/A
INSPIRE[1]	0.64	-	2.00	2.00	N/A
National Graduate Research Fellowship (NGRF)	109.24	109.64	162.57	52.93	48.3%
Graduate STEM Fellows in K-12 Education (GK-12)	27.92	26.95	-	-26.95	-100.0%
NSF Research Traineeship (NRT)[4]	31.01	31.20	26.33	-4.87	-15.6%

Totals may not add due to rounding.

Funding for the FY 2012 Actual and the FY 2012 Enacted/Annualized FY 2013 CR are shown in the FY 2014 structure for comparability.

[1] In FY 2014, Project and Program Evaluation (PPE) and INSPIRE are transferred from the Division of Research on Learning in Formal and Informal Settings (DRL) to the Division of Graduate Education (DGE).

[2] In 2012, the Department of Justice officially changed Federal Cyber Service: Scholarship for Service (SFS) to CyberCorps: Scholarship for Service (SFS). The term CyberCorps also was registered with the U.S. trademark office for use by the federal government.

[3] In FY 2014, CyberCorps: Scholarhips for Service/Cybercorps (SFS) is transferred from the Division of Undergraduate Education (DUE) to the Division of Graduate Education (DGE).

[4] NSF Research Traineeships (NRT) is a new program.

The Division of Graduate Education (DGE) supports U.S. graduate students and innovative graduate programs to prepare tomorrow's leaders in science, technology, engineering, and mathematics (STEM). The FY 2014 DGE emphases will include:

- Advancing the knowledge and evidence base for the most effective preparation of STEM professionals;
- Developing strategies for evaluating the impact of NSF's human capital investments in STEM professionals;
- Leveraging and linking current NSF investments to increase the NSF impact on preparation of STEM professionals by phasing out the IGERT program and introducing the new, NSF Research Traineeships (NRT) program; and
- Expanding the Graduate Research Fellowship (GRF) program into a National Graduate Research Fellowship (NGRF) program to include targeted experiences that will equip fellows from a range of STEM fields, including those fields of particular interest to Federal science mission agencies, with specialized skills and knowledge.

In FY 2014, NSF will challenge the community to expand innovation in graduate education through the NSF Research Traineeships (NRT) program, the successor to the current IGERT program. This program will build on what has been learned in the GK-12 program, IGERT, and in other national and NSF-sponsored efforts, such as the NSF Year of Dialogue, using the traineeship approach. Funded projects will support trainees and will be expected to design, implement, and study the implementation and impact of innovative practices, curricula, learning and research experiences, and graduate education policies through model traineeship programs. NSF will especially seek transformative approaches to graduate education that keep pace with science in emerging fields.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Learning and Learning Environments

- In FY 2014, Climate Change Education (CCE) resources ($5.50 million) are redirected to the newly proposed Catalyzing Advances in Undergraduate STEM Education (CAUSE) program in the Division of Undergraduate Education (DUE). For more information on CAUSE, please see the NSF-Wide Investments chapter.
- The leadership of the Project and Program Evaluation (PPE) program transfers from the Division of Research on Learning in Formal and Informal Settings (DRL) to DGE. A total of $23.95 million will allow for continuity and further development of the program.

STEM Professional Workforce

- DGE will lead the STEM Professional Workforce Preparation component of EHR's core R&D activity. The National Research Council report[4] on research universities shaped EHR's thinking about the STEM professional workforce, and the focus of this component extends beyond the graduate level to include the development of a range of STEM professionals, such as technicians, STEM teachers, undergraduate-level entrants to the STEM workforce, and others. This body of R&D will lead to a portfolio that supports implementation of successful approaches, practices, and models for STEM professional workforce preparation. DGE will work with other EHR divisions to release a single Core R&D solicitation. DGE will invest $5.0 million in this activity in FY 2014.
- In FY 2014, leadership of SFS transfers from the Division of Undergraduate Education (DUE) to DGE. A total of $25.0 million will allow for continuity of the program to develop the scientific and technical workforce in the field of cybersecurity, and to continue key collaborations with other agencies that have a direct interest in the preparation of the cybersecurity workforce, primarily the Department of Homeland Security.
- INSPIRE is funded at $2.0 million. In FY 2014, this program will transfer from DRL to DGE to be better aligned with STEM professional workforce development considerations.
- In FY 2014, funds are not requested for GK-12, as all financial out-year obligations will be completed as planned in FY 2013.
- This FY 2014 Budget Request includes initial steps towards re-thinking of investments in STEM graduate education programs in order to use existing resources more effectively, to eliminate redundancy, and to streamline the administration of programs.
    - The current Graduate Research Fellowship (GRF) program will become the National Graduate Research Fellowship (NGRF) program. NGRF will operate under the same general framework and principles currently used in GRF, and will include consultation with other agencies to help ensure the most effective practices are used and suitable targeted opportunities are provided. A

[4] National Research Council. *Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security*. Washington, DC: The National Academies Press, 2012.

$52.93 million increase over the FY 2012 Enacted is requested for a total EHR investment of $162.57 million. An equivalent investment ($162.57 million) is provided through International and Integrative Activities (IIA) for a total NGRF investment of $325.14 million. Through this expanded program, NSF will be able to award approximately 700 additional fellows bringing the total estimated number of new fellowships awarded in FY 2014 to 2,700. NGRF will address, as appropriate, the emphases and preparation needs in a number of other federal fellowship programs. For more information see the Major Investments in Science, Technology, Education, and Mathematics (STEM) Graduate Education narrative in the NSF-wide Investments chapter.

- In collaboration with the Research and Related Activities (R&RA) directorates and offices, DGE will invest $26.33 million in graduate traineeships as IGERT evolves into a new program, NSF Research Traineeships (NRT), which will encourage strong, well-documented efforts at innovation and design of graduate programs to support growth within specific priority areas (e.g., cyberinfrastructure) and solid preparation of the trainees. For more information see the Major Investments in Science, Technology, Education, and Mathematics (STEM) Graduate Education narrative in the NSF-wide Investments chapter.

DIVISION OF HUMAN RESOURCE DEVELOPMENT (HRD) $130,300,000 +$670,000 / 0.5%

HRD Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, HRD	**$129.41**	**$129.63**	**$130.30**	**$0.67**	**0.5%**
Learning and Learning Environments	**78.79**	**78.86**	**74.86**	**-4.00**	**-5.1%**
ADVANCE	1.49	1.53	1.28	-0.25	-16.3%
ADVANCE: Career Life Balance (CLB)	-	-	0.25	0.25	N/A
Alliances for Graduate Education and the Professoriate (AGEP)	7.84	7.84	7.84	-	-
Centers for Research Excellence in Science and Technology (CREST)	24.21	24.24	20.24	-4.00	-16.5%
Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	31.85	31.94	31.94	-	-
Tribal Colleges and Universities Program (TCUP)	13.39	13.31	13.31	-	-
Broadening Participation in STEM	**45.48**	**45.62**	**50.62**	**5.00**	**11.0%**
Core Research and Development	-	-	5.00	5.00	N/A
Louis Stokes Alliances for Minority Participation (LSAMP)	45.48	45.62	45.62	-	-
STEM Professional Workforce	**5.14**	**5.15**	**4.82**	**-0.33**	**-6.4%**
Excellence Awards in Science and Engineering (EASE)	5.14	5.15	4.82	-0.33	-6.4%

Totals may not add due to rounding.

Funding for the FY 2012 Actual and the FY 2012 Enacted/Annualized FY 2013 CR are shown in the FY 2014 structure for comparability.

The Division of Human Resource Development (HRD) aims to grow the U.S. science, technology, engineering, and mathematics (STEM) workforce by supporting the broader participation and success of individuals currently underrepresented in STEM, building the capacity of the institutions that serve them, and conducting research on effective mechanisms and models for achieving both of those goals.

The division is committed to both knowledge building and application, including investing in the creation of new knowledge, innovations, and models for broadening participation in the STEM enterprise and translating these for use by stakeholders**.** The expansion of stakeholder institutional capacity to support and engage diverse populations in high-quality STEM education and research programs is critical and will be advanced by HRD's programs. Program investments will include the following:

- Supporting institutional capacity building models and strategies;
- Engaging the field in new approaches to broadening participation that can respond to changing demographics, including increased engagement with Hispanics and Hispanic-serving institutions;
- Advancing the knowledge base in broadening participation research;
- Examining model practices and their relationships to particular institution types;

- Working with the Division of Undergraduate Education (DUE) to further study issues related to persistence in STEM students, especially the role of community colleges in attracting and retaining underrepresented minority students, women, and persons with disabilities to STEM; and
- Providing intellectual and strategic leadership to government-wide implementation of the CoSTEM priority on improving STEM participation of underrepresented groups. This will occur through collaboration with HRD awardee institutions, particularly minority serving institutions, and synthesis of the knowledge base being developed through HRD investments.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Learning and Learning Environments

- HRD's STEM Learning and Learning Environments component will include investments from several existing programs (ADVANCE, AGEP, CREST, HBCU-UP, and TCUP). This portfolio provides the settings for building and implementing models that contribute to a coherent body of knowledge about successful approaches for broadening STEM participation and for building the institutional capacity needed to do so. CREST will see a decrease of $4.0 million to a total of $20.24 million, which will result in fewer center awards. This reflects an emphasis on working with other NSF centers programs, including the Science and Technology Centers and the Engineering Research Centers, to seek synergies with key HRD communities. In addition, CREST will support EHR's SEES-related activities in FY 2014 at a level of $500,000.

Broadening Participation in STEM

- HRD will take responsibility for providing strategic direction and program guidance for the Broadening Participation and Institutional Capacity component of EHR's core R&D activity and will work with other EHR divisions to release a single Core R&D solicitation. HRD will invest $5.0 million in this activity in FY 2014.
- To provide continuity in the LSAMP program, funding is sustained at the FY 2012 Enacted level, $45.62 million.

STEM Professional Workforce

- EHR will invest $4.82 million in the EASE program, a decrease of $330,000 from the FY 2012 Enacted funding level. This reduction is achieved through reduced contractual costs associated with program management.

DIVISION OF UNDERGRADUATE EDUCATION (DUE) $226,970,000
+$36,320,000 / 19.1%

DUE Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, DUE	**$190.54**	**$190.65**	**$226.97**	**$36.32**	**19.1%**
Learning and Learning Environments	**71.57**	**71.76**	**102.08**	**30.32**	**42.3%**
Core Research and Development	-	-	5.00	5.00	N/A
Catalyzing Advances in Undergraduate STEM Education (CAUSE)[1]	-	-	97.08	97.08	N/A
STEM Talent Expansion Program (STEP)[2]	24.30	24.30	-	-24.30	-100.0%
Widening Implementation and Demonstration of Evidenced-based Reforms (WIDER)[2]	8.21	8.00	-	-8.00	-100.0%
Transforming Undergraduate Education in STEM (TUES)[2]	39.06	39.46	-	-39.46	-100.0%
STEM Professional Workforce	**118.96**	**118.89**	**124.89**	**6.00**	**5.0%**
Advanced Technological Education	64.07	64.00	64.00	-	-
Robert Noyce Teacher Scholarship Program (NOYCE)	54.89	54.89	60.89	6.00	10.9%

Totals may not add due to rounding.

Funding for the FY 2012 Actual and the FY 2012 Enacted/Annualized FY 2013 CR are shown in the FY 2014 structure for comparability.

[1] Catalyzing Advances in Undergraduate STEM Education (CAUSE) is a new program proposed for FY 2014.

[2] In FY 2014, the STEM Talent Expansion Program (STEP), Widening Implementation and Demonstration of Evidenced-based Reforms (WIDER), and Transforming Undergraduate Education in STEM (TUES) are consolidated into the CAUSE program.

The Division of Undergraduate Education (DUE) invests in transforming undergraduate STEM education through research and development (R&D) work on design, development, implementation, and scaling of effective STEM learning and teaching knowledge and practices. DUE's objectives are to strengthen the science and engineering workforce and prepare all undergraduate students for an increasingly technological global society.

In FY 2014, the Division of Undergraduate Education (DUE) will lead the Foundation in initiating a major program, Catalyzing Advances in Undergraduate STEM Education (CAUSE), and will promote implementation of evidence-based practices while stimulating research related to innovative models seeking to enlarge that evidence base. CAUSE will integrate and leverage the investments of EHR's STEM Talent Expansion Program (STEP), Transforming Undergraduate Education in STEM (TUES) program, Widening Implementation and Demonstration of Evidenced-based Reforms (WIDER) program, and other NSF undergraduate programs funded through the Research and Related Activities (R&RA) account. CAUSE will combine the resources of the former programs for greater impact on implementation of and research about evidence-based instructional activities; design, implementation, and study of academic and community efforts to promote student persistence in STEM majors; and systemic transformation in higher-education practice in curricular and co-curricular student support. For more information see the CAUSE narrative in the NSF-Wide Investments chapter.

DUE addresses the national need for a well-prepared STEM workforce through its Robert Noyce Teacher Scholarship (NOYCE) and Advanced Technology Education (ATE) programs. Aside from scholarship support for students, the R&D emphases within ATE and the capacity-building tracks of NOYCE invest in the design and development of tools aimed at increasing and tapping the diversity of the STEM workforce. For instance, NOYCE investments provide effective STEM teacher preparation models that can serve as a foundation to achieve the Administration's goal of training 100,000 new teachers. Collaborating across agencies with the Department of Energy and the Department of Defense, DUE contributes to the Administration's National Network for Manufacturing Innovation regional hubs by leveraging ATE investments in advanced manufacturing areas.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Learning and Learning Environments

- DUE will provide strategic direction and program guidance for the STEM Learning Environments component of EHR's Core R&D activity and will work with other EHR divisions to develop a single solicitation. DUE will invest $5.0 million in this activity in FY 2014.
- Catalyzing Advances in Undergraduate STEM Education (CAUSE) is initiated at $97.08 million. The program will have "tracks" that align with the goals of the former individual programs within EHR and in the R&RA directorates. For more information, see the CAUSE narrative in the NSF-wide Investments chapter.

STEM Professional Workforce

- DUE requests a $6.0 million increase to a total of $60.89 million in FY 2014 over the FY 2012 Enacted level for the NOYCE program to support a new Broadening Participation in STEM track. This effort is a collaboration between the Division of Human Resources Development (HRD) and DUE and will be informed by the anticipated FY 2013 National Academy of Sciences report jointly funded by DUE and HRD which is exploring persistence issues. (http://sites.nationalacademies.org/DBASSE/BOSE/CurrentProjects/DBASSE_080405#.UUhppOjT30k) The expected release date of the report is Oct 15, 2014. Data supporting the need for such a program include the observation that two-year schools have more-diverse student bodies overall, but much lower retention rates than do four-year schools (20 percent vs. 43 percent, respectively). This activity will seek to understand the factors that support student persistence in two-year schools and the successful matriculation to and persistence in four-year schools. Projects will be supported to ascertain which practices promote the success of all students or particular groups of students underrepresented in STEM, such as the large and fast-growing numbers of Hispanic students in the United States. This program also will build on the knowledge generated by the NSF-U.S. Department of Education K-16 Mathematics Initiative, which is focusing on the transition from high school to higher education.
- Support for the ATE program is maintained at $64.0 million to provide for continuity of the program, as well as contribute to ongoing, cross-agency collaborations in advanced manufacturing initiatives.

EHR FY 2014 Realignment for Program Movement Between Divisions

(Dollars in Millions)

FY 2013 Structure	FY 2014 Request		FY 2014 Structue	FY 2014 Request
Undergraduate Education	**$154.89**		**Undergraduate Education**	**$226.97**
Core Launch:STEM Learning Environments	5.00		Core Launch:STEM Learning Environments	5.00
Advanced Technological Education (ATE)	64.00		Advanced Technological Education (ATE)	64.00
Robert Noyce Scholarship Program (NOYCE)	60.89		Robert Noyce Scholarship Program (NOYCE)	60.89
CyberCorps: Scholarship for Service (SFS)	25.00			
			Catalyzing Advances in Undergraduate STEM Education (CAUSE)	97.08
Transforming Undergraduate Education in STEM (TUES)	-		*TUES is consolidated into CAUSE*	-
STEM Talent Expansion Program (STEP)	-		*STEP is consolidated into CAUSE*	-
Widening Implementation and Demonstration of Evidence-based Reforms (WIDER)	-		*WIDER is consolidated into CAUSE*	-
Graduate Education	**$194.20**		**Graduate Education**	**$245.15**
Core Launch: STEM Professional	5.00		Core Launch: STEM Professional	5.00
NSF Innovation Corps (I-Corps)	0.30		NSF Innovation Corps (I-Corps)	0.30
Graduate Research Fellowship (GRF)	162.57		**National Graduate Research Fellowship (NGRF)**	162.57
Graduate STEM Fellows in K-12 Education (GK-12)	-		Graduate STEM Fellows in K-12 Education (GK-12)	-
Integrative Graduate Education and Research Traineeship (IGERT)	26.33		**NSF Research Traineeships (NRT)**	26.33
Climate Change Education (CCE)	-		*CCE is consolidated into CAUSE*	-
			CyberCorps: Scholarship for Service (SFS)	25.00
			INSPIRE	2.00
			Project and Program Evaluation (PPE)	23.95
Human Resource Development	**$130.30**		**Human Resource Development**	**$130.30**
Core Launch: Broadening Participation and Institutional Capacity in STEM	5.00		Core Launch: Broadening Participation and Institutional Capacity in STEM	5.00
Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	31.94		Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	31.94
Louis Stokes Alliances for Minority Participation (LSAMP)	45.62		Louis Stokes Alliances for Minority Participation (LSAMP)	45.62
Tribal Colleges & Universities Program (TCUP)	13.31		Tribal Colleges & Universities Program (TCUP)	13.31
Alliances for Graduate Education and the Professoriate (AGEP)	7.84		Alliances for Graduate Education and the Professoriate (AGEP)	7.84
Centers for Research Excellence in Science and Technology (CREST)	20.24		Centers for Research Excellence in Science and Technology (CREST)	20.24
ADVANCE (including CAREER Life Balance)	1.53		ADVANCE (including CAREER Life Balance)	1.53
Excellence Awards in Science and Engineering (EASE)	4.82		Excellence Awards in Science and Engineering (EASE)	4.82
Research on Learning in Formal and Informal Settings	**$303.82**		**Research on Learning in Formal and Informal Settings**	**$277.87**
Core Launch: STEM Learning	10.00		Core Launch: STEM Learning	10.00
Discovery Research K-12 (DR-K12)	102.53		Discovery Research K-12 (DR-K12)	102.53
Advancing Informatl STEM Learning (AISL)	47.82		Advancing Informatl STEM Learning (AISL)	47.82
Research on Education and Learning (REAL)	60.44		Research on Education and Learning (REAL)	60.44
Math and Science Partnership (MSP)	57.08		**Science, Technology, Engineering, and Mathematics, including Computing Partnerships (STEM-C Partnerships)**	57.08
INSPIRE	2.00			
Project and Program Evaluation (PPE)	23.95			
Catalyzing Advances in Undergraduate STEM Education (CAUSE)	97.08			
TOTAL, EHR	**$880.29**		**TOTAL, EHR**	**$880.29**

H-1B NONIMMIGRANT PETITIONER FEES **$100,000,000**
+$0 / 0%

In FY 2014, H-1B Nonimmigrant Petitioner Fees are projected to be $100.0 million, equal to the FY 2013 estimate.

H-1B Nonimmigrant Petitioner Fees Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2013 Estimate	FY 2014 Request	Change Over FY 2013 Estimate Amount	Change Over FY 2013 Estimate Percent
H-1B Nonimmigrant Petitioner Fees Funding	$94.16	$100.00	$100.00	-	-

Beginning in FY 1999, Title IV of the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277) established an H-1B Nonimmigrant Petitioner Account in the general fund of the U.S. Treasury for fees collected for each petition for alien nonimmigrant status. That law required that a prescribed percentage of funds in the account be made available to NSF for low-income scholarships; grants for mathematics, engineering, or science enrichment courses; and systemic reform activities. In FY 2005, Public Law 108-447 reauthorized H-1B funding. NSF was provided with 40 percent of the total H-1B receipts collected. Thirty percent of H-1B receipts (75 percent of the receipts that NSF receives) are to be used for a low-income scholarship program, Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM). Ten percent of receipts (25 percent of the receipts that NSF receives) are designated for support of private-public partnerships in K-12 education through Innovative Technology Experiences for Students and Teachers (ITEST).

- **Low-income Scholarship Program: S-STEM**. The S-STEM program provides institutions with funds for student scholarships to encourage and enable academically talented U.S. students demonstrating financial need to enter the STEM workforce or STEM graduate school following completion of an associate, baccalaureate, or graduate degree in fields of science, technology, engineering, or mathematics. The program emphasizes the importance of recruiting students to STEM disciplines, mentoring and supporting students through degree completion, and partnering with employers to facilitate student career placement in the STEM workforce.

  Since its inception the low-income scholarship program has received over 5,500 proposals from all types of colleges and universities and has made awards for 1,270 projects. In addition to scholarships, projects include student support activities featuring close involvement of faculty, student mentoring, academic support, curriculum development, and recognition of the students. Such activities are important in recruiting and retaining students in high-technology fields through graduation and into employment. In FY 2014, S-STEM projects will contribute to the knowledge base of scholarly research in education by carrying out research on factors (such as recruitment and retention of STEM students), which affect associate or baccalaureate degree attainment. S-STEM projects report much higher retention and graduation rates among scholarship students than among other STEM majors. Approximately 90 awards are anticipated in FY 2014, with an emphasis on increasing involvement of community colleges.

- **Private-Public Partnerships in K-12: ITEST**. The ITEST program invests in K-12 activities that address the current concern about shortages of STEM professionals and information technology workers in the U.S. and seeks solutions to help ensure the breadth and depth of the STEM workforce. ITEST funds activities for students and teachers that emphasize mathematics, science, and engineering careers, and emphasizes the importance of evaluation and research to understand the

impact of such activities. The program supports the development, implementation, testing, and scale-up of models, STEM robotics projects, and research studies to improve the STEM workforce and build a student's capacity to participate in the STEM workforce. The solicitation places emphasis on capturing and establishing a reliable knowledge base about the dispositions toward and knowledge about STEM workforce skills in U.S. students. .

Since its inception, the ITEST program has received 1,949 proposals and funded over 200 projects that allow students and teachers to work closely with scientists and engineers on extended research projects, ranging from biotechnology to environmental resource management to programming and problem-solving. Projects draw on a wide mix of local resources, including universities, industry, museums, science and technology centers, and school districts in order to identify the characteristics that attract a wide range of young people to STEM, especially those students not successful in traditional school settings. Through a projected $216 million federal investment since its establishment, ITEST impacts an estimated 225,000 students (grades K-12), 8,000 educators, and 3,000 parents, adult volunteers, and caregivers. Approximately 15 awards are anticipated in FY 2014.

H-1B Financial Activities from FY 2003 - FY 2012

(Dollars in Millions)

	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Receipts	**$65.34**	**$0.57**	**$83.68**	**$105.32**	**$107.36**	**$104.43**	**$88.66**	**$91.22**	**$106.11**	**$128.99**
Unobligated Balance start of year	**$63.45**	**$83.90**	**$29.10**	**$89.58**	**$98.19**	**$63.37**	**$50.83**	**$52.62**	**$50.15**	**$60.93**
Obligations incurred:										
Scholarships in Science, Technology, Engineering, and Mathematics[1]	25.30	33.91	0.54	80.95	100.04	92.40	61.22	75.96	77.67	72.57
Grants for Mathematics, Engineering or Science Enrichment Courses	16.27									
Systemic Reform Activities	5.00	2.50	2.72							
Private-Public Partnership in K-12[2]		20.87	22.69	18.45	45.90	28.72	27.86	20.85	18.62	21.59
Total Obligations	**$46.57**	**$57.28**	**$25.95**	**$99.40**	**$145.94**	**$121.12**	**$89.08**	**$96.81**	**$96.29**	**$94.16**
Unallocated Recoveries							2.20	3.12	0.96	3.55
Unobligated Balance end of year	**$82.22**	**$27.19**	**$86.83**	**$95.50**	**$59.61**	**$46.68**	**$52.62**	**$50.15**	**$60.93**	**$99.31**

Totals may not add due to rounding.

[1] In FY 2006, the Computer Science, Engineering, and Mathematics Scholarships (CSEMS) was renamed to Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM).

[2] P.L. 108-447 directs that 10 percent of the H-1B Petitioner funds go toward K-12 activities in volving private-publice partnerships in a range of areas such as materials development, student externships, math and science teacher professional development, etc.

Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM). The S-STEM program began in 1999 under P.L. 105-277. At this time, the program was named Computer Science, Engineering, and Mathematics Scholarships (CSEMS) and supported grants for scholarships to academically-talented, financially needy students pursuing associate, baccalaureate, or graduate degrees in computer science, computer technology, engineering, engineering technology, or mathematics. Grantee institutions awarded scholarships of up to $2,500 per year for two years to eligible students.

The CSEMS activity continued under the American Competitiveness in the 21st Century Act (P.L. 106-313) with a prescribed percentage of H-1B receipts (22 percent) which totaled approximately 59.5 percent of the total H-1B funding for NSF. P.L. 106-313 also amended P.L. 105-277 by increasing the maximum scholarship duration to four years and the annual stipend to $3,125.

Under the Consolidated Appropriations Act, 2005 (P.L. 108-447), the prescribed percentage of H-1B receipts available for the low income scholarship program was increased to 30 percent (approximately 75 percent of the total H-1B funding for NSF). Eligibility for the scholarships was expanded from the original fields of computer science, engineering, and mathematics to include "other technology and science programs designated by the Director." The maximum annual scholarship award amount was raised from $3,125 to $10,000. Language also was added allowing NSF to use up to 50 percent of funds "for undergraduate programs for curriculum development, professional and workforce development, and to advance technological education." Because of these changes, the program was renamed in 2006 from Computer Science, Engineering, and Mathematics Scholarships (CSEMS) to Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM).

Grants for Mathematics, Engineering, or Science Enrichment Courses. Authorized under Title IV of the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277), these funds provided opportunities to students for enrollment in year-round academic enrichment courses in mathematics, engineering, or science.

Systemic Reform Activities. Authorized under Title IV of the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277), these funds supplemented the rural systemic reform efforts administered under the former EHR Division of Educational System Reform (ESR).

Private-Public Partnerships in K-12. The American Competitiveness in the 21st Century Act (P.L. 106-313) amended P.L. 105-277 and changed the way petitioner fees were to be expended. P.L. 106-313 directed the remaining 40.5 percent of the total H-1B funding for NSF (15 percent of H-1B receipts) toward K-12 activities involving private-public partnerships in a range of areas such as materials development, student externships, and mathematics and science teacher professional development. The Information Technology Experiences for Students and Teachers (ITEST) program was developed as a partnership activity in K-12 to increase opportunities for students and teachers to learn about, experience, and use information technologies within the context of STEM, including information technology (IT) courses. In FY 2005, P.L. 108-447 reduced the prescribed percentage of H-1B receipts available for private-public partnerships in K-12 to 10 percent (approximately 25 percent of the total H-1B funding for NSF).

Explanation of Carryover

Within the H-1B Nonimmigrant Petitioner account (Mandatory), $99.31 million was carried over into FY 2013, which consisted of $29.66 million in ITEST and $69.65 million in S-STEM. The carryover includes $69.65 million in third quarter H-1B receipts (received in August 2012) and $18.88 million in fourth quarter receipts (received in November 2012). Since NSF receives the largest quarterly payment of H-1B visa fees in August, there is insufficient time to obligate the receipts on awards before the end of the fiscal year.

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

$210,120,000
$43,070,000 / 25.8%

Major Research Equipment and Facilities Construction Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
Major Research Equipment and Facilities Construction	$198.08	$197.06	$210.12	$13.07	6.6%
FY 2013 Adjustment[2]		-$28.98			
Total, MREFC	**$198.08**	**$168.08**	**$210.12**	**$43.07**	**25.8%**

Totals may not add due to rounding.

[1] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore, this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2] This budget line is included to adjust for two items specific to the FY 2013 continuing resolution: first is $1.02 million for the 0.612 percent increase provided by the continuing resolution; second is an adjustment for the $30.0 million transfer executed in FY 2012 from the Research and Related Activities account to the Major Research Equipment and Facilities Construction account that is not included in the FY 2013 continuing resolution calculation.

The Major Research Equipment and Facilities Construction (MREFC) account supports the acquisition, construction, and commissioning of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. Initial planning and design, and post-construction operations and maintenance of the facilities are funded through the Research and Related Activities (R&RA) account.

MREFC Account Funding, by Project

(Dollars in Millions)

	FY 2012[1] Actual	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request	FY 2015 Estimate	FY 2016 Estimate	FY 2017 Estimate	FY 2018 Estimate	FY 2019 Estimate
AdvLIGO	$20.96	$20.96	$14.92	-	-	-	-	-
ALMA	2.50	3.00	-	-	-	-	-	-
ATST	10.00	10.00	42.00	20.00	20.00	9.93	-	-
IceCube	1.52	-	-	-	-	-	-	-
LSST	-	-	27.50	89.76	89.18	55.26	55.56	48.03
NEON	60.30	60.30	98.20	91.00	80.64	-	-	-
OOI	102.80	102.80	27.50	-	-	-	-	-
MREFC Total	**$198.08**	**$197.06**	**$210.12**	**$200.76**	**$189.82**	**$65.19**	**$55.56**	**$48.03**

Totals may not add due to rounding.

[1] In FY 2012, $30.0 million was transferred from the Research and Related Activities (R&RA) account to the Major Research Equipment and Facilities Construction (MREFC) account, as provided by the Science Appropriations Act, 2012, P.L. 112-55.

[2] A full-year appropriation for this account was not enacted at the time the budget was prepared; therefore, this account was operating under a continuing resolution (P.L. 112-175). The amounts shown in FY 2013 are placeholders. Upon development of the FY 2013 Current Plan, the FY 2013 funding amounts for each project will be determined.

Modern and effective research infrastructure is critical to maintaining U.S. leadership in science and engineering. The future success of entire fields of research depends upon access to new generations of powerful research tools. Increasingly, these tools are large and complex, and have a significant information technology component.

NSF requires that a project represent an exceptional opportunity to enable research and education to be considered for MREFC funding. The project should be transformative in nature, with the potential to shift the paradigm in scientific understanding. The projects included in this budget request meet these criteria based on NSF and National Science Board review.

In FY 2014, NSF requests funding to continue construction of four projects: Advanced LIGO (AdvLIGO), Advanced Technology Solar Telescope (ATST), Ocean Observatories Initiative (OOI), and the National Ecological Observatory Network (NEON). NSF is planning to begin construction of one new project in FY 2014, the Large Synoptic Survey Telescope (LSST).

NSF maintains a "no cost overrun" policy: it requires that (1) the total cost estimate for each project at the preliminary design stage include adequate contingency to cover all foreseeable risks, and (2) any total project cost increases not covered by contingency be accommodated by reductions in scope, provided that the actual enacted funding levels have been consistent with the established project profiles.

NSF agency-wide procedures are designed to ensure that cost and contingency tracking and management processes are robust and that the project management oversight has sufficient authority to meet this objective. If total costs for a project are revised during construction for reasons other than inadequate funding, NSF will identify mechanisms for offsetting any cost increases in accordance with the no overrun policy. In addition, all of the projects funded through the MREFC account undergo major cost and schedule reviews as required by NSF guidelines.

Appropriations Language

For necessary expenses for the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including authorized travel, ~~$196,170,000~~$210,020,000, to remain available until expended.

Major Research Equipment and Facilities Construction
FY 2014 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Carryover/ Recoveries	Adjustments to Prior Year Accounts	Transfers[1]	Total Resources	Obligations / Estimates
FY 2012 Appropriation	$167.06	$0.88	$0.83	$30.00	$198.77	$198.08
FY 2012 Enacted/ Annualized FY 2013 CR[2]	168.08	0.69			168.77	168.77
FY 2014 Request	210.12				210.12	210.12
$ Change from FY 2012 Enacted						$43.07
% Change from FY 2012 Enacted						25.8%

Totals may not add due to rounding.

[1] $30.0 million was transferred from the Research and Related Activities (R&RA) appropriation under the transfer authority provided by the Administrative Provision of the Science Appropriations Act, 2012, P.L. 112-55.

[2] This line adjusts for two items specific to the FY 2013 continuing resolution: first is $1.02 million for the 0.612 percent increase provided by the continuing resolution; second is an adjustment for the $30.0 million transfer executed in FY 2012 from the Research and Related Activities account to the Major Research Equipment and Facilities account that is not included in the FY 2013 continuing resolution calculation.

Explanation of Carryover

Within the **Major Research Equipment and Facilities Construction (MREFC)** appropriation, $690,000 was carried over into FY 2013; however, the obligation of these no-year funds may be spread over several years.

- NSF carried over $510,000 for the Atacama Large Millimeter Array (ALMA) into FY 2013. The FY 2012 appropriation provided $3.0 million for ALMA construction, which represents the final amount necessary to complete funding for the 11-year project, totaling $499.26 million. The remaining $510,000 in FY 2012 MREFC will be obligated in FY 2013 to complete construction.

- NSF carried over $180,000 million for South Pole Station Modernization (SPSM) for closing-out costs.

The MREFC Account in FY 2014

The following pages contain information on NSF's ongoing projects in FY 2014, grouped by sponsoring organization. These are:

ADVANCED LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY — $14,920,000

The FY 2014 Budget Request for the Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO) is $14.92 million, which represents the seventh and final year of a seven-year project totaling an estimated $205.12 million. The project's scheduled end date is March 31, 2015.

Appropriated and Requested MREFC Funds for the Advanced Laser Interferometer Gravitational-Wave Observatory

(Dollars in Millions)

FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	FY 2015 Estimate	Total Project Cost
$32.75	$51.43	$46.30	$23.58	$20.96	$20.96	$14.92	-	$205.12

Totals may not add due to rounding.

[1] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L. 112-175). The amounts shown in FY 2013 are placeholders. Upon development of the FY 2013 Current Plan, the FY 2013 funding amount will be determined. The FY 2013 Request based on the project's funding profile is $15.17 million. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

Baseline History

NSF first requested FY 2008 construction funds for AdvLIGO through the MREFC account in the FY 2006 Budget Request to Congress. The original proposal, received in 2003, estimated a total construction cost of $184.35 million. A baseline review in June 2006 established the project cost at $205.12 million, based upon known budget inflators at the time and a presumed start date of January 1, 2008. A second baseline review held in June 2007 confirmed this cost, subject to changes in inflators. Final Design Review in November 2007 recommended that construction begin in FY 2008. The National Science Board approved the project at a cost of $205.12 million in March 2008, and the project began in April 2008.

AdvLIGO is the planned upgrade of the Laser Interferometer Gravitational-Wave Observatory (LIGO) that will allow LIGO to approach the ground-based limit of gravitational-wave detection. LIGO consists of the world's most sophisticated optical interferometers, operating at two sites 3,000 km apart: Hanford, WA and Livingston, LA. These interferometers measure minute changes in arm lengths resulting from the passing of wave-like distortions of spacetime called gravitational waves, caused by cataclysmic processes in the universe such as the coalescence of two black holes or neutron stars. LIGO is sensitive to changes as small as one one-thousandth the diameter of a proton over the 4-km arm length; AdvLIGO is expected to be at least 10 times more sensitive. The LIGO program has stimulated strong interest in gravitational-wave research around the world, producing vigorous programs in other countries that provide strong competition as well as highly beneficial collaborations. LIGO has pioneered and led the field of gravitational-wave detection, and a timely upgrade is necessary to sustain progress in this area.

Total Obligations for AdvLIGO

(Dollars in Millions)

	Prior Years[1]	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request	ESTIMATES FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
R&RA Obligations:									
Concept & Development	$40.74	-	-	-	-	-	-	-	-
Management & Operations	30.30	30.40	30.40	39.50	39.50	41.00	41.00	41.00	41.00
Subtotal, R&RA Obligations	$71.04	$30.40	$30.40	$39.50	$39.50	$41.00	$41.00	$41.00	$41.00
MREFC Obligations:									
Implementation	154.06	20.96	20.96	14.92	-	-	-	-	-
Subtotal, MREFC Obligations	$154.06	$20.96	$20.96	$14.92	-	-	-	-	-
TOTAL Obligations	**$225.10**	**$51.36**	**$51.36**	**$54.42**	**$39.50**	**$41.00**	**$41.00**	**$41.00**	**$41.00**

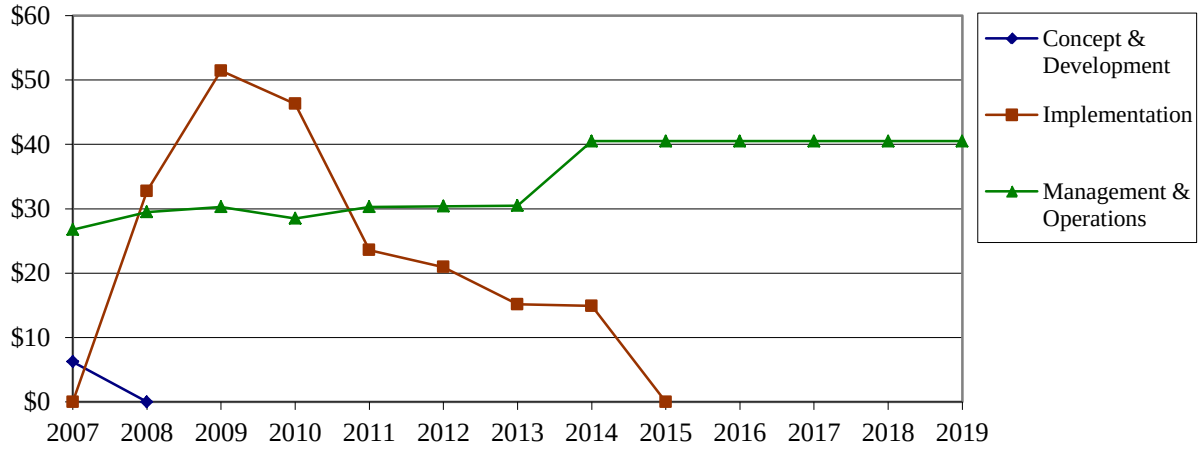
Totals may not add due to rounding.

[1] Concept & Development and Implementation funding is cumulative of all prior years; Management & Operations funding reflects the FY 2011 Actual only.

[2] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect the FY 2012 Enacted amount. The FY 2013 Request based on the project's funding profile is $45.67 million: $15.17 million for MREFC and $30.50 million for R&RA. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

AdvLIGO Funding, by Stage

(Dollars in Millions)



Note: Management & Operations refers to the continued operations of LIGO during the construction phase and the onset of operations for the newly constructed AdvLIGO planned for FY 2015.

Substantial connections with industry have been required for the state-of-the-art construction and measurements involved in the LIGO projects, with some partnerships leading to the development of new products and techniques. Areas of involvement include novel techniques for fabrication of LIGO's vacuum system, seismic isolation techniques, ultrastable laser development (new product introduced), high-power active optical components (new products), the development of new low-noise optical coatings, the development of new ultra-fine optics polishing techniques, and the development of new optical inspection equipment (new product).

LIGO has extensive international ties. The LIGO Scientific Collaboration, which sets the scientific agenda for LIGO, is an open collaboration of some 870 members that has formal ties with at least 77 institutions in 15 countries. Close collaboration is maintained with three other gravitational-wave observatories: GEO, a UK-German collaboration; Virgo, a French-Italian collaboration; and KAGRA, a nascent Japanese project. LIGO has signed an agreement with Virgo under which all data will be shared and analyzed cooperatively and all discoveries will be jointly credited. New technologies critical to AdvLIGO are being contributed by foreign institutions: the pre-stabilized laser source, funded and developed by the Max Planck Gesellschaft; the mirror/test mass suspension systems, funded and developed by the GEO collaboration; and auxiliary optical components, developed by the Australian National University and Adelaide University. At its August 2012 meeting, the National Science Board authorized a change in scope to the project that would permit the LIGO Laboratory to relocate one of the three planned interferometers to India. The associated changes in schedule, costs to NSF, and risk to the scientific program are minimal. The resulting global array, if realized, will be capable of locating the sky positions of gravitational-wave sources so that telescopes and particle detectors could perform rapid follow-up observations of the events; much more information about the sources could be obtained by such "multi-messenger" observations. Should the current strong expression of Indian interest result in their construction of a LIGO-like facility in which the AdvLIGO interferometer components would be installed, observations could begin some time after 2020. Should this opportunity not be realized, NSF will solicit proposals from the US gravity wave research community for their use.

Management and Oversight

- NSF Structure: NSF oversight is coordinated internally by a dedicated LIGO program director in the Division of Physics (PHY), working with staff from the Directorate for Mathematical and Physical Sciences (MPS); Offices of Budget, Finance, and Award Management (BFA); General Counsel (OGC); and Legislative and Public Affairs (OLPA). The Deputy Director for Large Facilities also provides advice and assistance. Formal reporting consists of quarterly and annual reports and brief monthly status reports submitted to the LIGO program officer, who in turn reviews, edits, comments, and submits the reports to the Deputy Director for Large Facility Projects.

- External Structure: LIGO is managed by the California Institute of Technology under a cooperative agreement with NSF. The LIGO Laboratory Directorate consists of the Executive Director, the Deputy Director, and the Spokesperson of the LIGO Scientific Collaboration (LSC). The Executive Director has overall responsibility for the LIGO Laboratory. The Deputy Director is responsible for executing the LIGO program and for organizing and directing the laboratory team. The LSC is responsible for assuring that the efforts of the LSC and LIGO Laboratory are well aligned. (The LSC carries out the LIGO advanced research and development program, the analysis of data, and the publication of scientific results, and it enables participation by collaborating external groups in appropriate LIGO activities). The Advanced LIGO construction project has its own management structure, which reports directly to the LIGO Executive Directorate. AdvLIGO management consists of a Project Leader, who is responsible for the overall management of the project, a Project Manager, who oversees construction, and the Systems Engineer, who is responsible for all project engineering.

Reviews

- Technical Reviews: NSF conducts annual scientific and technical reviews involving external reviewers, participates in meetings of the LIGO Scientific Collaboration (LSC), and conducts site visits to the Hanford, WA and Livingston, LA interferometers.
- Management, Cost, and Schedule Reviews: (1) AdvLIGO construction proposal review in 2003; (2) first baseline review in June 2006; (3) second baseline review in June 2007; (4) final readiness review in November 2007.
- Project Reviews: (1) First review of the active project in November 2008; (2) first annual review in

April 2009; (3) interim review in December 2009; (4) second annual review in April 2010; (5) interim review in December 2010; (6) third annual review in April 2011; (7) interim review in November 2011; (8) fourth annual review in April 2012, (9) interim review of LIGO's 2014-2018 operations proposal in November 2012. In April 2013, NSF will conduct a narrowly focused review of LIGO's plans to store the interferometer components anticipated for use in India. This will be followed about one month later by an annual review of construction progress.

Current Project Status

The National Science Board approved funding for AdvLIGO in March 2008, and the project began in April 2008. On October 20, 2010, the final LIGO science run ended and the facility was turned over to the AdvLIGO project for the installation of the advanced components. The project has pushed back two milestone dates, completion of installation at Livingston and at Hanford, by five months and one month, respectively, due to procurement difficulties; no impact on the project completion date is expected. Installation of major subassemblies is proceeding at both sites, and initial tests of interferometer sub-systems are in progress.

Cost and Schedule

The projected length of the project is seven years, with an 11-month schedule contingency. Advanced LIGO is currently 82 percent complete. Current project performance is consistent with ending on time and within budget. Total project contingency usage as of December 2012 was $28.20 million of the initial $39.10 million included in the $205.12 Total Project Cost.

Risks

The AdvLIGO project underwent a comprehensive external annual review in April 2012 followed by an interim review in December 2012. Based on these reviews, NSF program staff are confident that risk is being managed effectively but are monitoring progress, maintaining frequent communications with the project managers, and conducting frequent reviews.

Technical risks include uncertainties about such topics as eliminating parametric acoustooptic instabilities in the interferometers, minimizing thermal noise in the mirror optical coatings, mitigating possible degrading effects of the very high optical powers in the interferometers and input optics, and the maintenance and repair of a mature infrastructure. The LIGO Laboratory has been conducting research to minimize these and other risks, and an internal risk management team oversees these efforts. Some of these risks have been successfully retired. For example, a highly successful quantum-mechanical squeezing experiment demonstrated that the interferometer can attain its desired sensitivity at lower than planned optical power. Risk management is part of internal and biannual external reviews.

Management risks include the planned decommissioning and installation procedures as well as risks involving adherence to the project timelines and budget. NSF staff conduct weekly meetings with the project management to oversee the progress of the project. Monthly, quarterly, and annual reports, as well as annual reviews (supplemented by interim reviews), are also important project monitoring instruments. The project status is tracked with earned value management parameters.

Environmental risk is being effectively mitigated. The freely-suspended optical elements at the core of the observatory are carefully protected from earthquakes. Anthropogenic noise at the Livingston site due to logging and oil exploration has been mitigated by communication with local industry and by the early adoption of AdvLIGO seismic noise isolation technology.

Safety is maintained by strict adherence to institutional guidelines and to published LIGO Laboratory safety practices, overseen by dedicated safety officers at both sites. Hazard analysis is conducted before work is begun and mitigation is performed. External reviews have found satisfactory safety procedures.

Future Operations Costs

Future operations and maintenance costs for the LIGO laboratory, once construction is complete, are currently estimated to be $40.50 million per year, to be funded in the MPS Division of Physics.

Dr. Matt Heintze, a University of Florida and LIGO scientist, celebrates the installation of suspensions in AdvLIGO's most complex vacuum chamber at LLO. *Credit Caltech/MIT LIGO Laboratory*.

ADVANCED TECHNOLOGY SOLAR TELESCOPE $42,000,000

The FY 2014 Budget Request for the Advanced Technology Solar Telescope (ATST) is $42.0 million. The total project cost to NSF, $297.93 million, was finalized after a Final Design Review (FDR) in May 2009. The National Science Board approved an award for this amount at the NSF Director's discretion, contingent upon completion of compliance with relevant environmental and cultural/historic statutes. The environmental compliance requirements were completed on November 20, 2009, and the Record of Decision authorizing the construction was signed by the NSF Director on December 3, 2009. The Board on Land and Natural Resources (BLNR) approved the project's application for a Conservation District Use Permit (CDUP) on December 1, 2010. A challenge to the CDUP by a Native Hawaiian organization was resolved in November 2012 and full access to the site atop Haleakala on Maui, Hawaii followed shortly thereafter. Site preparation and excavation began in December 2012.

Appropriated and Requested MREFC Funds for the Advanced Technology Solar Telescope

(Dollars in Millions)

	FY 2009	FY 2010	FY 2011	FY 2012	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	FY 2015 Estimate	FY 2016 Estimate	FY 2017 Estimate	Total Project Cost
MREFC Approp.	$7.00	$13.00	$5.00	$10.00	$10.00	$42.00	$20.00	$20.00	$9.93	$151.93
ARRA MREFC Appropriation	146.00	-	-	-	-	-	-	-	-	146.00
Total, ATST	**$153.00**	**$13.00**	**$5.00**	**$10.00**	**$10.00**	**$42.00**	**$20.00**	**$20.00**	**$9.93**	**$297.93**

Totals may not add due to rounding.

[1] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders. Upon development of the FY 2013 Current Plan, the FY 2013 funding amount will be determined. The FY 2013 Request based on the project's funding profile is $25.0 million. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

Baseline History

ATST will enable the study of magneto-hydrodynamic phenomena in the solar photosphere, chromosphere, and corona. Determining the role of magnetic fields in the outer regions of the Sun is crucial to understanding the solar dynamo, solar variability, and solar activity, including flares and coronal mass ejections. These can affect civil life on Earth through the phenomena generally described as "space weather" and may have impact on the terrestrial climate. The relevance of ATST's science drivers was reaffirmed by the National Academy of Sciences 2010 Astronomy and Astrophysics Decadal Survey: *New Worlds, New Horizons* as well as the 2012 Solar and Space Physics Decadal Survey: *A Science for a Technological Society.*

Beginning in 2001, NSF provided funds to the National Solar Observatory (NSO) for an eight-year design and development program for ATST and its initial complement of instruments through the Division of Astronomical Sciences (AST) and the Division of Atmospheric and Geospace Sciences. The current design, cost, schedule, and risk were scrutinized in an NSF-conducted Preliminary Design Review (PDR) in October-November 2006. The FDR held in May 2009 determined that the project was fully-prepared to begin construction.

In FY 2009, $6.67 million was provided through the Research and Related Activities (R&RA) account. Of this total, $3.57 million in regular R&RA funds supported design activities to complete a construction-ready design. The remaining $3.10 million through the American Recovery and Reinvestment Act of 2009 (ARRA) supported risk reduction, prototyping, and design feasibility and cost analyses in areas

identified at preliminary and systems design reviews. Funding also provided for several new positions to complete preparation for the start of construction. Also in FY 2009, $153.0 million was provided through the Major Research Equipment and Facilities Construction (MREFC) account to initiate construction. Of these MREFC funds, $146.0 million was appropriated through ARRA. Given the timing of the receipt of budget authority and the complexity of project contracting, the entire $153.0 million was carried over from FY 2009 and subsequently obligated in FY 2010. Since then, the primary mirror blank has been purchased and contracts for the mirror's figuring and polishing have been let. Detailed design and fabrication contracts for the ATST major subsystems and instruments have been issued. A Habitat Conservation Plan, designed to protect and rehabilitate habitats of the endangered Hawaiian petrel and Hawaiian goose that could potentially be affected by the construction of the ATST, has been approved by the Hawaii Board on Land and Natural Resources. Formal consultation with the U.S. Fish and Wildlife Service with regard to the endangered Hawaiian Petrel was completed in calendar year 2011.

Because of the unexpected length of the delay associated with the environmental compliance process, an adjustment to the project baseline and total project cost is currently under consideration. This potential adjustment will not affect the amount requested for FY 2014, but future funding and total project cost requirements may change. These changes, if any, will be reflected in subsequent budget requests after review and approval by the National Science Board.

Total Obligations for ATST

(Dollars in Millions)

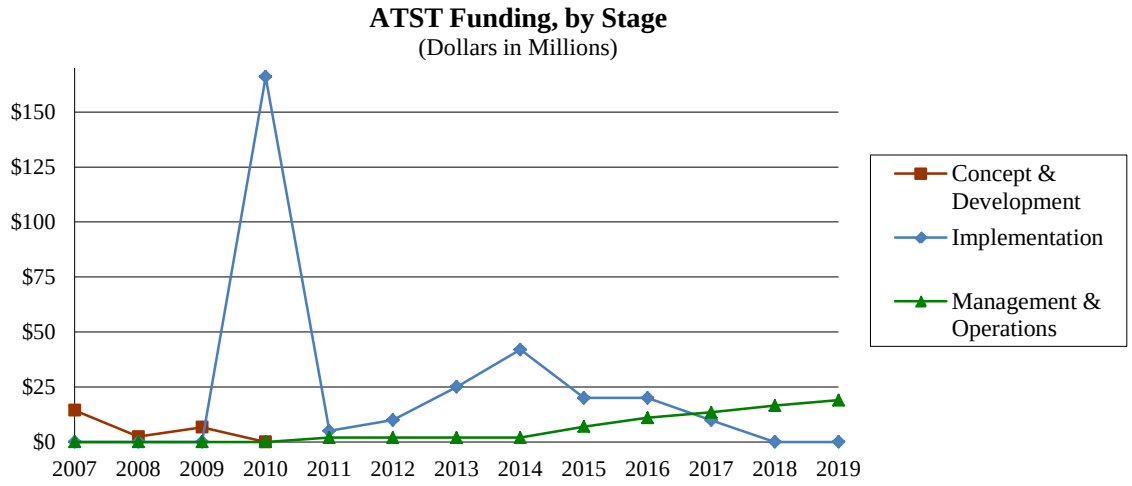
	Prior Years[1]	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request	ESTIMATES FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
R&RA Obligations:									
Concept & Development	$20.41	-	-	-	-	-	-	-	-
Management & Operations[3]	2.00	2.00	2.00	2.00	7.00	11.00	13.50	16.50	19.00
ARRA	3.10	-	-	-	-	-	-	-	-
Subtotal, R&RA Obligations	$25.51	$2.00	$2.00	$2.00	$7.00	$11.00	$13.50	$16.50	$19.00
MREFC Obligations:									
Implementation	25.00	10.00	10.00	42.00	20.00	20.00	9.93	-	-
ARRA	146.00	-	-	-	-	-	-	-	-
Subtotal, MREFC Obligations	$171.00	$10.00	$10.00	$42.00	$20.00	$20.00	$9.93	-	-
TOTAL Obligations	**$196.51**	**$12.00**	**$12.00**	**$44.00**	**$27.00**	**$31.00**	**$23.43**	**$16.50**	**$19.00**

Totals may not add due to rounding.

[1] Concept & Development and Implementation funding is cumulative of all prior years; Management & Operations funding reflects FY 2011 Actuals only.

[2] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L.112-175). The amounts shown for FY 2013 are placeholders and reflect the FY 2012 Enacted amount. The FY 2013 Request based on the project's funding profile is $27.0 million: $25.0 million for MREFC and $2.0 million for R&RA. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

[3] Of the total Management & Operations funding, $2.0 million per year for FY 2011 through FY 2020 is for cultural mitigation activities as agreed to during the compliance process.



The project is a collaboration of scientists and engineers at more than 20 U.S. and international organizations. Other potential partners include the Air Force Office of Scientific Research and international groups in Germany, the United Kingdom, and Italy. Now that there is firm funding for construction, details of these partnerships are being discussed. These include the following activities:

- The U.S. Air Force has replaced the aluminizing chamber at their Advanced Electro-Optical System telescope on Maui and sized it to accommodate the ATST primary mirror. This obviates the need to build an aluminizing chamber.
- Kiepenheuer-Institut fuer Sonnenphysik (Freiburg, Germany) is constructing a narrow-band visible tunable filter based first-light instrument.
- Queens University Belfast is considering contributing high speed cameras for ATST instrumentation.
- Arcetri Observatory (Italy) is considering the design and construction of an adaptive secondary (an upgrade to the current plans), as well as an infrared tunable filter.

Discussions of other possible contributions for second-generation instruments are continuing. Partner share of observing time on the facility will be calculated according to the value of their contributions.

Management and Oversight

- NSF Structure: Oversight from NSF is handled by a program manager in AST working with staff from the Directorate of Mathematical and Physical Sciences; Offices of Budget, Finance and Award Management; General Counsel; Legislative and Public Affairs; and the Division of Atmospheric and Geospace Sciences in the Directorate for Geosciences. The Deputy Director for Large Facilities also provides advice and assistance.
- External Structure: The project is managed by NSO. NSF funds NSO operation and maintenance and ATST design and development via a cooperative agreement with the Association of Universities for Research in Astronomy, Inc. (AURA). The ATST director is a senior NSO scientist who was a leader in the development of the science case and an expert in the field of solar adaptive optics, a critical technology for the ATST. The project manager has experience in several other NSF-funded large projects including ALMA and the Expanded Very Large Array. Several councils and working groups provide input from the solar and space physics communities.

Reviews

- Technical Reviews: Reviews have been conducted throughout the design and development phase. The preliminary design was found to be robust in the NSF-conducted Conceptual Design Review in

March 2005 and Preliminary Design Review in October-November 2006. The project has completed a comprehensive set of system-level design reviews for all major sub-systems.

- Management, Cost, and Schedule Reviews: ATST scope, schedule, budget estimate, and risk-adjusted total project cost were scrutinized and validated at the Preliminary Design and Final Design Reviews.
- The Final Design Review (FDR): The FDR was held on May 18-21, 2009 in Tucson, Arizona. The unanimous finding of the review panel was that the ATST project was fully prepared to begin construction.
- Re-baseline Review: A review of the revised project baseline was held in October 2012, and a decision on a new baseline is expected in summer 2013.

Current Project Status

Current activities include finalizing the detailed designs, ongoing fabrication of ATST subsystems and instruments, and site preparation and excavation.

Haleakala High Altitude Observatory on the island of Maui was chosen as the ATST site. The Final Environmental Impact Statement was submitted to the Environmental Protection Agency on July 24, 2009. Consultation with Native Hawaiian stakeholders has resulted in a fully-executed Programmatic Agreement that details steps to minimize impacts on the traditional cultural assets on Haleakala, thereby completing compliance with the National Historic Preservation Act. The record of decision authorizing the commencement of construction in FY 2010 was signed by the NSF Director and published in the Federal Register on December 9, 2009. All federal environmental compliance requirements are now complete. Highlights of construction include:

- Clearing of the ATST site and excavation of utility trenches began in December 2012, followed in January 2013 by the beginning of excavation for the ATST foundation.

- The primary mirror commissioning blank was delivered to the University of Arizona's College of Optical Sciences where it will be ground to its off-axis figure. The final blank is in production with delivery expected in 2014.

- The telescope mount assembly is in production at and the enclosure is being fabricated.

- Final designs for the first-light instruments are being completed by the instrument partners and prototyping of critical components is underway.

Cost and Schedule

The original baseline not-to-exceed, risk-adjusted cost was established following the FDR. A review of a revised project baseline was held in October 2012, and a decision on a new baseline is expected in summer 2013. Funding is derived from ARRA ($146.0 million) and annual appropriations in the MREFC account ($151.93 million). Initial awards of $146.0 million of ARRA and $20.0 million of MREFC funds were made via separate cooperative support agreements under the NSO management and operations cooperative agreement. Full science operations will begin in mid-2019.

Risks

Project management control, interface control, and change controls are in place. Delay in obtaining full access to the site and associated complexities and legal fees have impacted the total projected cost and schedule. These are being assessed in the current re-baselining activity and treated in accordance with the policies described at the beginning of this section.

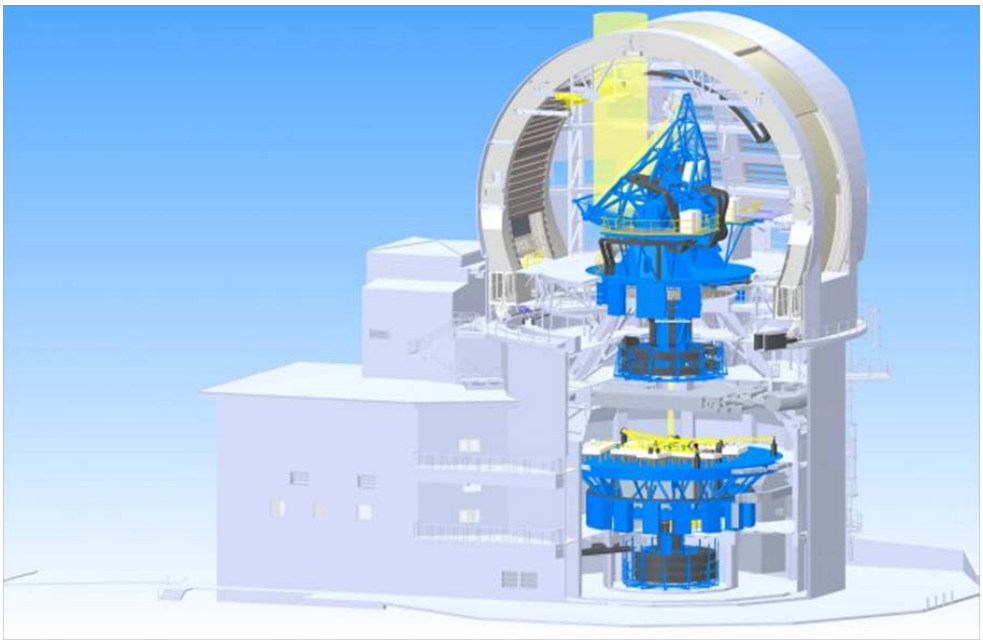
Technical: The remaining technical risk is very low as a result of the long design and development phase.

Environmental and Cultural Compliance: Given the recent history of telescope construction on mountains sacred to Native American and Native Hawaiian people, some delay in obtaining permission to begin construction was anticipated. However, the actual delay exceeded project estimates by more than 18 months. The Division of Astronomical Sciences, NSF's Office of the General Counsel, and the ATST project have worked carefully through the processes of the applicable statutes and a cultural monitor has been retained during construction. All required permits are in place.

Environmental Health and Safety: NSO has a well-developed safety program engendered in the ATST project. The ATST project has developed a site safety plan and conducted a thorough construction readiness review in 2011 and the first annual safety review in 2012.

Future Operations Costs

The estimated annual operations cost is $19.0 million in FY 2019, including $2.0 million annually for cultural mitigation. ATST will become the flagship solar telescope of NSO and will render some telescopes obsolete. About $5.0 to $7.0 million per year of NSO costs will be recovered from the closure or divestment of redundant facilities. NSO has a preliminary transition plan that will be revised and externally reviewed after construction begins. Cultural mitigation commitments have been made pursuant to terms of ATST environmental and cultural compliance as described in the final environmental impact study and the subsequent Record of Decision, and the Programmatic Agreement. These include $2.0 million of R&RA funding to be provided annually for 10 years for programs on Maui, supporting science, technology, engineering, and mathematics education and workforce development with an emphasis towards Native Hawaiian students. A ten-year award to develop and administer these programs was made to the University of Hawaii, Maui College (UHMC) in 2011.



Cutaway of the ATST enclosure showing the telescope and rotating instrument platform. *Credit: L. Phelps, NSO/AURA/NSF.*

LARGE SYNOPTIC SURVEY TELESCOPE $27,500,000

The FY 2014 Budget Request for the Large Synoptic Survey Telescope (LSST) is $27.50 million. This is the first year of support for an eight-year project that will begin in July 2014. The total project cost to NSF is estimated at $465.93 million. This project is being developed in partnership with the U.S. Department of Energy (DOE).

Appropriated and Requested MREFC Funds
for the Large Synoptic Survey Telescope

(Dollars in Millions)

FY 2014 Request	FY 2015 Estimate	FY 2016 Estimate	FY 2017 Estimate	FY 2018 Estimate	FY 2019 Estimate	FY 2020 Estimate	FY 2021 Estimate	Total Project Cost
$27.50	$89.76	$89.18	$55.26	$55.56	$48.03	$52.29	$48.35	$465.93

Totals may not add due to rounding.

Baseline History

Construction of the LSST is a joint NSF/DOE effort to realize an instrument that has been in design and development for over ten years, and which was ranked as the top large-scale ground based astronomy project by the National Academy of Sciences 2010 Decadal Survey.

Support for what became the LSST project began before the 2000 National Academy of Sciences (NAS) Decadal Survey of astronomy and astrophysics, where LSST was ranked as the third priority ground-based major project, and continued through to the 2010 NAS decadal survey, where LSST was ranked as the highest priority for "New Ground-Based Activities – Large Projects." Over $100 million has so far been invested by NSF, by NSF's primary federal partner – DOE, and by private partners. About two-thirds of this has gone to design and development and one third (from private funding) to early construction to buy down risk and procure long-lead-time items. In particular, casting, figuring, and preliminary polishing of the innovative combined primary-tertiary mirror, initial site preparation, and prototype detector creation and evaluation, have all significantly reduced any associated risks.

The project was baselined following a series of reviews conducted by NSF and DOE together in 2011 and 2012, and a special NSF/DOE review of the system interfaces between the scope funded by each agency and the means for project management of these interfaces. The risk-adjusted Total Project Cost (TPC) to NSF of $465.93 million reflects recommendations from Preliminary Design Review (PDR) and a subsequent cost estimation review. The updated construction plan synchronizes the DOE and NSF funding profiles and adds schedule contingency to the plan presented at PDR.

In addition to NSF's contribution, the overall estimated project cost in as-spent then-year dollars is $664.93 million, which includes an initial design estimate of $160.0 million from DOE for the camera and $39.0 million from non-federal sources, which has already been spent or committed. Operations costs, estimated in FY 2011 U.S. dollars, are $37.0 million per year with $19.0 million from NSF, $9.0 million from DOE, and the remainder from non-federal partners.

Total Obligations for LSST

(Dollars in Millions)

	Prior Years[1]	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request	ESTIMATES FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
R&RA Obligations:									
Concept & Development	$38.63	$4.50	$4.50	$6.50	-	-	-	-	-
Management & Operations	-	-	-	-	-	-	-	-	-
Subtotal, R&RA Obligations	$38.63	$4.50	$4.50	$6.50	-	-	-	-	-
MREFC Obligations:									
Implementation	-	-	-	27.50	89.76	89.18	55.26	55.56	48.03
Subtotal, MREFC Obligations	-	-	-	$27.50	$89.76	$89.18	$55.26	$55.56	$48.03
TOTAL Obligations	**$38.63**	**$4.50**	**$4.50**	**$34.00**	**$89.76**	**$89.18**	**$55.26**	**$55.56**	**$48.03**

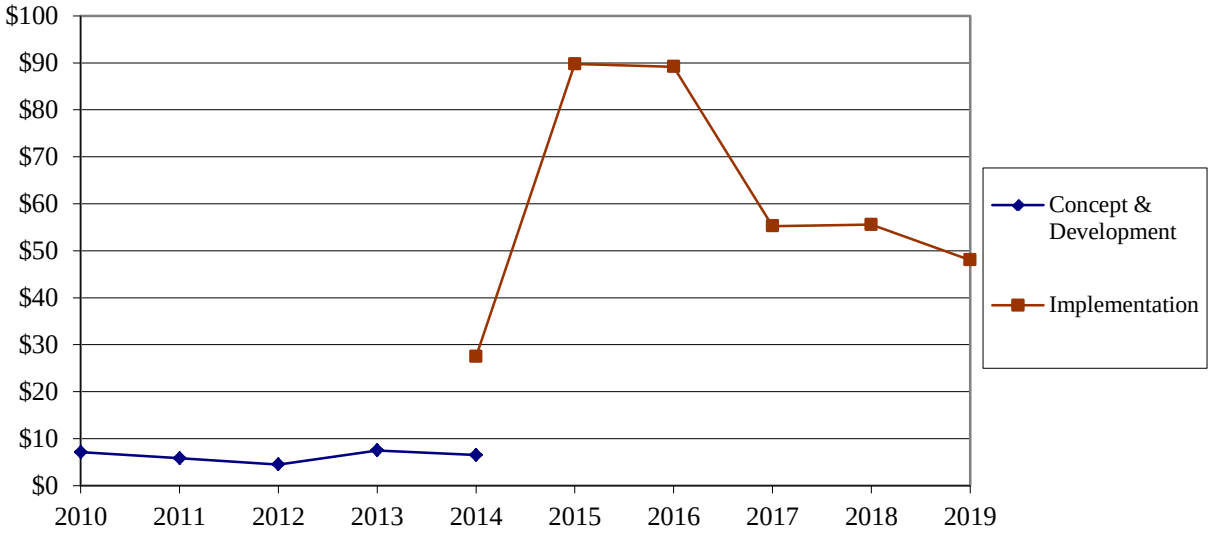
Totals may not add due to rounding.

[1] Concept & Development and Implementation funding is cumulative of all prior years; Management & Operations funding does not begin until FY 2020.

[2] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect the FY 2012 Enacted amount. The FY 2013 Request based on the project's funding profile is $7.50 million: $0.0 million for MREFC and $7.50 million for R&RA. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

LSST Funding, by Stage

(Dollars in Millions)



LSST will be an 8.4 meter primary, 6.7-meter effective aperture, special purpose optical telescope to be located on Cerro Pachón, Chile. The Chilean site was selected because of the excellent sky transparency and seeing, dark skies, small fraction of cloudy nights, and the geological characteristics that enable the rapid slew-and-settle cycle required to carry out the LSST survey. LSST will collect nearly 40 terabytes of multi-color imaging data every night for 10 years, producing a long-lived dataset of considerable utility. It will produce the deepest, widest-field sky image ever, and issue alerts for moving and transient objects within 60 seconds of their discovery. Principal science drivers include understanding the physics of dark energy and dark matter, detecting moderate red-shift supernovae, detecting and cataloging small

bodies in the solar system (including both potentially hazardous asteroids and distant objects in the outer solar system), studying the distances and motions of stars near the Sun, measuring the kinematics and structure of the galactic halo, and opening up the study of time-varying phenomena. Repeated deep imaging of every part of the accessible sky will turn up transient and explosive events such as cataclysmic variable stars, supernovae, and the optical counterparts of X-ray flashes, as well as less spectacular moving objects. An innovative citizen science program will involve people of all ages in LSST discoveries. The LSST survey will change every field of astronomical study, from the inner Solar System to the large scale structure of the Universe. No existing facility can provide the stability (both physical and optical), the ability to move rapidly across the sky with negligible 'setting time' lag before observing, and the very wide field, all of which are driven by the science goals. Several related but small science projects carried out on existing telescopes and on facilities not optimized for these features show clearly that this science can only be accomplished with this unique and ground-breaking facility.

LSST data will be widely accessible, and discovery opportunities will be available to the K-12 student as easily as to the professional astronomer. More than half of the cost during operations is for data management, including user-friendly interfaces tailored for the different anticipated communities. The survey strategy makes the same dataset usable for almost all of astronomy and for innovative education and public interest. The primary data archive will be located at the National Center for Supercomputing Applications, in Illinois.

Management and Oversight

- NSF Structure: Oversight from NSF is handled by a program manager in the Division of Astronomical Sciences working with staff from the Directorate of Mathematical and Physical Sciences; and the Offices of Budget, Finance and Award Management; General Counsel; and Legislative and Public Affairs. The Deputy Director for Large Facilities and other staff in the Large Facilities Office also provide advice and assistance. The NSF program manager works closely with counterparts in the DOE Office of High Energy Physics, who have oversight responsibility for the LSST Camera project. Coordination is accomplished through regular meetings of a Joint Oversight Group (JOG) and was formalized through a memorandum of understanding (MOU) between the agencies that was signed in July 2012.
- External Structure: The LSST Corporation (LSSTC) was established as a not-for-profit 501(c)3 Arizona corporation in 2003, solely to design, construct, and operate the Large Synoptic Survey Telescope (LSST). In 2011, the Association of Universities for Research in Astronomy (AURA) and LSSTC established the LSST Project Office (LSSTPO) as an AURA-managed center for the construction period. The LSST director and the LSST project manager are experienced in large facility construction and operation and are appointed by AURA, with the involvement and approval of the LSST Corporation and NSF.

Reviews

- Technical Reviews: Reviews have been conducted throughout the project. A Conceptual Design Review in September 2007 found the design to be robust. The PDR followed release of the 2010 National Academy of Sciences Decadal Survey and was completed in September 2011. The DOE Critical Decision (CD) review of the camera led to CD-1 approval in April 2012. All major sub-systems undergo regular system-level design reviews with external participants. Both NSF's Final Design Review (FDR) and DOE's CD-2 will further scrutinize these issues before final construction authorization.
- Management, Cost, and Schedule Reviews: Cost, schedule, and risk, were scrutinized by the PDR and by the DOE CD-1 review. The replanning required to comply with recommendations from those reviews was further verified by a Joint Interface and Management Review, and a Cost Estimation Review, both held in May 2012.

- FDR will be scheduled appropriately. Under the current schedule, this should occur in November or December 2013 or January 2014, to match the timescale needed for the required NSF and NSB procedures for obtaining approval to spend, anticipating a July 2014 construction start.
- Upcoming Reviews: Required agency-run reviews will be scheduled as the plan for construction start and the runout of construction funding become known.

Current Project Status

This project is currently addressing recommendations from PDR. Many of these recommendations were for activities that the project had already planned and that the team continues to develop. Continuing design and development (D&D) support is already included in DOE current and future budget requests and is being provided by NSF through reviewed and supported proposals. With this funding, the project is preparing bid packages for major work items and continuing with planning and design work, notably for the data management system, and development of pipeline data reduction algorithms and software. NSF- and DOE-supported activities remain tightly coordinated, both at the project level and between agency program managers, with regular meetings of sub-project managers, of the JOG, and between the JOG and the project.

Another focus is addressing a wide variety of data access, computation, and collaboration needs. Because there will be different communities of users, there will be various concurrent modes of access. Development of the data access policy continues and promising approaches are being considered. Transient alerts and 'postage stamp' images of the event will be made available within 60 seconds of detection without restriction; preprocessed single visit images will also be available without any proprietary period. There is also a planned annual release of higher level products, including stacked and calibrated images, and source and object catalogs. There is a separate procedure to develop data products suitable for the education and public outreach programs. Scientists and educators at U.S. or Chilean institutions and partners who contribute to the project would get access to all raw and processed data products immediately, while others would need to wait for expiration of proprietary periods still to be determined.

Cost and Schedule

The current estimated baseline not-to-exceed cost was established by replanning after the PDR and CD-1 reviews and validated by a subsequent cost estimation review. The year-by-year construction budget was planned so that the project could proceed at a rate constrained by the speed with which technical work could be accomplished, since this results in the lowest total project cost. There has been no scope change and only inflationary and marching army cost increases since the 2010 Decadal Survey, which included an independent cost estimation that arrived at essentially the same number supplied by the project. An updated cost and schedule baseline will be determined before the anticipated start of construction in July 2014.

Risks

Baseline cost, the project management control system, and the risk-based budget contingency percentage calculation, were validated by external review.

Technical: Much of the technical risk identified early in the project, including as late as the Conceptual Design Review, has now been retired by further design and development effort and by investment of private funds in preliminary construction, notably of the innovative combined M1/M3 mirror. Both PDR and CD-1 external reviewers identified the detectors in the camera as a possible source of risk, but in the months since those reviews, marked progress has been achieved and the risk is already significantly reduced. Nevertheless, the detector risk is being closely monitored at the project and agency levels. An additional risk was identified in the interface between the camera and the telescope and data systems, including mechanical interfaces subject to seismic, thermal and wind effects, and electrical and software

interfaces. To address this, the project, NSF, and DOE organized a Joint Interface & Management Review (May 2012), which found no problems and endorsed the current status and plans.

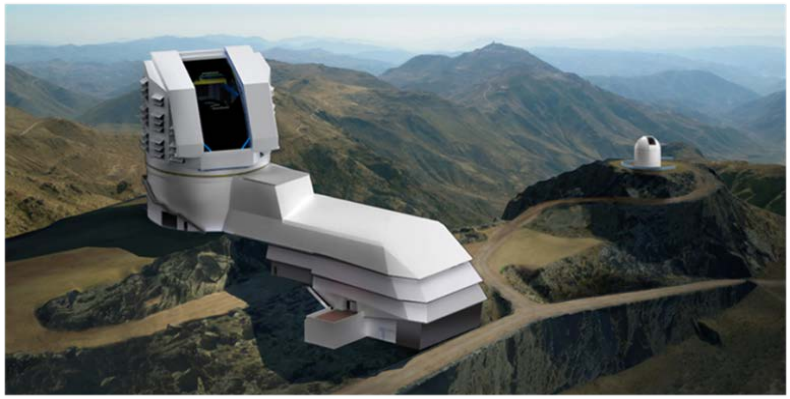
Environmental and Cultural Compliance: The Chilean environmental and cultural impact assessment has been completed and was reviewed and subsequently approved by NSF in October 2010, under Executive Order 12114 for extraterritorial projects. Mitigation work has started with the propagation of threatened plant species, ready for reintegration at the site. There are no further issues.

Site: The above assessment, and the subsequent finding equivalent to no significant impact, cleared the way for preliminary site work supported by non-federal funds. Local contractors have leveled the planned location for LSST and confirmed the results from the original test borings, finding no problems that could compromise the stability and rigidity of the mount as currently designed. There appear to be no remaining site risks.

Environmental Health and Safety: AURA operations in Chile have a long track record of safety, and continued vigilance leads to regular updates of the safety plans. DOE laboratories similarly have a strong safety culture. Privately funded early construction has proceeded without incident, including on-site blasting and complex mirror casting. The project has a preliminary safety plan which will be kept current during final preparations for full construction.

Partnership Risk: The project will be managed by a single project manager appointed by AURA under conditions to be included in NSF's cooperative agreement for the primary construction funding, and agreed to by DOE program management. The project director, also appointed by AURA and overseeing the entire project, is assisted by a deputy project director with complementary skills and experience. Budgetary management details will be clearly set out between the Project Director, the project manager, the project's change control board, the AURA Management Council for LSST, and the agency program managers, grant officers, and financial managers. The commitments by DOE and by NSF were officially recorded in an MOU between the agencies that was signed in July 2012. As noted there, the management structure treats the project as a single team and includes mechanisms and authority to make changes on either side of the DOE/NSF budgetary boundary, and even across that boundary if necessary. This therefore minimizes the risk of not obtaining the camera at all, or on a compromised schedule, and the JOG will be watching for any issues that might arise.

Operations Costs: The current estimate, in FY 2011 U.S. dollars, is $37.0 million per year. NSF and DOE have agreed to a nominal $28.0 million federal contribution, or $19.0 million and $9.0 million respectively. There will be a formal process to settle the operations plan and cost based on a proposal and review cycle run by the agencies approximately two years before the completion of construction. The project has spent some effort on possible scope reduction to shrink the total annual cost but has primarily focused on finding partners willing to contribute towards the $9.0 million difference. Letters of commitment have been received from some 68 institutions in 26 countries for a total annual contribution of over $10.0 million. NSF will begin negotiating binding agreements once NSF construction



A combination of photographs and renderings created this image of the LSST summit facility and of Calypso, the small adjacent atmospheric telescope. March 2011. *Credit: LSST Corporation*.

funding is awarded. Given the existence of the signed NSF/DOE MOU, and the high level of signatories to the partner letters of commitment, the operational support risk is low.

Future Operations Costs

Operation costs are estimated at $37.0 million per year. Following the recommendation of the 2010 NAS Decadal Survey, the NSF Division of Astronomical Sciences has prepared a plan to provide a nominal $19.0 million, and the DOE Office of High Energy Physics has committed to a nominal $9.0 million. In their joint MOU, NSF and DOE have agreed together to fund operations, increasing agency support and/or revising the operations plans, as appropriate.

THE NATIONAL ECOLOGICAL OBSERVATORY NETWORK $98,200,000

The FY 2014 Budget Request for the National Ecological Observatory Network (NEON) is $98.20 million, which represents the fourth year of a six-year project that totals an estimated $433.72 million.

Appropriated and Requested Funding for the National Ecological Observatory Network

(Dollars in Millions)

Prior Years[1]	FY 2011	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request	FY 2015 Estimate	FY 2016 Estimate	FY 2017 Estimate	Total Project Cost
$3.02	$9.57	$60.30	$60.30	$98.20	$91.00	$80.64	-	433.72

Totals may not add due to rounding.

[1]Per P.L. 110-161, $4.0 million was rescinded from prior year unobligated balances, leaving $3,015,121 available for future obligations.

[2]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders. Upon development of the FY 2013 Current Plan, the FY 2013 funding amount will be determined. The FY 2013 Request based on the project's funding profile is $91.0 million. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

NEON consists of geographically distributed field and lab infrastructure networked via cybertechnology into an integrated research platform for regional to continental scale ecological research. Cutting-edge sensor networks, instrumentation, experimental infrastructure, natural history archive facilities, and remote sensing will be linked via the internet to computational, analytical, and modeling capabilities to create NEON's integrated infrastructure.

Baseline History

In 2004, the National Research Council (NRC) evaluated the original NEON design of loosely confederated observatories and recommended that it be reshaped into a single integrated platform for regional to continental scale ecological research. Congress appropriated a total of $7.0 million through the Major Research Equipment and Facilities Construction (MREFC) account for NEON in FY 2007 and FY 2008, $4.0 million of which was rescinded in FY 2008. A Preliminary Design Review (PDR) was completed in June 2009 and a Final Design Review (FDR) was completed in November 2009. Project planning continued through FY 2011 until construction began in August 2011. The FDR also included a formal construction baseline review and cost review; an additional baseline review was conducted in April 2011 prior to initiation of construction that confirmed the baseline scope, cost, and schedule.

Total Obligations for NEON

(Dollars in Millions)

	Prior Years[1]	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request	ESTIMATES FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
R&RA Obligations:									
Concept & Development	$88.82	$1.70	$7.00		-	-	-	-	-
Management and Operations[3]	-	-	-	21.00	42.22	44.04	65.00	65.00	65.00
ARRA	9.96	-	-	-	-	-	-	-	-
Subtotal, R&RA Obligations	$98.78	$1.70	$7.00	$21.00	$42.22	$44.04	$65.00	$65.00	$65.00
MREFC Obligations:									
Implementation	$12.58	$60.30	$60.30	98.20	91.00	80.64	-	-	-
Subtotal, MREFC Obligations	$12.58	$60.30	$60.30	$98.20	$91.00	$80.64	-	-	-
TOTAL Obligations	**$111.36**	**$62.00**	**$67.30**	**$119.20**	**$133.22**	**$124.68**	**$65.00**	**$65.00**	**$65.00**

Totals may not add due to rounding.

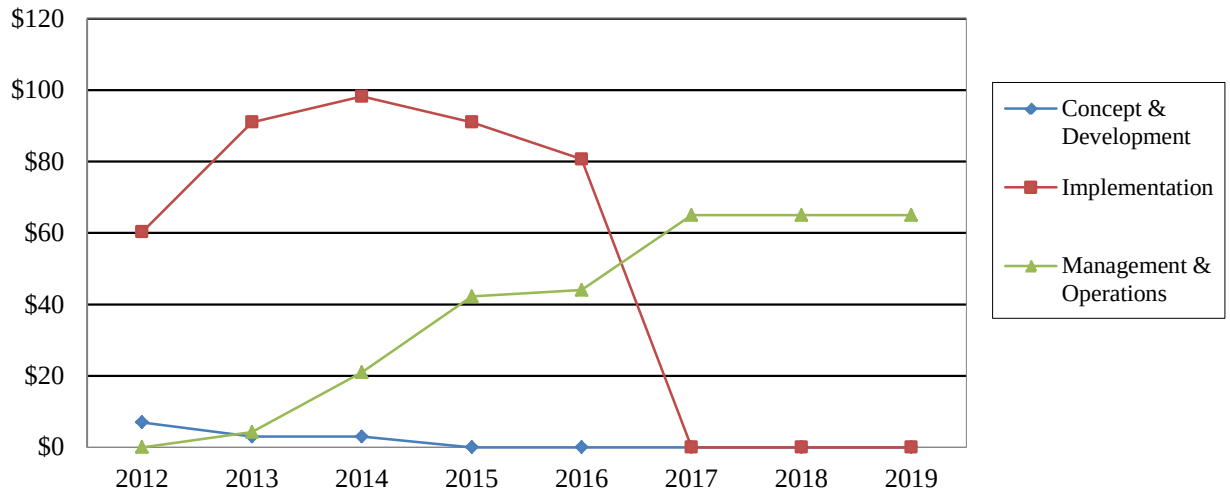
[1] Concept & Development and Implementation funding is cumulative of all prior years; Management & Operations funding reflects the prior year actual only.

[2] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect the FY 2012 Enacted amount. The initial FY 2013 Request was $124.39 million: $91.0 million for MREFC and $33.39 million for R&RA. FY 2013 requirements are now estimated to be $98.32 million: $91.0 million for MREFC and $7.32 million for R&RA, as further discussed in the Cost and Schedule section below. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

[3] Funding for Maintenance and Operations (M&O) in outyears has been capped at now-year dollars, pending the results of a three year initial M&O testing. A final M&O award, to be made after the three years concludes, will reflect these results.

NEON Funding, by Stage

(Dollars in Millions)

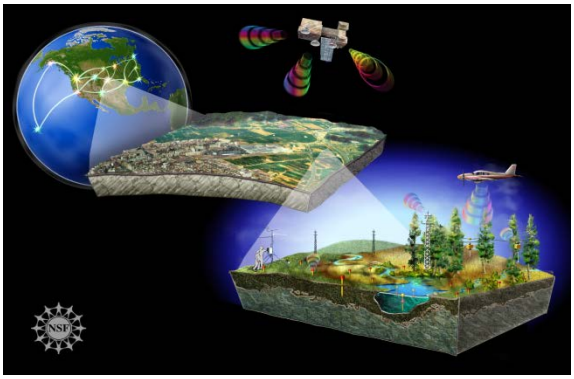


Since NSF supports 63 percent of the fundamental environmental biology research at U.S. academic institutions, advances in the field of ecology and the infrastructure to enable those advances depend largely on support from NSF. For the first time, NEON will enable scientists and researchers to address the complex phenomena driving ecological change in real time and at the scales appropriate for studying many grand challenge questions in ecology. NEON's technical and design requirements were informed

by knowledge acquired from previous NSF investments in research through the Long Term Ecological Research (LTER) program, and the Ecosystem, Ecology, and Long Term Research in Environmental Biology Programs. NEON is a user facility that will enable research at regional to continental scales. NEON infrastructure will be deployed at 60 sites, eleven of which are LTER sites. When operational, NEON will allow researchers to expand the scale of their research to understand large scale dynamics affecting ecosystems. As a continent-wide research instrument, NEON will support a large and diverse group of organizations and individuals; foremost are the scientists, educators, and engineers who will use NEON infrastructure in their research and educational programs. A NEON cyberinfrastructure gateway will provide resources to support formal and informal public education and provide opportunities for citizens to participate in scientific investigations. Data from standard measurements made using NEON will be available in "near real time." The basic NEON data streams will be open-access via web portals and available as soon as possible, once basic quality assurance and quality control procedures have been applied.

Recent United States Global Change Research Program (USGCRP) assessments[1] indicate that U.S. ecosystems will experience abrupt and unpredictable changes from a suite of human-driven processes in the near future. The Administration has identified these environmental issues as among the most important, demanding, and urgent global problems of our time, and scientific discovery and science-based decision making are critical to selecting mitigation and adaptation policies and strategies. NEON will provide an unprecedented opportunity to detect environmental signals as early as FY 2014.

NEON will enable research on the impacts of climate and land use change, water use, and invasive species on the Nation's living ecosystems at temporal and spatial scales that are relevant to human well-being. NEON will be the first research platform and the only national experimental facility specifically designed to enable basic research in these areas. All prior basic research infrastructure was designed and deployed on an *ad hoc*, question-, mission-, or site basis. NEON's unique statistically-determined, continental-scale design, with data products, data management, and standardization will support research on the dynamics of complex coupled systems needed for modeling and understanding rates of change on regional and continental scales. No other standalone system – federal or private – can provide the scientifically validated suite of data measurements that NEON anticipates providing. For example, federal operational agencies, such as the Environmental Protection Agency (EPA), provide comprehensive, sustained, and dependable observations in real time on a broad geographic basis, similar to the observations supporting the forecasts of the National Weather Service; these observations support information needs and forecasts for resource management. In contrast, NEON will provide infrastructure to enable hypothesis-driven basic biological and ecological research, with data and high-level data products available in close to real-time. NEON scientists will develop and use the latest technologies and sensors to push the envelope of knowledge. Just as NEON researchers will benefit from access to data from federal agency networks that provide spatial and temporal coverage of the U.S., so will federal



NEON will be a collaborative research platform of geographically distributed infrastructure connected via the latest information technology. By combining in-situ sensing with remote sensing observations, NEON will address pressing environmental questions on regional to continental scales. *Credit: NSF.*

[1] Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

agencies benefit as the techniques, sensors and knowledge gained through NEON-enabled activities migrate from research to societal applications and inform management decisions.

NSF and NEON, Inc. coordinate with other federal agencies through the NEON Federal Agency Coordinating Committee, Memoranda of Understanding (MOU), Memoranda of Agreements, and Cooperating Agency Agreements. Areas of coordination include planning, design, construction, deployment, environmental assessment, data management, geospatial data exchange, cyberinfrastructure, research, and modeling. In addition, NSF will continue to seek opportunities for new interagency and international partnerships. Examples of current partnerships include:

- Design: The Jet Propulsion Laboratory (JPL) at the National Aeronautics and Space Agency (NASA) designed and is building the hyperspectral sensors for the NEON airborne observation platform. NASA and NEON, Inc. are involved in joint instrument calibration and primary algorithm development.
- NEON infrastructure deployment sites: U.S. Department of Agriculture Forest Service, USDA Agricultural Research Service, Bureau of Land Management, Department of Energy (DOE), and National Park Service.
- Sharing of geospatial data, in-situ verification, and archival of NEON aerial remote sensing data with the U.S. Geological Survey (USGS).
- Partners in research, modeling, data exchange, standards, and protocols: NASA, the National Oceanic and Atmospheric Administration (NOAA), USGS, and EPA.
- International: Discussions between NEON, Inc. and Mexican and Canadian scientists to broaden linkages with NEON and expand the research capability to the North American continent are underway. Global partnerships with the European Union and Australia are developing.

Private organizations including the Heinz Center, National Geographic Society, Nature Serve, and the Science and Engineering Alliance, participated in NEON design and development activities. The Science and Engineering Alliance and the Ecological Society of America are assisting NEON, Inc. with education and inclusion of minority serving institutions in NEON science and education. Building enhanced accessibility for all institutions into the design will broaden the impact of NEON science and education to the next generation of scientists and educators. While the bulk of NEON's infrastructure and instrumentation will be "commercial off-the-shelf," NEON's scientific and networking design required certain technological innovations. Consequently, the Directorate for Biological Sciences (BIO) has provided Research and Related Activities (R&RA) funds for advanced research and development (R&D) activities in the areas of sensors, cyberinfrastructure, and remote sensing technology.

Management and Oversight

- NSF Structure: The NEON program is managed in the Directorate for Biological Sciences (BIO) Office of the Assistant Director (OAD/BIO) as part of the Emerging Frontiers (EF) subactivity. OAD/BIO provides overall policy guidance and oversight, and the location of the NEON program in EF within BIO fosters its broader biological and interdisciplinary science connections. The NEON program is managed by a dedicated program officer with assistance from a project manager, and two additional program officers participate in planning, development and oversight of NEON construction and NEON management and operations. A business oversight team chaired by the NEON program officer advises and assists with the business framework of the project. A BIO-NEON committee, which includes the Deputy Director for Large Facility Projects in the Office of Budget, Finance and Award Management (BFA) and a cross-NSF Program Advisory Team (PAT), assists in program planning for NEON. The NEON program officer served as the contracting officer's technical representative (COTR) for the NEON environmental assessment completed in FY 2010. A NEON

Environmental Assessment Team (EA) provides ongoing technical advice on the National Environmental Policy Act (NEPA) compliance and NSF environmental policy.

- External Structure: The NEON project is funded through cooperative agreements with NEON, Inc., a non-profit, membership-governed consortium, established to oversee the design, construction, management, and operation of NEON for the scientific community. Within that organization, the CEO provides overall leadership and management; the project manager oversees all aspects of the project design, review, construction, and deployment; the chief science officer provides scientific leadership; and the director of computing is responsible for oversight of the cyberinfrastructure and embedded sensor development. A Board of Directors and a Science, Technology, and Education Advisory Committee (STEAC) composed of members of the NEON user community, each provide oversight and guidance to the project and help ensure that NEON will enable frontier research and education. A Program Advisory Committee (PAC) will provide advice and guidance to the NEON Observatory on the use of NEON facilities.

Reviews

- Technical reviews: The NEON Observatory Design Review (including site selection and deployment design) was successfully completed in February 2009.
- Management, Cost, and Schedule reviews:
  - A Conceptual Design Review was held in November 2006.
  - A combined PDR/FDR of the airborne observation platform was successfully completed in February 2009.
  - A PDR for the entire project was successfully completed in June 2009.
  - An FDR was successfully completed in November 2009, including construction and cost reviews.
  - An additional Baseline Review, to ascertain readiness to begin construction, was conducted in April 2011 prior to construction.
  - An annual Construction Review is conducted each year.
- National Science Board (NSB) Review: The Board reviewed and authorized NEON construction subject to final appropriation of funds in May 2010.
- NSF conducted a Business Systems Review (BSR) and issued a final report in November 2011.
- An Operations Review of the project's operating plan and costs was held in January 2012.

Current Project Status

In November 2009, NSF conducted an external review of NEON's baseline design, scope, schedule, and risk-adjusted cost and found it to be well justified. The NEPA environmental assessment was also completed in November 2009. A "Finding of No Significant Impact" was signed by NSF in December 2009; the U.S. Fish and Wildlife Service concurred with this finding, as well as with NSF's compliance with the Endangered Species Act. In April 2010, a NEON-led operations review was completed; NSF staff participated as observers. NSF conducted a further construction review in 2011 to confirm that the risk-adjusted budget estimate was stable and credibly estimated, and that the project leadership was capable and ready to commence construction. In July 2011, the NSF Record of Decision was signed, which allowed construction to commence in August 2011. The first NSF-led operations review, covering the operating plan and associated budget, was conducted in January 2012.

In FY 2012, funding for Concept and Development was provided through BIO's Emerging Frontiers subactivity within the R&RA account. These funds were used to retire risk, complete detailed construction-ready design documents, and scale up final project activities, including: the airborne spectrometer; establishment of the NEON Calibration/Validation Laboratory for sensors and instrumentation; advanced design for the first six NEON domains and all NEON core sites; and permitting for the first six domains. In FY 2013 and FY 2014, funds will continue to be provided through

the R&RA account for innovation and advanced development of new technologies, new capabilities, observatory improvements and performance upgrades, collaborative partnerships with PI-led experiments involving observatory infrastructure that require engineering innovation, and sensors to reduce human-mediated measurements of biology.

Cost and Schedule

The projected length of the project is six fiscal years, with a six-month schedule contingency included. NEON is currently 13 percent complete. Current project performance is consistent with ending on time and within budget. Total project contingency usage as of December 2012 was $5.53 million of the initial $74.17 million included in the $433.72 Total Project Cost. The remaining unallocated contingency ($68.64 million) is equivalent to about 21.4 percent of the current Estimated Cost to Complete.

Due to significant changes in FY 2012 MREFC construction funding, NSF has revised the management and operations (M&O) funding request for FY 2013, based on revised operations costs from NEON, Inc. Reduced funding and a continuing resolution delayed the planned construction start by nine months, and additional planned FY 2012 site construction was moved to FY 2013. Since fewer sites than anticipated will be operational in FY 2013, the M&O funding request is reduced from $30.39 million to $4.32 million.

Risks

Technical: Dependence on commercial off-the-shelf technology will be mitigated by long-lead purchase orders and alternative vendors. Production quality, embedded and system-level cyberinfrastructure will be addressed by a combination of "in-house" design, commercial, contracts, and targeted research (e.g., cyber-dashboard).

Deployment: Environmental assessment and permitting may impact schedule and costs. These risks have been and continue to be addressed through multiple means, including: the direct contracting of the environmental assessment by NSF; the hiring of two national firms by NEON, Inc. for engineering and permitting; the identification of alternative sites if the primary sites are determined to have significant risk; and the allocation of two full-time equivalents (FTE) by the U.S. Forest Service to assist with environmental compliance issues on Forest Service lands.

Geospatial Data Acquisition: A potential risk is the long-term availability of satellite (e.g., LANDSAT and MODIS) borne sensors. This risk is mitigated through a partnership with the USGS Earth Resources Observation and Science (EROS) Data Center, which has the federal responsibility for curation and management of LANDSAT and MODIS images and having alternative satellite sensor sources to purchase images (e.g., SPOT - France, AWIFS – India, Terra and Aqua – U.S.). The proposed NEON airborne observatory platform (AOP) sensor system design and aircraft availability are also sources of technical and implementation risk. To minimize this risk, the AOP is being developed by JPL; similar instrument packages are being prototyped by NASA and Carnegie Institution at Stanford University. The sensor system fits multiple aircraft, including commercial aircraft. Experienced flight design engineers were contracted by NEON, Inc. to provide the baseline operations plans, aircraft analysis, and assessment of commercial companies that could potentially support NEON flight operations, and experienced research aircraft pilots serve on the design team.

Future Operations Costs

NEON will be the first research observatory that will maintain and operate in-situ instrumentation and conduct biological sampling in twenty domains (106 locations); three airborne observatories; a central operating facility; and a cyberinfrastructure center. Support will be provided to monitor the sensors, and receive, process, and archive the data from all measurement systems. NEON operations include

significant labor costs due to the labor-intensive processes required for biological sampling and data collection. NEON is reliant on sensors and cyberinfrastructure that have a defined lifecycle, so operations costs include scheduled replacement and refreshing of sensor, instrumentation, and cyberinfrastructure technology. Operations is planned to ramp up commensurate with commissioned sites.

NEON, Inc. developed an operations and maintenance plan for review that included scope, schedule, and costs for the first eight years of operations. NSF convened an operations and cost review in January 2012 to evaluate the plan, schedule, and costs. The panel concluded that the Operations and Maintenance Plan's scope, costs, schedules, staffing, and transition to operations were thorough and accurate, and that NEON has done an exemplary job of using prototyping to gain operational experience. The panel indicated that the budgeted costs are based on the best analyses of extant information and modeling, and any improvement in efficiencies or costs will require several years of operating experience.

The three year initial award for Maintenance and Operations funding will allow NEON to explore opportunities for schedule and cost efficiencies and provide the basis for funding for the outyears of full Observatory operations. For FY 2017 – FY 2019, the costs are held constant at the projected operations ceiling reviewed at both the Preliminary Design and Final Design Reviews.

OCEAN OBSERVATORIES INITIATIVE $27,500,000

The FY 2014 Budget Request for the Ocean Observatories Initiative (OOI) is $27.50 million, which represents the final year of a six-year construction project totaling $386.42 million.

Appropriated and Requested MREFC Funds for the Ocean Observatories Initiative
(Dollars in Millions)

	Prior Years[1]	FY 2009	FY 2010	FY 2011	FY 2012	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request	FY 2015 Estimate	Total Project Cost
Regular Approps	$5.91	-	$14.28	$65.00	$102.80	$102.80	$27.50	-	280.49
ARRA	-	105.93	-	-	-	-	-	-	105.93
Total, OOI	**$5.91**	**$105.93**	**$14.28**	**$65.00**	**$102.80**	**$102.80**	**$27.50**	**-**	**$386.42**

[1] This amount is net of $5.12 million that was rescinded from prior year unobligated balances, per P.L. 110-161.

[2] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders. Upon development of the FY 2013 Current Plan, the FY 2013 funding amount will be determined. The FY 2013 Request based on the project's funding profile is $65.0 million. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

OOI will provide the oceanographic research and education communities with continuous, interactive access to the ocean through an integrated network of observatories. Deployed in critical parts of the global and U.S. coastal ocean, OOI's 24/7 telepresence will capture climate, carbon, ecosystem, and geodynamic changes on the time scales at which they occur. Data streams from the air-sea interface through the water column to the seafloor will be openly available to educators and researchers in any discipline, making oceanography available to citizens and scholars who might never go to sea. Science themes for OOI include the ocean carbon cycle and its response to global change, ocean acidification, the impact of climate variability and ocean circulation, coastal ocean dynamics and ecosystem response, and the interplay of tectonically-driven fluid flow on the carbon cycle, deep ocean ecosystems, and earthquakes.

The OOI has three elements: 1) deep-sea buoys with designs capable of deployment in harsh environments such as the Southern Ocean; 2) regional cabled nodes on the seafloor spanning several geological and oceanographic features and processes; and 3) an expanded network of coastal observatories. A cutting-edge, user-enabling cyberinfrastructure will link the three components of OOI and facilitate experimentation using assets from the entire network. Data from the network will be made publicly available.

Baseline History

NSF first requested construction funding for OOI through the MREFC account in FY 2007 and received an initial appropriation of $5.12 million in that year. The OOI has undergone a series of technical reviews, with the Final Design Review (FDR) conducted on November 6-7 and 12-14, 2008. The FDR panel determined that OOI was ready to move to construction, assuming some adjustments to the baseline with respect to schedule and overall project contingency. Following the FDR, in an effort to focus OOI more specifically on high priority science issues related to climate change, ocean acidification, carbon cycling, and ecosystem health, NSF initiated a rapid turn-around process to develop a modified network design in January 2009, referred to as the Variant Design. An additional Science Review Panel and Cost/Schedule Review Panel convened by NSF in March 2009 supported proceeding with the Variant

Design and the project was approved at the May 2009 National Science Board meeting.

The project baseline has been maintained via change control processes and procedures that are part of the NSF terms and conditions of the award to the Consortium for Ocean Leadership. The cost baseline is adjusted for contingency when previously identified, predicted risks are realized. These include elements such as procurement bid risk and subaward/subcontract execution risk. Technical baselines are maintained via change control and document any changes related to observatory performance that impact science delivery. Sensor vendor and model changes have caused slight decreases in delivery, yet in other cases, newer sensor models on the market have increased capabilities due to technology maturity. Schedule is maintained via change control and reviewed in external panel reviews.

Total Obligations for OOI

(Dollars in Millions)

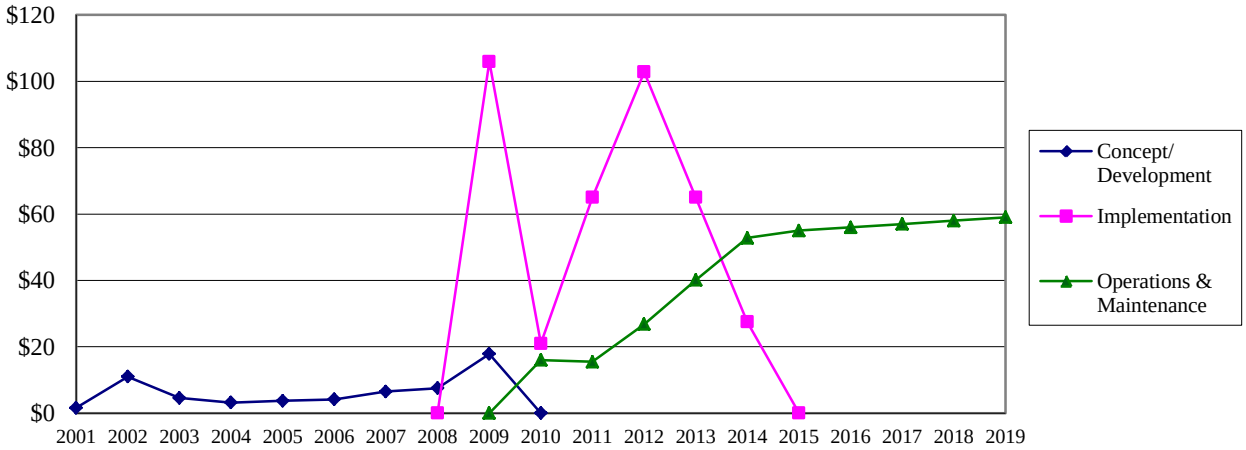
	Prior Years[1]	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request	ESTIMATES FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
R&RA Obligations:									
Concept & Development	$74.90	-	-	-	-	-	-	-	-
Management & Operations	15.49	26.80	26.80	52.80	55.00	56.00	57.00	58.00	59.00
Subtotal, R&RA Obligations	$90.39	$26.80	$26.80	$52.80	$55.00	$56.00	$57.00	$58.00	$59.00
MREFC Obligations:									
Implementation	85.19	102.80	102.80	27.50	-	-	-	-	-
ARRA	105.93	-	-	-	-	-	-	-	-
Subtotal, MREFC Obligations	$191.12	$102.80	$102.80	$27.50	-	-	-	-	-
TOTAL Obligations	**$281.51**	**$129.60**	**$129.60**	**$80.30**	**$55.00**	**$56.00**	**$57.00**	**$58.00**	**$59.00**

Totals may not add due to rounding.

[1] Concept & Development and Implementation funding is cumulative of all prior years; Management & Operations funding reflects FY 2011 Actuals only.

[2] A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this project was operating under a continuing resolution (P.L.112-175). The amounts shown for FY 2013 are placeholders and reflect the FY 2012 Enacted amount. The FY 2013 Request based on the project's funding profile is $105.10 million: $60.50 million for MREFC and $40.10 million for R&RA. Any FY 2013 shortfall might need to be addressed in future budgets and could impact the total project cost and schedule baseline.

OOI Funding, by Stage
(Dollars in Millions)



NOTE: FY 2009 implementation funding includes $105.93 million provided through the American Recovery and Reinvestment Act.

Management and Oversight

- NSF Structure: The project is managed and overseen by a program director in the Division of Ocean Sciences (OCE) in the Directorate for Geosciences (GEO). The program director receives advice and oversight support from an NSF Project Advisory Team (PAT) that includes representatives from GEO, the Directorates for Biological Sciences (BIO) and Engineering (ENG); the Office of Budget, Finance and Award Management (BFA); the Office of International and Integrative Activities (OIIA); the Office of General Counsel (OGC); and the Office of Legislative and Public Affairs (OLPA). The Deputy Director for Large Facility Projects (DDLFP) in BFA is also a member of the PAT and provides advice and assistance. NSF has established an Ocean Observing Science Committee (OOSC) via the University National Oceanographic Laboratory System (UNOLS). The committee is made up of ocean science community representatives. The OOSC is charged with providing guidance on decisions and plans from the science perspective related to all NSF observing systems. The OOSC will be an essential element in the process of communicating the science use perspective to NSF and project teams involved in deploying and operating ocean observatories.
- External Structure: NSF established a cooperative agreement with the Consortium for Ocean Leadership (Ocean Leadership) for the construction and initial operation of the OOI in September 2009. The program director at Ocean Leadership is responsible for designing, building, deploying, testing, commissioning, and conducting initial operations and maintenance for the OOI. The Ocean Leadership program director is accountable to NSF, the Ocean Leadership Board of Trustees, and an external scientific and technical advisory committee. The OOI Project Advisory Committee membership is drawn from individuals with expertise in ocean observing science and engineering. Subawards have been issued by Ocean Leadership to establish five Implementing Organizations (IOs). These IOs will deliver the regional cabled observatory (led by the University of Washington), cyberinfrastructure (led by the University of California-San Diego), education (led by Rutgers, The State University of New Jersey) and coastal/global observatories (led by Woods Hole Oceanographic Institution and Oregon State University). These IOs report directly to Ocean Leadership, which ensures integration, cooperation, and coordination between the IOs.
- NSF Oversight: NSF conducts a weekly meeting, attends weekly calls, convenes external panels and reviews monthly Earned Value Management reports from the project team. NSF attends internal project reviews; critical design reviews and conducts vendor site visits as required.

Reviews

Preconstruction Phase Reviews of OOI

- Technical reviews: NSF organized a series of external science reviews for OOI, including the Blue Ribbon Review in July 2006, which assessed whether the ocean observing network proposed in the OOI Conceptual Network Design would provide the capabilities for the ocean researchers to answer high priority science questions that require *in situ*, real-time measurements across the three scales of OOI. A second Blue Ribbon Review in October 2007 assessed whether the OOI Preliminary Network Design provided the experimental capabilities needed to address the scientific scope outlined for OOI. These science reviews provided a general endorsement of OOI, supplemented by a series of recommendations for improvement. These reviews also served as input to the paired design reviews (Conceptual and Preliminary). NSF convened a Blue Ribbon Review in March 2009 to assess a modified OOI network design and its ability to provide transformative research capabilities for the ocean science community. This OOI Variant Design is a modification to the existing network design that more closely focuses OOI infrastructure on climate processes, carbon cycling, ocean acidification, and ecosystem health. The Blue Ribbon Review panel noted that the OOI, as described by the Variant Network Design, remains a worthy investment, providing a transformative capability for the ocean science community.

Management, Cost, and Schedule Reviews

- The OOI Conceptual Design Review (CDR), held in August 2006, reviewed the scope and system-level implementation plans for OOI, including management plans and budgeting. It discussed whether all major risks with this project have been identified and whether appropriate initial system development specifications (performance requirements, major system components, and interfaces) have been established for each sub-element of OOI.
- The Preliminary Design Review (PDR) in December 2007 assessed the robustness of the technical design and completeness of the budget and construction planning for the OOI. The PDR panel also reviewed progress made by the OOI Project Team on the findings of the CDR.
- The FDR in November 2008 assessed whether OOI's project plans were fully ready for construction and determined that there was a high degree of confidence that the scope, as proposed, could be delivered within the parameters defined in the project baseline.
- A Cost-Schedule Review Panel in March 2009 assessed whether the OOI Variant Design project plans were fully ready for construction and determined that there was a high degree of confidence that the scope, as proposed, could be delivered within the parameters defined in the project baseline.
- A Business Systems Review (BSR) was conducted in 2012 and the draft report has been issued. Follow up and monitoring of report findings is in progress.

Construction Phase and Initial Operations Reviews of OOI

- Construction Reviews: NSF conducted three external panels to review the construction progress of the OOI. The panels took place in June 2010, May 2011, and November 2012. The May 2011 panel recommended the project produce a revised, fully integrated master schedule for the 66-month project. As this revision matured, Ocean Leadership recognized that delays in completion of the Coastal Global mooring design required significant adjustments be made to the baseline schedule and project management structure. Oregon State University (OSU) is now a direct subawardee to Ocean Leadership and will construct the Endurance Array moorings at OSU versus at Woods Hole as originally planned. Woods Hole, as planned, will deliver all four Global arrays as well as the Pioneer Array. This new management structure and schedule realignment will allow delivery of the observatory within the 66-month schedule. NSF supported this transition and conducted an external review in November 2012. The review scrutinized performance, execution, integration and management of the full project scope, schedule, budget, and risk. The panel acknowledged the project is proceeding to budget and significant project milestones have been achieved. The panel

recommended incorporation of an Integrated Project Team management structure to improve integration across the project. The project has applied this recommendation to the deployment efforts and integration has improved. The panel also reviewed the fully integrated master schedule that utilizes a partial deployment strategy in order to align vendor deliveries, build phase activities and deployment weather windows.

- NSF conducted two transition to Operations and Maintenance (O&M) reviews of the OOI in August 2010 and December 2011. The August 2011 panel recommended tighter linkages between the construction schedule and O&M ramp up plans. A second O&M review was conducted in December 2011. The panel recommended production of higher quality cost estimates for O&M prior to staff ramp up. The project continues to apply the recommendations from this panel and will present activity-based cost estimates to inform staffing ramp up plans for an important transition to O&M review in 2013.

Current Project Status

The project is in year five of the construction and transition to O&M effort. Major construction milestones were achieved on time and within budget. NSF signed a Site-specific Environmental Assessment Finding of No Significant Impact (FONSI) in January 2011 (www.nsf.gov/geo/oce/envcomp/ooi/ooi-final-fonsi-31jan11.pdf), which enabled the build and permitting phase of the project to commence. The cabled array observatory was the first segment of the project into the build phase. L3Maripro, under a University of Washington subcontract, successfully deployed the ocean cable in July 2011 and landed on shore in Pacific City, Oregon. In July 2012, the power step down nodes were successfully connected to the deployed cable in anticipation of the deployment of seafloor instrumentation in the summer of FY 2013 and mooring platforms in FY 2014.

Woods Hole Oceanographic Institution, Oregon State University, and Scripps Institution for Oceanography conducted major at-sea tests of moorings, subassemblies, and components during the summer and fall of 2011. Recovery of these test assets in 2012 informed the final critical designs in the summer of 2012 for a majority of the planned moorings. Completion of the critical design reviews enabled the institutions to enter the build phase for the coastal and global moorings. The project is currently in a large procurement and deployment readiness phase. Deployments are scheduled for FY 2013, FY 2014, and FY 2015 during available weather windows. Coastal Gliders were procured, tested, and delivered for deployment in FY 2013. Autonomous Underwater Vehicles designs will be finalized and tested in FY 2013. Ocean Gliders are in production for a summer FY 2013 deployment window at Station Papa. Supply chain management and on-time deliveries of components, subassemblies, and assemblies are critical to the project management in the remaining months of the project. With respect to cyberinfrastructure, University of California San Diego completed software release 1 and release 2 is currently in beta testing. The project is entering a critical build and deploy phase when strict adherence to schedule is crucial to accomplishing the integrated work to be completed during the FY 2013-FY 2015 timeframe. NSF has established a six-month external review panel frequency to assure quality oversight of schedule and budget performance.

OOI transition to operations and maintenance was funded in FY 2011, FY 2012, and FY 2013. The FY 2011 and FY 2012 funding allowed for a major procurement phase for the initial spare parts purchases for the network, initial hiring of operations personnel, and production of a more mature O&M plan. In FY 2012, release 1 cyberinfrastructure was accepted and transitioned to operations. Incremental transition to operations will increase in FY 2013, FY 2014, and FY 2015 when seafloor, water column, coastal and global components are deployed during multiple ocean cruises. At the end of FY 2014, the majority of the moorings, cables, and instruments will be deployed and transitioned to operations. In FY 2015, the remaining transitions will include: two southern site global moorings, the Pioneer Array Autonomous Underwater Vehicle dock and fuel cell, and the final cyberinfrastructure release. The transition to O&M will be accelerated in FY 2014 and completed by March 1, 2015.

The request for O&M funding for FY 2014 is $52.80 million. This funding will support transition to operations and maintenance for the majority of the Pioneer and Endurance Coastal arrays, the remaining seafloor and water column instrumentation for the Regional Array and two of the four global arrays (Station Papa and Irminger Sea). The O&M funding will provide for redeployments or "turns" of moorings and instruments as well as supporting labor and non-labor elements involved in maintaining the ocean sensors. Data from all deployed instruments will be available via the internet to the public, ocean science research community, educators, and students via Release 3 of the software enabling early science. Four implementing organizations will be funded with the Consortium for Ocean Leadership as the awardee. The project will present a clear transition to operations plan to an external panel in 2013 within the established funding constraints. Full operations and maintenance is planned for by the end of FY 2015 after deployment of remaining marine infrastructure pieces such as Autonomous Underwater Vehicle docks, fuel cells, and the two southern site global moorings.

Cost and Schedule

The projected length of the project is 66 months, with schedule contingency allocated to the ocean weather windows for deployment of the OOI infrastructure. OOI is currently 65 percent complete. Current project performance is consistent with ending on time and within budget. Total project contingency usage as of December 2012 was $57.20 million of the initial $88.10 million included in the $386.42 Total Project Cost. The remaining unallocated contingency ($30.90 million) is equivalent to about 21.1 percent of the current remaining estimated cost to complete.

Risks

- Management and Oversight risk: The complexity of the OOI scope and the organizational structure of a prime Project Office with tiered Implementing Organizations present a clear integration risk. A detailed project tracking system has been developed to assure that the scope, schedule and budget are continuously monitored.
- Scope contingency: The Project Team has requested an appropriate level of contingency for OOI as dictated by a comprehensive (top-down and bottom-up) risk analysis. Should this contingency be exhausted, reductions in the scope of the OOI network plan will be required. These potential reductions, or scope contingency, must be implemented based on clearly articulated scientific priorities. Any changes to technical scope (as well as cost or schedule) will follow the OOI Change Control Process, which has a tiered evaluation process for evaluating and determining any change to the project. There have been minor instrumentation adjustments to the project scope as some instrument vendor capacities have changed. The project schedule contains go/no-go decision points for critical designs and milestones for where plan B designs will be implemented. Scope management is now part of the project's risk management planning for the remaining two years of the project.
- Risks Related to the OOI Cyberinfrastructure (CI): The OOI CI will not only provide the network integration needed to achieve the scientific goals of OOI, but a robust, user-friendly CI will be essential to develop a vigorous OOI user community. Ensuring the "usability" of the CI was a key topic of discussion at all of the OOI reviews. The testing and design process will allow for real users to be involved in the final acceptance of the cyberinfrastructure. The most significant risk for cyberinfrastructure in FY 2014 is the schedule and delivery impact due to the later than originally planned delivery of software Release 2. NSF is closely monitoring progress and the awardee is developing mitigation strategies to recover progress during FY 2013, FY 2014 and FY 2015. The review process will assess progress and results.

- Risks Related to Environmental Compliance and Permitting: The OOI FONSI was approved in January 2010. The project is currently processing permits and notifications for the coastal, regional,

and global arrays. NSF is managing risk by assuring close agency coordination for federal permits. NSF is overseeing the efforts of the awardee and subawardees processing permits through regular reports and call updates.

- Schedule Management and Schedule Contingency: As stated above, supply chain management and vendor quality are critical to meeting schedule for the deployments within weather windows.

Future Operations Costs

The project is designed to ensure a smooth transition from construction to operations and maintenance. Staff, spare parts, integrated logistics, and facility readiness will ramp up as the construction elements are completed and accepted for operations. The funding profile presented shows an FY 2014 budget of $52.80 million. The OOI will be fully transitioned to operations by March 1, 2015 with a current budget estimate of $55.00 million. The expected operational lifespan of this project is 25 years. Operations cost reviews will be conducted prior to and throughout the operations phase to assess the project and inform future budget requests. Upon completion of construction, high quality ocean data will be delivered to the scientific community, educators and the public.

MODEL ORGANIZATION

"Perform as a Model Organization" (or "Model Organization") is one of three strategic goals outlined in *Empowering the Nation through Discovery and Innovation: NSF's Strategic Plan for Fiscal Years (FY) 2011-2016*. It is an internally focused goal that emphasizes the agency's efforts to attain excellence in all aspects of its operations. This is essential to carrying out and achieving NSF's mission and accomplish the agency's other strategic goals of "Transform the Frontiers" and "Innovate for Society." Model Organization underpins NSF programmatic activities and encompasses all the agency's management activities.

This summary provides an overview of the portfolio of activities directly associated with the Model Organization goal. It is organized into four sections: Model Organization by Major Component; Model Organization by Appropriation; NSF Workforce; and FY 2013 and FY 2014 Funding for E-Government initiatives. Table 2 on the following page shows the major components of Model Organization: Human Capital, Travel, Information Technology, Administrative Support, Future NSF, and support for the National Science Board (NSB) and the Office of Inspector General (OIG). Table 2 also shows the funding sources for the major components/activities, as several are funded through more than one appropriation.

Table 1: Model Organization FY 2014 Request

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
$422.47	$427.55	$447.85	$20.30	4.7%

[1]A full-year 2013 appropriation was not enacted at the time the Budget was prepared. The amount shown for FY 2013 is a placeholder and reflects the FY 2012 Enacted level.

As shown in Table 1, NSF's FY 2014 Request for activities in the Model Organization portfolio totals $447.85 million, a $20.30 million, or 4.7 percent, increase from the FY 2012 Enacted level of $427.55 million. Underlying this Request is NSF's ongoing pursuit of more efficient and effective approaches to operational activities, in accordance with the Administration's policies outlined in *Executive Order 13589*: *Promoting Efficient Spending* and *Promoting Efficient Spending to Support Agency Operations (OMB M-12-12)*. This request incorporates improved oversight and prioritization of funding related to travel, conferences, communications devices, printing, and investments in information technology (IT). As an example, these efforts have resulted in a reduction in the FY 2014 Request for AOAM-funded staff travel by 11 percent.

In FY 2014, NSF will support three new major efforts to improve program effectiveness and efficiency: Evaluation Capability will expand NSF's overall capability for evidence-based planning and decision-making; Merit Review Process Improvements will enhance one of NSF's critical business functions; and the Public Access Initiative focuses on the dissemination of research results quickly and broadly with the goal of accelerating the advancement of knowledge. More information about these efforts can be found in the NSF-Wide Investments chapter.

Table 2. Model Organization

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent	Funding Source and Sub-section/Page Where Details Are Available
Human Capital	$246.97	$254.50	$262.72	$8.22	3.2%	
Personal Compensation	198.16	202.91	210.17	7.26	3.6%	AOAM-2
Management of Human Capital	9.67	9.40	7.98	-1.42	-15.1%	AOAM-4
IPA Appointments	39.15	42.19	44.57	2.38	5.6%	
Compensation	35.15	37.90	40.21	2.31	6.1%	R&RA/EHR-1
Lost Consultant & Per Diem	4.00	4.29	4.36	0.07	1.6%	R&RA/EHR-1
Travel	8.84	8.36	8.45	0.09	1.1%	
NSF Staff	5.35	6.04	5.35	-0.69	-11.4%	AOAM-5
IPA Appointments	3.49	2.32	3.10	0.78	33.6%	R&RA/EHR-1
Information Technology (IT)	88.78	84.10	83.39	-0.71	-0.8%	
Agency Operations IT	30.66	26.10	22.18	-3.92	-15.0%	
Administrative Applications Services and Support	12.20	11.80	6.83	-4.97	-42.1%	AOAM-6
Associated Infrastructure Services and Support	15.67	11.51	13.01	1.50	13.0%	AOAM-7
Security and Privacy Services and Support	2.79	2.79	2.34	-0.45	-16.1%	AOAM-7
Program Related Technology (PRT)	58.12	58.00	61.21	3.21	5.5%	R&RA/EHR-3
Mission-Support Applications Services	41.13	41.13	43.84	2.71	6.6%	R&RA/EHR-4
Associated IT Operations and Infrastructure	14.03	13.91	14.41	0.50	3.6%	R&RA/EHR-5
Related Security and Privacy Services	2.96	2.96	2.96	-	-	R&RA/EHR-5
Administrative Support	56.70	59.34	71.83	12.49	21.0%	
Space Rental	26.80	26.39	31.38	4.99	18.9%	AOAM-8
Operating Expenses	13.55	15.26	13.22	-2.04	-13.4%	AOAM-8
Other Infrastructure	12.42	10.69	11.34	0.65	6.1%	AOAM-9
Other Program Related Administration	3.93	7.00	15.89	8.89	127.0%	
Major NSF-wide Investments						
Evaluation Capability	-	-	5.50	5.50	N/A	R&RA/EHR-6
Merit Review Process Improvements	-	-	0.3	0.3	N/A	R&RA/EHR-6
Public Access Inititative	-	-	1.75	1.75	N/A	R&RA/EHR-6
E-Government Initiatives[1]	0.65	0.70	1.07	0.37	52.9%	R&RA/EHR-7
General Planning and Evaluation Activities	3.28	6.30	7.27	0.97	15.4%	R&RA/EHR-7
Future NSF HQ	2.70	2.61	2.67	0.06	2.3%	AOAM-11
National Science Board (NSB)	4.37	4.44	4.47	-	-	NSB-1
Office of Inspector General (OIG)	14.12	14.20	14.32	0.12	0.8%	OIG-1
Total, Model Organization	**$422.47**	**$427.55**	**$447.85**	**$20.30**	**4.7%**	

Totals may not add due to rounding.

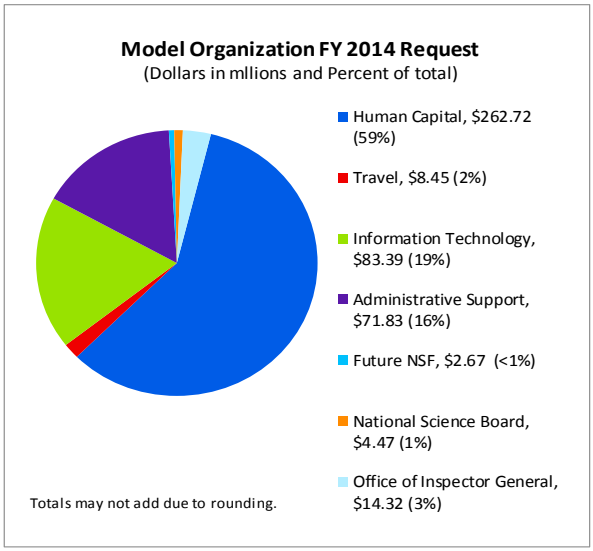
AOAM: Agency Operations and Awards Management; R&RA: Research & Related Activities; MO: Model Organization; IPA: Intergovernmental Personnel Act. Totals may not add due to rounding.

[1] FY 2013 and FY 2014 funding estimates for NSF-supported E-government initiatives can be found on pages Model Organization–8 and 9.

Model Organization by Major Component

The chart below shows the major components of NSF's FY 2014 Request for Model Organization.

1. **Human Capital:** Support for NSF's human capital activities is the largest component of Model Organization, accounting for 59 percent of the Model Organization portfolio. The Human Capital component includes personnel compensation and benefits of NSF's federal employees and as well as support for NSF's temporary employees hired through authority provided by the Intergovernmental Personnel Act, known as "IPAs." NSF's federal employee FTE (full-time equivalents) are funded through the Agency Operations and Award Management (AOAM) appropriation account while IPAs are funded through the Research and Related Activities (R&RA) and Education and Human Resources (EHR) appropriation accounts.



   The Human Capital component also includes support for the Management of Human Capital, which includes activities such as:
   - Human resources systems including the Federal Personnel Payroll System, the time and attendance system (WebTA), eRecruit capabilities using USAJobs, and security investigations for incoming staff.
   - Operational support for recruiting, hiring, and on-boarding of permanent and rotating staff; processing support for pay and benefits; and incentive and other awards.
   - Workplace and work life support for employees such as the Health Unit, the Employee Assistance Program, and child care subsidy.
   - Training and development programs – e.g., Learning Management System, LearnNSF, on-line training capabilities, Executive Leadership Retreat, and the Program Management Seminar.

   The FY 2014 Request for Human Capital increases by $8.22 million (3.2 percent) to $262.72 million. This increase reflects a higher FY 2014 FTE utilization rate and performance awards for the general workforce and SES bonuses. However, Management of Human Capital decreases 15 percent, to $7.98 million, as a result of reductions in contractor support and efficiencies in various administrative activities. More detailed information about Human Capital activities can be found beginning on page AOAM-3. Detailed information about IPAs can be found beginning on page R&RA/EHR-1.

2. **Travel:** The FY 2014 Request of $8.45 million for administrative and IPA travel accounts for about 2 percent of Model Organization. NSF's establishment of travel targets and use of automated reports to better manage travel has resulted in reducing the FY 2014 Request for NSF staff travel by more than 11 percent from the FY 2012 Enacted level, to $5.35 million. IPA travel increases by $780,000 in FY 2014, to $3.10 million, but is a decrease of $390,000 from the FY 2012 Actual of $3.49 million.

3. **Information Technology (IT):** IT investments are the second largest component of Model Organization, accounting for 19 percent. Table 3 shows NSF's IT investments by appropriation.

- Agency operations IT investments include activities that support the agency's basic administrative operations such as human resources management, the ongoing operation of the legacy financial accounting system, a portion (30 percent) of NSF's financial system modernization project (iTRAK), and routine maintenance of collaboration services such as SharePoint, the NSF website, and property and procurement applications. These efforts are funded through the AOAM appropriation and are discussed in more detail beginning on page AOAM-5.

- Program Related Technology (PRT) investments support NSF's programmatic activities and associated services, such as Research.gov, eJacket, FastLane, and a 70 percent portion of iTRAK. PRT supports the NSF grants management process, the merit review process, and mission-essential IT applications and office automation activities, including network and telecommunications requirements. PRT is funded through the R&RA and EHR appropriations. These activities are discussed in more detail beginning on page R&RA/EHR-3.

Table 3. Information Technology (IT) Investments by Appropriation
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Agency Operations and Award Management (AOAM)	$30.66	$26.10	$22.18	-$3.92	-15.0%
Program Related Technology (PTR)	58.12	58.00	61.21	3.21	5.5%
R&RA	*50.58*	*50.46*	*53.87*	3.41	6.8%
EHR	*7.54*	*7.54*	*7.34*	-0.20	-2.6%
Total	$88.78	$84.10	$83.39	-$0.71	-0.8%

Totals may not add due to rounding.

NSF's FY 2014 Request for IT investments is $83.39 million, a $710,000 decrease (nearly 1 percent) from the FY 2012 Enacted level of $84.10 million. In part, this decrease reflects a smaller contribution to iTRAK, as most implementation was funded in FY 2012 and FY 2013. In line with the Administration's focus on more efficient and innovative IT solutions, NSF will pursue IT cost savings through various means such as migrating IT infrastructure to cloud services and reducing security and privacy services by streamlining monitoring, vulnerability management, and incident response processes. NSF will invest in innovative IT solutions aimed at improving customer services or administrative efficiencies including planning and implementing an integrated enterprise data warehouse to provide a critical foundational capability for future innovative IT applications and systems; implementing new virtual meeting technologies that will result in cost savings for conducting virtual grant review panels; and increasing public access to NSF data.

4. **Administrative Support:** Funding for Administrative Support accounts for 16 percent of the Model Organization activity.
   - Space Rental includes services provided by the General Services Administration related to rent, utilities, taxes, and security. For FY 2014, estimates are based on an interim occupancy lease agreement for both existing NSF headquarters facilities.

   - Operating Expenses includes support for a variety of financial and award management and leadership activities in areas such as post-award monitoring, contract close-out activities, large

facilities oversight, ARRA and improper payments reporting, CEOSE (Committee on Equal Opportunities in Science and Engineering) activities, and the Enterprise Information System.

- Other Infrastructure includes administrative contracts that support services such as the mail center, the proposal processing unit, print shop, review panel support, travel support, and the agency's intranet operations; government goods and services such as the employee transit subsidy benefit and archival records storage; and administrative services, equipment, and supplies such as the security system maintenance, the public announcement system maintenance, library services, metered mail postage, and Federal Register notices for panels and advisory committees.

- Other Program Related Administration includes the support of E-government initiatives; general planning and evaluation activities such as the verification and validation of performance information; and select awards and fellowship programs including the Waterman Award and some AAAS fellowship program and internships. In FY 2014, NSF initiates three program-related management efforts: As part of Evaluation Capability a searchable repository will be built to house evaluation results and reports centrally so they can be readily accessed for decision-making. As part of Merit Review Process Improvements, an assessment of the impacts of various improvements will be conducted to identify impacts and further potential to enhance the process. As part of the Public Access Initiative, support will be provided for outreach, stakeholder engagement, and repository services. Additional information on all three activities is provided in the NSF-wide Investments chapter.

The FY 2014 Request for Administrative Support is $71.83 million, a $12.49 million or 21 percent increase from the FY 2012 Enacted level of $59.34 million. This increase supports funding for three new management efforts ($7.55 million) and space rental, which increases by nearly 19 percent ($4.99 million) to $31.38 million in FY 2014. Administrative Support activities are funded through the AOAM account except "Other Program Related Administration," which is funded through the R&RA and EHR appropriations. A more detailed discussion of each activity is included in the AOAM and Program Support sub-sections.

5. Future NSF: With NSF's current leases for the headquarters' facility set to expire in 2013, NSF has been working collaboratively with the GSA on a future working environment. GSA is conducting a competition for NSF's next headquarters long term lease, and anticipates an award by the beginning of FY 2014. The FY 2014 Request for Future NSF is $2.67 million, a $60,000 (2.3 percent) increase from the FY 2012 Enacted level of $2.61 million. FY 2014 resources will be used to provide technical expertise required to transition from planning to implementation of the project. Details about the FY 2014 Future NSF Request can be found on page AOAM-11.

6. **National Science Board (NSB):** The staffing and operations of the NSB office are supported through a separate NSB appropriation. Details about the NSB FY 2014 Request can be found in the NSB section.

7. **Office of Inspector General (OIG):** The staffing and operations of the OIG are supported through a separate OIG appropriation. Details about the OIG FY 2014 Request can be found in the OIG section.

Model Organization by Appropriation

The chart to the right and Table 4 shows funding for Model Organization by appropriation account. More than two-thirds of the activities included in the Model Organization portfolio are funded through AOAM.

- The R&RA and EHR appropriation accounts fund program support costs—$108.20 million (24 percent) through R&RA and $16.57 million (4 percent) through EHR in FY 2014. Program support costs include IPA appointments and technology and administrative operations directly related to program activities.

- The activities of the OIG and NSB are each funded by separate appropriations. The FY 2014 Request for the OIG of $14.32 million accounts for 3 percent of the Model Organization portfolio. The NSB FY 2014 Request of $4.60 million accounts for one percent of the Model Organization portfolio.

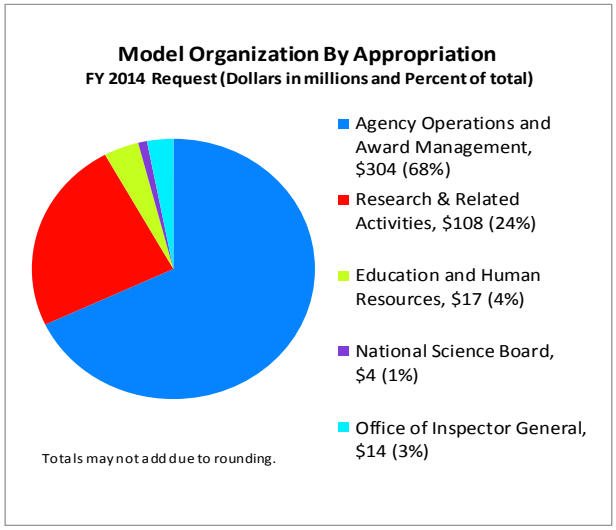


Table 4. Model Organization by Appropriation
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Agency Operations and Award Management	$299.30	$299.40	$304.29	$4.89	1.6%
National Science Board	4.37	4.44	4.47	0.03	0.6%
Office of Inspector General	14.12	14.20	14.32	0.12	0.8%
Research & Related Activities	90.62	94.12	108.20	14.08	15.0%
Education and Human Resources	14.06	15.39	16.57	1.18	7.7%
Subtotal, Program Support	*104.68*	*109.51*	*124.77*	*15.26*	*13.9%*
Total	**$422.47**	**$427.55**	**$447.85**	$20.30	4.7%

Totals may not add due to rounding.

NSF Workforce

Table 5 shows the agency's total workforce for the 2014 Request.

Table 5. NSF Workforce
Full-Time Equivalents (FTE)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
AOAM FTE Allocation					
Regular	*1,310*	*1,310*	*1,310*	-	-
Pathways Interns [1]	*42*	*42*	*42*	-	-
Subtotal, AOAM FTE Allocation	*1,352*	*1,352*	*1,352*	-	-
AOAM FTE Usage (Actual/Projected)					
Regular	1,281	1,285	1,310	25	1.9%
Pathways Interns[1]	39	42	42	-	-
Subtotal, AOAM FTE [2]	1,320	1,327	1,352	25	1.9%
Office of the Inspector General [3]	78	78	78	-	-
Regular	73	73	73	-	-
Student	5	5	5	-	-
National Science Board [4]	17	18	19	1	5.6%
Arctic Research Commission[5]	3	3	3	-	-
Total, Federal Employees (FTE)	1,418	1,426	1,452	26	1.8%
IPAs (FTE)	184	183	195	12	6.6%
Detailees to NSF	1	3	3	-	-
Contractors (est.)	449	449	449	-	-
Total, Workforce	**2,052**	**2,061**	**2,099**	**38**	**1.8%**

Totals may not add due to rounding.

[1]Pathways programs were established by Executive Order 13562, *Recruiting and Hiring Students and Recent Graduates.* The internship program offers part- or full-time paid internships in federal agencies to qualifying students (students in high schools, community colleges, four-year colleges, trade schools, career and technical education programs, and other qualifying technical education programs). This program allows students to explore federal career opportunities prior to graduation.

[2]Additional information about FTEs funded through the AOAM appropriation is available in the AOAM discussion.

[3]The Office of Inspector General is discussed in a separate chapter and is funded through a separate appropriation.

[4]The National Science Board is discussed in a separate chapter and is funded through a separate appropriation.

[5]The U.S. Arctic Research Commission is discussed in a separate chapter and is funded through the R&RA appropriation.

In FY 2014, NSF's AOAM federal employee FTE utilization will increase by 25 FTE over the FY 2012 Enacted level in order to reach the full FTE allocation. The staffing profile in Table 5 above shows that a small but significant percentage of the NSF workforce consists of temporary employees hired through the authority provided by the Intergovernmental Personnel Act (IPA) that do not count as federal FTE. The number of IPA FTE increases by 12 over the FY 2012 Enacted level. A smaller number of visiting staff – roughly 40 people annually – are employed through NSF's own Visiting Scientist, Engineer, and Educator Program (VSEE). VSEEs count as federal FTE and are included in the federal employee FTE total. The use of IPAs and VSEEs, commonly referred to as rotators, has been a defining characteristic of NSF since its inception in 1950, as it gives NSF a direct connection to the researchers and educators working at the frontiers of science and engineering. A discussion of FTE allocation and usage is included in the Personnel Compensation and Benefits discussion, in AOAM-3. A more detailed discussion about IPAs is included in the R&RA/EHR sub-section. The OIG, NSB, and Arctic Research Commission sections include discussions of their respective workforce issues.

NSF FY 2013 and FY 2014 Funding For E-Government Initiatives

Tables 6 and 7 show NSF contributions and service fees for various E-government initiatives.

Table 6.

NSF FY 2013 Funding Estimate for E-Government Initiatives

	FY 2013	FY 2013		Appropriations Account		
Initiative	**Agency Contributions**	**Agency Svc. Fees**	**NSF Total**	**AOAM**	**R&RA**	**EHR**
Grants.gov	-	$370,923	$370,923	-	$322,703	$48,220
E-Travel	-	257,684	257,684	257,684	-	-
Geospatial LoB	15,000	-	15,000	-	13,050	1,950
E-Training	-	370,000	370,000	370,000	-	-
E-Rulemaking	-	10,000	10,000	10,000	-	-
Recruitment One-Stop (USA Jobs)	-	8,312	8,312	8,312	-	-
Enterprise Human Resources Integration (EHRI)	-	32,427	32,427	32,427	-	-
Integrated Acquisition Environment (IAE)	-	15,406	15,406	15,406	-	-
IAE - Loans and Grants		89,973	89,973	89,973	-	-
Human Resources Management LoB	65,217	-	65,217	-	56,739	8,478
Financial Management LoB	150,870	-	150,870	-	131,257	19,613
Budget Formulation/Execution LoB	105,000	-	105,000	-	91,350	13,650
Performance Management LoB	34,000	-	34,000	-	29,580	4,420
E-Payroll (incl. Shared Services)	-	314,640	314,640	314,640	-	-
Total	**$370,087**	**$1,469,365**	**$1,839,452**	**$1,098,442**	**$644,679**	**$96,331**

LoB: Line of Business; Totals may not add due to rounding.

Table 7.
NSF FY 2014 Funding for E-Government Initiatives

Initiative	FY 2014 Agency Contributions	FY 2014 Agency Svc. Fees	NSF Total	Appropriations Account		
				AOAM	R&RA	EHR
Grants.gov	$467,754	-	$467,754	-	$411,624	$56,130
E-Travel	-	184,467	184,467	184,467	-	-
Geospatial LoB	25,000	-	25,000	-	22,000	3,000
E-Training [1]	-	370,000	370,000	370,000	-	-
E-Rulemaking	-	10,000	10,000	10,000	-	-
Recruitment One-Stop (USA Jobs)	-	7,537	7,537	7,537	-	-
E-HRI	-	23,099	23,099	23,099	-	-
Integrated Acquisition Environment (IAE)	-	18,079	18,079	18,079	-	-
IAE - Loans and Grants	-	235,465	235,465	-	207,209	28,256
Human Resources Management LoB	65,217	-	65,217	-	57,391	7,826
Financial Management LoB	139,094	-	139,094	-	122,403	16,691
Budget Formulation/Execution LoB	105,000	-	105,000	-	92,400	12,600
Performance Management LoB[1]	36,000	-	36,000	-	31,680	4,320
E-Payroll (incl. Shared Services) [1]	-	314,640	314,640	314,640	-	-
Total	**$838,065**	**$1,163,287**	**$2,001,352**	**$927,822**	**$944,707**	**$128,823**

LoB: Line of Business; Totals may not add due to rounding.

PROGRAM ACCOUNTS: **$124,770,000**
R&RA and EHR **+$15,260,000/ 13.9%**

R&RA and EHR funding accounts for about a quarter of the total Model Organization portfolio. There are two activities that comprise Program-Funded Model Organization – Intergovernmental Personnel Act (IPA) costs and Program Related Administration.

Summary of R&RA and EHR-Funded Model Organization
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
IPA Costs	$42.63	$44.51	$47.67	$3.16	7.1%
Program Related Administration	62.05	65.00	77.10	12.10	18.6%
Program Related Technology	*58.12*	*58.00*	*61.21*	*3.21*	*5.5%*
Other Program Related Administration	*3.93*	*7.00*	*15.89*	*8.89*	*127.0%*
Total, R&RA and EHR Funded Model Organization	**$104.68**	**$109.51**	**$124.77**	**$15.26**	**13.9%**

Totals may not add due to rounding.

IPA Costs

IPA Costs by Appropriation
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Number of IPAs[1]	184	183	195	12	6.6%
R&RA					
IPA Compensation	$30.35	$32.54	$34.68	$2.14	6.6%
IPA Lost Consultant & Per Diem	3.35	3.54	3.58	0.04	1.1%
IPA Travel	3.06	2.14	2.87	0.73	34.1%
Subtotal, R&RA Costs	36.76	38.22	41.13	2.91	7.6%
EHR					
IPA Compensation	4.80	5.36	5.53	0.17	3.2%
IPA Lost Consultant & Per Diem	0.65	0.75	0.78	0.03	4.0%
IPA Travel	0.43	0.18	0.23	0.05	27.8%
Subtotal, EHR Costs	5.87	6.29	6.54	0.25	4.0%
Total, IPA Costs[2]	**$42.63**	**$44.51**	**$47.67**	**$3.16**	**7.1%**

Totals may not add due to rounding.

[1]Includes five IPAs in staff offices (BFA, OIRM and OLPA) funded by Other Program Related Administration and included in General Program and Evaluation (P&E) activities.

[2]The costs associated with the five IPAs in staff offices are included in Other Program Related Administration.

A portion of NSF's workforce consists of temporary employees hired through the authority provided by the Intergovernmental Personnel Act (IPA). IPAs remain employees of their home institution while serving alongside NSF employees during their temporary assignment. They are not paid directly by NSF and are not subject to federal pay and benefits limitations. NSF reimburses the home institution directly for salary and benefits using the traditional grant mechanism. IPAs are eligible to receive relocation expenses or an allowance in lieu of an NSF-arranged household goods move, and reimbursement for a portion of income foregone because of their assignment at NSF (i.e., lost consulting fees).

The FY 2014 Request of $47.67 million represents an increase of $3.16 million, or 7.1 percent, from the FY 2012 Enacted level of $44.51 million. Additional funding supports an increase in IPA FTE utilization in FY 2014. NSF has managed its IPA program using an IPA allocation ceiling of 195 since FY 2009. In the last two years, IPA FTE utilization rates have been improving. Consequently, NSF anticipates IPA utilization will increase by 12 IPA FTE from the FY 2012 Enacted level to reach its IPA allocation of 195 IPA FTE.

The expertise provided by these additional IPAs is essential to help shape the NSF research portfolio and support transformational advances across the frontiers of all fields of science, engineering, and education, and to address the current workload imbalances identified during the workforce planning process employed by the Division of Human Resource Management (HRM) in 2012. In order to fully utilize the current IPA FTE allocation, NSF will continue to aggressively manage IPA staffing levels and recruiting efforts through concerted partnership between the directorates and offices, HRM, and academe.

FY 2014 funding for IPA Compensation is $40.21 million, an increase of $2.31 million from the FY 2012 Enacted level of $37.90. IPA Lost Consultant & Per Diem is funded at $4.36 million, an increase of $70,000 from FY 2012. Funding increases in these two categories are associated with full use of NSF's existing IPA FTE allocation.

The FY 2014 Request for IPA travel is $3.10 million, which represents a $780,000 increase over the FY 2012 Enacted level of $2.32 million, but a decrease of $390,000 below the FY 2012 Actual of $3.49 million. The decrease reflects actions taken to reduce travel spending in conjunction with OMB Memorandum M-12-12, *Promoting Efficient Spending to Support Agency Operations*. Institution of annual travel targets and the use of automated travel financial reports provide the means by which NSF directorates and offices can closely monitor and manage IPA travel obligations to ensure that travel reduction goals are achieved.

Program Related Administration

Program Related Administration (PRA) includes two categories of activities that support the Perform as a Model Organization Goal and that are directly funded from NSF's program accounts.

- Program Related Technology
- Other Program Related Administration

Program Related Administration
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
Program Related Technology	$58.12	$58.00	$61.21	$3.21	5.5%
Other Program Related Administration	3.93	7.00	15.89	8.89	127.0%
Total, Program Related Administration	**$62.05**	**$65.00**	**$77.10**	**$12.10**	**18.6%**

Totals may not add due to rounding.

Program Related Technology

Program Related Technology (PRT) activities, which relate directly to NSF's programmatic investments, are funded through the Research and Related Activities (R&RA) and Education and Human Resources (EHR) accounts. NSF's FY 2014 total information technology (IT) investment is $83.39 million; $61.21 million, or 73 percent, is funded by the R&RA and EHR appropriations as these investments relate directly to NSF's programmatic activities.

Resources to support administrative applications are discussed in the Agency Operations and Award Management (AOAM) account.

FY 2014 Program Related Technology Investments
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
PRT (R&RA and EHR)					
Mission-Support Applications Services	$41.13	$41.13	$43.84	$2.71	6.6%
Associated IT Operations and Infrastructure	14.03	13.91	14.41	0.50	3.6%
Related Security and Privacy Services	2.96	2.96	2.96	-	-
Total, Program Related Technology	**$58.12**	**$58.00**	**$61.21**	**$3.21**	**5.5%**

Totals may not add due to rounding.

NSF is dedicated to the support of fundamental research across all fields of science and engineering (with the exception of medical science) and all levels of science and engineering education. NSF fulfills its mission by issuing grants to fund specific research proposals that have been judged the most promising by a rigorous and objective review system. With this single mission focus, PRT investments are critical to supporting science and engineering research and education activities within the Foundation.

NSF's FY 2014, PRT information technology priorities include:

- Ensuring NSF's FY 2014 Information Technology (IT) investments align with the Administration's emphasis of ensuring the efficient and effective usage of federal resources by implementing practices that produce greater cost efficiencies, such as migrating IT infrastructure to cloud services, and investing in innovative IT solutions that produce a favorable return on investment within 18 months or demonstrably improve citizen services or administrative efficiencies. These new, innovative IT investments for the Foundation include planning and implementing an integrated data warehouse; employing new virtual meeting technologies to enable more virtual review panels for grant proposals; and increasing public access to NSF data.

- Supporting the implementation of iTRAK, the Foundation-wide strategic initiative to transition NSF from its disparate, aging financial and property management systems to a fully integrated financial management and property solution.

- Maintaining mission-related applications and services and the operations, infrastructure, and security that support these applications at current service levels.

The FY 2014 Request of $61.21 million for PRT represents an increase of $3.21 million over the FY 2012 Enacted and will be used for the following activities and initiatives:

Mission-Support Applications and Service (+$2.71 million, to a total of $43.84 million)
Investments in this category support NSF program staff in completing the merit review process, including pre-award planning and activities; receipt of proposals; processing proposals; reviewing proposals; award decisions, documentation, and notification; funding awards; post-award monitoring and oversight; dissemination of award results; and award close-out. Mission-related applications and services include investments such as Research.gov, eJacket, and FastLane.

- iTRAK is the Foundation-wide strategic initiative to transition NSF from its disparate, aging financial and property management systems to a fully integrated financial management and property solution. In FY 2014, the total request for iTRAK is $2.60 million. Consistent with the FY 2012 Enacted, 70 percent of this request will be funded by PRT and 30 percent will be funded by AOAM. For FY 2014, the PRT portion of the iTRAK request is $1.82 million. The majority of support for the implementation of iTRAK occurred in FY 2012 and FY 2013, therefore the FY 2014 funding amount represents a decrease of $2.11 million from the FY 2012 Enacted level. iTRAK implementation for core financial functions is scheduled for completion in FY 2014.
- Legacy mission applications, including FastLane ($5.85 million) and eJacket ($6.82 million), provide comprehensive services for NSF staff, applicants, and awardees to manage the grants life cycle. These legacy applications support NSF business processes, providing effective mission-support technology solutions for NSF's ongoing grants management needs. For FY 2014, the total request for legacy mission-related applications is $27.62 million. This reflects a $5.42 million increase over the FY 2012 Enacted, which will be used for the following activities:
  - $750,000 to increase public access to NSF data, thereby promoting and protecting open, transparent, and responsible scientific communication. Specifically, the funds requested will be used to make changes to NSF's legacy mission applications to integrate with an existing system that will support NSF in making its data publically available. Making changes to NSF's legacy systems in order to leverage an existing repository will make NSF data publically accessible in a more timely and cost effective manner than if NSF were to develop its own system for this purpose, which is consistent with the Administration's "Shared First" initiative that seeks to leverage agency IT spending through the shared usage of existing investments in the federal government.

  - The remaining $4.67 million increase will be used to make functional changes necessary for the ongoing operation of these applications. Many of these changes were deferred in FY 2012 and FY 2013 in order to support iTRAK and are critical to the continued operation of these applications.

- Research.gov is a community driven solution, led by NSF, that gives the general public, the science, engineering, research, and education community, and Congressional staff easy access to key information and services in one location (www.research.gov). Research.gov also provides services to help NSF staff plan and manage their programs and portfolios of proposals and awards. For FY 2014, the Research.gov request is $10.17 million, which represents a decrease of $4.83 million from the FY 2012 Enacted. The impact of this decrease will be to defer enhancements and augmentations to existing Research.gov services.

- To enable new and future innovative IT applications and systems that support mission-related activities, $4.23 million is requested to initiate planning and implementation, of an integrated enterprise data warehouse that will provide the foundation for these activities. Implementation of a data warehouse at the enterprise level avoids costs associated with operating separate data warehouses or data marts for individual IT investments; enables IT tools to support critical NSF mission activities, such as increased public access to NSF data and improved evaluation and assessment of NSF investments; and achieves administrative efficiencies by centralizing and streamlining access to NSF data.

Associated IT Operations and Infrastructure (+$500,000, to a total of $14.41 million)

Investments in this category provide basic maintenance and operations levels for ongoing operations. NSF's IT-enabled business infrastructure supports the operation of mission-essential IT applications and office automation activities, including its network and telecommunications requirements. This includes NSF's data center, network, hosting, phone, email, and remote access services. Network services include NSF's primary network for NSF staff, external network for NSF visitors, and connection to Internet2 for scientific purposes. Additionally, this category includes NSF's call center and customer care services. NSF provides customer care support for internal users (NSF staff) and external users (the research community including institutions, principal investigators, panelists, and other NSF visitors) 14-hours per day, five days per week. The call center assists NSF's research community of institutions and principal investigators with functions such as preparing and submitting proposals, financial reports, and progress reports to NSF. A call center, desktop support, and a walk-in center offer technical assistance to NSF staff and visitors.

The $500,000 increase over the FY 2012 Enacted is part of a $2.23 million investment in NSF's Merit Review Process Improvements initiative to expand NSF's infrastructure and virtual meeting technologies to enable increased virtual participation in reviews of NSF proposals. Currently, the predominant review method for NSF proposals is an in-person review panel where a set of experts travel to NSF to evaluate proposals. Enabling more virtual panels will reduce the overall cost of conducting review panels, avoid travel costs associated with onsite panels, and increase the diversity of NSF reviewers by allowing reviewers who are unable to travel to participate in the review process. The remainder of the investment will be funded by reducing infrastructure costs through consolidation and virtualization; moving additional infrastructure to the cloud; reducing call center and customer care services; and deferring replacement of aging infrastructure. Additional information on the Merit Review Process Improvement investment is provided in the NSF-wide Investments chapter of this request.

Related IT Security and Privacy Services (no change, to a total of $2.96 million)

Investments in this category include automated configuration management tools that manage security patches and provide proactive protection from viruses, spyware, and other threats. Critical investments

include network security, application security, security control testing and tools, automated vulnerability assessment tools, and remediation and intrusion detection services.

Other Program Related Administration ($8.89 million, to a total of $15.89 million)

FY 2014 Other Program Related Administration
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Major NSF-wide Investments					
Evaluation Capability	-	-	$5.50	$5.50	N/A
Merit Review Process Improvements	-	-	0.30	0.30	N/A
Public Access Initiative	-	-	1.75	1.75	N/A
Other					
E-Government Initiatives[1]	0.65	0.70	1.07	0.37	52.9%
General Planning and Evaluation Activities	3.28	6.30	7.27	0.97	15.4%
Total, Other Program Related Administration	**$3.93**	**$7.00**	**$15.89**	**$8.89**	**127.0%**

Totals may not add due to rounding.

[1] A full-year 2013 appropriation was not enacted at the time the budget was prepared. The amount shown for FY 2013 E-Government Initiatives funding is a placeholder and reflects the FY 2012 Enacted level. Current FY 2013 E-Government Initiatives funding estimates can be found in the Model Organization chapter of this request.

Major NSF-wide Investments

Evaluation Capability, (+$5.50 million, to a total of $5.50 million): In FY 2014, Other Program Related Administration resources will be used to strengthen the Foundation's evaluation and data collection activities. Two to three evaluations of NSF activities that cross organizational boundaries will be initiated. The programs chosen will be NSF-wide programs or strategic investments that span directorates. As part of this effort, NSF will build expertise on evaluation designs and methodology to plan and manage NSF-wide evaluations and to provide consultation NSF-wide. To improve the rigor of NSF evaluations, the evaluation capability will develop and manage a clearinghouse to review statements of work and evaluation designs against quality principles. A searchable repository will be built to house evaluation results and reports centrally so that information can routinely be used for decision making. Additional information on the Evaluation Capability is provided in the NSF-wide Investments chapter of this request.

Merit Review Process Improvements, (+$300,000, to a total of $300,000): FY 2014 Other Program Related Administration funding of $300,000 will support an assessment to determine the impacts of NSF's investments in improving the merit review process and to identify further potential to enhance the process. Additional information on the Merit Review Process Improvement investment is provided in the NSF-wide Investments chapter of this request

Public Access Initiative, (+$1.75 million, to a total of $1.75 million): FY 2014 funding for Other Program Related Administration will be used to support NSF's efforts to make the result of NSF research more broadly available to the public. Specifically, the funding will be used to support outreach, stakeholder engagement, and the required repository services. Additional information on the Public Access Initiative is provided in the NSF-wide Investments chapter of this request.

Other

E-Government Initiatives, (+$440,000, to a total of $1.07 million): In FY 2014, NSF program-supported funding for mission-related E-Government initiatives is $1.07 million, representing an increase of $440,000 over the FY 2012 Enacted. The FY 2014 increase is primarily associated with the shifting of NSF funding of $235,465 for the Integrated Acquisition Environment (IAE) – Loans and Grants initiative that was previously funding by the AOAM account to Other Program Related Administration. NSF proposes to begin funding IAE – Loans and Grants through Other Program Related Administration since the service benefits provided by the initiative – usage of the Dun and Bradstreet (D&B) Data Universal Numbering System (DUNS) by NSF's grant applicants and the public posting of NSF-award information on USASpending.gov – are directly related to NSF's grants-making mission. The remaining increase for E-Government Initiatives is due to an overall higher FY 2014 funding request submitted to NSF by the respective managing partner agencies. Additional detail on NSF funding for specific E-Government initiatives is provided in the Model Organization Overview section of this chapter.

General Planning and Evaluation Activities (P&E), (+$970,000, to a total of $7.27 million): FY 2014 Other Program Related Administration funding for P&E activities will be $7.27 million to support the verification and validation of performance information; the Waterman Award; some AAAS fellowship program and internships; IPAs associated with select NSF-wide activities; and studies and reports. The FY 2014 Request is based on the level of Other PRA activities and projects anticipated in FY 2014.

AGENCY OPERATIONS AND AWARD MANAGEMENT (AOAM)

$304,290,000
+$4,890,000/ 1.6%

Summary of Agency Operations and Award Management

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
Personnel Compensation & Benefits	$198.16	$202.91	$210.17	$7.26	3.6%
Management of Human Capital	9.67	9.40	7.98	-1.42	-15.1%
Travel	5.35	6.04	5.35	-0.69	-11.4%
Information Technology	30.66	26.10	22.18	-3.92	-15.0%
Space Rental	26.80	26.39	31.38	4.99	18.9%
Operating Expenses	13.55	15.26	13.22	-2.04	-13.4%
Other Infrastructure	12.42	10.69	11.34	0.65	6.1%
Future NSF	2.70	2.61	2.67	0.06	2.3%
Subtotal, AOAM	**299.30**	**299.40**	**304.29**	**4.89**	**1.6%**
FY 2013 Adjustment[2]		1.83			
Total, AOAM	**$299.30**	**$301.23**	**$304.29**	**$3.06**	**1.0%**

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2]This budget line is included to adjust for an item specific to the FY 2013 continuing resolution: $1.83 million for the 0.612 percent increase provided by the continuing resolution.

Investments in the Agency Operations and Award Management (AOAM) account, contained within NSF's *Perform as a Model Organization* strategic goal, continue to be an NSF priority. This activity provides the fundamental framework through which the Foundation's science and engineering research and education programs are administered. AOAM's priorities are framed by three strategic performance goals:

- Achieving management excellence through leadership, accountability, and personal responsibility;
- Infusing learning as an essential element of the NSF culture with emphasis on professional development and personal growth; and
- Encouraging and sustaining a culture of creativity and innovation across the agency to ensure efficiency and effectiveness in achieving high levels of customer service.

Personnel Compensation and Benefits (+$7.26 million to a total of $210.17 million)

AOAM NSF Workforce
(Full-Time Equivalent (FTE) and Other Staff)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
NSF AOAM -- Regular	1,310	1,310	1,310	-	-
NSF AOAM -- Pathways Interns	42	42	42	-	-
Subtotal, FTE Allocation	1,352	1,352	1,352	-	-
NSF AOAM -- Regular	1,281	1,285	1,310	25	1.9%
NSF AOAM -- Pathways Interns	39	42	42	-	-
Subtotal, FTE Usage	1,320	1,327	1,352	25	1.9%
Detailees to NSF	1	3	3	-	-
Total, Workforce (Usage)	**1,321**	**1,330**	**1,355**	**25**	**1.9%**

Totals may not add due to rounding.

Personnel Compensation & Benefits
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request[4]	Change Over FY 2012 Enacted Amount	Percent
Regular FTE Allocation	1,310	1,310	1,310	-	-
Regular FTE Usage (actual/projected)	*1,281*	*1,285*	*1,310*	*25*	*1.9%*
Regular Salary					
Base Salary[1]	$153.58	$155.74	$159.13	$3.39	2.2%
COLA & Locality Pay[2]	-	-	1.19	1.19	N/A
Subtotal, Regular FTE Salary	153.58	155.74	160.32	4.58	2.9%
Pathyways Intern FTEs	*39*	*42*	*42*	-	-
Pathways Intern Salary	1.40	1.44	1.44	-	-
Total, FTEs	*1,320*	*1,327*	*1,352*	*25*	*1.9%*
Subtotal, FTE Pay	154.98	157.18	161.76	4.58	2.9%
Benefits and Other Compensation[3]	43.18	45.73	48.41	2.68	5.9%
Total, PC&B	**$198.16**	**$202.91**	**$210.17**	**$7.26**	**3.6%**

Totals may not add due to rounding.

[1] Includes $3.48 million for the salary cost of 25 additional FTE used in FY 2014.

[2] The pay increase includes nine months of the projected 2014 pay raise of 1.0 percent, as well as anticipated within grade and promotion increases.

[3] This category includes employee benefits, terminal leave, awards, and other benefits.

[4] The increase in FY 2014 base salary reflects the full annual cost of employees hired throughout FY 2013.

The FY 2014 Request for Personnel Compensation and Benefits (PC&B) of $210.17 million represents an increase of $7.26 million over NSF's FY 2012 Enacted level of $202.91 million. The PC&B cost estimate includes a projected allocation and year-end usage of 1,310 regular full-time equivalent (FTE) employees, a total of 42 Pathways Intern FTE, a projected 2014 pay raise of 1.0 percent, associated cost of benefits,

general workforce performance awards (GWFPA) held at 2 percent of the salary pool, and SES bonuses held at 5 percent of the SES salary pool.

The FTE allocation of 1,310 regular FTE represents no change from the FY 2012 Enacted allocation, but it represents an increase of 25 FTE above the FY 2012 Enacted utilization level of 1,285 FTE. To reach regular FTE usage of 1,310 in FY 2014, NSF will take two actions. First, the Division of Human Resource Management (HRM) will work with the directorates and offices to more aggressively manage staffing levels and recruiting efforts. Second, NSF will re-assess FTE allocations across the agency. In late 2012, HRM initiated a rigorous workforce planning effort to address emerging workforce needs and to gain insight into what additional positions will be needed to support the FY 2014 NSF-wide priorities. The office heads of the Office of Information & Resource Management (OIRM) and the Office of Budget, Finance, and Award Management (BFA) will work with the Office of the Director to ensure that NSF's FTE allocations are aligned with the agency's priorities.

In FY 2014, NSF estimates increasing FTE utilization by 25 above the FY 2012 Enacted level of 1,285. These additional FTE will be used to address workload associated with the new efforts (+9 FTE) and to correct current workload imbalances (+16 FTE).

- A total of 9 FTE for the new Merit Review, Public Access and Evaluation Capability: 2 FTE for the Merit Review Process Improvements activity to support demand management; 2 FTE to lead and provide support to the NSF Public Access initiative; and 5 FTE for the NSF Evaluation Capability. Please refer to the NSF-wide Investments chapter of the budget for additional information.
- A total of 16 FTE to correct current workload imbalances in both mission and administrative organizations. Workload related to the Administration's commitment to building an innovation economy through investments in a broad portfolio of basic research is driving the need for additional staff with new skill sets. NSF's workforce planning process identified a need for additional program staff to support investments in cross-cutting research priorities, such as cyberinfrastructure, advanced manufacturing, and clean energy, as well as to support the agency's new lead role in strengthening undergraduate and graduate education reform. Administrative offices are experiencing increases in workload related to both new mission priorities and new required oversight activities in the areas of acquisition, human capital management, performance management, management and oversight of contractors, information technology, and financial management.

Management of Human Capital (-$1.42 million to a total of $7.98 million)

Management of Human Capital
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
$9.67	$9.40	$7.98	-$1.42	-15.1%

The FY 2014 Request for Management of Human Capital of $7.98 million represents a decrease of $1.42 million from the FY 2012 Enacted level. The decrease from FY 2012 reflects a reduction in contractor support for strategic human capital initiatives and administrative efficiencies in the delivery of training and other activities.

Collectively, the $7.98 million will support human capital activities and ongoing operations and maintenance of existing systems as follows:

- Maintain funding for NSF's basic HR systems accessed through shared service providers, such as the Federal Personnel Payroll System, the time and attendance system (WebTA), eRecruit capabilities using USAJobs, and security investigations for incoming staff. FY 2014 funding for these activities will be $1.0 million.
- Provide the day-to-day operational support for recruiting, hiring and on-boarding of permanent and rotating staff, as well as processing support for pay and benefits, and incentive and other awards. FY 2014 funding for these activities will be $3.10 million.
- Continue workplace and work life support for employees through NSF health and family-friendly activities, including the Health Unit, the Employee Assistance Program and the child care subsidy. FY 2014 funding for these activities will be $800,000.
- Maintain contracts in support of training and development programs such as the Learning Management System, LearnNSF, and related on-line training capabilities, as well as support for training and networking activities such as the Executive Leadership Retreat and Program Management Seminar. FY 2014 funding for these activities will be $1.95 million.
- Conduct management support contracts. FY 2014 funding for these activities will be $780,000. The focus will be on using assessments of past initiatives to consolidate effective practices in ongoing human capital management programs, and laying the groundwork for the next phases of activity in implementing Federal Employee Viewpoint Survey and Diversity and Inclusion Action Plans, with emphasis on reshaping performance management systems.

Travel (-$690,000 to a total of $5.35 million)

Travel

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
$5.35	$6.04	$5.35	-$0.69	-11.4%

The FY 2014 Request of $5.35 million for Travel represents a decrease of $690,000 from the FY 2012 Enacted level of $6.04 million. This level of funding reflects the agency's achievements in reducing administrative and programmatic travel costs in response to OMB Memorandum M-12-12, *Promoting Efficient Spending to Support Agency Operations*. In accordance with OMB M-12-12, NSF has taken prudent steps to reduce travel costs, while still protecting its investments in science and engineering and supporting professional development activities for its staff. Institution of FY 2013 travel targets and the use of automated travel financial reports provide the means by which NSF directorates and offices can closely monitor and manage travel obligations. The FY 2013 travel targets set the framework for reducing FY 2014 AOAM travel costs by $1.3 million, or 20 percent, from the FY 2010 actual of $6.65 million.

Information Technology (-$3.92 million, to a total of $22.18 million)

NSF funds administrative applications from the AOAM account while mission-related information technology (IT) investments that are directly associated with NSF programs are funded from program accounts. Resources to support mission-related IT investments are discussed in the Program Related Technology (PRT) section; see the Program Accounts: R&RA and EHR section of this chapter.

Administrative applications and associated IT operations and infrastructure and IT security and privacy services and support funded by the AOAM account are discussed below.

Agency Operations Information Technology (IT)

(Dollars in Millions)

Agency Operations IT	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Administrative Applications Services and Support	$12.20	$11.80	$6.83	-$4.97	-42.1%
Associated Infrastructure Services and Support	15.67	11.51	13.01	1.50	13.1%
Security and Privacy Services and Support	2.79	2.79	2.34	-0.45	-16.1%
Total, AOAM IT	**$30.66**	**$26.10**	**$22.18**	**-$3.92**	**-15.0%**

Totals may not add due to rounding.

Information technology for agency operations ensures high quality, reliable, and secure administrative applications and associated IT infrastructure support and services to meet the needs of the Foundation.

For FY 2014, NSF's information technology priorities include:

- Ensuring NSF's FY 2014 Information Technology (IT) investments align with the Administration's emphasis of ensuring the efficient and effective usage of federal resources by implementing practices that produce greater cost efficiencies such as; migrating IT infrastructure to cloud services, reducing

costs associated with security and privacy services by streamlining monitoring and vulnerability management, and investing in innovative IT solutions that produce a favorable return on investment within 18 months or demonstrably improve citizen services or administrative efficiencies. These new, innovative IT investments for the Foundation include planning and implementing an integrated data warehouse; employing new virtual meeting technologies to enable more virtual review panels for grant proposals; and increasing public access to NSF data. Additional information on these new IT investments is provided in the Program Accounts: R&RA and EHR chapter of this request.

- Supporting the implementation of iTRAK, the Foundation-wide strategic initiative to transition NSF from its disparate, aging financial and property management systems to a fully integrated financial management and property solution.
- Maintaining administrative applications and services and the operations, infrastructure, and security that support these applications at current service levels. Only replacements and upgrades critical to ongoing operations will be made in FY 2014.

The FY 2014 Request of $22.18 million for AOAM IT represents a decrease of $3.92 million, or 15.0 percent below the FY 2012 Enacted level. These resources will be used for the following activities and initiatives:

Applications Services and Support (-$4.97 million, to a total of $6.83 million)

Investments in this category support administrative applications, such as maintenance of NSF's legacy financial and accounting system and related functions, NSF's human resources management systems, the NSF website, and property and procurement applications.

iTRAK is the Foundation-wide strategic initiative to transition NSF from its disparate, aging financial and property management systems to a fully integrated financial management and property solution. In FY 2014, the total request for iTRAK is $2.60 million. Consistent with the FY 2012 Enacted budget, 70 percent of the iTRAK project will be funded by PRT and 30 percent will be funded by AOAM. In FY 2014, the AOAM portion of the iTRAK request is $780,000. The majority of support for the implementation of iTRAK occurred in FY 2012 and FY 2013, therefore the FY 2014 funding amount represents a decrease of $890,000 from the FY 2012 Enacted level.

For FY 2014, $3.50 million will be used for ongoing operations of the legacy financial and accounting system (FAS) and activities required for preparing data in FAS for transition to iTRAK. This represents an increase of $200,000 over the FY 2012 Enacted level. FAS is currently the primary system used by NSF to monitor, control, and execute the management and financial accountability of more than 56,000 active awards. FAS is also the financial system of record for the Foundation, managing all funding allocations, financial transaction processing, accounts maintenance, and rules processing. The FY 2014 increase will support the continued clean-up and migration of financial data in preparation for the move to iTRAK, continue decoupling FAS from interfaces with legacy business applications in order to prepare those applications to integrate with iTRAK, and make minor changes to FAS to maintain compliance with federal financial standards.

In FY 2014, $1.35 million will be used for ongoing operations and maintenance of the systems that support the strategic management of NSF human capital, including those to enable the effective recruitment, retention, development, and use of NSF staff. This is a decrease of $3.15 million from the FY 2012 Enacted. The impact of this decrease is to defer enhancements to HR systems and plans to increase automation of recruitment and workforce planning processes.

In FY 2014, $1.20 million will support ongoing operations and routine maintenance of collaboration services, such as SharePoint, the NSF website, and NSF's property and procurement applications. This

represents a decrease of $1.13 million from the FY 2012 Enacted. The impact of this decrease is to defer enhancements and functional changes to these applications.

Associated IT Operations and Infrastructure (+$1.50 million, to a total of $13.01 million)
Investments in this category provide basic maintenance and operations for ongoing operations that support administrative applications and services.

In addition to its primary purpose of supporting mission-related applications and services, NSF's IT-enabled business infrastructure supports the operation of administrative applications and office automation activities, including its network and telecommunications requirements. This includes NSF's data center, network, hosting, phone, email, and remote access services.

Additionally, this category includes NSF's call center and customer care services. NSF provides 14-hours per day, five days per week customer care support for NSF staff and external users (the research community, including institutions, principal investigators, panelists, and other NSF visitors).

In FY 2014, the $1.50 million increase will support upgrades to aging infrastructure that are critical to the ongoing operation of NSF's information technology environment.

Security and Privacy Services and Support (-$450,000, to a total of $2.34 million)
Investments in this category include automated configuration management tools that manage security patches and provide proactive protection from viruses, spyware, and other threats. This includes the relative portion of NSF's network security, application security, security control testing and tools, automated vulnerability assessment tools, and remediation and intrusion detection services related to administrative applications.

The $450,000 decrease in FY 2014 is associated with reduced costs for security and privacy services due to streamlining of monitoring, vulnerability management, and incident response processes.

Space Rental (+$4.99 million, to a total of $31.38 million)

Space Rental
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
$26.80	$26.39	$31.38	$4.99	18.9%

The FY 2014 Request for Space Rental is $31.38 million, an increase of $4.99 million, or 18.9 percent, over the FY 2012 Enacted.

Space Rental includes services provided by the General Services Administration (GSA) related to rent, utilities, taxes, and security.

NSF currently occupies 660,000 square feet of space, primarily in two adjoining, leased office buildings located in Arlington, Virginia. Both leases expire during 2013. The GSA procurement process for a new long term headquarters lease (see the "Future NSF" narrative below) is ongoing. An interim occupancy lease agreement will be required for both facilities from December 2013 until the new long term lease begins. Existing rental rates of $31.14 and $38.50 per square foot, respectively, for our two buildings will increase to $39.97/square foot. The additional $4.99 million reflects the cost increase associated with the interim occupancy agreement, related security services, and utility cost increases.

Operating Expenses (-$2.04 million to a total of $13.22 million)

Operating Expenses
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
$13.55	$15.26	$13.22	-$2.04	-13.4%

Operating Expenses include funding to support a wide variety of financial and award management and leadership activities, as well as funding for supplies, equipment, contracts, and other costs necessary to enable accomplishment of NSF's research and education mission.

The FY 2014 Request for Operating Expenses is $13.22 million, a decrease of $2.04 million, or 13.4 percent, from the FY 2012 Enacted level of $15.26 million. The key activities funded in Operating Expenses are described below.

- FY 2014 funding of $5.54 million, a reduction of $1.59 million from the FY 2012 Enacted, for training, equipment, communications devices, printing, and supplies for NSF's directorates and offices. Savings will be achieved from efficiencies implemented in response to Executive Order 13589, *Promoting Efficient Spending*.
- FY 2014 funding of $2.64 million for award management and oversight support services (AMOSS), which provides support services in the areas of post award monitoring, contract closeout activities, large facility oversight, ARRA reporting, and outreach activities/materials planned for NSF grantees. This level of funding represents a decrease of $964,000 from the FY 2012 Enacted level. The impact

of this decrease is to reduce the planned coverage of desk review advanced monitoring and to limit outreach and support of regional grant conferences.

- FY 2014 funding of $1.65 million, a decrease of $50,000 from FY 2012, for financial management support, including financial statement reporting, NSF property reporting, assistance in resolving audit deficiencies, and Access database development associated with the existing financial system; in addition to internal control quality assurance.
- FY 2014 funding of $330,000 for the congressionally-mandated Committee on Equal Opportunities in Science and Engineering (CEOSE) activity. This funding level represents an increase of $105,000 from the FY 2012 Enacted level, which will support the development of the CEOSE Biennial Report to Congress.
- FY 2014 funding of $350,000, held flat with the FY 2012 Enacted level, to support the Enterprise Information System (EIS) and the Budget Internet Information System (BIIS) to provide accurate, consistent information on funding rate, award size, and other statistics to NSF staff and the public. Support ensures that the system and related data analysis will continue to respond to evolving information needs.
- FY 2014 funding of $360,000 – commensurate with the FY 2012 Enacted level – to support on-going licensing, subscription, and infrastructure support for NSF's E-procurement system, the Automated Acquisition Management System (AAMS).
- FY 2014 funding of $350,000, a decrease of $50,000 from FY 2012, for an inter-agency agreement with the Department of Interior's National Business Center to negotiate indirect cost rate agreements on behalf of NSF with organizations where NSF has rate cognizance. Indirect cost rate negotiation is a federally mandated function and directly supports awardee business operations.
- FY 2014 funding of $250,000 for reasonable accommodations that NSF is responsible for providing to persons with disabilities, including NSF employees, applicants, and those conducting business at NSF. Funding increases by $20,000 from the FY 2012 Enacted level in order to maintain NSF's model Equal Employment Opportunity status.
- FY 2014 funding of $190,000 to support the review of grant payments and grantee expenditures of those payments as reported on the quarterly Federal Financial Reports (FFR) in order to comply with the Improper Payments Information Act (IPIA), NSF's post award monitoring program, and NSF's review of ARRA funds. The level of funding is held flat with FY 2012.

Other Infrastructure (+$650,000 to a total of $11.34 million)

Other Infrastructure
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
$12.42	$10.69	$11.34	$0.65	6.1%

The FY 2014 Request for Other Infrastructure of $11.34 represents an increase of $650,000 from the FY 2012 Enacted level.

Resources within Other Infrastructure support three sets of activities:

- **Administrative Contracts** - Includes the mail center, loading dock, shipping and receiving, supply and warehouse management, conference support, the proposal processing unit, print shop, FedTraveler support, infrastructure and database management (Inside NSF, nsf.gov, ePublish, Program Information Management System (PIMS), and NSF intranet operations and maintenance.

- **Government Goods and Services** - This category provides basic activities such as the employee transit subsidy benefit, infrastructure maintenance and building services, archival records storage, building improvements, and office space reconfiguration and realignment.
- **Administrative Services, Equipment and Supplies** - This category represents a full range of business activities supporting NSF's infrastructure, including the security system maintenance, badge office (ID issuance), public announcement (PA) system maintenance, NSF Alert System, Continuity of Operations support services, emergency management services, data center uninterrupted power supply (UPS) maintenance, office reconfigurations, furniture purchase/cleaning/refinishing, carpet cleaning and installation, library services, equipment leases and maintenance, copier paper for all of NSF, metered mail postage, printing of publications, and Federal Register notices for panels and advisory committees.

For FY 2014, additional investments are being proposed to modernize outdated systems and facilitate NSF's merit review process.

Investments in FY 2014 include a migration from Cold Fusion to Java (+$220,000) for the following applications: Multimedia Gallery, Online Document System, Online Conference Registration Form, Research Experiences for Undergraduates (REU) Search, and Medal of Science Awards. Conversion of these applications will result in fixes and minor enhancements being resolved more quickly and the elimination of legacy systems, which will reduce maintenance support and improve utility by consolidating all functions into one system.

Additional investments include a multi-year effort to upgrade technology in NSF conference rooms (+$1.0 million) in support of the Merit Review Process Improvements initiative. The conference room upgrades are needed to replace outdated equipment and increase virtual technology capabilities and increase opportunities for virtual panels. This is in support of the overall NSF initiative to increase the use of virtual panels leveraging the use of technology where practical and generating efficiencies in reduced travel costs. Additionally, the upgrades will increase staff efficiency by maximizing the utility of integrated media resources to facilitate meetings.

In FY 2014, resources will be allocated to support virtual technology and support services (+$560,000) to coincide with the upgrading of conference rooms to a virtual platform. Increased funding will allow for the purchase of additional licenses associated with the increased number of virtual seats in the NSF portfolio.

To partially offset these investments, the Foundation is undertaking various initiatives to streamline operations and reduce costs. An efficiency review has been undertaken to streamline library subscriptions (-$500,000). This assessment could lead to systematic changes throughout the Foundation and cost savings beginning in FY 2014. In addition, contract reductions (-$1.13 million) will occur as efficiencies are achieved in response to Executive Order 13589, *Promoting Efficient Spending* in printing and/or copying activities, among others.

In addition to upgrading the conference rooms to a virtual platform and acquiring additional licenses, support for the Merit Review Process Improvements effort is discussed in the Program Related Technology section of the Model Organization narrative. Please refer to the NSF-wide Investments chapter of the budget for additional information on the Merit Review Process Improvements effort.

Future NSF (+$60,000 to a total of $2.67 million)

Future NSF
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
$2.70	$2.61	$2.67	$0.06	2.3%

The FY 2014 Request for Future NSF of $2.67 million represents an increase of $60,000 over the FY 2012 Enacted level.

NSF headquarters has been located in Arlington, VA since 1993. Initially, the agency occupied the Stafford I building but subsequently expanded into an adjacent building (Stafford II) as the responsibilities, operations, and staff have grown over the past nineteen years. Leases for both facilities expire December 2013.

NSF has worked collaboratively with the General Services Administration (GSA) over the past several years to establish a new long-term lease. In December 2010, GSA submitted a prospectus to Congress requesting authorization to enter into a new 15-year operating lease for the Foundation. NSF's prospectus was authorized by the House in 2012. Approval by the Senate is pending. GSA has developed a detailed schedule to establish a replacement long-term lease for NSF before the end of FY 2013.

The FY 2014 resources will be used to provide the technical expertise required to transition from planning to implementation of the project, including space and technology design, construction, relocation strategy and subsequent operational commissioning plans. Specific work will include:

- Management support to the GSA lease procurement, real estate and development evaluations, program and design documentation, and architecture/engineering/construction planning oversight;
- Support for NSF space plans, design oversight, information technology planning and design, furniture and equipment pilot projects, and acquisition strategies and procurement support;
- Planning, design, execution, and oversight for NSF's new leased space will be required to meet federal mandates such as energy efficiency, data center reduction and consolidation, and space utilization rate goals. This work will be performed by the building owner and funded through allowances and/or credits provided as typically negotiated into a GSA lease. Future NSF will be responsible for conceptual designs, as well as for oversight and acceptance of work, and coordinating associated activities that may be required as a result, including NSF communications infrastructure cabling and furniture reuse and reconfigurations.

GSA is in the process of conducting a full and open competition for NSF's next headquarters long term lease. GSA anticipates an award by the beginning of FY 2014. GSA is also entering into an interim lease arrangement to carry the government's occupancy of Stafford I and II from December 2013 until the new long term lease begins. Following selection and award of a new lease, the project will transition from planning to full implementation and will require up to 36 months to complete, whether renovating the existing NSF space or constructing new space.

Agency Operations and Award Management by Object Class

The following table shows the planned distribution of obligations by object class. A brief explanation of each category follows.

AOAM by Object Class

(Dollars in Thousands)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
Personnel Compensation	$156,706	$161,128	$167,222	$6,094	3.8%
Personnel Benefits	41,452	41,782	42,948	1,166	2.8%
Travel and Transportation of Persons	5,350	6,039	5,350	-689	-11.4%
Transportation of Things	261	545	488	-57	-10.5%
Rental Payments to GSA	25,925	26,390	31,380	4,990	18.9%
Rent to Others	576	1,015	909	-106	-10.4%
Communications, Utilities and Misc. Charges	2,696	1,902	1,704	-198	-10.4%
Printing and Reproduction	121	432	387	-45	-10.4%
Advisory and Assistance Services	43,417	43,311	38,801	-4,510	-10.4%
Other Services	8,923	7,190	6,441	-749	-10.4%
Purchases of Goods & Srvcs from Gov't. Accts	7,404	1,914	1,715	-199	-10.4%
Operations and Maintenance of Equipment	88	128	115	-13	-10.2%
Supplies and Materials	4,199	3,866	3,463	-403	-10.4%
Equipment	2,182	3,758	3,367	-391	-10.4%
Subtotal, AOAM	**$299,300**	**$299,400**	**$304,290**	**$4,890**	**1.6%**
FY 2013 Adjustment[2]		$1,832			
Total, AOAM		**$301,232**			

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account is operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualized FY 2013 continuing resolution at the account level.

[2]This budget line is included to adjust for an item specific to the FY 2013 continuing resolution: $1.83 million for the 0.612 percent increase provided by the continuting resolution.

FY 2014 Request object class code estimates reflect NSF's response to Executive Order 13589, *Promoting Efficient Spending* and OMB Memorandum M-12-12, *Promoting Efficient Spending to Support Agency Operations*. The FY 2014 Request for Travel and Transportation is reduced from the FY 2012 Enacted level and is held flat with the FY 2012 Actual to meet the agency's FY 2014 travel efficiency reduction goal. Additionally, FY 2014 funding estimates in other object classes such as Advisory and Assistance Services, Other Services, and Supplies and Materials, have been reduced by 10.4 percent over the FY 2012 Enacted level to promote efficient spending in categories highlighted in the Executive Order.

Personnel Compensation and Benefits: Personnel compensation funds pay, awards/bonuses, reimbursable details to NSF, overtime, and terminal leave. Personnel Benefits include the Government's contribution towards retirement systems, health and life insurance, thrift saving plans, special overseas allowances, and unemployment insurance. Personnel Compensation increases by 3.8 percent and

Personnel Benefits increases by 2.8 percent over the FY 2012 Enacted level as a result of the increase of 25 FTE in FY 2014; the increase in the general workforce performance awards pool from 1.0 percent of aggregate salaries in FY 2012 to 2 percent of aggregate salaries in FY 2014; and the 1.0 percent pay raise.

Travel and Transportation of Persons: These resources fund travel required for planning, outreach, and increased oversight of existing awards, as recommended by the agency's Inspector General.

Transportation of Things: This category consists of household moves associated with bringing new staff to NSF.

Rental Payments to GSA: This category includes the rent charged by GSA for NSF's facility in Arlington, Virginia, and additional floors currently leased in an adjacent building. The FY 2014 Request for Space Rental is $31.38 million, an increase of $4.99 million, or 18.9 percent, over the FY 2012 Enacted. The additional $4.99 million reflects the cost increase associated with the interim occupancy agreement.

Rental Payments to Others: This category includes rent paid to a non-federal source for rental of space, land, and structures.

Communications, Utilities, and Miscellaneous Charges: This category includes all costs for telephone and other communication lines and services, both local and long distance, and postage.

Printing and Reproduction: This category includes contract costs of composition and printing of NSF's publications, announcements, and forms, as well as printing of stationery and specialty items.

Advisory and Assistance Services: This category includes development, learning, and career enhancement opportunities offered through the NSF Academy; contracts for human capital operational activities, work life initiatives, outreach, and related services; assistance in award oversight and monitoring; and support for OMB Circular A-123 reviews.

Other Services: This category includes warehousing and supply services, mail handling, proposal processing, equipment repair and maintenance, building-related costs, furniture repair, contract support for conference room services, security investigations, and miscellaneous administrative contracts.

Purchases of Goods and Services from Government Accounts: This category includes reimbursable services purchased from other government agencies. Examples include GSA for security guard services, some electrical upgrades, and modest renovation services, and Department of the Interior for payroll services.

Operation and Maintenance of Equipment: This category includes management and operation of the central computer facility 24x7 year-round; operation of the customer service center and IT help desk; maintenance of database server hardware and related peripherals; software licensing fees; data communications infrastructure and network systems support; electronic mail support; and remote access services.

Supplies and Materials: This category includes office supplies, library supplies, paper and supplies for the NSF central computer facility, and miscellaneous supplies.

Equipment: This category includes new and replacement computing equipment, desktop computers, data communications equipment, video-teleconferencing equipment, office furniture, file cabinets, and support equipment such as audio-visual equipment.

Appropriations Language

For agency operations and award management necessary in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); services authorized by 5 U.S.C. 3109; hire of passenger motor vehicles; not to exceed $8,280 for official reception and representation expenses; uniforms or allowances therefor, as authorized by 5 U.S.C. 5901-5902; rental of conference rooms in the District of Columbia; and reimbursement of the Department of Homeland Security for security guard services; ~~$299,400,000:~~*$304,290,000: Provided,* That contracts may be entered into under this heading in fiscal year ~~2013~~*2014* for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year.

Agency Operations and Award Management
FY 2014 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Carryover/ Recoveries	Transfers	Expired	Total Resources	Obligations/ Estimates
FY 2012 Appropriations	$299.40			-$0.10	$299.30	$299.30
FY 2012 Enacted/Annualized FY 2013 CR[1]	301.23				301.23	301.23
FY 2013 Request	304.29				304.29	304.29
$ Change from FY 2012 Enacted						$4.89
% Change from FY 2012 Enacted						1.6%

Totals may not add due to rounding.

[1]This line includes the adjustment for an item specific to the FY 2013 continuing resolution: $1.83 million for the 0.612 percent increase provided by the continuing resolution.

NATIONAL SCIENCE BOARD (NSB) $4,470,000
+$30,000/ 0.7%

The FY 2014 Request for the National Science Board is $4.47 million, which is $30,000 above the FY 2012 Enacted of $4.44 million. The FY 2014 Budget Request will enable the Board to fulfill its policy-making responsibilities for NSF. This funding will allow the Board to continue its responsibilities as outlined in the National Science Foundation Act of 1950, as amended (42 U.S.C. 1863) and Public Law 86-209 (42 U.S.C. 1880 et seq.), including activities related to the review of major research facilities projects. These resources will also be used to develop and submit *Science and Engineering Indicators 2014* and related products to the President and Congress.

Office of the National Science Board

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
Subtotal, NSB	**$4.37**	**$4.44**	**$4.47**	**$0.03**	**0.7%**
FY 2013 Adjustment[2]		0.03			
Total, NSB	**$4.37**	**$4.47**	**$4.47**	**-**	**-**
Full-Time Equivalents (FTEs)	17	18	19	1	5.6%

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2]This budget line is included to adjust for an item specific to the FY 2013 continuing resolution: $27,173 for the 0.612 percent increase provided by the continuing resolution.

Appropriations Language

For necessary expenses (including payment of salaries, authorized travel, hire of passenger motor vehicles, the rental of conference rooms in the District of Columbia, and the employment of experts and consultants under section 3109 of title 5, United States Code) involved in carrying out section 4 of the National Science Foundation Act of 1950, as amended (42 U.S.C 1863) and Public Law 86-209 (42 U.S.C. 1880 et seq.), ~~$4,440,000:~~*$4,470,000: Provided*, That not to exceed $2,500 shall be available for official reception and representation expenses.

National Science Board

FY 2014 Summary Statement

(Dollars in Millions)

	Enacted/ Request	Expired	Total Resources	Obligations/ Estimates
FY 2012 Appropriation	$4.44	-$0.07	$4.37	$4.37
FY 2012 Enacted/Annualized FY 2013 CR[1]	4.47		4.47	4.47
FY 2014 Request	4.47		4.47	4.47
$ Change from FY 2012 Enacted				0.03
% Change from FY 2012 Enacted				0.7%

Totals may not add due to rounding.

[1]This line includes the adjustment for an item specific to the FY 2013 continuing resolution: $27,173 for the 0.612 percent increase provided by the continuing resolution.

National Science Board in Context

The Board, established by the NSF Act of 1950, has dual responsibilities to: a) provide national science policy advice to the President and Congress; and b) establish policies for NSF. The Board is composed of 25 presidentially-appointed members, including the NSF Director, representing the broad U.S. science and engineering (S&E) community. Board Members, who serve 6-year terms on staggered appointments, are drawn from industry, academe, non-profit organizations and professional scientific societies, and represent the breadth of S&E disciplines supported by NSF. They are selected for their eminence in research, education, or public service.

The Board currently meets for five formally scheduled meetings a year and additional meetings as needed to review and approve major NSF awards and new programs, oversee and provide policy direction to NSF, and address significant science and engineering related national policy issues. It initiates and conducts studies and reports on a range of policy topics and reviews NSF's priorities both to ensure progress and consistency along the strategic direction set for NSF and to ensure balance among new investments and core programs.

Policy Responsibilities

Issues of importance to the science, engineering, and education communities in general and to the NSF in particular are often examined by the Board. Topics for exploration are determined through requests from Congress or the President or as identified by the Board in consultation with the science community and NSF management. Recent reports have examined topics such as merit review, mid-scale instrumentation, data policies, public research universities, science and engineering education, and the U.S. innovation system. Identification of Board items for study in FY 2014, in addition to the development and production of *Science and Engineering Indicators 2014* and its associated products, will be determined at a later date and is currently under discussion.

In addition to those special studies, the Board has several standing committees to assist with its responsibilities. The Committee on Audit and Oversight provides general supervision for the NSF Inspector General; oversight of major agency administrative processes and principal administrative systems; and review of the agency's GPRA Modernization Act (Government, Performance, and Results Act) requirements.

The Committee on Strategy and Budget (CSB) focuses on strategic planning and new investments for NSF; analyzes the Foundation's budget to ensure progress and consistency against strategic direction for the Foundation; and identifies strategic, typically long-term, issues that are critical to NSF's future. Within CSB, the Subcommittee on Facilities (SCF) provides guidance and review of the NSF-funded research equipment and facilities portfolio, including both Major Research Equipment and Facilities Construction (MREFC) account-funded and Research and Related Activities (R&RA) account-funded facilities.

The Committee on Education and Human Resources (CEH) focuses on policy direction and advice on major policy issues related to the NSF education, informal science, and training portfolio; and reviews proposals representing a significant expenditure of National Science Foundation resources and recommends actions for consideration by the Board. It also provides advice on major national policy issues in science, technology, engineering and mathematics (STEM) education, human resource needs and employment, and human resource development for consideration by the Board.

The Committee on Science and Engineering Indicators (SEI) oversees the development, production, and recommends approval to the Board for release of the Board's biennial report, *Science and Engineering Indicators*, and other related products; and keeps the Board informed on trends and other data with significant policy implications identified during the production of *Indicators.* The Board's publication,

Science and Engineering Indicators (SEI), is a statutory responsibility. Over the past several years, the Board has heightened its efforts to expand the audience for Indicators, implementing enhancements such as the on-line *Digest of Key Science and Engineering Indicators* that encourage audiences outside the normal community of users to become familiar with the data resources in Indicators and to facilitate the use of Indicators data in policy decisions and analyses. Release of the 2014 edition of SEI to Congress is scheduled for January, 2014. The Board has indicated an interest in developing additional policy statements based on the SEI data to assist policymakers in their deliberations on science and technology issues.

The Board is responsible for direct review and approval of the Foundation's largest awards, and is responsible for the review and approval of MREFC projects at all stages of development, including budget planning, review of proposals and management effectiveness, and approval of awards. The Committee on Programs and Plans (CPP) provides guidance and advice on major policy issues related to the NSF research and related activities portfolio, reviews proposals representing a significant expenditure of agency resources, and makes recommendations, as appropriate, to the full Board for its consideration and action.

The Board's Executive Committee (EC) is required by the National Science Foundation Act of 1950, as amended (42 U.S.C. Section 1865). It consists of the NSF Director, who chairs the Committee, and four other elected members from the Board. The Board may delegate to the Executive Committee or to the Director or both such of the powers and functions granted to the Board by the NSF Act as it deems appropriate.

On-going activities of the Board include review and approval of the following:

- Large awards, MREFC projects, or proposal funding requests and other proposals as needed;
- NSF's Management Response to the Office of Inspector General (OIG) Semi-annual Reports to Congress;
- The Budget for OIG for submission to the Office of Management and Budget (OMB);
- The NSF Budget Submission, including the NSB Budget, for transmittal to OMB;
- The priority order for projects in the MREFC Account;
- Inclusion of any new project(s) in a request for funding under the MREFC Account; and
- The NSF Strategic Plan.

The Board also receives reviews of the following from NSF:

- Financial management reports for NSF;
- The operation of NSF's merit review system;
- NSF research infrastructure portfolio; and
- NSF human capital reports.

Office of the National Science Board
Personnel Compensation and Benefits and General Operating Expenses
(Dollars in Thousands)

	FY 2012 Actual	FY 2012/ Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
Personnel Compensation and Benefits	$2,557	$2,973	$3,080	$107	3.6%
Staff Development & Training	30	36	36	-	-
Advisory & Assistance Services	1,445	903	898	-5	-0.6%
Travel & Transportation of Persons	195	365	333	-32	-8.8%
				0	
Communications, Supplies and Equipment	140	160	120	-40	-25.0%
Representation Costs	3	3	3	-	-
Total, NSB	**$4,370**	**$4,440**	**$4,470**	**$30**	**0.7%**
Full-Time Equivalent	17	18	19	1	5.6%

Totals may not add due to rounding.

Personnel Compensation and Benefits
The Board's FY 2014 Budget Request supports a core of full-time policy, administrative, legal, and operations staff. About 70 percent of the 2014 Request is for Board member and staff salaries and benefits. The Board Office staff provides both the independent resources and capabilities for coordinating and implementing science and education policy analyses and development, and the operational support that is essential for the Board to fulfill its mission. The FY 2014 Request funds a 1.0 percent provisional pay raise effective January 2014.

Other Operating Expenses
NSB's Advisory and Assistance Services includes the resources needed to produce policy reports to include the Board's *Science and Engineering Indicators (SEI) 2014*, a statutory responsibility. Over the past several years, the Board has heightened its efforts to expand the audience for *Indicators*, including the development of companion reports. Release of the 2014 edition of *SEI* to Congress is scheduled for January, 2014.

Most of the Board's reports require expert analysis from organizations such as the Science and Technology Policy Institute (STPI). Another major expense in the Advisory and Assistance Services line is the continued enhancement and maintenance of an electronic architecture to search, identify, and retrieve relevant documents for reference and research purposes. This electronic records center houses substantive Board materials, such as discussions, decisions, and meeting minutes. Other costs within the Advisory and Assistance Services line are associated with the Open Government initiative including the webcasting and archiving of all open Board meetings, as well as transcription services, and report printing and dissemination.

NSB's Travel and Transportation of Persons account primarily covers Board member travel costs to NSF headquarters for four meetings, and to one off-site meeting, as well as travel for invited speakers and participants in Board activities. The FY 2014 Travel and Transportation budget of $300,000 represents a reduction of $53,000 (or -15 percent) from the actual FY 2010 baseline. This level of spending is consistent with NSF's proposal for travel reductions under OMB memo M-12-12, *Promoting Efficient Spending to Support Agency Operations*. The Communications, Supplies, and Equipment line funds the range of electronic purchases, upgrades and installations, such as copiers and computers.

OFFICE OF INSPECTOR GENERAL (OIG) $14,320,000
+$120,000/ 0.8%

The Appropriations Act that funds the National Science Foundation provides for a separate appropriation for NSF's Office of Inspector General (OIG). Accordingly, the FY 2014 Request identifies the resources needed to support OIG, including amounts for personnel compensation and benefits (PC&B), contract services, training, travel, supplies, materials, and equipment.

The FY 2014 Budget Request for OIG is $14.32 million, which represents an increase of $120,000 over the FY 2012 Enacted of $14.20 million.

Office of Inspector General Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
Subtotal, OIG	$14.12	$14.20	$14.32	$0.12	0.8%
FY 2013 Adjustment[2]		0.09			
Total, OIG	**14.12**	**14.29**	**14.32**	**0.03**	**0.2%**
ARRA Obligations: FY 2012/FY 2013	*0.70*	*1.15*			
Total, OIG including ARRA	*$14.82*	*$15.44*	*$14.32*	*-$1.12*	*-7.3%*
Full-Time Equivalents (FTEs)	78	78	78	-	-

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2]This budget line is included to adjust for an item specific to the FY 2013 continuing resolution: $86,904 for the 0.612 percent increase provided by the continuing resolution.

Appropriations Language

For necessary expenses of the Office of Inspector General as authorized by the Inspector General Act of 1978, as amended, ~~$14,200,00,000,~~*$14,320,000,* to remain available until September 30, 2014, *of which not to exceed $400,000 shall remain available until September 30, 2015.*

Office of Inspector General
FY 2014 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Carryover/ Recoveries	Expired	Total Resources	Obligations/ Estimates
FY 2012 Appropriations	$14.20		-$0.08	$14.12	$14.12
FY 2012 ARRA[1]	-	1.84	-	1.84	0.70
FY 2013 ARRA[1]	-	1.15	-	1.15	1.15
FY 2012 Enacted/Annualized FY 2013 CR[2]	14.29		-	14.29	14.29
FY 2014 Request	14.32		-	14.32	14.32
$ Change from FY 2012 Enacted					0.12
% Change from FY 2012 Enacted					0.8%

Totals may not add due to rounding.

[1]$1.84 million in unobligated FY 2009 ARRA funds were carried over into FY 2012. The remaining unobligated balance of $1.15 million was subsequently carried over into and obligated during the first quarter of FY 2013.

[2]This line includes the adjustment for an item specific to the FY 2013 continuing resolution: $86,904 for the 0.612 percent increase provided by the continuing resolution.

Explanation of Carryover

Within the **Office of Inspector General ARRA** account, $1.15 million was carried over from FY 2012 into FY 2013. These multi-year funds are intended explicitly for ARRA oversight. These funds were obligated during the first quarter of FY 2013.

OIG Responsibilities

In February 1989, the National Science Board established OIG pursuant to the Inspector General Act Amendments of 1988. The statute confers on OIG the responsibility and authority to:

- Conduct and supervise audits of NSF programs and operations, including organizations that receive NSF funding;
- Conduct investigations concerning NSF programs and operations, including organizations that receive NSF funding;
- Evaluate allegations of research misconduct, such as fabrication, falsification, or plagiarism, involving individuals who participate in NSF-funded activities;
- Provide leadership, coordination, and policy recommendations for:
  - Promoting economy, efficiency, and effectiveness in the administration of NSF programs and operations, and
  - Preventing and detecting fraud and abuse in NSF programs and operations;
- Issue semiannual reports to the National Science Board and Congress to keep them informed about problems, recommended corrective actions, and progress being made in improving the management and conduct of NSF programs.

OIG performs audits of grants, contracts, and cooperative agreements funded by NSF's programs. The office also conducts audits and reviews of both internal agency programs and external organizations that receive NSF funding to ensure that financial, administrative, and programmatic activities are conducted economically, effectively, and in compliance with agency and federal requirements. OIG is also responsible for overseeing the audit of NSF's annual financial statements, which are required for all NSF accounts and activities by the Government Management Reform Act of 1994. Since FY 2006, funds to cover the complete cost of the financial audit have been requested in this appropriation. OIG also audits financial, budgetary, and data processing systems used by NSF to develop the financial statements. In addition, the office performs multi-disciplinary reviews – involving auditors, attorneys, management analysts, investigators, and others as needed – of financial, management, and program operations to identify broader problems and highlight best practices.

OIG investigates possible wrongdoing by organizations and individuals who seek or receive NSF funds such as those who submit proposals to, receive awards from, conduct business with, or work for NSF. Allegations of research misconduct are also investigated. OIG assesses the validity and seriousness of all the allegations it receives and recommends proportionate action. When appropriate, the office refers the results of these investigations to the Department of Justice or other authorities for criminal prosecution, civil litigation, or resolution via settlement agreements and institutional compliance plans. OIG refers other cases to NSF for administrative resolution and when needed will recommend modifications to agency policies and procedures to ensure the integrity of NSF's business systems. The office works closely with institutions on the conduct of their internal investigations and performs outreach activities aimed at preventing and detecting fraud, waste, and abuse; and at raising the awareness of funded researchers, institutional administrators, and agency employees about OIG's role and NSF's rules and expectations.

Because diverse skills, training, and experience are necessary to oversee NSF's many programs, the OIG staff includes scientists, attorneys, certified public accountants, investigators, evaluators, and information technology specialists. The subjects of investigations, audits, and other reviews are also varied and may include: an individual grant recipient or institution; a broad program or functional area of NSF; or a project involving multiple disciplines or entities. OIG also utilizes contractors to perform work when it is cost effective, or when OIG lacks the necessary expertise in-house, as in the case of the annual review of the agency's financial systems controls and their compliance with FISMA. In FY 2014, the office expects to see a decline in the number of audits and investigations of NSF programs, grants, contracts, and other activities associated with funding provided by the American Recovery and Reinvestment Act of 2009 (ARRA). However OIG will maintain its oversight of ARRA awards for as long as they are active. OIG received a special appropriation in 2009 to oversee ARRA funds that is set to expire on September 30, 2013.

Office of Inspector General
Personnel Compensation and Benefits and General Operating Expenses

(Dollars in Thousands)

	FY 2012 Actual	FY 2012 ARRA[2]	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2013 ARRA[2]	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
Personnel Compensation and Benefits	$11,158	-	$11,375	-	$11,660	$285	2.5%
Travel & Transportation of Persons	207	-	335	-	312	-23.00	-0.07
Advisory & Assistance Services[1]	2,466	696	2,130	1,149	1,988	-142	-6.7%
Communications, Supplies and Equipment, and Other Services	291	-	360	-	360	-	-
Training	*159*	-	*160*	-	*160*	-	-
Other	*132*	-	*200*	-	*200*	-	-
Subtotal, OIG	**$14,122**	**$696**	**$14,200**	**$1,149**	**$14,320**	**$120**	**0.8%**
Full-Time Equivalent	78	78	78		78	-	-

Totals may not add due to rounding.

[1] Includes the costs of the annual financial statements audit and the outsourcing of contracting services.

[2] $1.84 million in unobligated FY 2009 ARRA funds were carried over into FY 2012. The remaining unobligated balance of $1.15 million was subsequently carried over into and obligated during the first quarter of FY 2013.

The FY 2014 appropriation of $14.32 million would enable OIG to maintain current staffing levels and provide adequate oversight of NSF's core programs, largest contracts, and riskiest grant awards. Some planned initiatives will have to be deferred. OIG will have to delay investing in necessary systems and equipment upgrades, including the improvement of a data analytics capability for Audit and the acquisition of one for Investigations, and funding for preventive activities, such as educating researchers about rules and requirements at regional conferences, and outreach efforts to NSF employees and other stakeholders will be reduced. OIG will also absorb the rising costs of personnel compensation, health insurance and other benefits, travel, training, contracts, and equipment, by reducing its spending on contracted audits,.

OIG spent $328,538 for travel during FY 2010, including $157,893 for audits and investigations, and $114,172 for preventive activities consistent with the IG mission, such as giving presentations at conferences and conducting workshops aimed at informing the research community about their responsibilities as awardees, principal investigators, and administrators. These expenses are critical to our ability to perform our law enforcement and oversight responsibilities and, in accordance with the Executive Order M-12-12; they are exempt from the 30 percent reduction. We have also identified approximately $56,472 in travel expenses that were incurred mostly for training and interoffice meetings that we intend to reduce by 30 percent ($16,942). In order to meet this goal, OIG plans to expand its use of video conference equipment for meetings and further reduce travel associated with training, while meeting essential training and professional

certification requirements. We estimate that our total travel expense will decline to $312,000 in FY 2014, including the 30 percent reduction from FY 2010 for non-exempt travel.

Audits. OIG is implementing a plan to improve both the efficiency and effectiveness of its audits in concert with NSF's growing number of grants, contracts, and complex cooperative agreements. We are developing enhanced technical capabilities and data analytics that will improve oversight of NSF funds by 1) better targeting our audits toward the riskiest awardees and 2) more efficient screening and analysis of large volumes of data. Using analytics, we expect to exponentially increase the number of transactions we review during an audit from dozens to thousands, thereby increasing the average amount of questioned costs identified per audit from our current average of approximately $250,000, to as much as $6 million.

Based on this model, we plan for our in-house staff to conduct the analytics, applying our expertise to identify the riskiest transactions in the data. We would then provide the questionable data sets to our contract support to go on site at the institutions and perform the transaction testing, with our in-house staff providing oversight. Using this combination of in-house staff and contract support maximizes our effectiveness and helps to address our difficulties with hiring experienced grant auditors while also resolving quality and timeliness issues that we have experienced with our contractors. We are therefore in the process of determining the optimal number of audit staff and outside contractors that will enable us to achieve our goals. OIG's top priority is to reinvest in its Audit program (which has lost staff in recent years) in order to broaden the use of data analytics on its grant audits and achieve the type of outsized returns to the government seen thus far. Though OIG's contract funding for CPA and DCAA audits would decrease to approximately $649,000 in FY 2014 from an average of $1.16 million in 2010 and 2011, we intend to gradually increase it by diverting resources from other areas of Audit and OIG as they become available.

The requested funds would continue to support performance and information technology audits that reflect important federal and OIG priorities, including assessments of the effectiveness of: 1) NSF's acquisition program and its ability to meet existing and newly implemented federal requirements, 2) NSF oversight of contingency costs for construction projects, and 3) NSF's financial accountability and oversight responsibilities. Funds would also be used for a series of audits of the adequacy of NSF's cooperative agreements to manage and oversee its large facility awards, and to improve our oversight of IT security at NSF. Funds would be committed to audits that are mandated by law, including the annual Financial Statement Audit, the related Federal Information Security Management Act independent evaluation report, and the triennial audit of the National Science Board's compliance with the Government in the Sunshine Act.

Internal performance audit work will address federal and OIG priorities, including: 1) inventory management in the United States Antarctic Program; 2) NSF's high speed network; 3) NSF's expenditures on conferences; 4) costs associated with NSF's use of temporary personnel assigned under the Intergovernmental Personnel Act; 5) NSF's oversight of annual and final progress reports on funded projects; 6) agency management of its purchase card program; and 7) oversight of the construction of the *R/V Sikuliaq* – (formerly the Alaskan Region Research Vessel), a Major Research Equipment and Facilities Construction project that received $148 million of Recovery Act funding.

Investigations. Recent investments in OIG's investigative program have yielded an excellent return for the government. In addition to civil and criminal convictions, our cases frequently produce both financial settlements for institutional fraud and compliance agreements for correcting the underlying systemic problems, thus providing greater protection for future federal funding. Over the last three years, the average number of active criminal investigations has increased by 31 percent. Similarly the overall average number of active research misconduct investigations has increased by 40 percent while the average number of substantive research misconduct investigations (those resulting in referrals to NSF) have increased by 100 percent.

OIG opened 22 new SBIR investigations in 2011 and 30 more in 2012. We expect this trend to continue as a result of enhanced proactive investigative tools that were made available to OIGs by the Recovery Board, and improved coordination among the OIGs that participate in the SBIR Investigative Working Group. The establishment of the Working Group has opened a dialogue within the OIG community about the pursuit of SBIR fraud, resulting in numerous joint investigations of companies funded by the SBIR/STTR programs. Our office has helped lead this multi-agency effort since its inception, and sustaining a high level of commitment is a top priority, both to keep our own productivity high and to maintain the momentum that has been developed in the IG community.

The increased SBIR caseload prompted OIG to seek and receive statutory law enforcement (SLE) authority from the Department of Justice last year. With that authority, our Special Agents (SAs) are able to conduct investigative activities without reliance on special deputation, which results in investigative delay; our SAs are able to execute search warrants and arrest warrants; and they are more proficient and safer as a result of SLE's mandatory training regimen. SLE alleviates the need to request another federal agency to provide support in an operation and arrange a mutually agreeable schedule. However, SLE authority creates new mandatory costs for the office. OIG SAs will have to meet specific requirements, including extensive mandatory training, under the US Attorney General Guidelines. These include firearms training and qualifications, defensive tactics training, physical training and testing, and other professional qualifications and certifications, which will total almost $15,000 for all eight Special Agents. More significant is the cost of such activities in terms of lost productivity, which we estimate at 258 hours per Special Agent, or 2,064 hours total. The requirements involved in maintaining statutory law enforcement authority will effectively cost OIG the services of one Special Agent.

In accordance with the America Competes Act and in response to rising concerns about research integrity, NSF in 2010 implemented a Responsible Conduct of Research (RCR) requirement for NSF awards. In the course of our work, we have found that some institutions are implementing weak RCR programs that may technically comply with the requirements set by NSF, but indicate a lack a serious commitment to institutional oversight of research awards. Instances of scientific research misconduct continue to rise in number, complexity, and severity, particularly data fabrication and falsification cases. In one three-week period, we received five substantive allegations of data fabrication by graduate students and post-doctoral researchers. This trend shows the critical need for OIG oversight of institutional RCR plans, and ensuring such plans effectively address risk. During FY 2014 OIG plans to begin a large-scale review of a sample of institutional RCR programs to identify best practices as well as systemic weaknesses. We will then use the results of this review to provide NSF with RCR compliance information necessary for the agency to re-assess the effectiveness of its requirements. This review will require significant resources to conduct interviews with faculty, students and administration officials, and to collect and analyze data from numerous institutions throughout the country.

Our proactive review program has been very productive in generating new cases and identifying systemic problems that we have flagged to agency management through Management Implication Reports. The Recovery Accountability and Transparency Board recently provided access to the vast database analysis tools originally developed to uncover fraud in the federal expenditures under the American Recovery and Reinvestment Act. These tools are expected to increase the number of fraud investigations undertaken by OIG and will allow us to identify prospective NSF awardees that are high-risk recipients of federal funds based on their past misconduct. The requested funding level will enable this important proactive review program to continue.

Legal Legislative and External Affairs. In 2012, OIG created the Office of Legal, Legislative, and External Affairs (LLE) as a new organizational element under the executive leadership of an Assistant Inspector General. This division is comprised of two attorneys subordinate to the AIG (one of whom is

Federal Temporary employee), a Congressional liaison, and the front office administrative staff. LLE consolidates a number of functions that have historically worked together, but which were aligned directly under the Inspector General -- legal, legislative/congressional, and external affairs (including public/media contacts). In addition, LLE's portfolio includes an inspections and evaluation (IE) capability. These are quick-turnaround reviews of NSF operations and activities that do not fit into the traditional audit or investigative framework (e.g., they are not governed by the more structured and formal procedures pertaining to audits, and they are not focused on individual or organizational wrongdoing). This type of work is meant to provide information to assist NSF decision-making; recommend improvements to programs, policies, and procedures; provide factual and analytical information; monitor compliance; measure performance; identify best practices; and assess efficiency and effectiveness of specific aspects of agency programs.

Prior to LLE's inception, legal coverage was often crisis-focused, and there was no capability for routine review of OIG work product to identify and address potential legal (or other) issues at an early stage. We have made it a priority to expand legal coverage across the organization to better assist OIG in carrying out its statutory mission. For example, there is now a process for routine review of certain work products (particularly reports that are complex or high-profile) in order to identify and address potential issues at the earliest possible point. The change has also enabled more consistent attorney involvement in critical administrative areas, such as contract planning. The LLE staff actively supports government-wide projects in which NSF OIG has taken a leadership role, including those focused on increasing the use and effectiveness of suspension and debarment remedies to protect taxpayer funds; and preventing and detecting fraud, waste, and abuse in the Small Business Innovative Research Program.

Preventive initiatives. OIG has a robust program of activities to fulfill its core mission to prevent fraud, waste, and abuse. Our staff plays a key role in educating the agency's stakeholders, drawing on our extensive experience in dealing with grant fraud and research misconduct. OIG's proactive efforts are consistent with the emphasis on transparency and accountability mandated by the administration and the Congress, and they help to assure the integrity of federally-funded research by promoting effective oversight of NSF-funded activities. We conduct preventive activities to address: 1) growing concerns regarding the erosion of research integrity, as evidenced by a threefold increase in allegations in the past decade and studies indicating that 25 to 30 percent of scientists engage in questionable research practices; 2) the issues underlying the increasing number of allegations of serious misconduct that we are investigating, many of which are related to the employment of scientists from other countries who may not understand U.S. rules and procedures; 3) misconduct related to ARRA funds; and 4) the growth of SBIR program fraud. Our ability to continue a vigorous preventive program of proactive investigative reviews and effective outreach depends on whether our staffing and travel resources provide sufficient support, especially in light of our other urgent investigative priorities, as set out above. The direct interaction with the research community by our staff not only helps educate the community on how to maintain research integrity and financial accountability, but it also establishes vital channels of communication that provide our investigators and auditors with valuable information and insights into the needs and concerns of the institutions and researchers.

MAJOR MULTI-USER RESEARCH FACILITIES

Major Multi-user Research Facilities Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total Research and Related Activities	**$915.41**	**$896.05**	**$988.07**	**$92.02**	**10.3%**
Operations and Maintenance of Existing Facilities	679.41	657.90	702.86	44.96	6.8%
Federally Funded Research and Development Centers	201.00	195.85	201.91	6.06	3.1%
Operations and Maintenance of Facilities under Construction	28.80	28.80	75.80	47.00	163.2%
R&RA Planning and Concept Development	6.20	13.50	7.50	-6.00	-44.4%
Major Research Equipment and Facilities Construction	**$198.08**	**$197.06**	**$210.12**	**$13.07**	**6.6%**
Total, Major Multi-User Research Facilities	**$1,113.50**	**$1,093.11**	**$1,198.19**	**$105.09**	**9.6%**

Totals may not add due to rounding.

NSF investments provide state-of-the-art tools for research and education, such as multi-user research facilities, distributed instrumentation networks and arrays, accelerators, telescopes, research vessels, aircraft, and earthquake simulators. In addition, investments in internet-based and distributed user facilities are increasing as a result of rapid advances in computer, information, and communication technologies. NSF's investments are coordinated with those of other organizations, agencies, and countries to ensure complementarity and integration. Planning, operations, and maintenance of multi-user facilities are funded through the Research and Related Activities (R&RA) account, and most major construction projects are funded through the Major Research Equipment and Facilities Construction (MREFC) account.

This chapter provides descriptions of each major multi-user research facility supported through the R&RA account and provides funding information by life cycle phase for each facility. The information presented for each facility follows the overall framework established by NSF for large facility projects. Information on projects under construction funded through NSF's MREFC account is provided in the MREFC chapter.

Major Multi-user Research Facilities Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
Operations and Maintenance of Existing Facilities	**$679.41**	**$657.90**	**$702.86**	**$44.96**	**6.8%**
Engineering					
National Nanotechnology Infrastructure Network (NNIN)	16.00	15.86	15.46	-0.40	-2.5%
Network for Earthquake Engineering Simulation	20.39	20.50	22.00	1.50	7.3%
Geosciences					
Academic Research Fleet[1]	92.96	76.75	85.00	8.25	10.7%
Geodetic Facilities for Advancement of Geoscience & EarthScope (GAGE)	11.92	13.18	12.70	-0.48	-3.6%
International Ocean Discovery Program	51.68	44.40	50.00	5.60	12.6%
Polar Facilities and Logistics	294.63	295.79	314.21	18.42	6.2%
Seismological Facilities for Advancement of Geoscience & EarthScope (SAGE)	26.12	26.76	25.70	-1.06	-4.0%
Mathematical and Physical Sciences					
Arecibo Observatory	9.25	8.70	8.00	-0.70	-8.0%
Cornell High Energy Synchrotron Source (CHESS)	19.67	19.67	20.00	0.33	1.7%
Gemini Observatory	21.57	22.07	19.59	-2.48	-11.2%
IceCube	6.90	6.90	6.90	-	-
Large Hadron Collider	18.00	18.00	18.00	-	-
Laser Interferometer Gravitational Wave Observatory	30.40	30.40	39.50	9.10	29.9%
National High Magnetic Field Laboratory	26.80	25.80	32.64	6.84	26.5%
National Solar Observatory	9.10	9.10	8.00	-1.10	-12.1%
National Superconducting Cyclotron Laboratory	21.50	21.50	22.50	1.00	4.7%
Other Facilities[2]	2.52	2.52	2.66	0.14	5.6%
Federally Funded Research and Development Centers[3]	**$201.00**	**$195.85**	**$201.91**	**$6.06**	**3.1%**
National Center for Atmospheric Research	103.00	98.60	99.00	0.40	0.4%
National Optical Astronomy Observatory	26.25	25.50	25.50	-	-
National Radio Astronomy Observatory[4]	71.75	71.75	77.41	5.66	7.9%
Operations and Maintenance of Facilities under Construction	**$28.80**	**$28.80**	**$75.80**	**$47.00**	**163.2%**
Advanced Technology Solar Telescope (ATST)	2.00	2.00	2.00	-	-
National Ecological Observatory Network (NEON)	-	-	21.00	21.00	N/A
Ocean Observatories Initiative (OOI)	26.80	26.80	52.80	26.00	97.0%
R&RA Planning and Concept Development	**$6.20**	**$13.50**	**$7.50**	**-$6.00**	**-44.4%**
Pre-construction Planning[5]	-	2.00	1.00	-1.00	-50.0%
Concept and Development for MREFC projects	6.20	11.50	6.50	-5.00	-43.5%
Major Research Equipment and Facilities Construction	**$198.08**	**$197.06**	**$210.12**	**$13.07**	**6.6%**
Total, Major Multi-User Research Facilities	**$1,113.50**	**$1,093.11**	**$1,198.19**	**$105.09**	**9.6%**

Totals may not add due to rounding.

[1] An additional $2.0 million in FY 2012 Enacted and $1.0 million in FY 2013 for Regional Class Research Vessels is included in pre-construction planning.

[2] Other Facilities includes support for other physics and materials research facilities.

[3] Federally Funded R&D Centers does not include support for the Science and Technology Policy Institute, which is an FFRDC but not a multi-user research facility.

[4] Operations and maintenance of ALMA are included in NRAO.

[5] Pre-construction planning includes R&RA funding for potential next-generation major multi-user facilities.

NSF's Facilities Investments in FY 2014

The following pages contain information on NSF's ongoing facilities in FY 2014.

Facilities

Federally Funded R&D Centers

Other Facilities Funding

ACADEMIC RESEARCH FLEET

$86,000,000
+$7,250,000 / 9.2%

Academic Research Fleet
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$92.96	$78.75	$86.00	$7.25	9.2%

The Academic Research Fleet consists of 19 vessels in the University-National Oceanographic Laboratory System (UNOLS). These vessels range in size, endurance, and capabilities, enabling NSF and other federally-funded scientists with the means to conduct ocean science research with a diverse fleet capable of operating in coastal and open ocean waters. Funding for the Academic Research Fleet includes investments in ship operations; shipboard scientific support equipment; oceanographic instrumentation and technical services; and submersible support. Funding levels reported here reflect investments in the Directorate of Geosciences (GEO) by the Division of Ocean Sciences (OCE). In addition to operations, OCE has undertaken selected construction projects based on inter-agency planning and coordination as discussed in the Federal Oceanographic Fleet Status Report published in 2007.

Total Obligations for the Academic Research Fleet
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$87.89	$76.75	$85.00	$85.00	$85.00	$85.00	$85.00	$85.00
Fleet Renewal								
Human Occupied Vehicle	5.08	-	-	-	-	-	-	-
Regional Class Research Vessel	-	2.00	1.00	2.00	-	-	-	-
Total, Academic Research Fleet	**$92.96**	**$78.75**	**$86.00**	**$87.00**	**$85.00**	**$85.00**	**$85.00**	**$85.00**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only.

The Academic Research Fleet serves as the main platform for the collection of data and testing of hypotheses about the structure and dynamics of the ocean. Scientists contribute to advances in many areas including climate variability, marine ecosystems, fisheries, and ocean-related natural hazards, such as tsunamis through use of these facilities. Participating graduate and undergraduate students interact with scientists and marine technicians, enabling them to gain first-hand exposure to ocean science field research. Increasingly, technological innovations allow research conducted at sea to be transmitted via satellite back to the classroom, broadening the educational impact of the vessels.

The Academic Research Fleet is supported through an interagency partnership, principally with the Office of Naval Research (ONR) and the National Oceanic and Atmospheric Administration (NOAA). The operating costs for the Fleet are divided proportionally among the vessel users based on usage; NSF supports approximately 65 percent of the total. NSF also coordinates with ship-operating and ship-user academic institutions through UNOLS.

Support for scientists using the Fleet is provided by both NSF and other federal and state agencies. Within NSF, science is funded through competitive peer-reviewed proposals, most typically funded within OCE and through selected programs in the Division of Earth Sciences (EAR), the Division of Atmospheric and Geospace Sciences (AGS), the Division of Polar Programs (PLR), and the Directorate for Biological Sciences (BIO). Approximately 25 percent of OCE proposals request ship time. Not reflected in this number is the science that utilizes samples or data collected on prior cruises, scientists piggy-backing on scheduled cruises to accomplish additional science, international scientists sailing with the U.S. Academic Research Fleet, and science funded by other agencies.

The slight reduction in ship operation and upgrade costs is the result of reduced ship demand and the completion of support for upgrading the Human Occupied Vehicle *ALVIN*. The FY 2014 Request of $85.0 million will support approximately 2,100 ship operating days.

Fleet Operations

- Oversight: NSF provides oversight to the Academic Research Fleet through cooperative agreements with each ship-operating institution and through a separate cooperative agreement with the UNOLS Office. In addition, NSF oversees the Fleet through site visits, ship inspections, and participation at UNOLS Council and Committee meetings by NSF program directors. Several program directors within OCE at NSF, at NOAA, and at ONR are involved in the activities and overall oversight of the Academic Research Fleet. NSF conducted a Business Systems Review (BSR) of Columbia University/Lamont Doherty Earth Observatory as the operator of the R/V *LANGSETH*, and issued a final report in September 2010. No BSRs of Academic Research Fleet operating institutions are currently scheduled for 2013 or 2014.
- Management: Management of an operating institution's ship-operating facilities varies with the scale of the operation, but the core responsibility typically resides with the Director of the Institution, the Marine Superintendent (for all aspects of the facility), and the Ship's Captain (for at-sea operations). For larger multi-ship-operating institutions, a Chief of Marine Technicians, schedulers, and finance administrators may also be involved in facility management.
- Reviews: Based on projected science requirements identified in recent reports and workshops, a fleet of vessels supporting ocean science research will be needed far into the future. Recent documents supporting this need include the *National Ocean Policy* and the *Final Recommendations of the Interagency Ocean Policy Task Force* of July 19, 2010. Two applicable reports by the National Research Council (NRC) include *Science at Sea: Meeting Future Oceanographic Goals with a Robust Academic Research Fleet* published in 2009, and *Critical Infrastructure for Ocean Research and Societal Needs in 2030* published in 2011. In coordination with UNOLS and the other federal agencies which invest in ocean research, the Interagency Working Group on Facilities (IWG-F), which has been renamed as the Interagency Working Group on Facilities and Infrastructure (IWG-FI) under the National Ocean Policy, published a *Federal Oceanographic Fleet Status Report* in December 2007 reviewing the status and describing plans for modernizing the federal and academic oceanographic research and survey fleet. Ship operations and technical services proposals undergo external review by peers every five years. Detailed annual reports describing activities accomplished are provided by the operating institutions and budgets are negotiated yearly since they are dependent on the number of days the ships will be at sea in support of NSF-funded research programs.

Fleet Modernization

- Oversight: The NSF coordinator for Fleet modernization activities is the Program Director for Ship Acquisition and Upgrades, within the Integrative Programs Section (IPS) in OCE, with additional IPS staff providing project management assistance as required.
- Regional Class Research Vessel (RCRV): In March 2012, NSF leadership approved the request to

advance the RCRV to the Conceptual Design Review (CDR) phase as a candidate Major Research Equipment and Facilities Construction (MREFC) project. A solicitation was released in April 2012 to select the lead institution for the design and construction of up to three vessels. Competitive proposals were received in September 2012 and a panel of experts convened in early November 2012 to provide recommendations to NSF. On February 1, 2013, NSF made an award to Oregon State University for advancement to CDR. Funds for CDR will be provided from the Research and Related Activities account. Management and oversight will be similar to the R/V *SIKULIAQ* project. NSF has held several discussions with the NOAA Office of Marine and Aviation Operations to explore the potential for collaboration between the two agencies on the design of the RCRV and the modernization efforts being considered for the NOAA mid-size vessels. In addition, NSF is an active participant in the IWG-FI Ship Subcommittee, which is developing an update to the 2007 *Federal Oceanographic Fleet Status Report*, an action in the draft *National Ocean Policy (NOP) Implementation Strategy*[1]. The role of the RCRV in meeting the needs across the government agencies for research vessels in support of ocean science research is an integral aspect of the Fleet Status Report Update. Decisions on proceeding to further development stages will be based upon NSF, National Science Board (NSB), and interagency reviews.

Other Ongoing Activities

- Major overhaul and upgrade to the submersible Human Occupied Vehicle *(HOV) ALVIN* will be completed in FY 2013. This project, begun in FY 2004, to design and build an all-new submersible, experienced significant cost over-runs in 2008 due to schedule delays, increases in labor costs and levels of effort, and a rise in titanium prices. As a result, the project was re-scoped to be a major overhaul and upgrade of the existing vehicle and was renamed to the *ALVIN* Upgrade Project. It was placed on a revised review path, which included a Preliminary Design Review (PDR) in December 2009 and a Final Design Review (FDR) in September 2010. The FDR Panel recommended the project continue and determined the budget was adequately defined. The Panel also recommended NSF partner with the Navy, specifically Naval Sea Systems Command (NAVSEA), to achieve a reinstatement of certification to ensure the operational capability and safety of *ALVIN*. NSF subsequently entered into an interagency agreement with NAVSEA to do so, and the Woods Hole Oceanographic Institution (WHOI) team is supporting this effort.

  The *ALVIN* Upgrade Project is scoped in two phases. Phase I is the integration of a new titanium 6,500-meter-capable personnel sphere with existing *ALVIN* vehicle components. Phase I completion will provide a depth capability of 4,500 meters, the limit of the current *ALVIN* components to be retained during Phase I. A potential Phase II would provide upgrades to permit operations to a depth of 6,500 meters, but there has been no implicit or explicit commitment to proceed with Phase II at this time. Certification and sea trials for operation of the Phase I vehicle are scheduled for spring 2013, with an anticipated return to standard science operations in summer 2013.

Renewal/Recompetition/Termination

Ships supported by NSF are operated by academic institutions, each having a cooperative agreement with NSF. All ship cooperative agreements were renewed in FY 2012 using the NSB-approved criteria and review by an external panel. Awardees are subject to additional oversight measures, including BSRs conducted by NSF. In FY 2012, NSF announced plans for the FY 2013 retirement of the *R/V CAPE HATTERAS*, operated by a consortium of Duke University and the University of North Carolina from its homeport at the Duke University Marine Laboratory. This retirement action was completed on March 8, 2013.

[1] www.whitehouse.gov/administration/eop/oceans/implementationplan

R/V *SIKULIAQ*, formerly the Alaska Region Research Vessel (ARRV):

The Research Vessel *SIKULIAQ* (formerly known as the Alaska Region Research Vessel - ARRV) represents NSF's first major contribution to Fleet renewal in over twenty years. Construction of the *SIKULIAQ* was funded through the MREFC account, partially with American Recovery and Reinvestment Act (ARRA) funds. The project is led by the University of Alaska, Fairbanks (UAF) with engineering support from design through construction provided by UAF's naval architect, The Glosten Associates, Inc. Shipyard construction began in early 2011 and the vessel was successfully launched in October 2012. Delivery of the *SIKULIAQ* to UAF is scheduled for July 2013. This will be followed by a period of final outfitting, science trials, and transit to the first science operational area. Science operations are projected to begin in early 2014 with transition to the OCE Ship Operations Program for funding support. Ice trials and a warranty shipyard inspection will be conducted in 2014 using MREFC funds; both of which were within the original project scope.

The increased capabilities of the *SIKULIAQ* are expected to dramatically increase the number of proposals addressed to NSF for Arctic science. UAF conducted two science planning workshops (May 2011 and February 2012), to alert the U.S. science community to the vessel's capabilities and availability to support science beginning in 2014. Individual projects vary greatly in cost, as do the number of projects supported onboard at any given time. Assuming two simultaneous projects onboard for 3-4 weeks at a time and the average grant size in the Division of Ocean Sciences (OCE) in the Directorate for Geosciences (GEO), over $17.0 million in research conducted from R/V *SIKULIAQ* would be supported annually.

Baseline History

Total Obligations for R/V *SIKULIAQ (ARRV)*

(Dollars in Millions)

	Prior Years[1]	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
R&RA Obligations:									
Concept & Development	$2.24	-	-	-	-	-	-	-	-
Management & Operations	-	-	-	4.17	8.34	8.50	8.50	8.50	8.50
Subtotal, R&RA Obligations	$2.24	-	-	$4.17	$8.34	$8.50	$8.50	$8.50	$8.50
MREFC Obligations:									
Implementation	51.42		-		-	-	-	-	-
ARRA	148.07		-		-	-	-	-	-
Subtotal, MREFC Obligations	$199.49	-	-	-	-	-	-	-	-
Total, *SIKULIAQ*	**$201.73**	**-**	**-**	**$4.17**	**$8.34**	**$8.50**	**$8.50**	**$8.50**	**$8.50**

Totals may not add due to rounding.

[1] Concept & Development funding and Implementation funding are cumulative of all prior years; Management & Operations funding reflects the FY 2011 Actual only.

Satellite observations have shown that the perennial ice in the Arctic is thinning at a rate of nine percent per decade, which is beginning to have major regional and global consequences. Research is urgently needed on topics ranging from climate change, ocean circulation, ecosystem studies, and fisheries research, to natural hazards and cultural anthropology. The *SIKULIAQ* will provide a sophisticated and significantly larger platform for scientists, as well as graduate and undergraduate students to participate in complex multidisciplinary research activities and will enable the training of the next generation of scientists with the latest equipment and technology. The *SIKULIAQ* is expected to greatly expand research capabilities in the Arctic with up to 270-300 science days at sea annually. The ice-strengthened

hull will allow the vessel to operate in seasonal ice up to one meter thick and an anti-roll tank will permit it to operate effectively in the open waters of the Bering Sea, Gulf of Alaska, and North Atlantic. Due to its size and projected operating area, the *SIKULIAQ* will operate as a Global Class vessel within the U.S. Academic Research Fleet.

Management and Oversight

- NSF Structure: NSF oversight is described in the Program's Internal Management Plan (IMP). The NSF Program Officer for Ship Acquisition and Upgrades has primary responsibility for oversight of the project and resides within GEO/OCE/IPS. Periodic oversight is provided by a Project Advisory Team (PAT), which includes staff from GEO, the Division of Acquisition and Cooperative Support (DACS), the Large Facilities Office (LFO), the Office of the General Counsel (OGC), and the Office of Legislative Public Affairs (OLPA). External consultants and staff from IPS, LFO, and DACS provide the Program Officer with routine project management and technical assistance. To ensure effective management and oversight, monthly and annual reports provided by the UAF project office are closely monitored by the *SIKULIAQ* Program Officer for deviations from the established baseline using Earned Value Management. NSF conducted a Business Systems Review (BSR) of UAF as the awardee for the design and construction project and as the future operator of R/V *SIKULIAQ*. A final report was issued in July 2011.
- External Structure: UAF maintains project management offices in both Fairbanks and Seward, AK. UAF management also includes an experienced on-site team in Marinette, Wisconsin that will remain at the shipyard until delivery. The *SIKULIAQ* Oversight Committee (SOC), which includes community experts in research vessel design, construction, and operations, convenes monthly to review project status and provide technical and science support advice to both UAF and NSF.
- Reviews: With the ship now launched, NSF will conduct one more annual project review in September 2013, the Trials and Operational Readiness Review.

Cost and Schedule

The total project cost approved by NSF and NSB following FDR is $199.50 million. NSF first requested construction funding for the *SIKULIAQ* through the MREFC account in FY 2007. The project received an initial appropriation of $9.43 million in that year, followed by an additional appropriation of $42.0 million in FY 2008. $148.07 million was provided through ARRA. The majority of this total, $138.0 million, or 70 percent, is the fixed price contract with the shipyard. UAF management, which includes the purchase of propulsion units as Owner-Furnished Equipment, totals $34.70 million (17 percent). Final outfitting, science trials, and delivery are $11.20 million (6 percent). Uncommitted project contingency for the shipyard contract is approximately $8.30 million (4.2 percent).

Risks

Risk mitigation strategies have been employed by UAF, and the risk analyses reviewed by the R/V *SIKULIAQ* Project Review Panel in July 2012 indicate that sufficient contingency is currently in place to handle these remaining project risks. The Panel also was satisfied that proper change and contingency management control processes are in place to facilitate the project completing within budget.

Future Operations Costs

Vessel operations will be governed by the terms of a separate cooperative agreement with UAF through the Ship Operations Program within OCE/IPS. Daily rate estimates for both the ship and technical services will be updated in 2013. It is anticipated that OCE will utilize at least 65 percent of the annual vessel availability based on historical data from other Global Class ships in the Academic Research Fleet. Up to 35 percent of the *SIKULIAQ's* schedule is expected to be available to PLR and to other federal agencies. In short, the *SIKULIAQ* will fold into an already well-established framework for operating the Academic Research Fleet.

ARECIBO OBSERVATORY

$8,000,000
-$700,000 / -8.0%

Arecibo Observatory
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
$9.25	$8.70	$8.00	-$0.70	-8.0%

Totals may not add due to rounding.

The Arecibo Observatory (Arecibo), formerly the National Astronomy and Ionosphere Center, is a center for multidisciplinary research and education enabled by world-class observational facilities. The Observatory's principal facility is the world's largest single-dish radio/radar telescope, a 305-meter diameter reflector located near the town of Arecibo in western Puerto Rico on 120 acres of U.S. Government-owned land. Arecibo Observatory is currently operated and managed by SRI International and subawardees USRA (Universities Space Research Association) and Universidad Metropolitana (UMET) under a cooperative agreement with NSF that began October 1, 2011. It serves over 300 users annually with a wide range of research and observing instrumentation in passive radio astronomy, solar system radar astronomy, and space and atmospheric sciences. A peer-review telescope allocation committee provides merit-based telescope time to users. NSF does not provide awards targeted specifically for use of Arecibo Observatory, although many users are supported through NSF or NASA grants to pursue scientific programs that require use of the facility. Review and proposal-handling procedures have recently been revised to ensure greater accountability of long-term projects.

Including the Angel Ramos Foundation Visitor Center, Arecibo has a staff of about 120 full-time-equivalent positions, of which approximately 90 are supported by NSF funds. A permanent staff of 17 scientists and 34 engineers, technicians, and operators is available to help visiting investigators with observing programs. The remainder includes 26 management, administrative, and clerical positions, 37 maintenance staff, and several postdoctoral scholars and students.

Total Obligations for the Arecibo Observatory
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$9.25	$8.70	$8.00	$8.00	$8.20	$8.20	$8.20	$8.20
Astronomical Sciences (MPS)	*5.63*	*5.50*	*4.50*	*4.00*	*4.10*	*4.10*	*4.10*	*4.10*
Atmospheric & Geospace Sciences (GEO)	*3.63*	*3.20*	*3.50*	*4.00*	*4.10*	*4.10*	*4.10*	*4.10*
Total, Arecibo	**$9.25**	**$8.70**	**$8.00**	**$8.00**	**$8.20**	**$8.20**	**$8.20**	**$8.20**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends on September 30, 2016.

Arecibo is jointly supported by the Division of Astronomical Sciences (AST) in the Directorate for Mathematical and Physical Sciences (MPS) and the Division of Atmospheric and Geospace Sciences

(AGS) in the Directorate for Geosciences (GEO). In 2006 the AST Senior Review recommended a reduction of approximately 20 percent in annual NSF support for Arecibo to roughly $10.0 million by 2010 ($8.0 million from AST plus an assumed value of $2.0 million from AGS). NSF funding for Arecibo in FY 2008–2010 reflected this recommended ramp-down. The AST Senior Review also recommended that sufficient additional financial or in-kind personnel contributions be found to operate Arecibo with competitive scientific productivity after 2011 with an AST contribution not to exceed about half of the overall Arecibo budget. Planned AST support through FY 2016 is based upon the Senior Review recommendations, guidance from a third-party cost review of AST facilities, and a third-party estimate of Arecibo's non-scientific costs. As AST has ramped down support for Arecibo, AGS has significantly increased support, with funding estimated to ramp up to parity with AST in FY 2015 and beyond. (More on AGS activities at Arecibo can be found below under Management and Oversight).

In the latter part of 2011 and the first half of 2012, AST conducted a Portfolio Review in which a diverse 17-member panel of U.S. astronomers evaluated and recommended a balanced AST program for near- to medium-term budget scenarios that now appear more realistic than the scenario assumed by the 2010 National Research Council decadal survey in astronomy and astrophysics. The Portfolio Review Committee recommendations were driven by the desire to retain scientifically important capabilities traceable to that 2010 decadal survey. The recommendation of the Portfolio Review Committee was that support for Arecibo should be continued at funding levels near those currently planned, with a re-evaluation later in this decade. Decisions have not yet been made regarding detailed implementation of the Portfolio Review Committee recommendations.

Partnerships and Other Funding Sources: Arecibo leverages NSF support with funding from other federal and non-federal sources. Since FY 2010, the NASA Near Earth Object Observation Program has committed $2.0 million to Arecibo in support of the planetary radar program. NASA support is expected to continue at this level, subject to availability of appropriated funds. In FY 2010, observatory management finalized an assistance agreement with the Puerto Rico Infrastructure Financing Authority to receive $3.0 million for major infrastructure improvements at Arecibo Observatory. A grant to the Visitor Center from the Puerto Rico Department of Education is being finalized in early 2013.

An aerial image of the Arecibo Radio Telescope in Puerto Rico. The platform suspension structure, including the Gregorian dome that houses the main suite of research instruments, is visible over the 305-meter primary reflector dish below. *Credit: Arecibo Observatory/NSF.*

Education and Public Outreach (EPO): Arecibo hosts a Research Experiences for Undergraduates (REU) site, and Ph.D. students receive training through use of the facility. In collaboration with the National Radio Astronomy Observatory (NRAO), Arecibo holds a summer school on single-dish radio astronomy techniques. Arecibo also sponsors a major outreach program in Puerto Rico via the Angel Ramos Foundation Visitor Center and Learning Center, as well as summer workshops for K-12 teachers. This center attracts roughly 100,000 visitors each year; over 1.3 million people have visited since its opening in 1997. With funds from the Puerto Rico Department of Education, Arecibo recently hosted 25,000 K–12 school children through the *Inspiration for Science* program that provided transportation to the Observatory and science enrichment activities at no cost to participants.

Operations and Maintenance: Arecibo administers observing time to the astronomy and aeronomy

communities via competitive observing proposals and conducts educational and public outreach programs at all levels. Observing hours among science programs are based on the quality of observing proposals; the current average oversubscription rate of the telescope is approximately 3.5. This metric accounts for the number of current astronomical surveys requesting time for a given area of sky, plus the time request in the program year for small radio astronomy projects, solar system observations, and atmospheric sciences programs. About 80 percent of astronomy users conduct their observing remotely via networked control software, while radar observations typically employ on-site users.

Management and Oversight

- Division of Astronomical Sciences (AST), $4.50 million: AST funds basic operations costs and science programs in passive radio astronomy and solar system radar astronomy. Funding for the Astronomy program continues to decrease in FY 2013 and FY 2014, in response to recommendations of the AST Senior Review. Operational scope changes are anticipated in response to decreased AST funding, as part of the current five-year award for Arecibo management and operations. Since FY 2010, NASA has provided substantial support for planetary radar astronomy (see above).
- Division of Atmospheric and Geospace Sciences (AGS), $3.50 million: The incoherent scatter radar at Arecibo is part of an NSF-supported network of radars strategically distributed to observe the transport of radiative energy and charged particles, from their origins at the sun to their deposition in Earth's upper atmosphere. The unique sensitivity of the Arecibo incoherent scatter radar system allows it to measure the density, temperature, and motion of plasma in Earth's ionosphere with unrivaled time and spatial resolution. Arecibo is also the only aeronomy observatory located at tropical mid-latitudes, where many important ionospheric processes take place. An ionospheric high-frequency heating facility is currently under construction at Arecibo with completion anticipated in FY 2013.
- NSF Structure: Ongoing oversight is provided by the lead NSF program director in AST, in close cooperation with an assigned program director in AGS and in consultation with community representatives. The program directors make use of detailed annual program plans, long range plans, quarterly technical and financial reports, and annual reports submitted to NSF by SRI, as well as attending SRI governance committee meetings as appropriate. To address issues as they arise, the program directors work closely with other offices at NSF, particularly the Division of Acquisition and Cooperative Support; the Office of General Counsel; and the Large Facilities Office of the Office of Budget, Finance, and Award Management. The AST and AGS program directors conduct periodic site visits and frequent teleconferences.
- External Structure: Management is via a cooperative agreement with SRI and its subawardees, USRA and UMET. The awardees provide management and oversight through their own advisory and visiting committees, including an Arecibo Observatory Users Committee, a Scientific Management Advisory Committee, a Council of Puerto Rican Chancellors and Stakeholders, and an Executive Governing Committee. The Arecibo Director, resident at the telescope site, is the Principal Investigator of the operations award for the facility. Three deputy directors in the areas of Atmospheric Sciences, Planetary Radar, and Puerto Rican EPO report to the Arecibo Director. A new five-year cooperative agreement began in FY 2012.
- Reviews:
  - Last management review was held in March 2007. The next review is planned for early FY 2015.
  - Follow-up assessment of the response to the AST Senior Review recommendations was completed in March 2008.
  - AST and AGS jointly conduct annual external reviews of Arecibo program plans; the most recent review was held in November 2012, and these will continue annually.
  - Business Systems Review (BSR) involving all three partner organizations of Arecibo was conducted in late 2012.

Renewal/Competition/Termination

The current cooperative agreement with SRI for the management of Arecibo was awarded on schedule on October 1, 2011, when SRI succeeded the previous managing organization, Cornell University. This followed a competitive process for a new five-year cooperative agreement, consistent with National Science Board policy. This agreement is in effect through September 30, 2016.

In the context of the transition to a new managing organization, funds previously allocated to Arecibo infrastructure were re-assigned to cover allowable transition costs. Hence, a subsequent proposal was received and an award granted in FY 2012 in the amount of $1.85 million to accomplish these previously planned tasks related to maintaining Arecibo technical infrastructure and safety. These ranged from completing the painting of the azimuth arm, to upgrading electronics for digital Very Long Baseline Interferometry (VLBI) equipment, to demolition and modification of building structures.

CORNELL HIGH ENERGY SYNCHROTRON SOURCE

$20,000,000
+$330,000 / 1.7%

Cornell High Energy Synchrotron Source

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$19.67	$19.67	$20.00	$0.33	1.7%

Totals may not add due to rounding.

The Cornell High Energy Synchrotron Source (CHESS) is a high-intensity, high-energy X-ray users facility supported by NSF with partial interagency support from the National Institutes of Health (NIH). It uses synchrotron light given off by charged particles, both electrons and positrons, as they circulate in a ring at nearly the speed of light. CHESS provides capabilities for X-ray research in physics, chemistry, biology, materials, and environmental sciences. Areas of emphasis include soft matter and thin film studies, solution scattering, nanomaterials, high-pressure science, structural biology, time-resolved studies of materials, and X-ray studies of items of art and archaeology. Stewardship and oversight of CHESS is provided through the NSF Division of Materials Research (DMR) within the Directorate for Mathematical and Physical Sciences (MPS).

The FY 2014 Request supports operations of CHESS as a user facility and is consistent with funding levels in previous years. Funding will allow continued operation of the facility in support of synchrotron light users.

Total Obligations for the Cornell High Energy Synchrontron Source

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$19.67	$19.67	$20.00	$20.00	$20.00	$20.00	$20.00	$20.00

[1] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in March 2014.

The CHESS user program supports work in cancer research, new materials for electronics, aircraft and biotechnology, batteries, fuel cells, solar cells and other energy applications. X-ray detectors developed at CHESS are now in use at 3rd and 4th Generation X-ray sources around the world, including the world's first hard X-ray laser, the Department of Energy's (DOE) Linear Coherent Light Source.

CHESS staff assists in transferring radio frequency technology based on superconductors to industry. Several CHESS users are from industry, including pharmaceutical corporations (such as Rib-x Pharmaceuticals) and the research arms of Xerox and General Motors. Medical institutions such as the Dana Farber Cancer Institute, Boston Biomedical Research Institute, and Memorial Sloan-Kettering Institute are users of the facility. CHESS also has collaborations with DOE-supported synchrotron facilities such as the Advanced Photon Source and the National Synchrotron Light Source.

CHESS supports and enhances Ph.D. level graduate education, postdoctoral research, and research experiences for undergraduates and for K-12 science teachers. Each year there are about 25 Ph.D. degrees granted as a result of CHESS research. More than 60 undergraduates participate in research at the facility during the academic year; about 16 undergraduates and 10 K-12 teachers participate during the summer. In this educational role, CHESS is a key training ground for X-ray science and accelerator physics with CHESS students and postdoctorates going on to staff other X-ray facilities in the U.S. and around the world.

Management and Oversight

- NSF Structure: CHESS operations are supported by DMR and NIH. CHESS also hosts MacCHESS, a NIH-funded macromolecular crystallography program at Cornell. NSF and NIH provide oversight of CHESS through regular site visits by external reviewers.
- External structure: CHESS is administered by the Cornell Laboratory of Accelerator-based Sciences and Education (CLASSE), which reports to Cornell's Vice-Provost for Research. CHESS is operated by Cornell University in accordance with a cooperative agreement with NSF that set goals and objectives for the facility.
- CHESS is a national user facility accessed on the basis of competitive proposal review. The primary function of the CHESS staff is to maintain and operate the facility and to assist users. A policy and advisory board, appointed by the Cornell Vice President for Research, provides advice to the director of CHESS on policies related to the use and development of CHESS facilities and equipment for user experiments. A users committee appointed by the users of CHESS advises the director on matters of facilities operations and priorities for the users. An annual users meeting and several workshops help disseminate results from the facility.
- Reviews:
  - Annual site visit review of CHESS operations, November 2012.
  - Business Systems Review (BSR), final report issued in September 2011.
  - A subcommittee of the Mathematical and Physical Sciences Advisory Committee (MPS-AC) is conducting a study of NSF's role in synchrotron science, with a report due in Spring 2014. This report will inform the division's long-term future plans for investments in this area.

Renewal/Recompetition/Termination

In December 2009, a four-year award was approved by the National Science Board. The resulting cooperative agreement between NSF and Cornell University funds operations until March 2014. DMR is reviewing a five-year renewal proposal that requests continuing operations starting April 2014.

GEMINI OBSERVATORY

$19,590,000
-$2,480,000 / -11.2%

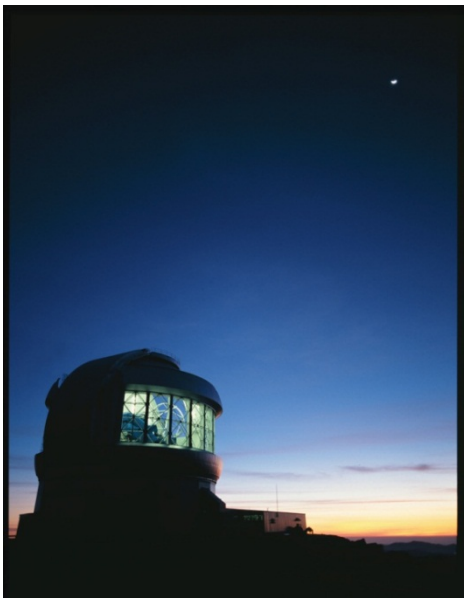
Gemini Observatory
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$21.57	$22.07	$19.59	-$2.48	-11.2%

Totals may not add due to rounding.

The Gemini Observatory consists of two optical/infrared 8-meter telescopes, one each in the northern and southern hemispheres. The northern telescope, Gemini North, is situated on Mauna Kea, Hawaii at an altitude of 4,200 meters, while Gemini South is located on Cerro Pachón, Chile, at an altitude of 2,700 meters. This siting of the two telescopes assures complete coverage of the sky and complements the observations from space-based observatories. The Gemini telescopes provide views of the center of our own Galaxy as well as the Magellanic Clouds, our nearest galactic neighbors. Both telescopes are designed to produce superb image quality and both use sophisticated adaptive optics technology to compensate for the blurring effects of the Earth's atmosphere.

Astronomers are working to resolve important questions about the age and rate of expansion of the universe, its overall topology, the amount and nature of non-luminous matter, the epoch of galaxy formation, the evolution of galaxies (including our own) once they are formed, and the formation of stars and planetary systems. The current generation of optical/infrared telescopes with large aperture (8-meter diameter and larger) provides unsurpassed sensitivity and spectral and spatial resolution. Technological advances in a number of key areas of telescope design and construction optimize the telescopes' imaging capabilities and infrared performance, as well as the ability to rapidly reconfigure the attached instrumentation in response to changing atmospheric conditions.



The Gemini South telescope in Chile prepares for the beginning of observation. The telescope is visible through the three-story-high vents on the rotating dome, which permit air flow across the telescope to provide good image quality. *Credit: Gemini Observatory/AURA.*

The Gemini telescopes help educate and train U.S. astronomy and engineering students. An estimated 10 percent of the roughly 500 U.S. users per year are students. Gemini is also providing a focus for public outreach and high school student training in all the partner countries, including "sister city" arrangements between Hilo, Hawaii and La Serena, Chile, involving students and teachers at high school and elementary school levels. Gemini staff members also provide guidance and support to the Imiloa Science Center, a public astronomy and cultural center in Hilo, Hawaii.

Total Obligations for the Gemini Observatory
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations & Instrumentation	$21.57	$22.07	$19.59	$21.61	$21.61	$21.61	$21.61	$21.61

[1] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in FY 2016.

With the withdrawal of the U.K. at the end of calendar year (CY) 2012, the international partnership that operates Gemini now consists of the U.S., Canada, Australia, Chile, Argentina, and Brazil. Construction of the telescopes and their instrumentation used a large number of industrial entities in these and other countries, with areas of specialization that included large and/or complex optical systems, aerospace, electronics, engineering, etc. Continued involvement of such industries is part of the instrumentation and facilities renewal activities included in the operating budget of Gemini Observatory.

Peer-review telescope allocation committees provide merit-based telescope time but no financial support. NSF does not provide awards targeted specifically for use of Gemini. Many U.S. users are supported through separate NSF or NASA grants to pursue scientific programs that require the use of Gemini.

Laser guide star systems, which greatly improve the telescopes' ability to correct for atmospheric blurring, are available for both telescopes, with the laser on Gemini North in routine use. The advanced "multi-conjugate" adaptive optics system on Gemini South is currently in science verification, the final commissioning phase prior to routine use. The laser system yields crisp images over a substantially larger field of view than any other astronomical adaptive optics system in the world. Several new instruments are in various states of development. A high-performance infrared spectrometer is once again available for science observations following refurbishment; and the Gemini Planet Imager, an advanced camera for the southern telescope designed to directly detect planets around nearby stars, is scheduled to arrive at the telescope in early CY 2013.

The 2012 Portfolio Review Committee of the NSF Division of Astronomical Sciences (AST) ranked Gemini Observatory to be a critical component of our Nation's future astronomical research resources, and recommended that the U.S. retain a majority share in the international partnership for at least the next several years. However, given the constrained budget scenarios that were considered, the review committee suggested that this should be achieved with a maximum U.S. contribution of $17.0 million per year to the operations component of Gemini in 2017 and beyond. The committee also recommended that the component of Gemini funding that is set aside for major instrumentation should be competed against other similarly-sized projects in a new mid-scale program administered by AST. Both pieces of advice are complicated by the need for long-term commitments to the international Gemini partnership and (in the case of instrumentation) the intersection with needs of other U.S. national components, so decisions regarding their implementation have not yet been made.

The FY 2014 Request includes the full U.S. contribution to general operations committed in the Gemini international agreement (which totals about $17.40 million in FY 2014), but a somewhat reduced contribution to the Instrument Development Fund compared to the long-term international planning goals. Budget projections for FY 2015 represent a level of effort adopted by the Gemini Board and NSF for planning purposes. Flat funding is assumed thereafter, following the expiration of the Gemini current cooperative agreement. These future requirements will be considered in the context of NSF's overall review of the 2012 Portfolio Review and discussion of the post-2015 international agreement with Gemini partners.

Management and Oversight

- NSF Structure: NSF has one seat on the Gemini Board and an additional NSF staff member serves as the executive secretary to the board. Programmatic management is the responsibility of an assigned NSF program manager for Gemini in the Division of Astronomical Sciences in the Directorate for Mathematical and Physical Sciences. The program manager approves funding actions, reports and contracts, and conducts reviews on behalf of the Gemini partnership.
- External Structure: The Observatory is governed by the Gemini Board, established by the International Gemini Agreement signed by the participating agencies. NSF serves as the executive agency for the partnership, carrying out the project on their behalf. With the withdrawal of the U.K., the U.S. now holds six of the 13 seats on the Gemini Board (including the NSF seat mentioned above). Gemini is currently managed by Associated Universities for Research in Astronomy (AURA), Inc., on behalf of the partnership through a cooperative agreement with NSF. AURA conducts its own management reviews through standing oversight committees, such as the AURA Observatory Council for Gemini.
- Reviews: NSF conducts periodic reviews of the management and Observatory programs as requested by the Gemini Board. The most recent mid-term management review was held in September 2008. In addition, NSF conducted a Business System Review of the Observatory in March 2009. The current cooperative agreement to AURA was awarded after a renewal proposal review in March 2011 and extends through December 31, 2015.

Renewal/Recompetition/Termination

With the withdrawal of the U.K. from the partnership effective December 31, 2012, and the remaining Gemini partner countries having decided to not increase their financial contributions nor to pursue a replacement partner, the operations model of the Observatory is being adjusted to accommodate an approximately 24 percent reduction in operations budget. Commensurate with the reduced funding, total staffing of Gemini Observatory is slated to contract from its current level of 195 to 151 employees over the next three years. All partners, with the exception of the U.K., certified their commitment to this objective by renewing the International Agreement through the end of CY 2015.

The current NSF cooperative agreement to AURA for managing Gemini Observatory through the end of CY 2015 includes the transition to the new operations model. Reductions in project scope that accompany the decline in budget include a reduced instrument complement available on each telescope, a reduction in manpower for the scheduling queue, decreased development and outreach activities, and a tighter operational focus on serving the partner user communities vs. internal scientific research activities. The funding recommendation for this plan was approved by the National Science Board in February 2012.

At present, NSF is beginning the process of competition for the next management agreement for Gemini Observatory, which will take effect on January 1, 2016. All international partners with the exception of Australia (currently a 6.3 percent partner) have re-affirmed their commitment to the Gemini partnership for the post-2015 period, and Australia has expressed their desire to purchase observing time on Gemini on a year-by-year basis thereafter. The Gemini Board is discussing an approach to finding another partner to replace Australia after 2015.

GEODETIC FACILITIES FOR THE ADVANCEMENT OF GEOSCIENCE AND EARTHSCOPE

$12,700,000
-$480,000 / -3.6%

Geodetic Facilities for the Advancement of Geoscience and EarthScope

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
$11.92	$13.18	$12.70	-$0.48	-3.6%

The Geodetic Facilities for the Advancement of Geoscience and EarthScope (GAGE) comprise a distributed, multi-user, national facility for the development, deployment, and operational support of modern geodetic instrumentation to serve national goals in basic research and education in the Earth sciences with a focus on studies of Earth's surface deformation at many scales with unprecedented temporal and spatial resolution. GAGE facilities support fundamental research and discovery on continental deformation, plate boundary processes, the earthquake cycle, the geometry and dynamics of magmatic systems, continental groundwater storage, and hydrologic loading. GAGE is managed and operated for NSF by UNAVCO, Inc., a consortium of 104 U.S. universities and non-profit institutions with research and teaching programs in geophysics and geodesy and 78 associate members from foreign institutions. GAGE will be formed in late FY 2013 from part of the EarthScope program and UNAVCO. FY 2012 and FY 2013 funding shown in all tables presented here have been restated for comparative purposes.

Total Obligations for GAGE

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$11.92	$13.18	$12.70	$12.70	$12.70	$12.70	$12.70	$12.70

[1] Outyear funding estimates are for planning purposes only. The new cooperative agreement begins in FY 2013.

The ability to determine position with respect to a well-constrained terrestrial reference frame using space geodetic techniques has, over the last three decades, improved to submillimeter capability. Space geodesy applications are extremely broad and expanding to include important societal research on earthquake and tsunami hazards, volcanic eruptions, hurricanes, coastal subsidence, wetlands health, soil moisture, groundwater distribution, and space weather. Applications of geodetic techniques to understanding the complex interplay between climate change, continental ice sheet and mountain glacier dynamics, crustal isostatic adjustments, and sea level change is of foremost relevance to current global issues confronting humanity.

To serve the research needs of the broad Earth science community, GAGE is organized under three primary Service Areas and two Special Emphasis Areas:

- **Geodetic Infrastructure**
  - The EarthScope Plate Boundary Observatory (PBO) includes more than 1,100 continuous Global

Positioning System (GPS) stations distributed across the United States, and concentrated on the active plate boundaries in the western contiguous U.S. and southern Alaska. PBO also includes 75 borehole strainmeters and 78 borehole seismometers deployed along the San Andreas Fault and above the Cascadia subduction zone and volcanic arc. Tiltmeters (26) and pore pressure sensors (22) are also collocated with the other borehole instruments.

- Global GPS Arrays outside of the PBO footprint are supported by GAGE in partnership with investigators. Nearly 600 continuous GPS observations from around the world are maintained, monitored, and data compiled into the GAGE data system. GAGE supports 61 of the over 250 GPS sites in the National Aeronautics and Space Administration (NASA)-supported Global Navigation Satellite System (GNSS) array that supports satellite orbit and clock corrections and the refinement of the International Terrestrial Reference Frame (ITRF). GAGE is also developing a 100 station Caribbean region GPS and meteorological sensor network (COCONet) to support tectonic, volcano, tropical storm, and sea level change investigations.
- Community GPS receiver and geodetic technology pool includes a pool of over 450 GPS receivers, ancillary equipment, and five terrestrial laser scanners (TLS), which can be used by investigators for short- and long-term deployments on qualified research projects
- Polar Networks supports GAGE's polar GPS networks in Antarctica (ANET) and Greenland (GNET) and development of specialized GPS monumentation, power, and telemetry solutions for use in harsh environments. GAGE also provides portable campaign deployment geodetic instrumentation, training, and field support for experiments in the polar regions. Additional supplemental funding for these activities is provided through the Division of Polar Programs (PLR).
- Investigator Project Support includes project management, field engineering, and technical support services to plan and execute GPS surveys and permanent station installations. GAGE also maintains a staff focused on geodetic technology equipment testing services to evaluate new geodetic technologies and improve performance for science applications.

- **Geodetic Data Services**
  - Geodetic Data Services manages an archive of over 70 terabytes of GPS, laser scanning, Synthetic Aperture Radar (SAR) and borehole geophysical instruments from all GAGE components including EarthScope PBO, global continuous GPS networks, and campaign GPS observations; operates automated and manual systems to ensure the quality of all data stored in the archive; and provides systems to give the national and international research community with timely access to these data. The archive of SAR imagery maintained and distributed by GAGE to support interferometric SAR imagery of continuous surface deformation at scales of 100s to 1,000 km is complementary to discrete GPS measurement of displacement. As the U.S. currently has no civilian spaceborne SAR sensor, UNAVCO, as the manager of GAGE, brokers for cost-effective community access to the SAR imagery acquired by foreign SAR satellite systems.

- **Education and Community Engagement**
  - The GAGE Education and Community Outreach (ECE) Program enables audiences beyond geodesists to access and use geodetic data and research for educational purposes, including technical short courses, student internships, web-based materials, and programs for strengthening workforce development and improving diversity in the geosciences.

- **Special Emphasis Areas**
  - Community Activities include scientific and technical workshops that bring together the international seismic community and publications designed to communicate GAGE activities and results to the community.

- External Affairs maintains outreach efforts to policymakers and planning for coordination with the international geodesy community.

.Besides its role in providing the observational data essential for basic Earth science research, GAGE also plays a significant role providing geodetic infrastructure support to NASA investigators and the international community through activities in maintaining a subset of the Global GNSS Network (GGN); which supports the refinement of the ITRF and corrections to satellite orbits and clocks, all contributing to the capability for millimeter-level geodetic positioning, subtle observations of Earth's time-varying gravity field and detection of annual millimeter-level changes in sea level.

Commercial surveyors and engineering firms download GAGE facility real-time GPS data daily to support precision positioning. The economic impact of this service to the commercial sector has not been quantified, but is likely substantial.

The EarthScope, Instrumentation and Facilities Programs in the Division of Earth Sciences (EAR); and Programs in the Arctic and Antarctic sections of the Division of Polar Programs (PLR) provide most of the funds, totaling approximately $15.0 million per year, for NSF-sponsored research making use of GAGE. These funds permit deployment of portable geodetic instruments and use of data managed by Geodetic Data Services to solve major Earth science problems.

Management and Oversight

- NSF Structure: EAR, through its Instrumentation & Facilities Program (IF), provides general oversight of GAGE to help assure effective performance and administration. The program also facilitates coordination of GAGE programs and projects with other NSF-supported facilities and projects, and with other federal agencies, and evaluates and reviews the performance of UNAVCO in managing and operating GAGE. The Deep Earth Processes section head and division director in EAR provide other internal oversight.
- External Structure: GAGE is managed and operated by UNAVCO, which is incorporated as a non-profit consortium representing 104 U.S. universities and non-profit organizations with research and teaching programs that rely on geodetic technologies for Earth Science research. Each voting Member Institution of the Consortium appoints a Member Representative, and these Member Representatives elect the seven members of the UNAVCO Board of Directors, five of which are drawn from member institutions, and two Directors-at-Large. The Board members, who serve two-year terms, vet all internal program decisions associated with GAGE management and operation, through consultation with UNAVCO staff and GAGE advisory committees (one for each major GAGE component and additional *ad hoc* working groups appointed for special tasks). The Board of Directors appoints a president of UNAVCO to a renewable two-year term. The president is responsible for UNAVCO operations, all of which are managed through the UNAVCO Corporate Headquarters in Boulder, CO.
- Reviews: All major ongoing geoscience facilities routinely undergo mid-award reviews of their management, in addition to peer review of proposals for new or continued support. The formal NSF merit review of the 5-year proposal for the GAGE facility took place in 2012 and 2013 and was also the most recent review of UNAVCO. Although the *ad hoc* reviewers and two independent review panels had a number of specific recommendations at the working level for GAGE, overall the review found that GAGE was a critical facility for U.S. and international Earth sciences. Furthermore, the reviewers found that UNAVCO is a well-managed and effective organization that has, through its commitment to the collection and open dissemination of the highest quality geodetic data, transformed the discipline of geodesy and its geoscience applications.

Renewal/Recompetition/Termination

The initial cooperative agreement for GAGE begins in FY 2013. In FY 2017, in keeping with the phased integration and recompetition plan presented to the National Science Board in December 2009, NSF intends to solicit proposals for a future facility or facilities to support the Earth sciences research and education community currently supported by GAGE and the related Seismological Facilities for the Advancement of Geoscience and EarthScope (SAGE). NSF is currently considering the precise form of this solicitation, and any possible future facility/facilities are currently being considered within NSF and through discussions with the GAGE and SAGE support communities.

ICECUBE NEUTRINO OBSERVATORY

$6,900,000
+$0.00 / 0.0%

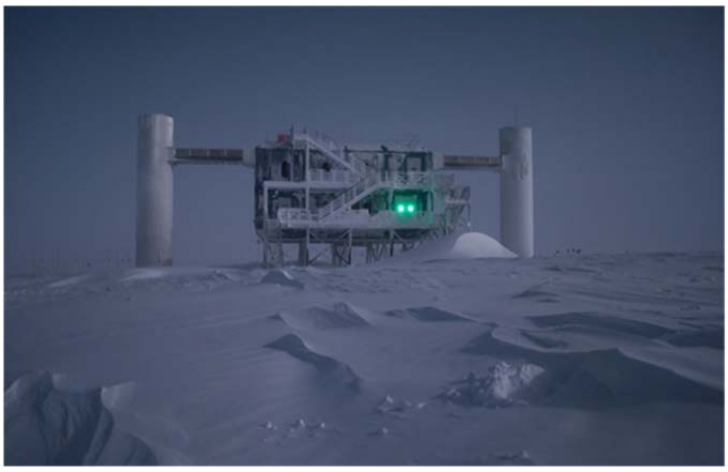
IceCube Neutrino Observatory

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$6.90	$6.90	$6.90	-	-

IceCube is the world's first high-energy neutrino observatory, located deep within the ice cap under the U.S. Amundsen-Scott South Pole Station in Antarctica. It represents a new window on the Universe, providing unique data on the engines that power active galactic nuclei, the origin of high-energy cosmic rays, the nature of gamma ray bursts, the activities surrounding supermassive black holes, and other violent and energetic astrophysical processes. Approximately one cubic kilometer of ice is instrumented with photomultiplier (PM) tubes to detect neutrino-induced, charged reaction products produced when a high-energy neutrino interacts in the ice within or near the cubic kilometer fiducial volume. An array of 5160 Digital Optical Modules (DOMs), each containing a PM and associated electronics, is distributed uniformly from 1.5 km to 2.5 km beneath the surface of the South Pole ice cap, a depth where the ice is highly transparent and bubble-free. The energy and arrival direction of high-energy neutrinos ranging in energy from 100 GeV (10^{11} electron Volts [eV]) to 10 PeV (10^{16} eV) are derived from the IceCube data stream.

The Observatory includes a Deep Core Array (DCA). The DCA is composed of eight strings with the DOMs concentrated in the lower-middle part of the array. The tighter spacing of the DOMs allows the Observatory to detect lower energy neutrinos (down to about 10 GeV), thus opening the door to studies of neutrino oscillation measurements and studies of Weakly Interacting Massive Particles (WIMPs) below 250 GeV. In essence, the DCA closes the energy gap between the IceCube Neutrino Observatory and the Super-Kamiokande detector in Japan, and also allows effective observations of high-energy neutrinos entering from the sky of the southern hemisphere.



The IceCube project has transformed one cubic kilometer of natural Antarctic ice into a particle detector. The sensors keep watch for momentary flashes of blue light made by subatomic particles called muons; some are produced in collisions of neutrinos with atomic nuclei inside or near the detector. Since completion in 2010, the IceCube detector has been taking data in its final configuration with an up-time of well over 99 percent. IceCube detects one neutrino every 6 minutes in a background of 2700 cosmic ray muons per second. To handle the high rates, initial analysis of the data is performed by a cluster of computers housed in a two-story building placed on top of the array. The filtered data is sent over geostationary satellites to the IceCube Research Center at the University of Wisconsin. *Credit: IceCube Collaboration.*

Total Obligations for IceCube

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
R&RA Obligations:								
Operations & Maintenance (MPS)	$3.45	$3.45	$3.45	$3.45	$3.45	$3.45	$3.45	$3.45
Operations & Maintenance (GEO)	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45
Subtotal, R&RA Obligations	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90
MREFC Obligations:								
Implementation	1.52	-	-	-	-	-	-	-
Subtotal, MREFC Obligations	1.52	-	-	-	-	-	-	-
TOTAL Obligations	**$8.42**	**$6.90**	**$6.90**	**$6.90**	**$6.90**	**$6.90**	**$6.90**	**$6.90**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only. FY 2015 is the final year of the current cooperative agreement. Funding beyond FY 2015 asssumes continued operation of the facility.

The IceCube Neutrino Observatory is led by the University of Wisconsin (UW) and was constructed with support from four countries (U.S., Belgium, Germany, and Sweden). The science collaboration is much broader, currently consisting of 16 U.S. institutions and 22 institutions in nine other countries (Germany, Belgium, Sweden, New Zealand, Australia, Canada, Japan, Switzerland, and the United Kingdom). NSF's foreign partners contribute a *pro rata* share of operations and maintenance costs based on the number of PhD-level researchers involved. IceCube construction was successfully completed at the South Pole on December 18, 2010.

Management and Oversight

- NSF Structure: Oversight of the IceCube Neutrino Observatory is the responsibility of the Geosciences Directorate's Division of Polar Programs (PLR). Support for operations and maintenance, research, and education and outreach is shared by PLR and the Directorate for Mathematical and Physical Sciences (MPS) Physics Division, as well as other organizations and international partners. NSF provides oversight through regular site visits by NSF managers and external reviewers.
- External Structure: The UW management structure for IceCube includes leadership by the project's Principal Investigator and a project director. At lower levels, project management includes international collaboration representatives, as well as participation by staff at collaborating U.S. institutions. UW has in place an external Scientific Advisory Committee and a Software and Computing Advisory Panel that meet annually and provide written advice to the project. UW leadership, including the Chancellor, provides additional awardee-level oversight.
- Reviews: NSF will conduct a review of operations, management, and science in May 2013.

Operations Costs

Full operations and maintenance in support of scientific research began in FY 2011. The associated costs are and will continue to be shared by the partner funding agencies – U.S. (NSF) and non-U.S. – proportional to the number of PhD researchers involved (currently about 55:45). Since total annual costs are about $13.0 million, the current U.S. share of full science operations and maintenance is $6.90 million.

Support for U.S. institutions working on more refined and specific data analyses, data interpretation

(theory support), and instrumentation upgrades is provided through the Research and Related Activities (R&RA) account in response to merit-reviewed proposals.

The general operations of South Pole Station, reported in the Polar Facilities and Logistics narrative, also contribute to supporting IceCube. The cost of IceCube operations shown in the table herein includes only those that are project-specific and incremental to general South Pole Station operations. The expected operational lifespan of the IceCube Neutrino Observatory is 25 years beginning in FY 2011.

Education and Outreach

IceCube provides a vehicle for helping to achieve national and NSF education and outreach goals. Specific outcomes include the education and training of next-generation leaders in astrophysics, including undergraduate students, graduate students, and postdoctoral research associates; K-12 teacher scientific/professional development, including development of new inquiry-based learning materials and using the South Pole environment to convey the excitement of astrophysics, and science generally, to K-12 students; increased opportunity for involvement of students in international collaborations; increased diversity in science through partnerships with minority institutions; and enhanced public understanding of science through broadcast media and museum exhibits (such as the Adler Planetarium) based on IceCube science and the South Pole environment. NSF supports evaluation and measurement-based education and outreach programs under separate grants to universities and other organizations that are selected following standard NSF merit review.

Renewal/Recompetition/Termination

The current IceCube Maintenance & Operations award expires in September 2015. Prior to expiration, the award will be re-competed in accordance with NSF policy.

THE INTERNATIONAL OCEAN DISCOVERY PROGRAM

$50,000,000
+$5,600,000 / 12.6%

International Ocean Discovery Program

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
$51.68	$44.40	$50.00	$5.60	12.6%

The International Ocean Discovery Program (IODP), beginning in FY 2014, replaces the Integrated Ocean Drilling Program, which began in FY 2004 and is an expanded successor program to the Ocean Drilling Program. The new IODP represents an international partnership of the scientists, research institutions, and funding organizations of 26 nations to explore the evolution and structure of Earth as recorded in the ocean basins. The new program management structure is streamlined and focused on maximizing facility efficiency, while retaining the intellectual cooperation and exchange of the previous drilling program. NSF, the Ministry of Education, Culture, Sport, Science and Technology (MEXT) of Japan, and the European Consortium for Ocean Research Drilling (ECORD) will continue to provide drilling platforms. IODP platforms provide sediment and rock samples (cores), in-situ monitoring, sampling, and measurement from borehole observatories, shipboard and shorebased descriptive and analytical facilities, downhole geophysical and geochemical measurements (logging), and opportunities to conduct experiments to determine in-situ conditions beneath the sea floor.

JOIDES Resolution underway for a science expedition, March 10, 2009. *Credit: NSF*

Total Obligations for IODP

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$51.68	$44.40	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only. Funding for FY 2015 through FY 2019 is estimated assuming renewal of the program.

Annual operations and maintenance support for IODP includes the costs of operating the *JOIDES Resolution*, the primary platform of IODP. The *JOIDES Resolution* is leased from an offshore drilling contractor under a long-term contract with favorable day rates. Another commercial contractor provides downhole-logging services. Maintaining databases, preparing scientific publications emerging from IODP expeditions, and management of the international program are additional IODP science integration costs, made minimal to NSF because of international contributions to IODP. In addition, NSF provides

support for U.S. scientists to sail on IODP drilling platforms and to participate in IODP advisory panels through an associated grants program. The annual costs for the associated science integration and science support (not included in the table above) are approximately $12.0 million.

The new IODP scientific program includes emphasis on the following research themes:
- Climate and Ocean Change: Reading the Past, Informing the Future;
- Biosphere Frontiers: Deep Life, Biodiversity, and Environmental Forcing of Ecosystems;
- Earth Connections: Deep Processes and Their Impact on Earth's Surface Environment; and
- Earth in Motion: Processes and Hazards on Human Time Scales.

Starting in FY 2013 under the International Ocean Discovery Program, an umbrella forum provides a venue for all IODP entities to exchange ideas and views on the scientific progress of the program. In the simplified new IODP management structure, each drillship is governed by independent facility boards, each unique and optimized for their respective drilling platform. In the case of the *JOIDES Resolution* Facility Board (JRFB), three advisory panels review proposals and give science and safety advice. A U.S. scientist leads the JFRB, with other members from the scientific community, funding agencies, and the facility operator.

IODP participants include the United States, Japan, ECORD (Austria, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, and the United Kingdom), Brazil, the People's Republic of China, Korea, India, Australia, and New Zealand, with all participants except Japan providing financial contributions to *JOIDES Resolution* operations. Japan provides program support through substantial investment in *Chikyu* operations, with U.S. and Japanese scientists enjoying reciprocal rights on each drilling vessel.

Over 2,400 scientists from over 42 nations have participated on Ocean Drilling Program and Integrated Ocean Drilling Program expeditions since 1985, including approximately 1,120 U.S. scientists from over 150 universities, government agencies, and industrial research laboratories. Samples and data have been distributed to around 1,000 additional U.S. scientists. Scientists from these groups propose and participate in IODP cruises, are members of the program's advisory panels and groups, and supply data for planning expeditions and interpretation of drilling results.

Management and Oversight
- NSF Structure: The Division of Ocean Sciences (OCE) in the Directorate for Geosciences (GEO) manages the IODP under the NSF Ocean Drilling Program. NSF's Ocean Drilling Program is located within the Marine Geosciences Section, with several program officers dedicated to its oversight. One of the program officers serves as the contracting officer's technical representative for the Central Management Office (CMO) contract and the System Integration Contractor (SIC) contract.
- External Structure: NSF and MEXT have signed a Memorandum of Cooperation, which identifies procedures for joint management of a contract to an IODP CMO. A non-profit corporation of U.S., Japanese, and other international institutions (IODP Management International, Inc.) has been contracted by NSF for the CMO activity. The CMO coordinates and supports scientific planning, drilling platform activity, data and sample distribution, and publication and outreach activities through its management of commingled international science funds, collected and provided by NSF. Drillship providers are responsible for platform operational management and costs. NSF provides a light drillship through a contract with the U.S. systems integration contractor, an alliance formed by the Consortium for Ocean Leadership, Inc. (COL) together with subcontractors at Texas A&M University and Lamont-Doherty Earth Observatory, Columbia University. MEXT manages its drillship through the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), while the British Geological Survey manages ECORD drilling contributions.

- Scientific advice and guidance for IODP is provided through the science advisory structure (SAS), recently streamlined and made more efficient in response to independent, contractual management review. The SAS now consists of a Science Implementation and Policy Committee (SIPCOM), a Proposal Evaluation Panel (PEP), and a series of service panels. The CMO is responsible for coordinating the SAS committee and panels, and for integrating the advice from the SAS into drilling and operational guidance for IODP. Representation in the SAS is proportional to IODP member financial contributions.
- Reviews: Both the CMO and SIC contracts call for management reviews every three years by independent, external panels. Both the SIC and CMO contracts underwent external review in FY 2010.[23] Performance under both contracts will be reviewed again in FY 2013. Reviews for each expedition are carried out on a regular basis to evaluate operational and scientific performance, with review of scientific progress in broader thematic areas conducted by an independent panel every several years.

Renewal/Recompetition/Termination

Originally scheduled to end in FY 2013, the contract to operate IODP was extended through FY 2014 to allow for competitive selection of an operator for the *JOIDES Resolution* under a cooperative agreement. Pending selection of an acceptable proposal that fits within broader OCE priorities and National Science Board approval, a cooperative agreement supporting the *JOIDES Resolution* is expected to be in place to provide seamless FY 2015 IODP science operations. This cooperative agreement will contain language encouraging the awardee to facilitate novel partnerships involving support of *JOIDES Resolution* operations between the U.S. scientific drilling community and commercial industry, thereby providing new intellectual opportunities and potential reduction in overall facility cost.

To facilitate and support the activities of U.S. scientists participating in IODP activities, an IODP Science Support Office has also been funded. Management of this office is also being competitively solicited, with selection of an awardee expected in summer 2013.

The *JOIDES Resolution* Operations and Science Support Cooperative Agreements will contain a provision for annual external review of performance by an independent panel. A more intensive mid-award review at the end of the third year, in FY 2017, will consider whether the cooperative agreement should be extended or re-competed. NSF and its IODP partners contributing funds to *JOIDES Resolution* operations are negotiating formal agreements, which identify rights of participation on the *JOIDES Resolution* and its facility board and advisory panels based upon partner financial contributions to *JOIDES Resolution* operations. A brief letter of understanding regarding berthing exchange is being negotiated between NSF and the Japanese Agencies MEXT and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). Similarly, MEXT manages its drillship through JAMSTEC, while the British Geological Survey manages ECORD drilling contributions.

[2] www.iodp-usio.org/Publications/IODP_OA_2010.pdf
[3] www.iodp.org/triennium-review/

LARGE HADRON COLLIDER

$18,000,000
$0.00 / 0.0%

Large Hadron Collider
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$18.00	$18.00	$18.00	-	-

Totals may not add due to rounding.

The Large Hadron Collider (LHC), an international project at the CERN laboratory in Geneva, Switzerland, is the premier facility in the world for research in elementary particle physics. The facility consists of a superconducting particle accelerator providing two counter-rotating beams of protons, approximately 16.5 miles in circumference, with each beam to have a design energy up to 7 TeV ($1TeV=10^{12}$ electron volts). It can also provide colliding beams of heavy ions, such as lead. Data-taking with colliding proton beams at 3.5 TeV began in the Spring of 2010; currently the accelerator operates at a beam energy of 4 TeV per beam. Starting in March 2013, the LHC will undergo a 20-month period of extensive repairs and enhancements that will enable it to operate at the full design energy of 7 TeV per beam.

The U.S. is involved in the maintenance and operation of two particle detectors, a Toroidal LHC Apparatus (ATLAS) and the Compact Muon Solenoid (CMS). These have been built to characterize the different reaction products produced in the very high-energy proton-proton collisions that occur in intersection regions where the two beams are brought together. The same detectors are also being used to study the reaction products from heavy ion beam collisions. A total of 45 international funding agencies participate in the ATLAS detector project and 42 in the CMS detector project. NSF and the Department of Energy (DOE) provide U.S. support to both experiments. CERN is responsible for meeting the goals of the international LHC project. The ATLAS and CMS detectors take data approximately 200 days per year. The remaining time is to be used for maintenance and testing. During the 20-month maintenance period noted above, the detectors will also undergo a series of repairs and enhancements to prepare for higher-energy operations.

The successful operation during 2012 of the accelerator complex, the ATLAS and CMS detectors, and the world-wide LHC computing grid culminated in the first major discovery at the LHC. On July 4, 2012, the CMS and ATLAS collaborations announced the discovery of a particle consistent with the long-sought Higgs boson. Further study of the properties of this new particle will reveal whether it is the Higgs boson predicted in the Standard Model of particle physics, which will provide a deeper understanding of the origin of mass of the known elementary particles. The LHC program also includes searches for particles predicted by a powerful theoretical framework known as supersymmetry, which may provide clues as to how the known forces, weak, strong, electromagnetic, and gravitational, evolved from different aspects of the same "unified" force in the early universe, and can investigate the possibility that there are extra dimensions in the structure of the universe. Through the participation of young investigators, graduate students, undergraduates, and minority institutions in this international project, LHC serves the goal of helping to produce a diverse, globally-oriented workforce of scientists and engineers. Further, innovative education and outreach activities, such as the QuarkNet project, allow high school teachers and students to participate in this project (see www.quarknet.fnal.gov).

Total Obligations for LHC
(Dollars in Millions)

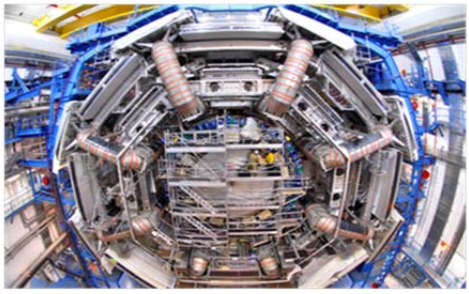
	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$18.00	$18.00	$18.00	$20.00	$20.00	$20.00	$20.00	$20.00

[1] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in FY 2016.

The U.S. LHC collaboration continues to be a leader in the development and exploitation of distributed grid-based computing. The LHC grid enables U.S. universities to access LHC data and computing resources, and thus train students, in both state of the art science and computational techniques. The distributed computing tools and techniques developed for the LHC are expected to have broad application throughout the scientific and engineering communities.

Major component procurements of warm and superconducting magnets as well as high-speed electronics are made through U.S. industries. In the construction phase, approximately $45.0 million was devoted to materials procurements. In FY 2014 material procurements are estimated to be about $5.0 million, which is included within the $18.0 million detector operating costs.

Both collaborations continue to operate the detectors smoothly and to analyze the collected data efficiently using world-wide computing resources. The LHC experiments are also adapting quickly to the gradual increase in beam energy and the increases in beam intensities. While challenging, these increases significantly enhance the chances of more ground-breaking discoveries at the LHC. During the accelerator shut-down period starting in 2013, the collaborations will carry out needed maintenance on the detectors while continuing to analyze the many Petabytes of data collected in the previous two years.



The ATLAS detector in February 2007. *Credit: CERN.*

Management and Oversight

- NSF Structure: A program director in the NSF Division of Physics (PHY) is responsible for day-to-day project oversight.
- External Structure: U.S. LHC program management is performed through a Joint Oversight Group (JOG), created by the NSF and DOE. The JOG has the responsibility to see that the U.S. LHC program is effectively managed and executed to meet commitments made under the LHC international agreement and its protocols. NSF support for operations is provided through cooperative agreements with Princeton University for US-CMS and with Columbia University for ATLAS.
- Reviews: There is one major management/technical review each year with a panel of external, international experts, as well as bi-weekly telephone reviews by NSF/DOE program directors to monitor progress. The next major management/technical review is scheduled for March 2013. Two JOG review meetings per year monitor overall program management.

Renewal/Recompetition/Termination

The LHC project is expected to continue at least through the end of the next decade. In December 2011, new cooperative agreements were negotiated with the ATLAS and CMS collaborations to extend funding for an additional five years to support their role in the international collaborations.

LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY — $39,500,000 +$9,100,000 / 29.9%

Laser Interferometer Gravitational-Wave Observatory
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
$30.40	$30.40	$39.50	$9.10	29.9%

Totals may not add due to rounding.

Einstein's theory of general relativity predicts that cataclysmic processes involving extremely dense objects in the universe, such as the collision and merger of two neutron stars or black holes, will produce gravitational radiation. Detection of these gravitational waves is of great importance for fundamental physics, astrophysics, and astronomy. The Laser Interferometer Gravitational-Wave Observatory (LIGO), the most sensitive gravitational-wave detector ever built, comprises two main facilities, one in Livingston Parish, LA and one in Hanford, WA. At each facility, a large vacuum chamber with two 4-km arms joined at right angles houses one or more optical interferometers; the Hanford chamber contains a second 2-km interferometer. The interferometers are used to measure minute changes in the distances between mirrors at the ends of the arms caused by a passing gravitational wave. The predicted distortion of space caused by a gravitational wave from a likely source is on the order of one part in 10^{21}, meaning that the expected change over the apparent 4-km length is only on the order of 4×10^{-18} meters, or about 1/1000th the diameter of a proton. The 4-km length for LIGO, the largest for any optical interferometer, was chosen to make the expected signal as large as possible within terrestrial constraints. Looking for coincident signals in all the interferometers simultaneously increases the likelihood for gravitational wave detection.

In April 2008 construction began on the Advanced LIGO (AdvLIGO) Major Research Equipment and Facility Construction (MREFC) project, which is designed to increase the sensitivity of LIGO tenfold. AdvLIGO is being built within the existing LIGO laboratory. LIGO's current and projected operations and maintenance expenses are designed to sustain operation of the LIGO laboratory during the time that the construction is underway. These include support for basic infrastructure costs not directly related to the AdvLIGO construction project, data analysis for the S5 and S6 science runs, maintenance of computational resources for data storage and analysis, research and development for any pre-design costs and risk reduction related to AdvLIGO that are outside the scope of the AdvLIGO project, and education and outreach projects associated with the laboratory.

An aerial view of the Livingston, LA LIGO site. *Credit: Caltech/MIT LIGO Laboratory.*

The LIGO Science Education Center at the Livingston site is the focal point for augmenting teacher education at Southern University and other student teacher activities state wide through the Louisiana Systematic Initiative Program. The LIGO Science Education Center's programs include funding for an external evaluation firm that provides both assistance in aligning future activities with proposed goals and evaluating outcomes.

Substantial connections with industry have been required for the state-of-the-art construction and measurement involved in LIGO projects, with some innovations leading to new products. Interactions with industry include exploring novel techniques for fabrication of LIGO's vacuum system, seismic isolation techniques, ultrastable laser development (new product), high optical power electrooptic components (new products), new ultra-fine optics polishing techniques, and optical inspection equipment (new product).

Total Obligations for LIGO

(Dollars in Millions)

	FY2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$30.40	$30.40	$39.50	$39.50	$41.00	$41.00	$41.00	$41.00

[1] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in FY 2013.

In 1997 LIGO founded the LIGO Scientific Collaboration (LSC), an open collaboration that organizes the major international groups doing research supportive of LIGO. The LSC now has more than 77 collaborating institutions in 15 countries with more than 870 participating scientists, and LSC membership is growing at a rate of approximately 10 percent per year. A Memorandum of Understanding (MOU) between the LIGO Laboratory and each institution determines the membership responsibilities. The LSC plays a major role in many aspects of the LIGO effort, including research and development (R&D) for detector improvements, R&D for AdvLIGO, data analysis and validation of scientific results, and setting priorities for instrumental improvements at the LIGO facilities. Annual NSF support for science and engineering research directly related to LIGO activities through ongoing research and education programs is about $5.50 million, provided through the disciplinary programs.

LIGO concluded its initial phase of existence with the S6 science run, which, in addition to the acquisition of science data, also tested technologies that will become part of AdvLIGO. This run began in July 2009 and ended in October 2010. The detector sensitivity was about 30 percent higher than that during the previous S5 run, making the S6 science run both a scientific success and a valuable testbed for AdvLIGO. At the end of this run the LIGO instruments were turned over to the AdvLIGO project for decommissioning and for installation of advanced components. LIGO and the LSC are currently analyzing the data from the S6 run.

AdvLIGO construction will conclude in FY 2014 with anticipated first commissioning of the upgraded facility to begin in early FY 2015. During the AdvLIGO construction period, normal operations costs were reduced as attention was focused on construction. With the completion of the AdvLIGO project, LIGO operations will revert from the lower level of operations funding to the $33.0 million in operations funding prior to the onset of construction in FY 2007, plus the increase support required to manage more sophisticated instruments installed as part of the construction project.

For more information on AdvLIGO, see the MREFC chapter.

Management and Oversight

- NSF Structure: NSF oversight is coordinated internally by the LIGO program director in the NSF Division of Physics (PHY), who also participates in the PHY AdvLIGO Project Advisory Team, comprised of staff from the NSF Office of General Counsel, Office of Legislative and Public Affairs, International Science and Engineering , as well as the the Deputy Director for Large Facility Projects in the Office of Budget, Finance, and Award Management.
- External Structure: LIGO is managed by the California Institute of Technology under a cooperative agreement. The management plan specifies significant involvement by the user community, represented by the LSC, and collaboration with the other major gravitational-wave detector activities in Asia, Europe, and Australia. External peer-review committees organized by NSF help provide oversight through an annual review.
- Reviews:
  - AdvLIGO Baseline Review, May-June 2006
  - LIGO Annual Review, November 2006
  - AdvLIGO Baseline Update Review, June 2007
  - LIGO Annual Review and LIGO FY 2009-2013 Operations Proposal Review, November 2007
  - LIGO Business Systems Review (BSR), final report issued March 2008
  - LIGO Annual Review, November 2008
  - AdvLIGO Annual Review, April 2009
  - LIGO Annual Review and AdvLIGO Interim Review, December 2009
  - AdvLIGO Annual Review, April 2010
  - LIGO Annual Review and AdvLIGO Interim Review, December 2010
  - AdvLIGO Annual Review, April 2011
  - LIGO Annual Review and AdvLIGO Interim Review, November 2011
  - LIGO Annual Review and AdvLIGO Interim Review, November 2012

Installation of a quantum-mechanical squeezing experiment at LIGO in 2011. The temporary experiment allowed LIGO to increase its sensitivity by more than 20 percent over most of its frequency range. Such research is conducted by LIGO Laboratory and the LIGO Scientific Collaboration to reduce risk in the Advanced LIGO construction project. *Credit: Caltech/MIT LIGO Laboratory.*

Renewal/Recompetition/Termination

LIGO began operating under a new five-year cooperative agreement in early FY 2009. As a condition of approval of this award (and a possible future award), the National Science Board stipulated that the operation of LIGO be recompeted no later than 2018. The projected lifetime of the LIGO facility is 20 years.

NATIONAL HIGH MAGNETIC FIELD LABORATORY

$32,640,000
+$6,840,000 / 26.5%

National High Magnetic Field Laboratory
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
$26.80	$25.80	$32.64	$6.84	26.5%

Totals may not add due to rounding.

The National High Magnetic Field Laboratory (NHMFL) is operated by Florida State University (FSU), the University of Florida (UF), and Los Alamos National Laboratory (LANL). NHMFL develops and operates high magnetic field facilities that scientists and engineers use for research in core areas of condensed matter and material physics, materials science and engineering, chemistry and various areas of the biological and biochemical sciences, as well as work on energy and the environment. It is the world's premier high magnetic field laboratory with a comprehensive assortment of high-performing magnet systems and extensive support services. The facilities are available to all qualified scientists and engineers through a peer-reviewed proposal process; external users number about 1,100 per year as well as faculty and staff at the three collaborating institutions.

The lab is an internationally recognized leader in magnet design, development, and construction, including the development of conducting and superconducting materials. Many of the unique magnet systems were designed, developed, and built by the Magnet Science and Technology (MS&T) Division of the NHMFL. In 2012, the lab set the world's record for the highest nondestructive pulsed magnetic field at 100.75 tesla. The 45 tesla hybrid magnet currently provides the highest steady-state magnetic fields in the world. Both magnets enable scientists to get new insights into the electronic structures of novel materials such as graphene, topological insulators, high temperature superconductors, and more. MS&T works with industry and other international magnet laboratories on a variety of technology projects. These include analysis, design, component development and testing, coil fabrication, cryogenics, system integration, and testing.

A $15.0 million award funded by the American Recovery and Reinvestment Act of 2009 (ARRA) through the NSF Division of Chemistry enabled the purchase of a 21 tesla magnet for the construction of a Fourier Transform Ion Cyclotron Resonance Spectrometer (FT-ICER) that will be world-record holding in sensitivity and selectivity. This instrument will be capable of analyzing chemical samples of unprecedented complexity, such as biological fluids and biofuels, and with unprecedented resolution and speed. This new capability will have high impact in several areas including chemistry, molecular biology, and heavy petroleum analysis. Construction and factory testing of the 21 tesla magnet are scheduled for completion in May of 2013, and delivery to the NHMFL FT-ICR facility in June 2013. Subsequent instrument development will then follow for approximately six to twelve months.

The FY 2014 Request will allow the facility to continue operations, focus on magnet development, and strengthen education, training, user support, and in-house research. It is consistent with prior levels for this activity. (The FY 2012 level is relatively lower due to about $6.0 million in forward funding provided by previous appropriations).

Total Obligations for NHFML

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$26.80	$25.80	$32.64	$33.67	$34.66	$35.79	$35.79	$35.79

[1] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in December 2017.

Current magnet development at NHMFL focuses on new energy-saving, high-field magnet technologies, including the design, development and construction of all-superconducting magnets based on high-temperature superconductor technology. The goal is to develop high-field magnets for the NHMFL user program that double current energy-efficiency. NHMFL collaborates with more than 60 private sector companies, national laboratories, and federal centers, including those supported by the Department of Energy (DOE), such as the Spallation Neutron Source and the Advanced Photon Source at Argonne National Laboratory. International collaboration includes magnet development with the Helmholtz-Zentrum Berlin (HZB) (previously known as the Hahn-Meitner-Institute Berlin), the International Thermonuclear Experimental Reactor (ITER) in France, and national magnet labs in France, the Netherlands, Germany, and China.

NHMFL provides a unique interdisciplinary learning environment. The Center for Integrating Research and Learning at NHMFL conducts education and outreach activities, which include a Research Experience for Undergraduates program, summer programs for teachers, a summer camp for middle school girls, and activities to raise the scientific awareness of the general public.

Management and Oversight

- NSF Structure: NHMFL is supported by the Division of Materials Research (DMR) and the Division of Chemistry (CHE) in the NSF Directorate for Mathematical and Physical Sciences (MPS). DMR is the steward supporting the broad mission of the facility, providing 95 percent of the funds. CHE supports the Fourier Transform Ion Cyclotron Resonance (FT-ICR) Laboratory and provides about 5 percent of funding. Primary responsibility for NSF oversight is with the national facilities program director in DMR, with help from the FT-ICR program director in CHE.
- External Structure: A consortium of the three institutions (FSU, UF, and LANL) operates NHMFL under a cooperative agreement. FSU, as the signatory of the agreement, has the responsibility for appropriate administrative and financial oversight and for ensuring that operations of the laboratory are of high quality and consistent with the objectives of the cooperative agreement. The principal investigator serves as the NHMFL director and reports to the FSU Vice President for Research. Four senior faculty members are co-principal investigators. The NHMFL director receives guidance primarily from the NHMFL executive committee and the NHMFL science council. He also receives recommendations from an external advisory committee, the NHMFL diversity committee, and the users' executive committee.
- Reviews: NSF conducts annual external reviews, which assess user programs, in-house research, long-term plans to contribute significant research developments both nationally and internationally, and operations, maintenance, and new facility development. Annual reviews also assess the status of education training and outreach, operations and management efficiency, and diversity plans. In addition to a panel of experts from the community, representatives from other federal agencies such as DOE and the National Institutes of Health (NIH) attend these site visits. Recent and upcoming reviews include:
  - Business Systems Review (BSR), final report issued in September 2009.

- Renewal Review by external panel of site visitors, December 2011.
- Annual Site Review by external panel of site visitors, December 2013.
- NSF initiated a broad-based community study through the National Research Council on opportunities in high magnetic field research. This report, expected in May 2013, will inform future plans for investments in this area.

Renewal/Recompetition/Termination

A comprehensive renewal review was conducted in FY 2012. The National Science Board approved a five-year renewal award not to exceed $168.38 million for FY 2013-2017.

NATIONAL NANOTECHNOLOGY INFRASTRUCTURE NETWORK **$15,460,000**
-$400,000 / -2.5%

National Nanotechnology Infrastructure Network

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$16.00	$15.86	$15.46	-$0.40	-2.5%

The National Nanotechnology Infrastructure Network (NNIN) will complete its second and final five-year funding period in FY 2013. In FY 2014, the National Science Foundation will establish, through an open competition, a Next-Generation National Nanotechnology Infrastructure Network (NG NNIN) for Fiscal Years 2014-2018. NG NNIN will build on the concept of NNIN in comprising multiple university sites to form an integrated national network of user facilities supporting research and education across diverse disciplines in nanoscale science, engineering, and technology. NG NNIN will continue to provide users across the Nation with access, both on-site and remotely, to leading-edge tools, instrumentation, and expertise for fabrication, synthesis, characterization, design, simulation, and integration. In addition, the NG-NNIN will offer a broader scope and user base than the current network of facilities through the following:

- A user base that is broadened to include communities of environmental sciences, geosciences, and biosciences;
- Availability of new leading-edge fabrication capability;
- Capabilities to create complex and three-dimensional nanoscale systems through heterogeneous integration;
- Capabilities to build nanoscale systems across multiple dimensional scales through hierarchical design and fabrication;
- Capabilities for fabrication in soft matter including potentially biological interfaces;
- New generations of modeling and simulation along with the use of new design tools to maximize overall understanding and fabrication efficiency;
- Facilities capable of supporting the translation of discovery into prototypical elements suitable for evaluation of manufacturability and proof of business concept;
- Partnerships with industry, government, and other groups to provide specialized capabilities within the network when warranted, including linkages with other networks and federal infrastructure investments;
- Unified program of education and outreach built upon the unique nature of the network and funded at a level commensurate with the goals and directions of the program; and
- Commitment to support and champion environmental responsibility, health, and safety (EHS) by providing direct capabilities including characterization, fabrication, and synthesis.

Total Obligations for NNIN

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$16.00	$15.36	$15.46	$16.00	$16.00	$16.00	$16.00	$16.00

[1]Outyear funding estimates are for planning purposes only. FY 2014 will be the first year of the cooperative agreement for NG NNIN. Funding beyond FY 2014 assumes continued operation of the facility as the next-generation NNIN, as described in the Renewal/Recompetion/Termination section of this narrative.

NNIN's national user facilities have enabled the Nation's researchers from academia, small and large industry, and government to pursue transformative research, seek new discoveries and applications in a broad range of domains of nanoscale science and engineering, and stimulate technological innovation. The network also has developed the infrastructure and intellectual and institutional capacity needed to examine and address societal and ethical implications of nanotechnology, including issues of environment, health, and safety. The NNIN user facilities have promoted interdisciplinary research by bridging the gap between materials, mechanics, electronics, photonics, biology and diverse fields, and enabling longitudinal pathways from fundamental studies to devices and systems.

NNIN has undertaken, on a national scale, a broad spectrum of innovative activities in education, human resource development, knowledge transfer, and outreach to the science, engineering, and technological communities. Special emphasis has been placed on education and training of a diverse science and engineering workforce that involves non-traditional users and under-represented groups, including women and minorities. NNIN has sought to leverage its capabilities through connections and collaborations with national and industrial laboratories and with foreign institutions. Through such partnerships, joint meetings, and workshops, the network has shared expertise and perspectives, provided specialized training opportunities, coordinated access to unique instrumentation, and transferred newly developed technologies.

NNIN has leveraged research strengths of universities to bring them to the external community. The institutions comprising the NNIN have had strong underlying internal research programs that provided the knowledge base for developing new processes, methodologies, and instrumentation, as well as much of the capital infrastructure. NSF and other agencies independently have awarded research grants to principal investigators who used NNIN facilities to carry out some aspects of their research projects.

In the FY 2009 renewal period, three institutions joined the network, each bringing new capabilities and broadening the user base: the University of Colorado, which focused on research in energy-related problems and in precision sciences that include measurements, standards, and systems; Arizona State University, which focused on organic/inorganic interfaces in electronics, biodesign, implantable devices, flexible electronics, sensors, and outreach to underrepresented communities in the Southwest; and Washington University in St. Louis, whose research focused on nanomaterials and nanosciences for environment, health, and safety. NNIN, through lead efforts at the University of Washington and University of Michigan, also has served as a technology source to facilitate collaboration for ocean sensing infrastructure between the geosciense community and the nanotechnology sensor community.

During NNIN's ninth full year of operation encompassing the period from March 2012 through February 2013, 6,323 unique users (an increase of 4 percent over the previous year period) performed a significant part of their experimental work at NNIN facilities. Of these, 5,270 were academic users (roughly 85 percent graduate students, 7 percent undergraduate students, and 8 percent postdocs) from over 200 academic institutions. In addition, 970 were industrial users, of which 760 were from small companies.

Over 3,300 publications, patents, and patent applications, several of them significant scientific and engineering highlights of the year, resulted from the work of the user community. A major task of staff of NNIN is in training of this user community, particularly graduate students from across the United States, where there is a continuous and significant turnover. A total of 2,081 new users were trained in the vast instrument set, large and small, at the networks facilities.

Management and Oversight

- NSF structure: In preparation for the new award for NG NNIN, NSF will continue to provide oversight under a cooperative agreement with the lead institution. The cognizant program officer for the NNIN activity will reside in the Division of Electrical, Communications and Cyber Systems (ECCS) in the Directorate for Engineering (ENG). The program officer will coordinate NG NNIN oversight with the NG NNIN working group comprised of representatives from all NSF directorates and the Office of International and Integrative Activities. NG NNIN will be reviewed annually through site reviews held at one of the network sites. These reviews will involve an external team of experts selected by the NSF working group.

- External structure: The current NNIN is managed as a cohesive and flexible network partnership through a Network Executive Committee derived from the individual site directors, and the Education/Outreach and Society/Ethics coordinators. The position of Network Director is now held by the director of the Stanford University site. The Network Director provides intellectual leadership for the network and is also responsible, in cooperation with the Network Executive Committee, for developing strategies, operational plans, and coordination of the activities of the network, and serves as the principal contact on behalf of the network with NSF. An external Network Advisory Board meets at least annually and provides independent advice and guidance to the network director and Executive Committee concerning the network's programs, activities, vision, funding allocations, and new directions. The Advisory Board shares its major recommendations with the NSF. The site directors are responsible for local management functions of the individual user facilities, for interfacing with other facilities and with the management team for the overall network, and for connections with the outside communities. NSF anticipates a similar management structure will be established for the NG NNIN.

- Reviews: The first comprehensive annual review of the NNIN was held following an initial 9 months of operation at the Georgia Institute of Technology site in December 2004. The second annual review was held at the University of Texas-Austin site in February 2006. The third annual review was held at the University of Michigan site in May 2007. The fourth annual review was held at the Stanford University site in May 2008. This review also served to evaluate the NNIN renewal proposal for the five-year period FY 2009-2013. A mid-year informational review was held at NSF in October 2009. The sixth annual review was held at the University of Washington site in May 2010. The seventh annual review was held at the University of Colorado-Boulder site in May 2011. The eighth and final annual review of NNIN was held at the Georgia Institute of Technology site in May 2012.

Renewal/Recompetition/Termination

The National Science Board approved NSF's review-based recommendation in December 2008 and authorized renewal of the NNIN award for a final five-year period from FY 2009-2013. In April 2012, NSF convened a Nanotechnology Infrastructure Workshop of recognized national experts to evaluate the needs and appropriate future investments in the national infrastructure for nanotechnology. The workshop report has been used to help prepare the solicitation for the new open competition for NG NNIN. The NG NNIN solicitation NSF 13-521 was released in December 2012, with the intent of making a new 5-year award for FY 2014-2018.

NATIONAL SOLAR OBSERVATORY

$8,000,000
-$1,100,000 / -12.1%

National Solar Observatory
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$9.10	$9.10	$8.00	-$1.10	-12.1%

Totals may not add due to rounding.

The National Solar Observatory (NSO) operates facilities in New Mexico and Arizona as well as a coordinated worldwide network of six telescopes specifically designed to study solar oscillations. NSO leads the community in construction of the Advanced Technology Solar Telescope (ATST). (See the Major Research Equipment and Facilities Construction chapter for more information). NSO makes available to qualified scientists the world's largest collection of optical and infrared solar telescopes and auxiliary instrumentation for observation of the solar photosphere, chromosphere, and corona. NSO also provides routine and detailed, synoptic solar data used by many researchers and other agencies through its online archive and data delivery system.

NSO telescopes are open to all astronomers regardless of institutional affiliation on the basis of peer-reviewed observing proposals. In FY 2012, 61 unique observing programs from 20 U.S. and 19 foreign institutions were carried out using NSO facilities. Students carried out 25 percent of these, which included 10 Ph.D. thesis programs. Nearly eleven terabytes of NSO synoptic data were downloaded from the NSO digital archives. Approximately 137 staff members are employed at NSO.

A community-based review of the entire portfolio of the Division of Astronomical Sciences (AST) was completed during FY 2012. Its findings and recommendations will inform future budget allocation and planning activities. Prior to receiving this Portfolio Review report, NSF had instructed NSO to begin divestment of the McMath/Pierce solar telescope on Kitt Peak, thereby accelerating the already-planned divestment by a few years. The Portfolio Review Committee endorsed this decision. In addition, it recommended continued operation of the Dunn Solar Telescope through 2017 and reduced support of the synoptic programs. At this time, NSF is considering the Portfolio Review Committee's recommendations, and no decisions have been made. The impact of the Portfolio Review on long-term funding will be presented in future Requests.

Total Obligations for NSO
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
NSO-Operations	$7.25	$7.25	$6.70	$6.70	$6.70	$6.70	$6.70	$6.70
NSO-Development	1.50	1.50	1.00	1.00	1.00	1.00	1.00	1.00
NSO-Research & Education	0.35	0.35	0.30	0.30	0.30	0.30	0.30	0.30
Total, NSO	**$9.10**	**$9.10**	**$8.00**	**$8.00**	**$8.00**	**$8.00**	**$8.00**	**$8.00**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only and do not include ATST operations. The current cooperative agreements ends in FY 2014.

Partnerships and Other Funding Sources: The managing organization for NSO is the Association of Universities for Research in Astronomy, Inc., (AURA), which is comprised of thirty-nine U.S. member institutions and seven international affiliate members. NSO partners include the U.S. Air Force Office of Scientific Research, U.S. Air Force Weather Agency, NASA, and industrial entities. Other funding entities include universities and institutes, which collaborate with NSO on solar instrumentation development and on the design and development of ATST. New telescopes, instrumentation, and sensor techniques are developed through industry sub-awardees in aerospace, optical fabrication, and information technology. Observing time on NSO telescopes is assigned on the basis of merit-based review, not funding source.

Education and Public Outreach: NSO supports U.S. education goals by promoting public understanding and support of science and by providing education and training at all levels. NSO introduces undergraduate students to scientific research by providing stimulating environments for basic astronomical research and related technologies through NSF's Research Experiences for Undergraduate students (REU) program. NSO has diverse education programs, including teacher training and curriculum development, visitor centers, and a web-based information portal at www.nso.edu.

NSO-Operations, $6.70 million: NSO Operations include facility operations at Sacramento Peak Observatory (SPO) in New Mexico, the world-wide Global Oscillations Network Group (GONG), and solar facilities based on Kitt Peak, Arizona. ATST will replace several of the NSO telescopes at SPO and on Kitt Peak.

NSO-Development, $1.0 million: NSO development funding reported here includes only work apart from ATST, notably for the synoptic program consisting of the GONG array and the SOLIS (Synoptic Optical Long-term Investigations of the Sun) telescope. ATST construction is funded through the Major Research Equipment and Facilities Construction (MREFC) account. (See the ATST narrative in the MREFC chapter for more information).

NSO-Research & Education, $300,000: NSO supports public education in solar physics through its education and public outreach office at SPO. This office provides science community outreach, a visitors' center, news and public information, and activities on Maui in collaboration with University of Hawaii Maui Campus.

Management and Oversight

- NSF Structure: An NSF program director in AST provides continuing oversight, including consultation with an annual NSF program review panel. The program director makes use of detailed annual program plans, annual long-range plans, quarterly technical and financial reports, and annual reports submitted by NSO as well as attending AURA Solar Observatory Council meetings. The latter committee is formed from the national solar physics community and provides a window into community priorities and concerns. The AST program manager works closely with other offices at NSF, particularly the Division of Acquisition and Cooperative Support, the Office of General Counsel, and the Large Facilities Office in the Office of Budget, Finance, and Award Management.
- External Structure: AURA is the managing organization for NSO. The NSO Director reports to the president of AURA, who is the principal investigator on the FY 2010 NSF cooperative agreement. AURA receives management advice from its Solar Observatory Council, composed of members of its scientific and management communities. NSO employs visiting and users' committees for the purposes of self-evaluation and prioritization. The visiting committee, composed of nationally prominent individuals in science, management, and broadening participation, reviews for AURA all aspects of the management and operations of NSO. The users committee, composed of scientists with considerable experience with the observatory, reviews for the NSO Director all aspects of NSO that affect user experiences at the observatory.

- Reviews: In addition to reviews held mid-way through all cooperative agreements, NSF conducts both periodic and ad hoc reviews of AURA management, as needed, by external committees. The last extensive review for NSO was in FY 2008, and led to the award of a new cooperative agreement at the beginning of FY 2010. Annual reviews are anticipated for both NSO program plans beginning in early 2013. A Business Systems Review is scheduled for spring 2013. A re-baseline review for the ATST project, described in the ATST narrative, was held in October 2012 and a follow-up review will occur in early 2013.

Renewal/Recompetition/Termination

A management review of AURA's performance was carried out in August 2006. In response to the favorable review, the National Science Board extended the existing cooperative agreement with AURA for eighteen months, through September 30, 2009. A proposal for renewal of the cooperative agreement was received from AURA in December 2007 and underwent review in 2008. The National Science Board authorized a new cooperative agreement with AURA for management and operation of NSO for the period October 1, 2009, through March 31, 2014. Since NSO is the home for the ATST construction project, and ATST is not expected to begin operation until 2019, the current cooperative agreement will likely be extended beyond its current expiration in 2014.

NATIONAL SUPERCONDUCTING CYCLOTRON LABORATORY $22,500,000
+$1,000,000 / 4.7%

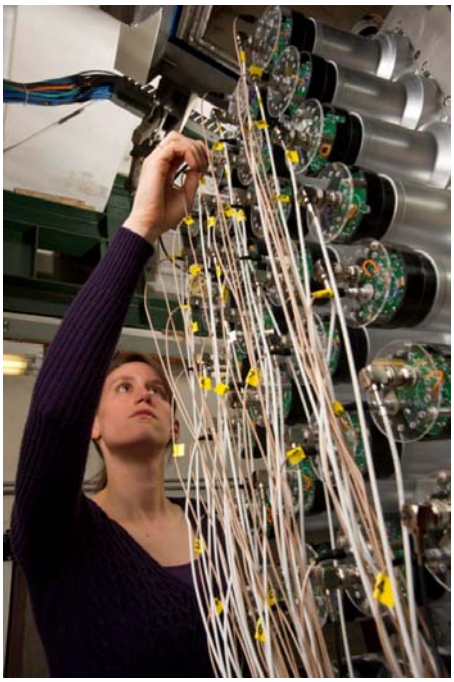
National Superconducting Cyclotron Laboratory
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$21.50	$21.50	$22.50	$1.00	4.7%

The National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University (MSU) is a university-based national user facility. With two linked superconducting cyclotrons, K500 and K1200, it is the leading rare isotope research facility in the U.S. and is among the world leaders in heavy ion nuclear physics and nuclear physics with radioactive beams. Funding for NSCL also supports the MSU faculty and staff research program.

NSCL scientists employ a range of tools for conducting advanced research in fundamental nuclear science, nuclear astrophysics, and accelerator physics. Applications of the research conducted at the NSCL benefit society in numerous areas, including new tools for radiation treatments of cancer patients and the assessment of health risks to astronauts. The K500 was the first cyclotron to use superconducting magnets, and the K1200 is the highest-energy continuous beam accelerator in the world. Through the Coupled Cyclotron Facility (CCF), heavy ions are accelerated by the K500 and then injected into the K1200, enabling the production of rare unstable isotopes at much higher intensities. The laboratory is completing construction and commissioning of an MSU-funded reaccelerator facility (ReA3) that will enable experiments at very low energies – a domain of particular interest to nuclear astrophysics.

Scientists at NSCL work at the forefront of rare isotope research. They make and study atomic nuclei that cannot be found on Earth and perform experimental research using beams of unstable isotopes to extend our knowledge of new types of nuclei, many of which are important to an understanding of stellar processes. Research activities include a broad program in nuclear astrophysics studies, the studies of nuclei far from stability using radioactive ion beams, and studies of the nuclear equation of state. In addition, research is carried out in accelerator physics.



MSU graduate student Krista Meierbachtol working on the S800 CsI Hodoscope, part of the focal plane detector of the S800 magnetic spectrograph. *Credit: NSCL*

NSCL supports and enhances doctorate graduate education and post-doctoral research experiences. About 10 percent of all doctorates granted in nuclear physics in the U.S. are based on research at NSCL. The lab also provides research experiences for undergraduate students, K-12 students, and K-12 teachers.

The coupled cyclotron facility supports a broad experimental program. The mix of experiments is determined by beam use proposals. An external program advisory committee selects the best proposals at a typical success rate of about 50 percent. The science output of NSCL is driven by these experiments, with most running one to three days.

Total Obligations for NSCL

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$21.50	$21.50	$22.50	$22.50	$22.50	$20.00	$15.00	$10.00

[1]Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in FY 2016.

Management and Oversight

- NSF Structure: MSU operates NSCL under a cooperative agreement with NSF. NSF oversight is provided through annual site visits by the cognizant program officer of the NSF Division of Physics and other staff, accompanied by external experts.
- External Structure: NSCL is managed by its director and four associate directors for research, education, operations, and new initiatives. The laboratory director has the authority to appoint associate directors and designate responsibilities, notifying NSF of changes. NSCL's research program is guided by a program advisory committee of external experts as well as an in-house expert, and includes the chairperson of the full NSCL user group. The procedure for users includes writing and submitting proposals to the NSCL director and oral presentations. There are two proposal submission opportunities each year. About 4,000 beam hours are provided for experiments annually, with a backlog of at least a year.
- Reviews:
  - A 5-year review in FY 2011 covered results and achievements related to intellectual merit and broader impacts for the past five years (FY 2007 – FY 2011) and future funding for the next five years (FY 2012 – FY 2016).
  - Latest Review: An annual review of the science, operations, and future funding was in July 2012.
  - Next Review: An annual review is planned for June 2013.

Renewal/Recompetition/Termination

In December 2008 the Department of Energy (DOE) announced that it had selected Michigan State University as the site for a new world-class Facility for Rare Isotope Beams (FRIB). FRIB will be built on the site of the present NSCL and will make use of much of the NSCL beamlines and general infrastructure. Michigan State University will be the performing institution under a cooperative agreement with DOE for the future FRIB. The first FRIB cooperative agreement between DOE and MSU was signed in 2009. To facilitate interagency planning and allow for a smooth transition from the NSF-funded NSCL to the DOE-funded FRIB, a Joint Oversight Group (JOG) of DOE and NSF personnel has been established. NSF anticipates eventually phasing out funding for operations and maintenance for the NSCL facility, as indicated in the table above for FY 2017 through FY 2019. DOE and NSF will coordinate transfer of stewardship of the facility from NSCL to FRIB, which relies on the existing NSCL infrastructure. This responsibility will be assumed by the DOE. NSF will continue to fund individual investigators carrying out research at the new FRIB.

NETWORK FOR EARTHQUAKE ENGINEERING SIMULATION $22,000,000
+$1,500,000 / 7.3%

Network for Earthquake Engineering Simulation

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
$20.39	$20.50	$22.00	$1.50	7.3%

The Network for Earthquake Engineering Simulation (NEES) is a national, networked simulation resource of 14 advanced, geographically distributed, multi-user earthquake engineering research experimental facilities with telepresence capabilities. NEES provides a national infrastructure to advance earthquake engineering research and education through collaborative and integrated experimentation, computation, theory, databases, and model-based simulation to improve the seismic design and performance of U.S. civil infrastructure systems. Experimental facilities include shake tables, geotechnical centrifuges, a tsunami wave basin, large-scale laboratory experimentation systems, and mobile and permanently installed field equipment. NEES facilities are located at academic institutions (or at off-campus field sites) throughout the United States, networked together through a high performance Internet2 cyberinfrastructure system (NEEShub). NEES completed construction on September 30, 2004, and opened for user research and education projects on October 1, 2004. NEES was operated during FY 2005-FY 2009 by NEES Consortium, Inc., located in Davis, CA. During FY 2008 and FY 2009, NSF recompeted NEES operations using program solicitation NSF 08-574, George E. Brown, Jr. Network for Earthquake Engineering Simulation Operations (NEES Ops) FY 2010-FY 2014. The outcome of that competition was an award to Purdue University for a five-year cooperative agreement with NSF to operate NEES from FY 2010-FY 2014. Purdue University operates the NEES experimental facilities and cyberinfrastructure; coordinates education, outreach, and training; and develops national and international partnerships.

Total Obligations for NEES

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$20.39	$20.50	$22.00	$12.00	$13.00	$12.50	$12.50	$12.00

[1] Outyear funding estimates are for planning purposes only. FY 2014 is the final year of the current cooperative agreement. Funding beyond FY 2014 assumes continued operation of the facility as a second generation NEES, as described in the Renewal/Recompetion/Termination section of this narrative.

NEES' broad-based national research facilities and cyberinfrastructure enable new discovery and knowledge through capabilities to test more comprehensive, complete, and accurate models of how civil infrastructure systems respond to earthquake loading and tsunamis. This enables the design of new methodologies, modeling techniques, and technologies for earthquake and tsunami hazard mitigation. NEES engages students in earthquake engineering discovery through on-site use of experimental facilities, telepresence technology, archival experimental and analytical data, and computational resources

with the aim of integrating research and education. Purdue University operates NEES under a strategic plan and develops a broad spectrum of education and human resource development activities with special emphasis on non-traditional users and underrepresented groups through its Research Experiences for Undergraduates (REU) program. Purdue also organizes an annual meeting for NEES users/researchers and facility operators.

Using a unique landslide tsunami generator, researchers at the Georgia Institute of Technology in cooperation with faculty at University of Alaska at Fairbanks are investigating a methodology for improved assessment and mitigation of landslide and tsunami hazards. Field data from landslide-generated tsunamis events are limited to very few cases with marginal data that are generally missing the most important information related to tsunami generation characteristics. Researchers are compensating for this lack of field data by creating physical models of three-dimensional tsunami generation by deformable landslides and source run-up in the NEES Tsunami Wave Basin at Oregon State University. *Credit: Devin K. Daniel, California Polytechnic State University, San Luis Obispo, NEES summer 2010 REU student*

Through the National Earthquake Hazards Reduction Program (NEHRP), which includes the Federal Emergency Management Agency (FEMA), the National Institute of Standards and Technology (NIST) as the lead agency, the U.S. Geological Survey (USGS), and NSF, NEES supports research and outreach related to earthquake hazard mitigation. Connections to industry include private engineering consultants and engineering firms engaging in NEES research or using data and models developed through NEES. NEES leverages and complements its capabilities through connections and collaborations with large testing facilities at foreign earthquake-related centers, laboratories, and institutions. NSF has developed a partnership to utilize the NEES infrastructure with the 3-D Full-Scale Earthquake Testing Shake Table Facility (E-Defense), located in Miki City, Japan, and built by the Japanese National Research Institute for Earth Science and Disaster Prevention (NIED), which became operational in 2005. To facilitate NEES/E-Defense collaboration, in September 2005 NSF and the Japanese Ministry of Education, Culture, Sports, Science, and Technology signed a Memorandum Concerning Cooperation in the Area of Disaster Prevention Research. In August 2011, two NSF-supported research projects used a full-scale, five-story steel frame structure at the E-Defense facility to test new seismic base isolation concepts and the response of non-structural systems during strong seismic motion, and in 2012 an NSF-supported research project participated in large-scale experiments at the E-Defense facility to investigate soil-structure interaction of underground structures.

Along with direct operations and maintenance support for NEES, NSF separately provides support for research to be conducted at the NEES experimental facilities through ongoing research and education programs. The NEEShub also provides a platform for the earthquake engineering and tsunami communities, as well as other communities, to develop new tools for shared cyberinfrastructure. The annual support for such activities, funded through annual NEES research program solicitations, is estimated to be up to $9.0 million in FY 2013. These awards support basic research in multi-hazard engineering involving experimental and computational simulations at the NEES facilities, addressing important challenges in earthquake and tsunami engineering research. ENG support for NEES Operations will continue to support core research conducted at the 14 network sites through FY 2014.

Management and Oversight

- NSF structure: NSF provides oversight to NEES operations through a cooperative agreement with Purdue University during FY 2010-FY 2014. NEES operations are reviewed through annual site visits and through periodic site visits to the individual NEES facilities. The annual site reviews are held at either the headquarters or at NSF. All reviews involve an external team of experts selected by

NSF staff. The NSF program manager for NEES is located in the Division of Civil, Mechanical and Manufacturing Innovation (CMMI) in the Directorate for Engineering (ENG). The Deputy Director for Large Facility Projects in the Office of Budget, Finance and Award Management (BFA) provides advice and assistance.

- External structure: Purdue University provides the headquarters and staffing to coordinate network-wide operation of the NEES experimental facilities, cyberinfrastructure, and education, outreach, and training activities as well as develop national and international partnerships. Day-to-day operations of the network are overseen by the headquarters staff led by a director. A governance board meets several times a year and provides independent advice and guidance to the director concerning the network's programs, activities, vision, funding allocations, and new directions. The governance board shares its major recommendations with NSF. Each of the 14 experimental facilities has an on-site director responsible for local day-to-day equipment management, operations, and interface with Purdue, other NEES facilities, users, and the NEEShub for network coordination. The NEEShub provides telepresence, the NEES Project Warehouse data repository, and collaborative, simulation, and other related services for the entire NEES network.

- Reviews
  - Management reviews: NSF BFA Business Systems Review: May 2006
  - Mid-award operations reviews: NSF Annual Merit Reviews: June 2005, April 2006, July 2007
  - Experimental facility reviews: NSF Periodic Merit Reviews: FY 2006-FY 2008
  - Transition review: April 2010
  - Management reviews: NSF BFA Business Systems Review: March 2011
  - Mid-award operations reviews: NSF Annual Merit Reviews: FY 2010-FY 2013
  - Experimental facility reviews: Up to three annually: FY 2010-FY 2013

Renewal/Recompetition/Termination

In FY 2008, NSF recompeted NEES operations for a second five-year period from FY 2010-FY 2014. The competition was announced in program solicitation NSF 08-574, George E. Brown, Jr. Network for Earthquake Engineering Simulation Operations (NEES Ops) FY 2010-FY 2014. As an outcome of that competition, the National Science Board, at its August 5-6, 2009 meeting, approved NSF's recommendation for a five-year cooperative agreement (FY 2010-FY 2014) to Purdue University. Annual funding to Purdue University for NEES operations is based upon satisfactory progress and availability of funding. During FY 2010, the prior NEES operations awardee, NEES Consortium, Inc., was supported by NSF to provide continuity of operations and to help transition software, documents, and other inventory to Purdue University. During FY 2010, NEES Consortium, Inc., also closed out its support for NEES operations.

In FY 2010, NSF supported two studies for the assessment of the need for earthquake engineering experimental and cyberinfrastructure facilities beyond 2014, as described in the Dear Colleague Letter NSF 10-071 (http://nsf.gov/pubs/2010/nsf10071/nsf10071.jsp). One study, a workshop held by the National Research Council on the Grand Challenges in Earthquake Engineering Research, was completed in FY 2011 and the second study was completed in FY 2012. These studies provided input to NSF for the determination of support for future earthquake engineering research infrastructure beyond 2014. The plan to support, as the outcome of an open recompetition to be held during FY 2013-FY 2014, a smaller "second generation" NEES during FY 2015-FY 2019 was presented to the National Science Board at their July 2012 meeting and described in the Dear Colleague Letter NSF 12-107 (www.nsf.gov/pubs/2012/nsf12107/nsf12107.jsp). In February 2013, the Foundation released solicitation NSF 13-537 to re-compete and operate the second generation of NEES (NEES2) for the five-year period from FY 2015 – FY 2019. NSF also will support longer-term community planning for FY 2020 – FY 2029.

POLAR FACILITIES AND LOGISTICS

$314,210,000
+$18,420,000 / 6.2%

Polar Facilities and Logistics
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
Polar Facilities	$185.02	$184.73	$202.69	$17.96	9.7%
Polar Logistics	109.60	111.06	111.52	0.46	0.4%
Total, Polar Facilities and Logistics	**$294.63**	**$295.79**	**$314.21**	**$18.42**	**6.2%**

Totals may not add due to rounding.

Polar Facilities

The Division of Polar Programs (PLR) within the Directorate for Geosciences (GEO) provides the infrastructure needed to support U.S. research conducted in Antarctica, including research funded by U.S. mission agencies, for year-round work at three U.S. stations, on two research ships, and at a variety of remote field camps. One example of support to other agencies includes mission-essential satellite communications support at McMurdo Station for the Joint Polar Satellite System (JPSS) and the National Aeronautics and Space Administration's (NASA) Ground Networks for the relay of data. In addition, PLR enables important climate monitoring activities for the National Oceanic and Atmospheric Administration (NOAA) at the Clean Air Facility at South Pole Station, one of only five such sites around the globe. PLR also provides support for NASA's Long Duration Balloon program that enables research in fields ranging from astrophysics to cosmic radiation to solar astronomy. PLR also provides support to the U.S. Geological Survey's (USGS) South Pole Remote Earth Science and Seismological Observatory (SPRESSO), the most seismically-quiet station on earth, and access to its Global Navigation Satellite System (GNSS).

All support for these activities is provided by PLR, including transportation, facilities, communications, utilities (water and power), health and safety infrastructure, and environmental stewardship. The U.S. Antarctic Program (USAP) maintains the U.S. presence in Antarctica in accordance with U.S. policy, and supports Antarctic Treaty administration under State Department leadership.

Total Obligations for Polar Facilities
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Antarctic Infrastructure & Logistics	$185.02	$184.73	$202.69	$202.69	$202.69	$202.69	$202.69	$202.69
Total, Polar Facilities	**$185.02**	**$184.73**	**$202.69**	**$202.69**	**$202.69**	**$202.69**	**$202.69**	**$202.69**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only.

PLR contracts with a prime contractor for science support, operations, the leasing of research vessels, and

the maintenance of the Antarctic stations and related infrastructure in New Zealand and Chile. The contractor is selected through a competitive process. Rotary- and fixed-wing aircraft used in support of research are also provided through separate competitively awarded contracts. Other agencies and contractors provide technical support in areas of expertise such as engineering, construction, and communications.

Management and Oversight

- NSF Structure: PLR staff including, subject matter experts in operational and scientific disciplines, have overall responsibility for funding and managing Polar Facilities under the U.S. Antarctic Program that NSF budgets for and manages on behalf of the Nation. This includes planning all activities, and overseeing contractors. PLR's Antarctic Sciences Section funds merit-reviewed research proposals for which access to Antarctica is essential to advancing the scientific frontiers, including research in a broad array of geo- and bio- sciences, including earth system science, as well as space and astrophysical sciences that can only be achieved or are best achieved with research work in Antarctica and the Southern Ocean. The Antarctic Infrastructure & Logistics Section enables research in Antarctica on behalf of the U.S. Government through a network of stations, labs, equipment, and logistical resources. The Environment, Safety & Health Section oversees the environmental, safety, and health aspects of research and operations conducted in Polar Regions.

Helicopters provide support to field parties in the McMurdo Dry Valleys in southern Victoria Land and at remote field camps. *Credit: Kristan Hutchison, RPSC*

- External Structure: The Antarctic support contract was competed and awarded to Lockheed Martin Corporation in December 2011. There are many separate subcontractors for supplies and technical services, and other services are procured through separate competitively bid contracts.
- Reviews: PLR evaluates the performance of the Antarctic support contractor annually via an Award Fee Plan, which involves multiple tiers of review, including a Performance Evaluation Board (PEB) composed of representatives from PLR and the Office of Budget, Finance, and Award Management (BFA). In addition, PLR's performance is reviewed externally by Committees of Visitors and the GEO Advisory Committee. The USAP Blue Ribbon Panel (BRP) released a report on its review of the Program in July 2012. [4] The NSF Response to the USAP Blue Ribbon Panel report was released in March 2013.[5]

Current Status

- All facilities (stations, research vessels, and field camps), including the recently-constructed South Pole Station, are currently operating normally.
- South Pole Station Modernization (SPSM) was funded through NSF's Major Research Equipment and Facilities Construction (MREFC) account. The new station was dedicated in January 2008 and construction was completed in January 2011. The new station replaced the previous U.S. station at the South Pole, built 30 years ago and inadequate in terms of capacity, efficiency, and safety. The new station is an elevated complex with two connected buildings, supporting 150 people in the summer and 50 people in the winter. The completed station provides a platform for the conduct of science at the South Pole and fulfills NSF's mandate to maintain a continuous U.S. presence at the South Pole in accordance with U.S. policy. Operations and maintenance of South Pole Station is consolidated within the requested budget for polar facilities.

[4] www.nsf.gov/od/opp/usap_special_review/usap_brp/rpt/index.jsp
[5] www.nsf.gov/od/opp/usap_special_review/usap_brp/rpt/nsf_brp_response.pdf

- The USAP BRP report concluded that ushering in a new age of Antarctic science simply by expanding traditional methods of logistical support would be prohibitively costly. Instead, they recommended numerous ways to more efficiently and cost-effectively support research while maintaining high standards of safety and increasing the flexibility to support evolving science foci in the future. NSF's response to the report, released in March 2013, responds directly to the ten overarching recommendations made by the BRP and includes information on planned improvements over the near- and long-term, such as roboticizing the South Pole traverse, improving boating access at Palmer Station, conducting a study to improve fire suppression capabilities, and initiating design work to consolidate warehousing facilities at McMurdo Station. For additional information on planned BRP response activities during FY 2014, see the Division of Polar Programs (PLR) narrative in the Directorate for Geosciences chapter.

Renewal/Recompetition/Termination

- NSF recently concluded an effort to recompete the Antarctic support contract. Lockheed Martin Corporation was awarded a 13.5 year contract, consisting of a five-year base period and four option periods exercised on the basis of performance and totaling an additional 8.5 years.
- U.S. policy directs NSF to maintain an active and influential presence in Antarctica, including year-round occupation of South Pole Station and two coastal stations. The research emphases at the three stations change as the scientific forefronts addressed there evolve with time, as does the infrastructure needed to support it.

Polar Logistics

Polar Logistics consists of two activities: the U.S. Antarctic Logistical Support program within the Antarctic Infrastructure and Logistics Section, and the Research Support and Logistics program within the Arctic Sciences Section.

Total Obligations for Polar Logistics
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
U.S. Antarctic Logistical Support	$67.52	$67.52	$67.52	$67.52	$67.52	$67.52	$67.52	$67.52
Arctic Research Support and Logistics	42.08	43.54	44.00	44.00	44.00	44.00	44.00	44.00
Total, Polar Logistics	**$109.60**	**$111.06**	**$111.52**	**$111.52**	**$111.52**	**$111.52**	**$111.52**	**$111.52**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only.

The U.S. Antarctic Logistical Support program funds support activities provided by the U.S. Department of Defense (DoD). DoD operates as a logistical support provider on a cost-reimbursable basis. Major funding elements of DoD support include: military personnel, LC-130 flight operations and maintenance support through the 109th Airlift Wing of the New York Air National Guard in Scotia, New York, and Antarctica; transportation and training of military personnel supporting the U.S. Antarctic Program; support for air traffic control, weather forecasting, and ground electronics maintenance; the charter of Air Mobility Command airlift and Military Sealift Command ships for the re-supply of McMurdo Station;

bulk fuel purchased from the Defense Logistics Agency; and reimbursement for use of DoD satellites for communications.

The Research Support and Logistics program in the Arctic Sciences Section of PLR is driven by and responds to science supported by the section. Funding is provided directly to grantees or to key organizations that provide or manage Arctic research support and logistics. A contractor provides research support and logistics services for NSF-sponsored activities in the Arctic. Additional major support components include: access to U.S. Coast Guard and other icebreakers, University-National Oceanographic Laboratory (UNOLS) vessels and coastal boats; access to fixed- and rotary-wing airlift support; upgrades at Toolik Field Station, University of Alaska Fairbanks' field station for ecological research on Alaska's North Slope; safety training for field researchers and funding for field safety experts; global satellite telephones for emergency response and improved logistics coordination; and development of a network of strategically placed U.S. observatories linked to similar efforts in Europe and Canada.

Management and Oversight

- NSF Structure: PLR has overall responsibility for U.S. Antarctic Logistical Support and Arctic Research Support & Logistics.
  - U.S. Antarctic Logistical Support is budgeted for and managed by the Antarctic Infrastructure and Logistics Section, which includes managers with operational expertise responsible for planning and overseeing all U.S. Antarctic Program support.
  - Arctic Sciences personnel support merit-reviewed research proposals in social, earth systems, and a broad range of natural sciences; its Research Support & Logistics program is driven by and responds to research by assisting researchers with access to the Arctic and sharing of plans and results with local Arctic communities. The Environment, Safety & Health Section oversees the environmental, safety, and health aspects of research and operations conducted in Polar Regions.
- External Structure:
  - DoD operates as a logistical support provider on a cost-reimbursable basis. The agencies cooperate under a Memorandum of Agreement that includes guidance for planning and scheduling and sets forth the terms and conditions for reimbursement to DoD by NSF.
  - The Arctic support contract was recently re-competed and awarded to the incumbent, CH2M Hill, in September 2011. There are many separate subcontractors for supplies and technical services, and other services are procured through separate competitively bid contracts.
- Reviews: PLR evaluates the performance of the Arctic support contractor informally on an ongoing basis and formally each year using feedback from the research community they support, and by conducting site visits that include representatives from PLR and BFA. PLR's performance is externally reviewed by Committees of Visitors and the GEO Advisory Committee.

Current Status

- All facilities (stations, research vessels, and field camps) are currently operating as normal.

Renewal/Recompetition/Termination

- NSF recently recompeted the Arctic support contract and made an award to the incumbent contractor, CH2M Hill, in September 2011. The contract has an initial term of four years and the possibility of two, two-year extensions exercised on the basis of performance.

SEISMOLOGICAL FACILITIES FOR THE ADVANCEMENT OF GEOSCIENCE AND EARTHSCOPE **$25,700,000**
-$1,060,000 / -4.0%

Seismological Facilities for the Advancement of Geoscience and EarthScope

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
$26.12	$26.76	$25.70	-$1.06	-4.0%

The Seismological Facilities for the Advancement of Geoscience and EarthScope (SAGE) comprise a distributed, multi-user, national facility for the development, deployment, and operational support of modern digital seismic instrumentation to serve national goals in basic research and education in the Earth sciences, earthquake research, global real-time earthquake monitoring, and nuclear test ban verification. SAGE is managed and operated for NSF by the Incorporated Research Institutions for Seismology (IRIS), a consortium of 116 U.S. universities and non-profit institutions with research and teaching programs in seismology, 21 educational affiliates, and 116 foreign affiliates. SAGE will be formed in late FY 2013 from part of the EarthScope program and the IRIS facility. FY 2012 and FY 2013 funding shown in all tables presented here have been restated for comparative purposes.

Total Obligations for SAGE

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$26.12	$26.76	$25.70	$25.70	$25.70	$25.70	$25.70	$25.70

[1] Outyear funding estimates are for planning purposes only. The new cooperative agreement begins in FY 2013.

The Earth's interior remains a major scientific frontier holding the key to understanding the origin of the planet. Recent developments in seismic sensor design, and the acquisition, transmission, and storage of data have resulted in dramatic improvements in the resolving power of seismic imaging of the interior. To serve the research needs of the broad Earth science community, SAGE is organized under three primary Service Areas and two Special Emphasis Areas:

- **Instrumentation Services**
  - The Global Seismographic Network (GSN) consists of over 150 permanently installed broadband digital seismic stations, most of which have real-time data access.
  - Portable Seismology (PS) includes a pool of over 5,200 portable seismometers that are made available to the Earth science research community for a wide range of principal investigator-driven experiments largely funded through the NSF merit review process, and incorporates equipment from the former Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL) and EarthScope USArray/Flexible Array (FA) activities.
  - Polar Support Services (PSS) supports the development of specialized seismic equipment for use in harsh environments and provides instrumentation, training, and field support for experiments in

the Polar regions. Additional supplemental funding for these activities is provided through the Division of Polar Programs (PLR).

- The Transportable Array (TA) is a continental-scale seismic observatory designed to provide a foundation for integrated studies of continental lithosphere and deep Earth structure over a wide range of scales. TA incorporates over 400 stations across the lower 48 states and Alaska.
- The Magnetotelluric (MT) component exploits the natural variations in Earth's magnetic and electric fields to provide information on the distribution and composition of fluids in Earth's crust and upper mantle, which gives constraints on Earth's structure that are complementary to those resulting from seismology. MT comprises seven long-term, continuously operating backbone stations and 21 transportable instruments used for short-term deployments.
- Instrumentation Services-Coordinated Activities, include future-focused efforts to develop the next generation of seismic instrumentation for large-scale scientific experiments; global scale geophysical networks; and training courses to distribute best practices to partners worldwide.

- **Data Services**
  - SAGE Data Services (DS) manages an archive of 200 terabytes of seismic, magnetotelluric, and other data from all SAGE components, the EarthScope program, and numerous affiliated networks; operates automated and manual systems to ensure the quality of all data stored in the archive; and provides systems to give the national and international research community with timely access to these data.

- **Education and Public Outreach**
  - The SAGE Education and Public Outreach (EPO) Program enables audiences beyond seismologists to access and use seismological data and research, including student internships, and programs for under-resourced educational institutions.

- **Special Emphasis Areas**
  - Community Activities include scientific and technical workshops that bring together the international seismic community and publications designed to communicate SAGE activities and results to the community.
  - International Development Seismology (IDS) leverages the core SAGE Service Areas to provide capacity building and training for earthquake hazard mitigation in developing countries, through technical assistance and research collaborations with scientists at U.S. academic institutions.

A student volunteer prepares to deploy a sensor on a wind farm near Palm Springs, California, that will record high-frequency seismic waves for the Salton Sea Imaging Project. Principal Investigators: John Hole, Virginia Tech, Joann Stock, Caltech, and Gary Fuis, USGS. *Credit: IRIS.*

Besides its role in providing the observational data essential for basic Earth science research, SAGE also plays a significant role providing real-time seismic data to the U.S. Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA) for global earthquake, volcano, and tsunami monitoring; international seismic monitoring of compliance with the Comprehensive Test Ban Treaty; and bringing seismology to students and the public through the activities of its EPO program.

SAGE is heavily involved in partnership activities, many international in nature. Installation and operation of the GSN has put IRIS in contact with scientists, as well as government and non-government organizations, from around the world. Many international GSN stations are designated as the official stations for nuclear test ban monitoring in their host countries. SAGE also provides multi-use resources for other government agencies that have responsibilities for

development of a nuclear test ban monitoring capability and for monitoring global seismicity. For these purposes, agencies in partnership with NSF have provided substantial support for accelerated development of the GSN, shared operation and maintenance of the GSN, and accelerated development of the Portable Seismology instrument pool.

The use for investigations of the shallow crust by instruments made available through SAGE Portable Seismology component provides opportunities for collaboration with the petroleum exploration industry. Many students involved in these experiments receive training in techniques that prepare them for careers in the exploration industry. In a broader sense, IRIS continues to collaborate closely with industry in development of seismic instrumentation and software.

The EarthScope, Geophysics, GeoPRISMS, and Tectonics Programs in the Division of Earth Sciences (EAR); the GeoPRISMS and Marine Geology and Geophysics Programs in the Division of Ocean Sciences (OCE); and the Geology and Geophysics Program and the Glaciology Program in the Antarctic Research Section of the Division of Polar Programs (PLR) provide most of the funds, totaling approximately $15.0 million per year, for NSF-sponsored research making use of SAGE. Funds permit deployment of portable seismic instruments and use of data managed by Data Services to solve major Earth science problems.

Management and Oversight

- NSF Structure: EAR, through its Instrumentation & Facilities Program (IF), provides general oversight of SAGE to help assure effective performance and administration. The program also facilitates coordination of SAGE programs and projects with other NSF-supported facilities, and with other federal agencies, and evaluates and reviews the performance of IRIS in managing and operating SAGE.
- External Structure: SAGE is managed and operated by IRIS, which is incorporated as a non-profit consortium representing 116 U.S. universities and non-profit organizations with research and teaching programs in seismology. Each voting Member Institution of the Consortium appoints a Member Representative, and these Member Representatives elect the nine members of the IRIS Board of Directors. The Board members, who serve three-year terms, vet all internal program decisions associated with SAGE management and operation, through consultation with IRIS staff and SAGE advisory committees (one for each major SAGE component and additional *ad hoc* working groups appointed for special tasks). The Board of Directors appoints a president of IRIS to a renewable two-year term. The president is responsible for IRIS operations, all of which are managed through the IRIS Corporate Office located in Washington, DC.
- Reviews: All major ongoing geoscience facilities routinely undergo mid-award reviews of their management, in addition to peer review of proposals for new or continued support. The formal NSF merit review of the 5-year proposal for the SAGE facility took place in 2012 and 2013 and was also the most recent review of IRIS. Although the *ad hoc* reviewers and two independent review panels had a number of specific recommendations at the working level for SAGE, overall the review found that SAGE was a critical facility for U.S. and international Earth sciences. Furthermore, the reviewers found that IRIS is a well-managed and effective organization that has, through its commitment to the collection and open dissemination of the highest quality seismological data, transformed the discipline of seismology. A review of the IRIS Data Services also took place during 2012. The review panel was impressed by the level of service provided to the research community by the Data Services Program, and made specific recommendations to IRIS and to NSF to further enhance the services provided by this component of the facility.

Renewal/Recompetition/Termination

The initial cooperative agreement for SAGE begins in FY 2013. In FY 2017, in keeping with the phased integration and recompetition plan presented to and concurred with by the National Science Board (NSB)

in December 2009, NSF intends to solicit proposals for a future facility or facilities to support the Earth sciences research and education community currently supported by SAGE and the related Geodetic Facilities for the Advancement of Geoscience and EarthScope (GAGE). NSF is currently considering the precise form of this solicitation, and any possible future facility/facilities are currently being considered within NSF and through discussions with the SAGE and GAGE support communities.

FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS (FFRDCs)

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

$99,000,000
+$400,000/ 0.4%

National Center for Atmospheric Research
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Change over FY 2012 Enacted Percent
$103.00	$98.60	$99.00	$0.40	0.4%

The Mesa Laboratory, designed by architect I.M. Pei, in Boulder, CO. *Credit: NCAR.*

The National Center for Atmospheric Research (NCAR) is a Federally Funded Research and Development Center (FFRDC) serving a broad research community, including atmospheric scientists and researchers in complementary areas of the environmental and geosciences. NCAR is managed under a cooperative agreement with NSF by the University Corporation for Atmospheric Research (UCAR), a university-governed and university-serving organization comprising 78 Ph.D. granting academic institutions.

As of November 2012, NCAR supported a total of 824.5 full time equivalents (FTEs), of which 360.6 are funded under the NSF primary award to UCAR.

Number of FTEs Supported at NCAR

FTEs	Primary Award[1]	All Funding
Career Scientists	84.8	116.7
Scientific Support[2]	258.8	576.6
Other Staff[3]	17.0	131.2
Total	**360.6**	**824.5**

[1] The primary award supports substantial facility infrastructure that does not include staff costs.

[2] Scientific Support includes Associate Scientists, Project Scientists, Post Docs, Software Engineers, Engineers, System Support and Technicians.

[3] Other Staff includes Administrative positions, Managers, Paid Visitors, Pilots and Mechanics.

NCAR provides facilities, including world-class supercomputing services, research aircraft, airborne and portable ground-based radar systems, atmospheric sounding, and other surface sensing systems for atmospheric research, to university, NCAR, and other atmospheric researchers. In addition, NCAR operates several facilities dedicated to the study of the Sun, solar phenomena, space weather, and the responses of the upper atmosphere to the Sun's output.

Total Obligations for NCAR

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Aircraft Support	$10.00	$9.50	$9.50	$9.50	$9.50	$9.50	$9.50	$9.50
Computational Infrastructure	25.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
Other Facility Support	25.00	21.10	21.50	21.50	21.50	21.50	21.50	21.50
Research & Education Support	43.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00
Total, NCAR	**$103.00**	**$98.60**	**$99.00**	**$99.00**	**$99.00**	**$99.00**	**$99.00**	**$99.00**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only.

Partnerships and Other Funding Sources: NCAR leverages NSF support with funding provided by other federal agencies and non-federal sources. In FY 2012, NCAR received approximately $38.90 million in support from other federal agencies, such as the National Oceanographic and Atmospheric Administration (NOAA) and the Federal Aviation Administration (FAA), and $18.0 million from non-federal sources.

Major Investments in FY 2014: In FY 2014, investments at NCAR will focus on issues of societal importance in the areas of atmospheric chemistry, climate, including climate models, cloud physics, severe storms, weather hazards to aviation, and interactions between the Sun and Earth. In all of these areas, NCAR scientists will work with their university colleagues to look closely at the role of humans in both creating climate change, responding to severe weather occurrences, and to better understand the characteristics of the Sun and Sun-Earth connections. Example investments are an increased emphasis on preparing input for the next Intergovernmental Panel on Climate Change (IPCC) assessment in FY 2014 and research into significantly enhancing our ability to understand and predict changes in hurricane intensity.

Aircraft Support: NCAR operates a C-130 and a Gulfstream-V (G-V, also known as the High Altitude Instrumented Airborne Platform for Experimental Research, or HIAPER), both of which are highly modified and equipped with specialized instrumentation, to enable the support of research activities designed to understand complex environmental processes. The two aircraft will support several community-originated projects deemed by peer review to be of exceptional scientific merit.

Computational Infrastructure: NCAR's computational facility supports high-end modeling and simulation of climate, weather, and other Earth Systems processes. Additionally, this facility supports the development and application of the Interagency United States Global Change Research Program (USGCRP) Community Earth System Model (CESM), which uses mathematical formulas to simulate and better understand the chemical and physical processes that drive Earth's climate system.

NCAR completed construction of the NCAR-Wyoming Supercomputing Center (NWSC) in early 2012, which is a joint effort between NCAR and the University of Wyoming and other Wyoming partners. This new facility, along with the installation of the petascale *Yellowstone* Supercomputer in late 2012, provides the physical infrastructure and computational capability to better meet the high-end computational needs of the atmospheric and related sciences and to allow the development of supercomputing research and educational activities of specific interest to the University of Wyoming and the state.

Other Facility Support: In addition to the C-130 and G-V aircraft, NCAR also provides support for a number of other atmospheric observing platforms through its Earth Observing Laboratory (EOL),

including a large transportable Doppler radar, upper atmosphere observing capabilities, and other experimental systems. NCAR operates a coronagraph as a community resource, and supports community weather and climate models, as well as other infrastructure. These facilities are used by both NCAR and community researchers to undertake cutting edge research projects.

Research and Education Support: Total funding for research and education support at NCAR totals $41.0 million in FY 2014. As an internationally recognized center of excellence, NCAR operates scientific research programs that include the following areas:

- studies of large-scale atmospheric and ocean dynamics that contribute to an understanding of the past and present climate processes and global climate change;
- global and regional atmospheric chemistry, including atmospheric connections to geochemical and biogeochemical cycles;
- the variable nature of the sun and the physics of the corona and their interaction with the Earth's magnetic field;
- the physics of clouds, thunderstorms, precipitation formation, and their interactions and effects on local and regional weather; and
- the examination of human society's impact on and response to global environmental change.

Research collaborations among NCAR staff and university colleagues are integral to its success as an institution, and serve as a focus and meeting point for the broader atmospheric and related sciences community. Further, NCAR works to develop new collaborations and partnerships with the private sector through directed research and technology transfer. These activities span improved capabilities for detecting, warning, and forecasting mesoscale weather phenomena of economic and social importance to the private and public sectors to longer-term economic consideration of climate change issues.

Educational activities include the SOARS (Significant Opportunities in Atmospheric Research and Science) program, an undergraduate-to-graduate bridge program designed to broaden participation in the atmospheric and related sciences, which integrates research, education, and mentoring.

In addition, NCAR further supports the scientific community by providing fellowships, internships, workshops, and colloquia for students and visiting scientists, and disseminates knowledge of the geosciences. Professional training courses, innovative and award-winning science education websites[6], as well as the directed activities of NCAR's education and outreach programs are further examples of how NSF's goal of integrating research and education is attained through NCAR activities.

Management and Oversight

- NSF Structure: NSF's Division of Atmospheric and Geospace Sciences (AGS), along with the Division of Acquisitions and Cooperative Support (DACS), provide oversight of NCAR and the cooperative agreement with the University Corporation for Atmospheric Research (UCAR) for NCAR's management. The cooperative agreement between UCAR and NSF encourages interactions between NCAR scientists and AGS staff and ensures close coordination between AGS and NCAR management. The agreement contains requirements necessary for AGS's oversight of the NCAR program and UCAR management activities that affect NCAR. These include a provision that UCAR submit an annual program plan for AGS approval that provides details on how resources will be used in that fiscal year. In addition, NCAR summarizes its past year's accomplishments in an annual scientific report. Annual strategic planning sessions between AGS, UCAR, and NCAR are held to ensure that scientific and facility priorities remain consistent with those of NSF.

[6] www.spark.ucar.edu

- External Structure: UCAR works in partnership with NSF and the university community to ensure the effective implementation of the strategic mission of NCAR to the benefit of the research community. In addition, other research sponsors, such as the National Aeronautics and Space Administration (NASA), NOAA, the Department of Energy (DOE), the Department of Defense (DOD), the Environmental Protection Agency (EPA), and the FAA support research collaboration wherever it enhances NCAR's basic NSF-supported research goals or facilities missions.

- Reviews: A Committee of Visitors (COVs) is conducted every three years; the most recent was FY 2012. A Business Systems Review (BSR) was conducted in FY 2011; the next will take place in FY 2016. No significant issues were raised in either review.

Renewal/Recompetition/Termination

The award to manage NCAR was last re-competed in FY 2007, and the new award began on October 1, 2008. During 2011, AGS conducted a series of six site visits to NCAR, with a total of 38 external reviewers, to examine NCAR's science programs and management. Each site visit team reported that NCAR continues to serve a critical role in the ongoing success of the atmospheric and related sciences communities and that the Center and staff remain at the forefront of their respective fields.

Based on the strong endorsement of reviewers and UCAR's conduct during the award period, AGS informed the National Science Board in May 2012 that UCAR would be permitted to submit a proposal to renew the award for a further five years, after which it would be competed again. UCAR was advised that its proposal should follow the guidance in the 2007 solicitation. The proposal was received in September 2012, and the review process began in October. Final action is anticipated by May 2013.

NATIONAL OPTICAL ASTRONOMY OBSERVATORY

$25,500,000
$0 / 0.0%

National Optical Astronomy Observatory
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$26.25	$25.50	$25.50	-	-

Totals may not add due to rounding.

The National Optical Astronomy Observatory (NOAO) was established in 1982 by uniting operations of the Kitt Peak National Observatory (KPNO) in Arizona and the Cerro Tololo Inter-American Observatory (CTIO) in Chile. NOAO is a Federally Funded Research and Development Center (FFRDC) for research in ground-based, nighttime, optical, and infrared (OIR) astronomy. NOAO is the gateway for the U.S. astronomical community to the International Gemini Observatory and to other U.S. OIR telescopes that offer public access. For all of these telescopes, NOAO peer-review telescope allocation committees provide competitive merit-based telescope time allocation, but no financial support. NOAO manages national community involvement in the development of potential future infrastructure projects and is closely involved in the design, development, and potential construction and operations of the Large Synoptic Survey Telescope (LSST). LSST was the highest priority recommendation for "New Ground-Based Activities – Large Projects" of the 2010 Decadal Survey conducted by the National Research Council's Astronomy and Astrophysics Survey Committee, and is requested for an FY 2014 construction start funded through the Major Research Equipment and Facilities Construction (MREFC) account. Presently NOAO is expected to be responsible for the telescope and site during the construction phase of the LSST project.

NOAO telescopes are open to all astronomers regardless of institutional affiliation on the basis of peer-reviewed observing proposals. They serve nearly 1,200 U.S. and foreign scientists annually. In FY 2012, 72 thesis students and an additional 80 non-thesis graduate students from U.S. institutions used NOAO telescopes for their research. In FY 2012 NOAO employed 356 personnel in Arizona and Chile, including 46 support scientists and 13 postdoctoral fellows.

The NSF Division of Astronomical Sciences in the NSF Directorate for Mathematical and Physical Sciences (MPS/AST) carried out a community-based review of its entire portfolio during FY 2012. The recommendations from the Portfolio Review Committee's report included divesting NSF support from three telescopes located on Kitt Peak: the 4-meter Mayall telescope, the 2.1-meter telescope, and the 3.5-meter WIYN (Wisconsin-Indiana-Yale-NOAO) telescope. The first two of these telescopes are fully available (except for closure due to weather or maintenance) for public access. The WIYN telescope is owned and operated by a collaboration among three universities (University of Wisconsin, Indiana University, and Yale University) and NOAO. NOAO's share of the WIYN telescope time for public access is 40 percent. At this time, NSF is considering the Portfolio Review Committee's recommendations, and no decisions have been made. The impact of the Portfolio Review on long-term funding will be presented in future Requests.

Total Obligations for NOAO

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
NOAO-Operations	$20.00	$19.80	$20.00	$21.00	$21.00	$21.00	$21.00	$21.00
NOAO-Development	4.10	3.90	3.40	4.00	4.00	4.00	4.00	4.00
NOAO-Research and Education	0.65	0.60	0.60	0.50	0.50	0.50	0.50	0.50
LSST[2]	1.50	1.20	1.50	-	-	-	-	-
Total, NOAO	**$26.25**	**$25.50**	**$25.50**	**$25.50**	**$25.50**	**$25.50**	**$25.50**	**$25.50**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in FY 2014.

[2] Outyear projections for LSST assume an MREFC construction start late in FY 2014.

Partnerships and Other Funding Sources: The managing organization for NOAO is the Association of Universities for Research in Astronomy, Inc., (AURA), which is comprised of thirty-nine U.S. member institutions and seven international affiliate members. A key ongoing NOAO partnership has been the preparation of the 4-meter CTIO Blanco telescope for the Dark Energy Survey, which is beginning in early 2013. This survey is a collaboration with the Department of Energy (DOE) to conduct a five-year survey of the southern sky to investigate the nature of dark energy. In addition, DOE has recently issued a "Critical-Decision-0" statement of need for a dark-energy spectroscopic survey on a 4-meter optical telescope; the NOAO Mayall telescope on Kitt Peak and the Blanco telescope on Cerro Tololo both are candidate platforms for such a survey. Along with the WIYN telescope mentioned above, NOAO is a partner in the 4.1-meter SOAR (Southern Astrophysical Research) telescope at CTIO. SOAR partners include the University of North Carolina, Chapel Hill; Michigan State University; and the Ministério da Ciência, Tecnologia, e Inoviçao of Brasil. Finally, in the context of the aforementioned Portfolio Review report, NOAO issued a call for expressions of interest in possible partnerships for funding of its large telescopes on Kitt Peak; the replies to this call are being evaluated by NOAO and NSF.

A large number of U.S. universities support their own astronomical facilities at KPNO and CTIO with reimbursed services provided by NOAO. Development of new telescopes, instrumentation, and sensor techniques is done in partnership with universities and with industry through subawards to aerospace, optical fabrication, and information technology companies. NOAO leverages NSF support with funding from other federal agencies and non-federal sources. In FY 2012, NOAO received $10.31 million for reimbursed services from partnerships and tenant observatory support, from the Kitt Peak Visitors' Center, and from grants from other federal agencies.

Education and Public Outreach: NOAO supports U.S. education goals by promoting public understanding and support of science and by providing education and training at all levels. Over 200 U.S. and foreign graduate students observe on NOAO telescopes yearly and a significant fraction of the observations contribute to PhD dissertations. The observatories introduce undergraduate students to scientific research by providing stimulating environments for basic astronomical research and related technologies through NSF's Research Experiences for Undergraduate Students (REU) program. NOAO has a diverse education program, visitor centers, and a web-based information portal at www.noao.edu.

NOAO-Operations: $20.0 million: NOAO-Operations support covers the operation of facilities at KPNO, CTIO, and the headquarters, offices, laboratories, and workshops in Tucson, Arizona and La Serena, Chile.

NOAO-Development: $3.40 million: This supports the modernization of telescopes as well as the development of new instrumentation for telescopes at KPNO and CTIO. The 2006 NSF Senior Review recommended that the instrumentation at KPNO and CTIO urgently be modernized. In FY 2010 NOAO began a multi-year effort to introduce new capabilities to the U.S. community. Three new instruments are under development – two are expected to be put on telescopes in 2013 and the third will be available in 2015.

NOAO-Research and Education: $600,000: NOAO links the research conducted at its facilities to education of the public through its education and public outreach office in Tucson.

LSST: $1.50 million: These funds support design, development, and planning activities for future construction of the LSST telescope, site, and enclosure in Chile, as well as for engaging the astronomical community in developing science missions for research using the LSST data sets.

Management and Oversight

- NSF Structure: An NSF program director in the Division of Astronomical Sciences (AST) provides continuing oversight, including consultation with an NSF Program Review Panel that meets twice a year. The program director reviews detailed annual program plans, annual long range plans, quarterly technical and financial reports, and annual reports submitted by NOAO, and attends AURA governance committee meetings. Governance committees are formed from the national astronomical community and provide additional windows into community priorities and concerns. The AST program manager works closely with other offices at NSF, particularly the Office of General Counsel, and the Division of Acquisition and Cooperative Support and the Large Facilities Office in the Office of Budget, Finance, and Award Management.
- External Structure: AURA is the managing organization for NOAO. The NOAO director reports to the president of AURA, who is the principal investigator on the FY 2009 NSF cooperative agreement. AURA receives management advice from an observatory council composed of members of its scientific and management communities. NOAO employs separate visiting and users committees for the purposes of self-evaluation and prioritization. The visiting committees, composed of nationally prominent individuals in science, management, and broadening participation, review for AURA all aspects of the management and operations of the observatories. User committees, composed of scientists with considerable experience with the observatories, review for the NOAO Director all aspects of user experiences at the observatory.
- Reviews: In addition to reviews held mid-way through all cooperative agreements, NSF conducts both periodic and ad hoc external reviews of AURA management. A Business Systems Review (BSR) is underway during FY 2013. A mid-term management review is being planned.

Renewal/Recompetition/Termination

A management review of AURA's performance was carried out in August 2006. In response to the review, the National Science Board extended the previous cooperative agreement with AURA for eighteen months, through September 30, 2009. A proposal for renewal of the cooperative agreement was received from AURA in December 2007 and underwent review in 2008. The National Science Board authorized a new cooperative agreement with AURA for the management and operation of NOAO for the period October 1, 2009, through March 31, 2014. AST plans to extend the current cooperative agreement through FY 2015 to allow for the possible implementation of Portfolio Review recommendations that could significantly alter NOAO's operations and hence the scope of the work for the managing organization. A solicitation is being developed and will be promulgated in late 2013 for the management of NOAO under a new cooperative agreement to begin October 1, 2015.

NATIONAL RADIO ASTRONOMY OBSERVATORY

$77,410,000
+$5,660,000 / 7.9%

National Radio Astronomy Observatory
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change over FY 2012 Enacted Amount	Percent
$71.75	$71.75	$77.41	$5.66	7.9%

Totals may not add due to rounding.

The National Radio Astronomy Observatory (NRAO) provides state-of-the-art radio telescope facilities for scientific users. NRAO conceives, designs, builds, operates, and maintains radio telescopes used by scientists from around the world to study virtually all types of astronomical objects known, from planets and comets in our own Solar System to quasars and galaxies billions of light-years away.

As a Federally Funded Research and Development Center (FFRDC), NRAO operates major radio telescopes in Green Bank, West Virginia; near Socorro, New Mexico; and at ten telescope array sites spanning the U.S. from the Virgin Islands to Hawaii. Headquartered in Charlottesville, Virginia, NRAO is the North American (N/A) implementing organization for the international Atacama Large Millimeter/submillimeter Array (ALMA) project. These federally funded, ground-based observing facilities for radio astronomy are available to any qualified astronomer, regardless of affiliation or nationality, on the basis of scientific peer-reviewed proposals, and annually serve over 1,500 users worldwide. The Observatory allocates telescope time on the basis of merit and provides some financial support to students. NSF does not provide individual investigator awards targeted specifically for use of NRAO facilities. Many users are supported through NSF or NASA grants to pursue scientific programs that require use of the facilities.

Including the ALMA operations staff located at NRAO, Observatory staff consists of 472 FTEs in the operations and maintenance components of the Observatory: 84 in Observatory Science Operations, 272 in Observatory Telescope Operations, 30 in Observatory Development Programs, 62 in Observatory Administrative Services, and 24 in the Director's Office.

The Division of Astronomical Sciences (AST) has conducted a community-based review of its entire portfolio, to allow implementation of a balanced program in budget scenarios more realistic than the scenario assumed by the National Research Council's decadal survey in astronomy and astrophysics, completed in 2010. The Portfolio Review Committee report was delivered in FY 2012, which gave very high priority ranking to two NRAO telescopes, ALMA and the Karl G. Jansky Very Large Array (VLA). The Robert C. Byrd Green Bank Telescope (GBT) and the Very Long Baseline Array (VLBA) were recommended for divestment from the AST budget because of less compelling mapping onto the science questions of the 2010 decadal survey. NSF is considering the findings and recommendations from this review, which may inform future budget allocation and planning activities.

The Atacama Large Millimeter/submillimeter Array (ALMA) will complete construction in FY 2013 and has begun science operations. ALMA, an international partnership between North America, Europe and East Asia, provides orders-of-magnitude improvement in observing sensitivity and image quality over existing facilities. *Credit: NRAO/AUI*

Total Obligations for NRAO

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	ESTIMATES[1] FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Operations and Maintenance	$43.14	$43.14	$41.00	$41.00	$41.00	$41.00	$41.00	$41.00
Observatory Management	*6.03*	*6.03*	*5.73*	*5.73*	*5.73*	*5.73*	*5.73*	*5.73*
Observatory Operations	*31.77*	*31.77*	*30.20*	*30.20*	*30.20*	*30.20*	*30.20*	*30.20*
Science, Acad. Affairs, EPO	*3.62*	*3.62*	*3.44*	*3.44*	*3.44*	*3.44*	*3.44*	*3.44*
Central Development Lab	*1.72*	*1.72*	*1.63*	*1.63*	*1.63*	*1.63*	*1.63*	*1.63*
ALMA Operations	28.61	28.61	36.41	39.17	39.17	39.17	39.17	39.17
Total, NRAO	**$71.75**	**$71.75**	**$77.41**	**$80.17**	**$80.17**	**$80.17**	**$80.17**	**$80.17**

Totals may not add due to rounding.

[1] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in September 2015.

Increased funding in FY 2014 supports the planned ramp up to full ALMA operations. Funding for the implementation of the VLA expansion project concluded in FY 2011.

Partnerships and Other Funding Sources: NRAO supplements Division of Astronomical Sciences (AST) support with funding provided by other NSF sources, other federal agencies, and non-federal sources. In FY 2012, NRAO received approximately $1.10 million from non-AST sources at NSF, $1.30 million from other federal agencies, and $530,000 from U.S. universities, foreign scientific and technical institutes, and other non-federal and industrial sources. The development of new telescopes, instrumentation, and sensor techniques is conducted in partnership with relevant industries through competitive sub-awards to various large and small aerospace companies, radio antenna manufacturing firms, and specialized electronics and computer hardware and software companies.

Education and Public Outreach: NRAO supports a comprehensive outreach program that makes information about radio astronomy available to the public (www.nrao.edu/index.php/learn). With over 150 students involved per year, NRAO facilities are used by graduate students carrying out dissertation research and work experience programs and by undergraduate students participating in the Research Experiences for Undergraduates (REU) program. NRAO sites also support visitor and education centers and conduct active educational and public outreach programs. The Green Bank Science Center and the visitor center at the VLA together attract over 60,000 public visitors each year.

Observatory Management, $5.73 million: This includes the director's office, administrative services, and the New Initiatives Office.

Observatory Operations, $30.20 million: This includes support for operating facilities at Green Bank, West Virginia, in New Mexico, and the computer and information services that support the facilities.

Science & Academic Affairs and EPO, $3.44 million: This area includes staff research, science training and education, science centers, the library, science community outreach, and news and public information.

Central Development Laboratory (CDL), $1.63 million: The CDL is developing next generation electronics and detectors for radio astronomy, making fundamental contributions to materials science, the physics of quantum detectors, electromagnetics, photonics, and radio propagation.

ALMA Operations, $36.41 million: NRAO is engaged in construction of the international ALMA Observatory, which in FY 2013 is in the final stages of construction, funded through the Major Research Equipment and Facilities Construction (MREFC) account. Early operations funding for ALMA began in FY 2005 and ramps up sharply from FY 2008 to FY 2015. A funding profile through FY 2015 was authorized by the National Science Board in February 2011.

As part of ALMA Operations, in 2006 NRAO created the North American ALMA Science Center (NAASC) to support the broad user community in fully realizing the scientific capabilities of ALMA. NAASC is increasing its activity in conjunction with the ramp up in ALMA operations. NAASC serves two key functions: (1) supporting basic ALMA operations as an ALMA Regional Center (ARC), providing day-to-day support for ALMA operations carried out in Chile, and (2) providing easy access and strong support to the broad astronomical community that will be using ALMA. NAASC organizes summer schools, workshops, and courses in techniques of millimeter and submillimeter astronomy.

Management and Oversight

- NSF Structure: Continuing oversight and assessment is carried out for NRAO and ALMA by dedicated AST program officers and in consultation with community representatives making use of detailed annual program plans, long-range plans, quarterly technical and financial reports, and annual reports submitted to NSF, as well as by the attendance of AST program officers and AST management at ALMA governance board and governance committee meetings of the managing organization, Associated Universities, Inc. (AUI). To address issues as they arise, AST works closely with other NSF offices, such as the Office of General Counsel, the Office of International Science and Engineering, the Division of Acquisition and Cooperative Support, and the Large Facilities Office in the Office of Budget, Finance, and Award Management.
- External Structure: Management is through a cooperative agreement with AUI. AUI manages the observatory through its own community-based oversight and users' committees. The NRAO director reports to the president of AUI. Oversight of the international ALMA project is vested in the ALMA Board, whose membership includes an NSF member; coordination and management of the merged international efforts is the responsibility of the Joint ALMA Observatory (JAO) whose staff includes an ALMA director. An international ALMA Management Advisory Committee (AMAC) advises the ALMA Board.
- Reviews: NSF conducts annual reviews of the NRAO Program Operating Plan, the Long Range Plan, ALMA construction and operations, and the AUI Management Report. A Business Systems Review and mid-term Management Review were conducted in FY 2012.

Renewal/Recompetition/Termination

A management review of AUI's performance and plans was carried out in 2008. In response, the National Science Board authorized renewal of the cooperative agreement with AUI for the management and operation of NRAO for the period October 1, 2010 through September 30, 2015. Preparations are underway for a NRAO management and operations solicitation that will be promulgated in FY 2013 for a new cooperative agreement to begin October 1, 2015.

In response to guidance from the National Science Board, NSF has assessed separating the management and operation of NA ALMA from NRAO and finds that there would be significant detrimental cost, operational, and community impacts with no compensatory advantages in engendering competition. Therefore, NA ALMA will remain a part of NRAO, and the recompetition will treat them as a single entity. In addition, to sustain the scientific and operational synergies of NA ALMA and the VLA while increasing flexibility exploring cost-efficient operational models and sustainable partnerships for GBT and VLBA, NSF will separate GBT and VLBA from the upcoming competition. As noted above, further information on this recompetition will be available later this year.

OTHER FACILITIES FUNDING

Major Research Equipment and Facilities Construction Account Projects

The MREFC account supports the acquisition, construction, and commissioning of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. Projects supported by this account are intended to extend the boundaries of technology and open new avenues for discovery for the science and engineering community. Initial planning and design, and follow-on operations and maintenance costs of the facilities are provided through the Research and Related Activities (R&RA) and Education and Human Resources (EHR) accounts.

For information on projects funded through this account, refer to the MREFC chapter of this Budget Request.

Preconstruction Planning

Within the R&RA account, funds are provided for preconstruction studies for prospective large facility projects. This funding generally supports such activities as design, cost estimates, and other actions that prepare potential projects for oversight review, agency decisions milestones, and potential implementation.

NSF-WIDE INVESTMENTS

Major FY 2014 Investments:

STEM Education:

Other NSF-wide Activities:

NSTC Activities

CYBER-ENABLED MATERIALS, MANUFACTURING, AND SMART SYSTEMS (CEMMSS)

Overview

In response to the Administration's Materials Genome Initiative (MGI), Advanced Manufacturing Partnership, and the National Robotics Initiative (NRI), the Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS) framework aims to integrate a number of science and engineering activities across the Foundation – breakthrough materials, advanced manufacturing, robotics, and cyber-physical systems. Through deployment of new cyber-enabled paradigms, materials with unique properties and functionality will be discovered and developed more reliably and efficiently. Further, using advanced manufacturing strategies, new materials can be fashioned into artifacts and systems embedded with computational intelligence, thereby transforming today's static systems, processes, and edifices into adaptive, pervasive smart systems.

The smart systems of tomorrow and the materials from which they will be composed will vastly exceed those of today in terms of adaptability, autonomy, functionality, efficiency, reliability, safety, usability, recoverability, and recyclability. These advances have the potential to accelerate scientific discoveries to address key national and societal challenges critical to U.S. security and competitiveness.

Total Funding for CEMMSS
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
$144.32	**$141.65**	**$300.42**

Goals

Goal 1: Science and Engineering

Establish a scientific basis, a codified knowledge base, and shared approach that advance cyber- and data-enabled principles for discovery, design, development, and production of new classes of advanced materials. Develop and deploy advanced manufacturing methods to produce artifacts and systems with superior functionality, including embedded intelligence to make them smart, responsive, and adaptive. Develop the core science needed to engineer systems that build from and depend upon the synergy of computational and physical components in real-world contexts. The goal is integrated programs across CEMMSS research areas, for example, in cyber-manufacturing, materials informatics, and smart systems.

Goal 2: Education, Workforce Development, and Community Building

Create integrated research communities from incongruent disciplines. Educate a cadre of high caliber disciplinary and interdisciplinary researchers with a wide range of skills, including skills in the use of cyber- and data-enabled approaches to science and engineering. Engage the support of related research and education programs at the National Science Foundation (NSF), such as Engineering Research Centers; Materials Research Science and Engineering Centers; and Science, Technology, Education, and Mathematics (STEM) education programs. Partner with other government agencies, international funding organizations, and industry. The goal is to build a thriving CEMMSS ecosystem.

Goal 3: Research Infrastructure Development

Develop the critical research infrastructure – cyber and experimental – to be used to discover, develop, test, refine, and validate the advanced materials, design, manufacturing, and development methods as well

as to enable the transition to practice of smart systems from the lab to the field. In the short-term, the goal is cyberinfrastructure for advanced manufacturing, cyber-physical systems, robotics, and materials. The longer-term goal is to stitch together disparate testbeds for explorations at the CEMMSS frontiers.

Approach

The CEMMSS framework of bringing together researchers focused on breakthrough materials, advanced manufacturing, robotics, and cyber-physical systems is expected to increase collaboration and communication among these research communities, leading to enhanced disciplinary and interdisciplinary research. These efforts will transform static systems, processes, and edifices into adaptive, pervasive smart systems with embedded computational intelligence that can sense, adapt, and react. Success in CEMMSS will drive transformations that address the pressing technological challenges facing the Nation, promoting U.S. economic competitiveness.

Programmatic

To generate new capabilities with meaningful impact, NSF is developing a portfolio that coordinates and synchronizes activities across four main research areas – breakthrough materials, advanced manufacturing, robotics, and cyber-physical systems – and encourages interdependencies and common research elements to surface and be exploited at each subsequent stage of the evolution of the program.

Organizational

CEMMSS leadership is shared across the relevant division directors in the Directorate for Computer and Information Science and Engineering (CISE), the Directorate for Engineering (ENG) and the Directorate for Mathematical and Physical Sciences (MPS). The CEMMSS coordination team is comprised of program directors from CISE, ENG, MPS, and the Directorate for Biological Sciences (BIO). This group is charged with developing CEMMSS activities and implementing the suite of activities over the next four years. The team will also work with internal and external program evaluation experts to help develop a set of metrics by which program progress can be evaluated over time.

Scope

Numerous CEMMSS interdisciplinary connections already exist at NSF. Many are pairwise and expanding, such as robotics and manufacturing; materials and manufacturing; cyber-physical systems and robotics; cyber-physical systems and manufacturing materials; and robotics and the biological sciences. NSF has sponsored and will continue to hold community-building workshops and will request white papers to contribute to the development and evolution of CEMMSS. The intention is to go beyond these two-way collaborations and drive research in new directions. This will be achieved through a combination of new solicitations and Dear Colleague Letters (DCLs). CEMMSS currently includes many interagency activities; new cross-agency partnerships are continuously being developed. Industry partnerships also are a key element in CEMMSS's success; industry and venture capital groups will be invited to workshops and principal investigator (PI) meetings. NSF also expects that international activities will become increasingly relevant over the period of time that CEMMSS is an NSF-wide investment area. CEMMSS presents a unique opportunity to accelerate integrative research and educational activities. The interaction of research ideas that is promoted by CEMMSS multiplies their impact across multiple research communities.

Investment Framework

CEMMSS Funding by Directorate
(Dollars in Millions)

Directorate	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$3.00	$3.00	$5.00
Computer and Information Science and Engineering	50.50	50.50	103.00
Engineering	56.00	56.00	126.42
Mathematical and Physical Sciences	34.82	32.15	66.00
Total	**$144.32**	**$141.65**	**$300.42**

Totals may not add due to rounding.

FY 2012 – FY 2013

Science and Engineering
In 2012, NSF jumpstarted CEMMSS's science and engineering activities through a suite of activities, including DCLs, solicitations, and Early-concept Grants for Exploratory Research (EAGER) projects. These activities promoted smart systems by focusing on advanced manufacturing, robotics, cyber-physical systems, scalable nanomanufacturing, and advanced materials.

In FY 2013, the program is emphasizing mid-scale team-based interdisciplinary research that will build the knowledge necessary to make progress in CEMMSS, including opportunities for transitioning discoveries into practice. Investments will continue to build pair-wise programmatic activities across CEMMSS focus areas to develop the next generation of robots, cyber-physical systems, cyber-manufacturing tools, and advanced materials. For example, pilot programs will further integrate materials science and engineering with processing, design, and manufacturing research, including Designing Materials to Revolutionize and Engineer the Future (DMREF), NSF's premier program in support of MGI involving CISE, MPS, and ENG.

Education, Workforce Development, and Community Building
To foster and accelerate the building of integrated research communities among various disciplines, in FY 2012, NSF held technical workshops, design sessions, focused meetings, and panels about advanced manufacturing, MGI, and cybersecurity for cyber-physical systems. An organizational meeting was held with representatives from academic and industrial organizations to discuss collaborative work in health applications of emerging robotics technologies. NSF also continued to support the cyber-physical systems (CPS) Virtual Organization. Among the awards given in FY 2012, NRI funded the use of robotics to facilitate and motivate STEM learning across the K16 continuum. In addition to co-chairing the National Science and Technology Council Subcommittee for MGI and the CPS Senior Steering Group (SSG), NSF participated in interagency award meetings to structure a balanced NRI portfolio across agencies. NSF has worked to enhance CPS cooperation with other agencies through the NITRD program and has developed memoranda of understanding (MOUs) with Department of Defense agencies related to MGI.

In FY 2013, the associated big data and cyberinfrastructure components necessary for making advances in CEMMSS will be identified. NSF will continue to co-chair and/or participate in interagency NSTC Subcommittees, SSGs, and working groups. Each focus area will develop curriculum and new education

programs. In the area of advanced manufacturing, a program is being started with industry to provide support for undergraduate laboratories to use existing cyber-manufacturing infrastructure in project work. NSF has developed an MOU for interagency cooperation in CPS with the Department of Transportation

Research Infrastructure Development

In FY 2012, there were initial pilot investments in testbeds and prototypes for cyber-enabled materials, manufacturing, and smart systems. The NRI solicitation funded the development of co-robot testbeds for technology testing, demonstration, and validation. Pilot investments at Purdue University were utilized to integrate the NSF-funded HubZero cyberinfrastructure with the Department of Commerce-led National Digital Engineering and Manufacturing Consortium. Purdue has now launched ManufacturingHub.org, and is using this cyberinfrastructure to link manufacturers to state-of-the-art computational modeling and simulation tools to solve real world manufacturing problems more accurately and rapidly.

In FY 2013, NSF will build upon successful pilots and expand development of cybermanufacturing assets and link academic and government-furnished tools to industry needs and opportunities. NSF is also encouraging the development of new, or the use of existing, testbeds to evaluate advances in cyber-physical systems. DMREF plans to build an integrated network of platforms that develop and utilize advanced computational and experimental tools to accelerate the discovery, synthesis, and deployment of new materials as well as their transfer to the manufacturing sector.

FY 2014 Request

To advance the science and engineering goal in FY 2014, the focus will be on evolving a comprehensive, integrated program across the focus areas to encourage new connections, discoveries, and/or emerging fields of science and engineering. Investments will be made in advanced manufacturing ($159.73 million), including investments in scalable nanomanufacturing ($10.0 million); cyber-physical systems ($50.0 million); core programs that integrate materials science and engineering with processing, design, and manufacturing research ($36.0 million); DMREF/MGI ($42.0 million); and NRI ($31.50 million). A workshop is planned to bring together communities engaged in materials research on sensors and detectors with those in manufacturing and cyber-physical systems. This will enhance community building and identify science and engineering challenges for this new community. In addition, CEMMSS will conduct the first round of challenges and contests.

To advance the Education, Workforce Development, and Community Building goal, NSF will continue its role in interagency Subcommittees, SSGs, and working groups and will develop further partnerships with other agencies as well as with the European Union. Interagency MGI activities specific to DMREF will include evaluation methods for cross-agency projects, development of a strategic plan for MGI, and program assessment and planning meetings for subsequent solicitations. NSF will also expand its use of MOUs to share cyber and experimental facilities operated by interagency partners. NSF will continue to support the CPS Virtual Organization, which is a broad community of interest for CPS researchers and developers. There will be workshops and PI meetings in all four focus areas. For example, CPS/CEMMSS education workshops will address graduate curricula, undergraduate courses, and strategies for the new NSF Research Traineeships (NRT) program in CPS. Also, a workshop that will bring together the DMREF community will invite industry as well as venture capitalists to attend part of the workshop.

The Research Infrastructure Development goal will involve all four focus areas. The CPS solicitation will include a focus area on testbeds and will seek partnerships among CISE, ENG, and interagency partners. DMREF will invest in data sharing, analysis, and visualization capabilities to enhance data-driven material discovery, assessment, and deployment. The challenges and contests conducted as part of NRI in FY 2014 will highlight cyberinfrastructure goals by making four awards based on the following criteria: current cost to manufacture, expectation of broader impact, innovation of integrated solution, and ease of

transition to other projects and/or industry.

FY 2015 – FY 2017

To further develop the foundational science and engineering basis of CEMMSS, NSF will develop several integrated programs in cyber-manufacturing, advanced materials, and smart systems. The long-term goal is to build a thriving ecosystem of cyber-enabled systems and advanced materials. There will be a continued focus on bringing communities together by engaging students, teachers, and educators in cybermanufacturing workshops as well as workshops on other topics that cross the four areas, and by participating in working groups. NSF will expand partnerships with other agencies, international organizations, and industry. These will be grounded in the collaborations NSF has already initiated. To date, NSF has worked with other agencies, such as the National Institute of Standards and Technology, the National Institutes of Health, the National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, and the Departments of Transportation and Defense, which are currently building and deploying smart systems of all kinds (e.g., underwater sensor networks; autonomous vehicles that swim, fly, crawl up walls; portable energy efficient storage devices, etc.). Combining mission agency investments with the basic science and engineering funded by NSF could have a significant impact on future U.S. critical infrastructure by embedding computational intelligence in the underlying systems and the materials from which they are composed.

Solicitations will emphasize a call for high impact solutions integrated across the CEMMSS disciplines, especially those that enhance manufacturing processes, and utilize advanced materials and computational intelligence. CEMMSS will also promote high-risk, breakthrough applications and testbeds in order to continue to push the boundaries of discovery in advanced materials, cybermanufacturing, and smart systems. In FY 2015, the CEMMSS coordination team will engage external contractors to conduct portfolio analysis, for example, identifying gaps and opportunities for further interagency, industry, and international cooperation in cyber-enabled materials, manufacturing, and smart systems.

Evaluation Framework

At the end of FY 2012, NSF contracted with the Science and Technology Policy Institute (STPI) to develop a framework for assessment and a set of program-specific metrics to be available for use within ten to eleven months.

STPI will assist with identifying metrics to measure progress across the three goals. Possible indicators include:

- For science and engineering – increases in the number and quality of breakthrough discoveries; the emergence of new fields; increasing agency, industry, and international partnerships; and increasing transition of discoveries into practice (i.e., patents, start-ups, new products);
- For education – increases in the number of smart systems courses offered, faculty recruited, and students graduating from academic programs; and
- For cyberinfrastructure – the development of de facto standards for interoperability; increased use of shared data analytic, simulation and modeling tools, and common software platforms; and the growth of computer-integrated and cyber-based manufacturing across the U.S.

The preliminary work to set out a baseline for these metrics will be carried out in FY 2013, allowing program evaluation to be deployed during FY 2014. Yearly program assessments will be carried out by the CEMMSS coordination team and presented to NSF senior management.

CYBERINFRASTRUCTURE FRAMEWORK FOR 21ST CENTURY SCIENCE, ENGINEERING, AND EDUCATION (CIF21)

Overview

The Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21) investment promises to accelerate and transform the processes and outcomes of scientific discovery and innovation by providing advanced cyberinfrastructure that enables new functional capabilities across all disciplines in computational and data-enabled science and engineering (CDS&E).

Future science, engineering, and education endeavors will be transformed by a comprehensive and scalable cyberinfrastructure that bridges diverse scientific communities and brings theoretical, computational, experimental, and observational approaches together. Large volumes of research data are being generated by scientific instruments, observing systems, surveys, mobile and embedded systems, as well as by publications, experiments, simulations, evaluations, and analyses. In addition, scientists using thousands of distributed scientific instruments, such as gene sequencers and sensors, are generating many more small data archives – creating the long-tail of science – that today generate heterogeneous data sets at an unprecedented rate. CIF21 is a portfolio of activities to provide integrated cyber resources that will enable multidisciplinary research opportunities in all areas of science and engineering. It will leverage ongoing cyberinfrastructure investments across NSF by coordinating and deploying common approaches and components to manage data, provide computational support, and develop new multidisciplinary research communities.

Total Funding for CIF21

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
$91.23	**$78.00**	**$155.47**

Goals

The goal of CIF21 is to accelerate the deployment and use of advanced cyberinfrastructure facilities and capabilities to support all areas of science, engineering, and education. CIF21 has three primary components: 1) establishment of a national data infrastructure; 2) development of new computational and data-intensive capabilities; and 3) community building and workforce development.

Approach

The overarching vision of CIF21 is to catalyze new thinking, paradigms, and practices in science and engineering by fostering a pervasive cyberinfrastructure that enables research and deployment at unprecedented scales, complexity, resolution, and accuracy by integrating and coordinating computation, data, and experiments in novel ways, nationally and internationally.

Organizational. The CIF21 organizational structure employs four interrelated groups to ensure that CIF21 continues to build upon NSF's history of providing leadership in the design, development, and use of the cyberinfrastructure required to transform science, engineering, and education in the 21st century.

- The Directorate for Computer and Information Science and Engineering (CISE), in particular the Division of Advanced Cyberinfrastructure (ACI) (formerly the Office of Cyberinfrastructure), provides leadership for CIF21 activities, including developing coordinated CIF21 programs and

solicitations and identifying common approaches for a scalable, comprehensive cyberinfrastructure.

- The CIF21 Steering Committee of assistant directors and office heads provides oversight and advice on strategic directions and programs for CIF21.
- The CIF21 Cyberinfrastructure Leadership Group (CLG) coordinates and manages CIF21 programs across NSF, including developing solicitation guidance for common CIF21 programs, coordinating common CIF21 activities, developing and maintaining an investment roadmap, and providing planning and budgeting for CIF21.
- The NSF Advisory Committee on Cyberinfrastructure (ACCI) reviews cyberinfrastructure activities and programs across all of NSF, and provides advice and strategic feedback on NSF plans and existing efforts.

Scope. To guide the approach of CIF21, the ACCI produced a set of six reports and recommendations for cyberinfrastructure.[1] These reports and recommendations have been critical in identifying new approaches and capabilities required to advance data,[2] computing infrastructure,[3] software,[4] and workforce development for CIF21. These reports, along with on-going focused workshops and events, help to further define and prioritize programs and activities within the CIF21 framework.

CIF21 uses a combination of solicitations, Dear Colleague Letters (DCL), programs, and focused workshops to fund the research, development, and deployment of cyberinfrastructure and related applications. Partnerships with industry are emphasized, especially as disruptive technologies change how a technology or approach should be used to support science. The ubiquity of cyberinfrastructure requires partnerships and joint collaborations with other federal agencies and international groups. Workshops, conferences, and focused IdeaLabs will be used to reach out to new communities of researchers and educators.

Investment Framework

CIF21 Funding by Directorate

(Dollars in Millions)

Directorate/Office	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$2.00	$2.00	$6.50
Computer and Information Science and Engineering	47.94	35.00	90.67
Engineering	3.70	5.00	12.00
Geosciences	4.49	8.00	16.50
Mathematical and Physical Sciences	27.60	11.50	22.30
Social, Behavioral, and Economic Sciences	5.50	5.50	7.50
International and Integrative Activities	-	11.00	-
Total	**$91.23**	**$78.00**	**$155.47**

Totals may not add due to rounding.

[1] NSF Advisory Committee for Cyberinfrastructure: www.nsf.gov/od/oci/taskforces/index.jsp
[2] A Vision and Strategy for Data in Science, Engineering and Education: www.nsf.gov/od/oci/cif21/DataVision2012.pdf
[3] Advanced Computing Infrastructure: Vision and Strategic Plan: www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf12051
[4] Software for Science and Engineering; www.nsf.gov/od/oci/taskforces/index.jsp

FY 2012 – FY 2013

Multiple CIF21 solicitations and programs involving Biological Sciences (BIO), Computer and Information Science and Engineering (CISE), Engineering (ENG), Geological Sciences (GEO), Mathematical and Physical Sciences (MPS), and Social, Behavioral, and Economic Sciences (SBE) were issued in FY 2012. These solicitations focused on data-enabled science, software development, community research networks, new computational infrastructure, and access and connections to facilities.

In FY 2013, investments in CIF21 expanded both the scope and activities across the Foundation to support science, engineering, and education, with continued consideration of the ACCI Task Force reports. The National Big Data Research and Development Initiative remained a CIF21 centerpiece, focusing on the research and development of new capabilities for data-intensive and data-enabled science to create actionable information that leads to timely and more informed decisions. The NSF Big Data program invested in four key areas: innovation and new foundational research, cyberinfrastructure, community building, and education and workforce development. The science and engineering research and education scope of the Big Data solicitation expanded to include topics aligned with big data and new capabilities dedicated to creating large-scale, next-generation data resources and relevant analytic techniques to advance fundamental research in scientific fields supported by the SBE and Education and Human Resources (EHR) Directorates.

A unique virtual program in CDS&E was established by ACI, ENG, and MPS. It is rooted in the individual divisions and is also coordinated across directorates, responding to both disciplinary and cross-disciplinary needs.

CIF21 program activities fostered broadening of the cyberinfrastructure development and research communities in FY 2013. In particular, software programs and data activities expanded to include participation by new domains and included joint international software and data collaborations with the European Union, Australia, and China. Through the ACI-supported XSEDE (eXtreme Science and Engineering Discovery and Education) environment, new CIF21 research communities have access to advanced computational infrastructure, including two new significant computational resources that became operational in FY 2013: the University of Illinois at Urbana-Champaign Blue Waters project, and the Texas Advanced Computational Center's new Stampede project.

New research communities were also established to address multidisciplinary research challenges that are emerging as a result of new data and cyberinfrastructure capabilities. These include the EarthCube communities in the geosciences, and a new community effort to develop integrated data management infrastructure in the mathematical and physical sciences, which will create communities around grand challenge problems. The Building Community and Capacity solicitation supports the development of new research communities for SBE and EHR.

FY 2014 Request

In FY 2014, CIF21 will make the following investments:

- The National Data Infrastructure program will be expanded in scope to address issues associated with open access and will invest in one or two pilots to address management and use of multidisciplinary data.
- The Big Data solicitation will be expanded to include additional themes critical to the missions of NSF directorates; workshops will be convened to develop R&D pathways for the next five to ten years, including exploring partnerships and participation with more agencies and industry.
- CDS&E program activities will be expanded to include new efforts and approaches for simulation and modeling; new prototypes in specific domains will be developed with an emphasis upon collaboration across disciplines. Based on the response to FY 2013's consolidated solicitation, additional changes will be made to the program with a specific focus to scale CDS&E efforts.

- New data conceptualization and data pilot awards will be made in collaboration with additional directorates and offices through the Data Infrastructure Building Blocks (DIBBs) program and data coordination pilots in development in BIO and GEO. The data program will broaden the base and use of advanced computational services and capabilities across disciplines that have not used advanced cyberinfrastructure resources before; and it will explore new approaches to data-intensive computational resources, including a mix of clouds, data centers, and distributed computing systems.
- Conceptualization awards, along with early pilots, prototypes, and best practices approaches, will be made to several communities to develop data and software; to resolve governance issues; and develop requirements to support multidisciplinary communities.
- Additional community-building awards will focus on the development of new research communities, including next generation data resources and access.
- The CIF21 track within the NSF Research Traineeships (NRT) will address the need to educate and support the next generation of researchers able to address fundamental challenges in: 1) core techniques and technologies for advancing big data science and engineering; 2) analyzing and dealing with challenging CDS&E problems; and 3) researching, providing, and using cyberinfrastructure that makes cutting-edge CDS&E research possible in any and all disciplines.
- EarthCube will expand its support for the development of community-guided cyberinfrastructure to integrate data into a framework that will expedite the delivery of geoscience knowledge to the science and engineering enterprise.

FY 2015 – Beyond

To further accelerate scientific discovery and innovation in FY 2015 and beyond, it is essential to develop a national data infrastructure ecosystem that provides new capabilities and functionalities to support a broad spectrum of science, engineering, and education users and communities. These activities include provision of data access and data exchange; development of at-scale multi-disciplinary data pilots and prototypes; and continued development of new algorithms, tools, and software, as well as expanding both the scope and depth of new research communities and the future CDS&E workforce.

- National Data Infrastructure efforts will be expanded to include more participation and collaboration across all NSF directorates, with an emphasis on coordination and common approaches to leverage investments and ensure interoperability. The efforts will also include development of new partnerships with campuses, other federal agencies, and international partners.
- Based on portfolio analyses, cyberinfrastructure programs and activities will be restructured to more fully support long-term data and computational needs for research and education, including open access, curation, preservation, and development of expertise to meet data-intensive science across all disciplines.
- Foundational research efforts will be expanded to include additional analysis and discovery tools, software and computational capabilities, including new domains and research communities. One focus will be on the transition of data analysis tools into practice, especially those that have applicability across multiple domains and are based on analyses of the Big Data and National Data Infrastructure portfolios and the results achieved to date. Another focus will be on new computational approaches for science that bridge across multiple domains, especially supporting long-tail science and users that have not been able to effectively leverage CDS&E resources. This will also include broadening and expanding the base and diversity of users (e.g., faculty, students, and the public) to take advantage of new capabilities in data and computation.
- Additional prototype and proof-of-concept approaches for CDS&E will be developed; involvement from other federal agencies, such as the Department of Energy, the National Institutes of Health, the National Aeronautics and Space Administration, and the U.S. Geological Survey will be pursued. Based on continued community input from all scientific domains and cyberinfrastructure communities, solicitations and programs will be revised and updated to support and develop new research communities, including effective use of new technologies, and the rapidly developing

national data infrastructure.

- The CIF21 track in NRT will be expanded to support the education of the next generation of researchers able to address fundamental challenges in advancing big data science and engineering.
- EarthCube will continue its support for the development of community-guided cyberinfrastructure to integrate data into a framework that will expedite the delivery of geoscience knowledge to the science and engineering enterprise.

Evaluation Framework

NSF will deploy a variety of tools to evaluate the scientific and educational impact and progress of the various CIF21 programs. The CIF21 Steering Committee and the CIF21 Leadership Group will consider a matrix of assessment methods and measures, including incorporating input and guidance from the NSF Advisory Committee on Cyberinfrastructure. In the short-term, these groups will conduct portfolio analyses and identify metrics. In the long-term, NSF will engage an external organization to conduct an assessment of CIF21 research, infrastructure, and education investments and outcomes.

INTEGRATED NSF SUPPORT PROMOTING INTERDISCIPLINARY RESEARCH AND EDUCATION (INSPIRE)

Overview

INSPIRE was established to address some of the most complicated and pressing scientific problems that lie at the intersections of traditional disciplines and to advance the NSF's strategic goal of *Transform the Frontiers*[1] and Performance Goal T-1: *Make investments that lead to emerging new fields of science and engineering and shifts in existing fields.* INSPIRE will strengthen NSF's support of interdisciplinary, potentially transformative research by complementing existing efforts with a suite of highly innovative Foundation-wide activities and funding opportunities. It responds to issues raised in a variety of external and internal publications, including a National Academies report[2] that identified barriers to interdisciplinary research (IDR), documents relating to the America COMPETES Reauthorization Act of 2010, the report of the NSF Facilitating Transformative and Interdisciplinary Research (FacTIR) working group,[3] and to perceptions in the research community that NSF does not always provide good opportunities for comprehensive review and support of unsolicited IDR proposals that cross traditional boundaries.

Total Funding for INSPIRE
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
$29.10	**$20.35**	**$63.00**

Goals

Goal 1: NSF program officers will have the necessary tools and management support to empower cross-cutting collaboration and risk-taking in developing and managing their awards portfolio.

Goal 2: Researchers will submit and NSF will support a greater proportion of unusually novel, creative interdisciplinary proposals.

Approach

Approach 1: Toward Goal 1, INSPIRE seeks to empower program officers to overcome a variety of factors that create pressure toward funding of safe, conventional, disciplinary choices. INSPIRE provides financial incentives through co-funding and establishes an expectation that NSF management will promote a bolder interdisciplinary and potentially transformative vision. INSPIRE identifies changes to NSF systems and training practices to enable and facilitate interdisciplinary activities.

Approach 2: Toward Goal 2, while existing NSF programs support potentially transformative IDR through the agency's highly regarded merit review process, INSPIRE seeks to increase NSF's support of bold, high-risk interdisciplinary projects that transcend typical programmatic scope, through novel funding and merit review mechanisms. These mechanisms are intended to increase the community's submissions of such proposals and will provide additional funding for their support. The value of a

[1] *Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years (FY) 2011-2016,* www.nsf.gov/news/strategicplan/index.jsp (2011).
[2] Committee on Facilitating Interdisciplinary Research, Committee on Science, Engineering, and Public Policy (2004). *Facilitating interdisciplinary research.* National Academies. Washington: National Academy Press.
[3] Final Report, *Facilitating Transformative and Interdisciplinary Research (FacTIR),* www.inside.nsf.gov/od/factir/FacTIRFinalReport_091221.pdf (2009).

portfolio of merit review mechanisms at agencies has been called out in a recent PCAST report.[4]

The desired outcome will be a portfolio of novel, high-impact IDR projects and a larger community of researchers that develops and submits such proposals to NSF.

- **Lifecycle of activity:** The ramp-up phase of INSPIRE is planned to cover the five-year period of FY 2012-2016. After that, the awards programs are planned to maintain a steady state at that level, subject to a thorough review of INSPIRE as discussed below. Evaluation activities for each INSPIRE goal will be ongoing.
- **Mechanisms to be used:** INSPIRE will address its two goals through two approaches. Goal 1 will be addressed primarily through Approach 1, which focuses on how NSF supports science that may fall outside of the scope of existing NSF programs. In particular, Approach 1 activities will encompass improvements in business practices, funding culture, training, and evaluation. Goal 2 will be addressed primarily through Approach 2, which supports the development of new funding opportunities and mechanisms that encourage the pursuit of novel, creative projects. New INSPIRE funding mechanisms will signal to research communities the priority that NSF places on interdisciplinary and potentially transformative research.
- **Leadership structure and governance:** The NSF Office of International and Integrative Activities (OIIA) serves as the organizational lead for INSPIRE. The INSPIRE Working Group (IWG) was established to guide INSPIRE's activities and is co-chaired by members from OIIA and the research directorates. All research directorates and programmatic offices are represented. The IWG reports to the NSF Director through NSF's Senior Management Roundtable.
- **Scope within NSF:** By design, the scope of INSPIRE is broad. For Approach 1 activities, all research directorates and offices are engaged. In addition, the Office of Information and Resource Management (OIRM) and the Office of Budget, Finance, and Award Management (BFA) are called on to address issues, e.g., business systems, performance plans, and novel forms of evaluation. For Approach 2, each directorate participates by providing co-funding to support research projects. Funding from the Integrative and International Activities (IIA) budget line also provides matching support. Program officers from every research directorate and office are engaged in communicating the goals of INSPIRE to their communities and facilitating cross-Foundational partnering in the review and support of individual proposals. INSPIRE proposals can be in any field of science and engineering supported by NSF.
- **External stakeholders:** For the external research community, INSPIRE will establish a new high-visibility awards program to support pioneering, potentially transformative IDR, to build IDR communities, to foster IDR career pathways, and to provide interdisciplinary training of the scientific workforce.

[4] President's Council of Advisors on Science and Technology, *Transformation and Opportunity: The Future of the U.S. Research Enterprise*, www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_future_research_enterprise_20121130.pdf (2012).

Investment Framework

INSPIRE Funding by Directorate

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$3.06	$2.00	$4.00
Computer and Information Science and Engineering	3.84	0.50	5.00
Education and Human Resources	0.64	-	2.00
Engineering	2.99	-	6.00
Geosciences	0.86	2.00	6.00
Mathematical and Physical Sciences	1.97	3.00	7.00
Social, Behavioral and Economic Sciences	3.32	0.50	1.00
International and Integrative Activities	12.43	12.35	32.00
Total	**$29.10**	**$20.35**	**$63.00**

Totals may not add due to rounding.

FY 2010-FY 2013

INSPIRE was announced in February 2011 in the NSF FY 2012 Budget Request to Congress, which included funding on the IIA budget line, to be augmented by co-funding from directorates and offices. The IWG was established in FY 2011, and program planning was initiated.

Under Approach 1, web-based inquiry and letter-of-intent forms were developed to enable principal investigators (PIs) to identify multiple NSF programs of interest and to enable program officers to more easily collaborate on evaluation of INSPIRE funding inquiries shared across programs; this became the pathway to eventual proposals and awards under Approach 2. Tracking of web-based inquiries was implemented, and text-based classification and clustering methods were developed to analyze the scientific content of the inquiries. In FY 2013 a statement of work is in progress for baseline data gathering and a feasibility study (see the Evaluation Framework section below). Review and improvement of internal practices, systems, and evaluation is ongoing.

Under Approach 2, the IWG designed the first INSPIRE award mechanism in FY 2012. It was initially called CREATIV, then simply referred to as INSPIRE, and now evolved into "INSPIRE Track 1" in FY 2013. INSPIRE Track 1 targets individuals and small investigator groups and is open to potentially transformative interdisciplinary ideas on any NSF-supported topic. Forty awards of up to $1.0 million each, generally internally reviewed, were made for almost $30.0 million in FY 2012.

In FY 2013, the program includes mid-scale "INSPIRE Track 2" awards of greater scope. These awards are chosen by a combination of internal and external review. Additionally, the program will make prestigious "Director's INSPIRE Awards" to interdisciplinary individual investigators nominated by program officers from Track 1 submissions and selected by the NSF Director after a rigorous multi-stage process.

FY 2014 Request

In Approach 1, the baseline data and feasibility study will inform an outcome evaluation and impact

assessment of the first two years of INSPIRE Track 1. The Track 1 outcome evaluation design will be modified as needed for INSPIRE Track 2 and Director's INSPIRE Awards, and an internal report will describe the modified design. In consultation with BFA and OIRM, NSF will begin a review to determine feasible improvements to eBusiness systems to facilitate IDR by allowing for interdisciplinary classification of proposals and awards, and will develop an implementation plan.

In Approach 2, the INSPIRE awards program will continue to ramp up to a total of $63.0 million (with approximate breakdowns of: INSPIRE Track 1, $23.0 million; INSPIRE Track 2, $35.0 million; and Director's INSPIRE Awards, $5.0 million).

FY 2015 – FY 2016

In Approach 1, the first two years of INSPIRE Track 2 and Director's INSPIRE Awards will be evaluated. In FY 2015, plan recommendations for changes to eBusiness systems will be implemented. These plans will continue in FY 2016.

In Approach 2, funding is planned to increase in FY 2015 and FY 2016, divided (approximately) between INSPIRE Track 1 (about 25% of funds), INSPIRE Track 2 (about 58% of funds), and Director's INSPIRE Awards (about 17% of funds).

Evaluation Framework

In FY 2011-2013, the primary tasks for evaluation were: (1) to develop a logic model for the INSPIRE funding mechanism, identify metrics, develop indices to estimate interdisciplinarity, and determine failure targets for high-risk research, and refresh the baseline of data that was collected in the 2007 proposer survey that was done as part of the IPAMM (Impact of Proposal and Award Management Mechanisms) study; [5] and (2) to initiate a feasibility study to do (a) a short-term portfolio analysis, (b) a medium-term collection of data on outcomes from awards funded by INSPIRE and non-INSPIRE mechanisms, and (c) a long-term study plan for a possible impact study.

In FY 2014 and beyond, baseline results from previous years' portfolio of awards will make it possible to determine whether the new mechanism is resulting in types of awards that were not being funded with previous mechanisms. Case studies and qualitative assessments of the review process for projects with promising results are expected to provide helpful information. Analyses of the results from program monitoring will determine whether these results suggest that a rigorous impact evaluation is feasible.

Consistent with the goal of providing model business practices at NSF, INSPIRE aims to pilot new streamlined review procedures. NSF has made the mitigation of additional internal and external workload implications a high priority in formulating INSPIRE activities. In FY 2013, Letters of Intent were introduced and will be reviewed to establish the appropriateness of full proposal invitations. In this way, approximately 90 percent of inquiries are expected to be resolved without the internal workload associated with a proposal submission. As was the case for the FY 2012 CREATIV opportunity (now evolved into INSPIRE Track 1), most of the authorized INSPIRE full proposals will be awarded through internal review, placing no burden on the external reviewer community. The larger INSPIRE Track 2 and prestigious individual Director's INSPIRE Awards will involve an element of external review through the use of a Blue Ribbon Panel. The success of these pilot processes will be studied on an ongoing basis, including surveys and topical analyses to determine the extent to which INSPIRE has better positioned NSF to enable interdisciplinary and potentially transformative research.

[5] www.nsf.gov/od/ipamm/ipamm_2007 survey.jsp

NSF INNOVATION CORPS (I-Corps)

Overview

The National Science Foundation (NSF) seeks to develop and nurture a national innovation ecosystem that builds upon fundamental research to guide the output of scientific research toward the development of technologies, products, and processes that benefit society.

In order to cultivate a national innovation ecosystem, NSF established the NSF Innovation Corps (I-Corps) in FY 2011. The NSF I-Corps' purpose is to support NSF-funded researchers who, with teams, are interested in transitioning their research out of the lab. I-Corps awards are based the on maturity of the effort (i.e. is the research ready to leave the lab), strength of the team, and anticipated market value. The teams selected for I-Corps awards will receive additional support – in the form of mentoring and funding – to accelerate innovation that can attract subsequent third-party funding.

The I-Corps Team grant gives the project team access to resources to help determine the readiness to commercialize technology developed by previously-funded or currently-funded NSF projects. The outcome of the I-Corps projects is threefold: 1) a clear go/no go decision regarding viability of products and services, 2) should the decision be to move the effort forward, a transition plan to do so, and 3) a technology demonstration for potential partners.

In FY 2014 NSF will support two additional I-Corps competitions – Sites and Nodes – to further build, utilize, and sustain a national innovation ecosystem that augments the development of technologies, products, and processes that benefit the Nation. I-Corps Sites are funded at academic institutions, having already existing innovation or entrepreneurial units, to enable them to nurture and support multiple, local teams to transition their ideas, devices, processes or other intellectual activities into the marketplace. The I-Corps Nodes will establish regional nodes to provide training to I-Corps Teams; develop tools and resources that will impact and expand the benefits of the entire I-Corps program within a two to three year timeframe, and identify and pursue longer-term (five+ years) research and development projects.

I-Corps has its genesis in many of the long standing innovation ecosystem programs. Most closely related to I-Corps is the Partnership for Innovations' (PFI) Accelerating Innovation Research (AIR) program in the Directorate for Engineering (ENG), started in FY 2011. The AIR program:

- encourages the translation of the numerous, technologically-promising, fundamental discoveries made by NSF researchers, while drawing upon and building the entrepreneurial spirit of the researchers and students; and
- fosters connections between existing NSF innovation research alliances.

Those existing NSF innovation research alliances include consortia such as Engineering Research Centers (ERC), Industry University Cooperative Research Centers (I/UCRC), Partnerships for Innovation (PFI), Science and Technology Centers (STC), Nanoscale Science and Engineering Centers (NSEC), Materials Research Science and Engineering Centers (MRSEC), and other institutions. Their complementary focus will spur the development of discoveries into innovative technologies through collaboration.

All of these activities are designed to strengthen the U.S. innovation ecosystem.

Total Funding for I-Corps

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
$6.77	**$7.50**	**$24.85**

Goals

The goals of the I-Corps program are:

- to build on NSF's investment in fundamental research;
- to offer academic researchers and students an opportunity to learn firsthand about technological innovation and entrepreneurship, and thereby fulfill the promise of their discoveries; and
- to prepare students for real-world experience through curricular enhancements, and provide them with opportunities to learn about and participate in the process of transforming scientific and engineering discoveries to meet societal needs.

Approach

NSF's core mission is to fund basic research in all fields of science and engineering. I-Corps supports this mission by helping to transform scientific output into technological innovation. I-Corps will leverage existing funding for programs like Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR), and will utilize additional support from private-sector and regional partners, including universities, industries, venture capitalists, and nonprofits. The partnership with universities will also contribute to the development of novel pedagogical tools.

The I-Corps program will also help create a new network that will strategically connect NSF-funded scientists and innovators to the national innovation ecosystem, including direct connections with mentors and potential future investors.

Leadership structure and governance: I-Corps is led by a core group of cognizant NSF program officers comprised of representatives from all directorates. The lead program officer is from ENG and is currently detailed to the Office of International and Integrative Activities. In addition to working closely with all subject matter experts within the directorates and offices, the lead program officer and the I-Corps team regularly meet with other federal agency representatives who have expressed interest in implementing similar programs within their own agency.

Scope within NSF: Principal Investigators (PIs) from every directorate, previously or currently supported for their research and education activities by NSF, are now benefiting from this educational and financial support through I-Corps.

External stakeholders: The primary focus of I-Corps is to help the 'traditional' academic research community better connect with experts in innovation and entrepreneurship, who can in turn help those in the academic community evaluate the commercial viability of their ideas. The program has been well received by future small business interests, the venture capital community, and large established enterprises interested in the intellectual property generated by NSF-supported researchers.

Investment Framework

I-Corps Funding by Directorate

(Dollars in Millions)

Directorate/Office	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$0.10	$0.50	$2.00
Computer and Information Science and Engineering	2.55	2.75	9.00
Education and Human Resources	0.36	-	0.30
Engineering	2.72	2.50	8.00
Geosciences	0.19	0.25	1.75
Mathematical and Physical Sciences	0.65	1.00	3.30
Social, Behavioral, and Economic Sciences	0.20	0.50	0.50
Total, NSF	**$6.77**	**$7.50**	**$24.85**

Totals may not add due to rounding.

FY 2011-FY 2013

The Innovation Corps program is a key element in a series of NSF-supported programs concentrating on the innovation ecosystem. As explained above, I-Corps has its genesis in a number of long-standing programs within the NSF that support the innovation ecosystem. In FY 2011 and FY 2012, investments in the inaugural year for I-Corps complemented these long-standing investments in programs, such as ERC, I/UCRC, PFI, STC, NSEC, and MRSEC. All of these programs are built on the backbone of support for core research, primarily to individual investigators, found in every directorate at NSF.

The I-Corps program is comprised of three elements, namely:

- Financial support to the team for the development of a prototype or a proof of concept;
- A specific structure for the I-Corps team, comprised of a principal investigator, an entrepreneurial lead, and an innovation/entrepreneurial mentor; and
- A strong educational component focusing on a hypothesis-driven approach to developing a methodology for evaluating both the technical merits and the marketability of the concept being proposed.

In FY 2012, the I-Corps program supported 124 Team awards, at $50,000 each, for up to six months. The projects were submitted to NSF in response to NSF solicitation 11-560 and were reviewed under NSF's standard Grants for Rapid Response Research (RAPID) mechanism.

The FY 2013 plan begins with the basic I-Corps structure developed in 2011-2012, the elements of which will not change substantively in 2013.

Today, a hypothesis-driven approach to evaluating technical and market viability is offered to all I-Corps teams. The I-Corps program delivers this immersive curriculum through regional I-Corps nodes, wherein the hypothesis driven innovation educational offerings for PIs and their teams are developed and provided by the universities involved in these nodes. This approach appears to be very successful and experience to date indicates it provides significant "value added" to the PI and their teams. In FY 2011, there was one I-Corps Node and in FY 2012, there were two. In FY 2013, NSF is offering opportunities to other universities to develop the curriculum, using the lessons learned in the execution of the I-Corps program

in FY 2011 and FY 2012 and to compete for more I-Corps Nodes.

Recognizing several universities have existing institutional infrastructure and mechanisms to support entrepreneurship within their campuses, NSF plans to launch I-Corps Sites. These sites will provide infrastructure, advice, resources, networking opportunities, training, and modest funding to enable formation of teams that can apply to the I-Corps program.

FY 2014 Request

- NSF will support up to 175 Innovation Team awards to fund NSF-funded researchers who will receive additional support - in the form of mentoring and funding - to accelerate innovation that can attract subsequent third-party funding. Each I-Corps grant provides the project team with resources to determine the readiness to commercialize technology developed by previously-funded or currently-funded NSF projects.

- NSF will support approximately 15 new Innovation Corps Sites in FY 2014. NSF provides up to $100,000 per year for three years to established academic institutions that already have existing innovation or entrepreneurial units to nurture and support multiple teams.

- NSF will support up to three new Innovation Corps Nodes in FY 2014. NSF provides $350,000 to $1.25 million per year for up to three years, depending upon the number of institutions involved, to establish regional nodes to provide training, tools, and resources for longer term (5+ years) projects that meet I-Corps program goals.

FY 2015 and beyond

NSF plans to achieve full-scale integration and dissemination of this program throughout the country, in the FY 2016 – FY 2017 timeframe utilizing a regional hub model. Full-scale implementation will likely include approximately 270 I-Corps Teams annually, a steady state of approximately 40 active I-Corps Sites and 10 regional I-Corps Nodes. The intention, from the outset, has been to solicit participation of universities throughout the country in offering these dynamic and powerful curricula for innovation. NSF also anticipates that, in the out years, several I-Corps recipients will apply to the SBIR program. NSF has already seen, in just the short time since launching this program in July of 2011, a significant number (24) of SBIR proposals from among the I-Corps cohorts resulting in 14 SBIR awards.

Evaluation Framework

I-Corps directly contributes to one of NSF's three Priority Goals for FY 2012 and FY 2013. Progress towards Priority Goals is assessed quarterly by agency senior management and reported on the website *Performance.gov*. The Priority Goal is to increase the number of entrepreneurs emerging from university laboratories. Specifically, the Priority Goal states that by September 30, 2013, 80 percent of teams participating in the Innovation Corps program will have tested the commercial viability of their product or service as evidenced by completion of the I-Corps immersion course, where teams make 'Go/No-Go' decisions about moving forward with commercialization.

Additional primary outcomes and milestones for the I-Corps program center on tangible measures that relate directly to the societal application realized from NSF's investments in basic research. For example, successful completion of the I-Corps grant would be expected to contribute to one or more of the following:

- New start-up businesses, 25-30 percent of I-Corps recipients;
- Licensing of patents or trademarks to third parties, 5 percent of recipients;
- SBIR proposals, 10-15 percent of recipients;
- A business plan suitable for review by third-party investors, 10-15 percent of recipients;

- Students prepared to be entrepreneurially competitive, 80 percent of recipients; and
- New curriculum development or improvement in current curricula focusing on entrepreneurship and innovation.

In time, the I-Corps program will have a positive impact on all these measures. Given the high visibility and high community interest in I-Corps, there is naturally going to be close examination almost immediately of the impact of this program on metrics such as these. It may take several years to gather data to see real and substantive outcomes on these measures, and for this reason, approaches to tracking short-term progress also needs to be implemented.

Therefore, initial evaluations will focus on input measures primarily, such as level of interest and number of proposals, and the ability to expand the mentor network. Outcome indicators such as start-ups, SBIR submissions, and third party investment will become critical as the program matures. The projected timeline is:

- FY 2012: The Foundation established a baseline of "Pre I-Corps" activities.
- FY 2013: The Foundation will initiate evaluations and initiate the I-Corps Nodes and I-Corps Sites programs.
- FY 2014: NSF will continue with regular evaluations of the previously described metrics and develop a chronological database that allows for more detailed historical analysis of program impact. The approach will be similar to that taken with the ERC and I/UCRC programs since 1985.

SCIENCE, ENGINEERING, AND EDUCATION FOR SUSTAINABILITY (SEES)

Overview

A sustainable world is one in which human needs are met equitably without harm to the environment, and without sacrificing the ability of future generations to meet their needs. Meeting this formidable challenge requires a substantial increase in our understanding of the integrated system of supply chains, society, the natural world, and the alterations humans bring to Earth. Given the pressing national and global need to realize a sustainable human future, the National Science Foundation (NSF) has developed a coordinated research portfolio spanning the entire range of scientific domains at NSF: the Science, Engineering, and Education for Sustainability (SEES) program.

SEES is a broad investment in the scientific underpinnings of sustainability at numerous temporal and spatial scales. Multiple perspectives and areas of expertise are required to increase our understanding of integrated systems of human society and the natural world. Thematic programs are aimed at building the knowledge base, while simultaneously encouraging interdisciplinary linkages, new partnerships, and education and outreach efforts.

Total Funding for SEES

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
$157.55	**$157.00**	**$222.79**

Goals

SEES has three main goals to advance sustainability:

1. Support interdisciplinary research and education that can facilitate the move towards global sustainability (Research and Education);
2. Build linkages among existing projects and partners and add new participants in the sustainability research enterprise (Collaboration); and
3. Develop a workforce trained in the interdisciplinary scholarship needed to understand and address the complex issues of sustainability (Workforce).

Approach

SEES is planned to be a decade-long effort across NSF to coordinate and grow research and education associated with the environment, energy, and sustainability. NSF's work under SEES is a blend of activities – formal solicitations and less formal announcements of interest (e.g., Dear Colleague Letters) that span across scientific disciplines and require input and oversight from multiple NSF directorates. Research in such areas as complex environmental and climate-system responses and pathways continue to be supported and emphasized across NSF and are supplemented by increased emphasis on activities focused on sustainable and clean energy technologies and engineering processes. NSF also works with other federal agencies and national and international stakeholder groups whose function and mission complement NSF's role to ensure that sustainability goals are carried forward.

The portfolio approach—as opposed to a large single program—facilitates communication, coordination, monitoring, and impact across the major investment areas and also across NSF, as SEES activities are complex and highly interdisciplinary. The SEES organizational structure includes:

- A senior leadership committee composed of assistant directors/office heads who provide long-term planning and overall guidance;

- A cross-agency implementation group composed of division directors and lead program directors, who develop consistent guidelines, provide internal and external communication, and shape evaluation plans; and
- Working groups of program directors, each overseen by assistant directors/office heads/division directors who are most relevant to the specific activity to manage programs or activities. When interagency or international partnerships, such as with the European Union (EU), have been established, then members of those entities may also be members of the working group to facilitate preparation of joint solicitations, establishment of Memoranda of Understanding (MOU)/Memorandum of Agreement (MOAs), or other arrangements for collaboration.

Investment Framework

SEES Funding by Directorate

(Dollars in Millions)

Directorate/Office	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$27.25	$27.25	$35.75
Computer and Information Science and Engineering	9.02	9.50	19.00
Education and Human Resources	6.00	6.00	0.50
Engineering	19.77	19.25	26.76
Geosciences	58.75	58.75	86.27
Mathematical and Physical Sciences	17.03	16.50	35.26
Social, Behavioral, and Economic Sciences	7.75	7.75	9.25
International and Integrative Activities	11.98	12.00	10.00
Total	**$157.55**	**$157.00**	**$222.79**

Totals may not add due to rounding.

FY 2010-FY 2013

In FY 2010, NSF developed SEES in response to numerous major community reports, including the August 2009 National Science Board (NSB) report *Building a Sustainable Energy Future*, which emphasized the need for a coordinated program. Initial efforts focused on developing and coordinating a suite of research and education programs at the intersection of climate and environment, with specific attention to human behavior. These solicitations (Dimensions of Biodiversity; Regional and Decadal Earth System Modeling; Ocean Acidification; Water Sustainability and Climate; and the Climate Change Education Program) resulted in awards totaling approximately $70 million.

In FY 2011, NSF maintained momentum in the SEES investment area by augmenting existing interdisciplinary programs (Coupled Natural and Human Systems (CNH), Research Coordination Networks (RCN)) and issuing a Dear Colleague Letter (DCL) that advanced the research and education activities proposed for 2011 and laid the groundwork for programs proposed for continuance and expansion in FY 2012.

In its FY 2012 Budget Request, NSF proposed to expand SEES through significant investments in programs related to energy and collaborative networks. During FY 2011, interdisciplinary working groups drafted and NSF released solicitations, although at reduced scope and funding levels, for four new activities consistent with the FY 2012 plans. These four new activities were: the NSF SEES Fellows

program, at the postdoctoral level; Sustainability Research Networks (SRN), that include existing and new centers of collaboration; Sustainable Energy Pathways (SEP) focused on integrated energy resource utilization; and a SEES-focused Partnerships for International Research and Education (PIRE) competition, which advances international networks.

In FY 2013, NSF initiated five SEES programs that complemented programs developed in FY 2012 and prior years. These investments are consistent with long term planning for the SEES investment area, and focus on environmental, technological, and societal resilience; dissemination of results, responsiveness to societal needs, and workforce development. These five programs are:

Two programs related to complex interactions in highly vulnerable areas:

- *Coastal SEES* is designed to enable place-based system-level understanding of coastal systems on a variety of spatial and temporal scales; yield outcomes with predictive value in coastal systems; and identify pathways by which outcomes could be used to enhance coastal sustainability.
- *Arctic (ArcSEES)* seeks both fundamental research that improves our ability to evaluate the sustainability of the Arctic human-environmental system as well as integrated efforts which will provide community-relevant sustainability pathways and engineering solutions.

Two programs related to environmental and societal resilience:

- *Hazards SEES* seeks to: (1) advance understanding of fundamental processes associated with specific natural hazards and technological hazards linked to natural phenomena, and their interactions; (2) better understand causes, interdependencies, impacts and cumulative effects of hazards on individuals, the natural and built environment, and society as a whole; and (3) improve capabilities for forecasting or predicting hazards, mitigating their effects, and enhancing capacity to respond to and recover from resultant disasters.
- *Sustainable Chemistry, Engineering and Materials (SusChEM)* will enable the basic science and engineering discoveries needed to utilize new (non-petroleum based) sources of important raw materials; replace rare, expensive and/or toxic chemicals and materials with earth abundant, inexpensive and benign alternatives; economically recycle chemicals and materials that cannot be replaced such as the rare earth elements; and devise environmentally friendly chemical reactions and processes that require less energy, water and organic solvents and generate less waste than current practice.

One program that will advance sustainability on many fronts:

- *Cyber SEES* aims to advance interdisciplinary research in which the science and engineering of sustainability are enabled by new advances in computing, and where computational innovation is grounded in the context of sustainability problems.

FY 2014 Request

In FY 2014, the SEES portfolio increases by $65.79 million, or 41.9 percent, over the FY 2012 Enacted level. Although no new programs will be added in FY 2014, existing programs established in FY 2011-FY 2013 will be augmented. In particular, the five programs initiated in FY 2013 will continue to grow. *Sustainable Chemistry* will support additional research on replacing and recycling earth abundant, single source critical elements; *Coastal SEES* will shift to full research proposals from incubator awards; and *Hazards SEES* will focus on the collaborative science of disaster mitigation, preparedness, and response. Also in FY 2014, *Dimensions of Biodiversity* and *Water Sustainability and Climate* will issue follow-on solicitations, per multi-year plans for these programs.

FY 2015 – FY 2019

Up to $3.0 million may be redirected for community planning for a new focus area in FY 2015 on sustainable and resilient food systems. This interdisciplinary challenge will focus on processes aimed at meeting current food needs without comprising the ability to meet needs of future generations; thriving in the face of challenges that affect the supply and/or distribution of food; and conserving, protecting, and regenerating the biogeophysical and human environments. Example activities include workshops, research coordination networks in the CNH track, supplements to existing SEES awards, and exploration of alternative programmatic means to advance fundamental research on this topic.

Long-term planning will continue to stress consolidation and coordination of existing activities; networking and dissemination of information from the rapidly growing SEES knowledge base to the scientific community, policy-makers, and the public; and the workforce development critical for producing the next generation of sustainability scientists and engineers.

At the conclusion of SEES, NSF, in collaboration with its partners across government, academia, and industry, expects to have made significant investment and progress towards a sustainable human future. With respect to the three over-arching SEES goals, NSF expects to see:

1. Goal 1, Research and Education: the sustainability science and engineering knowledge base available and accessible to scientists, decision-makers, and society at large;
2. Goal 2, Collaboration: the private sector will be able to more rapidly identify and deploy technologies and methods to address sustainability issues; and
3. Goal 3, Workforce: multidisciplinary approaches to sustainability education are common practice; the U.S. has a robust cadre of early career scientists and engineers to address sustainability issues.

Evaluation Framework

NSF employs a variety of tools to evaluate the scientific impact and progress of the various programs in the SEES portfolio. NSF is conducting select evaluation activities using internal resources, and will seek external support for evaluation activities that require specialized expertise.

Examples of planned evaluation activities for the SEES portfolio include:

Goal 1: Research and Education

Short-term: Text and data analysis of project reports, PI meeting reports, workshop and symposia reports to analyze the growth of sustainability research under the SEES portfolio.

Long-term: Historical review to determine the types of sustainability activities that were conducted and supported by NSF before and after establishment of the SEES portfolio.

Goal 2: Collaboration

Short-term: Portfolio analyses to identify collaborations, evidence of increased interdisciplinarity, and new tools and data sets developed under the SEES portfolio.

Long-term: Network analyses to identify collaborations, and evidence of increased interdisciplinarity.

Goal 3: Workforce

Short-term: Develop and baseline a monitoring system to collect metrics associated with the goals of SEES workforce development programs (such as SEES Fellows).

Long-term:

- Comparative analysis to examine whether education and career pathways of individuals involved in SEES projects differ from individuals in the same disciplines who did not participate in SEES projects; and
- Use monitoring data to determine if a formal impact evaluation for large investments is indicated.

Currently, many of these evaluation activities are underway or have been successfully completed, including:

- Developed evaluation questions and draft logic model for SEES portfolio and WSC program;
- Received feedback on evaluation strategy from NSF's Advisory Committee for Environmental Research and Education during fall 2012 committee meeting; and
- Multiple transdisciplinary workshops, including: WSC PI Meeting: Synthesis, Observations, Systems and Modeling (Nov 2011); Geothermal at the Environmental, Energy and Economy Nexus (Nov 2011); Natural and Engineered Carbon Sequestration (Oct 2011); Research in Landscape Sustainability: Earth-surface processes in the SEES context (Oct 2011); Research at Intersection of Marine/Hydrokinetic Energy and Aquatic Environment (Oct 2011); Sustainability Science: Enhancing Cooperation between Non-Governmental Organizations and Scientists (Oct 2011); Earth System Modeling PI Meeting (July 2012); and SusChEM Workshop (Jan 2012).

Because solicitations are a key component of the SEES portfolio, NSF program directors will be looking for success indicators such as representation of multiple disciplines in proposals, development of new international collaborations, and increased number of proposals received indicating engagement of the field with new interdisciplinary solicitations. NSF is particularly interested in measuring results in terms of new and productive connections made between researchers in a range of disciplines, and the development of new knowledge and concepts that advance the over-arching goal of a sustainable human future; and development of a workforce capable of meeting sustainability challenges. NSF senior leadership will take into consideration the findings and recommendations based on evaluation activities for purposes of outyear planning and budgeting. Evaluation findings may inform development of future SEES focus areas, as well as subject areas ready for a diminished emphasis and investment.

SECURE AND TRUSTWORTHY CYBERSPACE (SaTC)

Overview

The Secure and Trustworthy Cyberspace (SaTC) investment is aimed at building a cybersecure society and providing a strong competitive edge in the Nation's ability to produce high-quality digital systems and a well-trained workforce. Achieving a cybersecure society is a critical challenge in today's world, as corporations, agencies, national infrastructure, and individuals have been victims of cyber-attacks. These attacks exploit weaknesses in technical infrastructures and human behavior. Understanding the motivations and incentives of individuals and institutions, both as attackers and defenders, can aid in creating a more secure and trustworthy cyberspace. Addressing this problem requires multi-disciplinary expertise in computational, statistical, mathematical, economic, and computer sciences, and ultimately the transition of new concepts and technologies to practice.

Fundamental research in algorithms, models, probability theory, reliability, statistical theory and analysis, cryptanalysis, system structures, and secure computing is needed to stay ahead of new threats enabled by new technologies. The increasing power and ubiquity of computers implies that in the next era of computing many existing algorithms used to secure transmissions will no longer be robust or adequate. Research is needed in market mechanisms that can align incentives, hedge risks, and reduce the frequency and severity of attacks, and research that provides a deeper understanding of the social and behavioral factors affecting cybersecurity. The development and deployment of innovative cybersecurity models and practices throughout scientific environments is also required. This research and development requires a well-trained professional workforce with new skills and knowledge, necessitating creative and innovative approaches to the education and preparation of tomorrow's cybersecurity researchers.

Total Funding for SaTC

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
$113.37	**$111.75**	**$110.25**

Goal

The long-term goal of the SaTC program is to build the knowledge base in cybersecurity that enables discovery, learning, and innovation in this critical area, and ultimately leads to a more secure and trustworthy cyberspace. The program aligns with the President's *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program* (released in December 2011), which details four subgoals that together cover a set of interrelated priorities for the federal agencies that conduct or sponsor research and development in cybersecurity. These four goals are: (1) inducing change, (2) developing scientific foundations, (3) maximizing research impact, and (4) accelerating transition to practice. In order to achieve these goals, a coordinated, interdisciplinary program is needed.

Approach

The Directorates for Computer and Information Science and Engineering (CISE); Education and Human Resources (EHR); Engineering (ENG); Mathematical and Physical Sciences (MPS); and Social, Behavioral, and Economic Sciences (SBE) participate in this program. Each of these organizations supports a research community whose abilities are needed to collectively build the envisioned cybersecure and trustworthy environment and to prepare the scientists and supporting workforce needed

to sustain and improve that environment. The SaTC program is managed by a Working Group (WG) made up of program directors from the participating directorates.

EHR invests in the CyberCorps: Scholarship for Service (SFS) program, which supports cybersecurity education and workforce development. SFS has funded more than 1,700 students and provides capacity building grants to promote cybersecurity education and research at higher education institutions. SFS will continue its focus on increasing the number of qualified students entering the fields of information assurance and cybersecurity, and enhancing the capacity of the United States higher education enterprise to continue to produce professionals in these fields to secure the Nation's cyberinfrastructure.

The following paragraphs describe the specific objectives of NSF's SaTC program, and how they relate to the four thrusts of the Federal Cybersecurity Strategic Plan:

Inducing Change

- Focus the direction of research on four game-changing research topics – designed-in security, moving target defense, tailored trustworthy space, and cyber economic and behavioral incentives – to better understand the motivations, incentives, and behaviors of users, attackers, and defenders. For example, study how information flows within and between these groups, how organizations or policies can be developed to align individual and societal incentives, or how targets are selected and defended.
- Provide the foundations and tools for privacy, confidentiality, accountability, and anonymity, as well as extraction of knowledge from massive datasets without compromising societal values.
- Advance the design and implementation of software that exhibits resiliency in the face of an attack, the design and composition of software components into large-scale systems with known security properties, the design of reliable systems including attention to behavior and human factors that can function dependably even if some subset of components do not function as intended, and support the transition of novel software into shared cyberinfrastructure.

Developing Scientific Foundations

- Develop the scientific foundations for digital systems that can resist attacks, including a range of cryptographic algorithms and statistical tools that can withstand attacks from novel computing engines, such as quantum computers, and that support operation in environments with restricted computational resources.
- Develop the mathematical and statistical theory and methodologies required to model and predict the behavior of large-scale, complex systems; assure that the large-scale computations in many fields of research are not vulnerable to manipulation or compromise; and develop and implement improved cybersecurity defenses for scientific environments and cyberinfrastructure.
- Develop the scientific foundations to understand how individuals, groups, organizations, and other actors make decisions in the realm of cybersecurity.
- Develop market-based approaches to align incentives for investments, efficiently share risks, and internalize externalities.

Maximizing Research Impact

- Ensure that the Nation's populace understands the security and privacy characteristics and limitations of the digital systems on which they rely daily.
- Coordinate with the NSF Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS) investment to support foundational research in cybersecurity issues arising in advanced manufacturing, robotics, and critical infrastructure, such as Smart Grids.

- Investigate opportunities and challenges in organizational alliances around cybersecurity; examine alternative governance mechanisms, for example, private-public partnerships and international agreements.

Accelerating Transition to Practice

- Provide insight and incentives into the process for innovation diffusion and adoption at the organizational, group, and individual levels.
- Drive innovation through applied research, development, and experimental deployment. Transition successful basic research results and commercial innovations into early adoption and use tailored for NSF communities and learning environments. Enable NSF cyberinfrastructure as a premier proving ground and state-of-the-art environment for advancing cybersecurity solutions and moving them into technical and organizational practice.

In addition, SaTC will address the pivotal issues in the education and preparation of tomorrow's cybersecurity researchers. Specific objectives are:

- Promote innovation and development of new curricula and learning opportunities to create and sustain an unrivaled cybersecurity workforce, capable of developing sound and secure cyberinfrastructure components and systems.
- Study new approaches to training and education in cybersecurity to understand their impact and provide a basis for continual refinement and improvement.

Investment Framework

SaTC Funding by Directorate

(Dollars in Millions)

Directorate/Office	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Computer and Information Science and Engineering	$58.89	$59.00	$75.00
Education and Human Resources	44.98	45.00	25.00
Engineering	5.00	3.25	4.25
Mathematical and Physical Sciences	0.50	0.50	2.00
Social, Behavioral, and Economic Sciences	4.00	4.00	4.00
Total	**$113.37**	**$111.75**	**$110.25**

Totals may not add due to rounding.

FY 2012 – FY 2013

In FY 2012, 61 SaTC proposals were funded from a solicitation jointly issued by CISE (including the Division of Advanced Cyberinfrastructure, formerly the Office of Cyberinfrastructure), MPS, and SBE. These proposals support the four thrust areas of the Federal Cybersecurity Strategic Plan: inducing change, developing scientific foundations, maximizing research impact, and accelerating transition to practice. In addition, six CAREER awards associated with SaTC were funded in FY 2012. In FY 2013, a SaTC solicitation was jointly issued by CISE, EHR, ENG, MPS, and SBE to elicit research proposals to expand research and development of secure and trustworthy cyberspace using the approach outlined above in the Federal Cybersecurity Strategic Plan.

To develop the SaTC community, in FY 2012, the directorates held community-building workshops and Principal Investigator (PI) meetings. In 2013, meetings will be held to facilitate the exchange of ideas on the SaTC program and related research and development. Interdisciplinary workshops that focus on specific problems (e.g., metrics, fundamental results, evidence-based research) in the scientific foundations of cybersecurity are planned, as well as meetings to educate SaTC program directors about other NSF programs that focus on transitions to practice, such as NSF Innovation Corps and the Accelerating Innovation Research activity in the Partnerships for Innovation program. NSF held a workshop in partnership with the Computing Community Consortium and the Semiconductor Research Corporation on fundamental cybersecurity issues of interest to both industry and academic researchers.

NSF has collaborated with, and will continue to collaborate with, other federal partners on cybersecurity: NSF co-chairs the NITRD Cyber Security and Information Assurance Senior Steering Group, which provides leadership across the government in cybersecurity R&D and provides a forum for information sharing. In addition, NSF and the Department of Education co-lead the Formal Education Component of the National Initiative for Cybersecurity Education. In FY 2012, NSF and the National Security Agency (NSA) jointly held a Principal Investigator (PI) workshop, as well as jointly funded the Cyber-Physical Systems Virtual Organization at Vanderbilt University to encourage it to extend its scope into cybersecurity and to better understand how it relates to smart systems.

In FY 2012, the SFS program continued its focus on increasing the number of qualified students entering the fields of information assurance and cybersecurity and enhancing the capacity of the United States higher education enterprise to continue to produce professionals in these fields to meet the needs of our increasingly technological society. SFS funded 43 projects in FY 2012. In FY 2013, NSF will continue funding SFS capacity building proposals focusing on broadening participation of women, veterans, and underrepresented minority groups. At least two university pilots on cybersecurity education and secure programming, jointly supported by CISE and EHR, will be launched in FY 2013. NSF will hold a workshop to help create a community of researchers and students interested in cross CISE-SBE-EHR related issues. These efforts will include the development of a National Virtual Lab for Cybersecurity Education to promote collaboration and resource sharing.

In FY 2013, a fourth perspective on cybersecurity education has been added to the SaTC solicitation with the aim to promote innovation, development, and assessment of new learning opportunities and to create and sustain an unrivaled cybersecurity workforce capable of developing secure cyberinfrastructure components and systems, as well as to raise the awareness of cybersecurity challenges to a more general population.

FY 2014 Request

The following activities are planned:

- Expand the research portfolio to include more cross-disciplinary projects to cover a broader set of research topics and to increase transition to practice.
- Fund up to two large, multi-institutional projects that provide high-level visibility to grand challenge research areas.
- Develop a mechanism for supporting foundational research that has industrial impact, such as Grant Opportunities for Academic Liaison with Industry (GOALI) supplements or co-funding with an industrial consortium.
- Expand cybersecurity outreach and collaboration efforts by establishing a partnership with at least one other agency (e.g., the Department of Homeland Security, National Institute of Standards and Technology, NSA) for co-funding or transition of projects, and hold a workshop with the European Union to determine mutual interests.
- Hold a SaTC PI meeting to help build a broad community that crosses disciplinary interests.

- Expand the education and preparation of cybersecurity researchers by funding projects on curriculum development and evaluation in cybersecurity. Support efforts to define a cybersecurity body of knowledge and to establish curricula recommendations for new courses, degree programs, and educational pathways.

FY 2015 – Beyond

Building on the knowledge base developed during the previous years, SaTC will continue to focus on game-changing research and education and the development of digital systems that are resistant to attacks. In coordination with the CEMMSS WG, the focus will be to secure advanced manufacturing systems, robotics, and critical infrastructure; and transition to practice research results ready for experimental deployment, early adoption, commercial innovation, or implementation in cyberinfrastructure. To more effectively achieve its long-term goals, SaTC will develop partnerships with other agencies, industry, and international organizations. The cybersecurity research community is also expected to grow to include more researchers who cross the boundaries between computer science, engineering, economics, social and behavioral sciences, statistics, and mathematics, thereby creating a flourishing cybersecurity research and development ecosystem.

NSF will continue to promote the development of new curricula and learning opportunities to augment the cybersecurity workforce with focused efforts to recruit and retain underrepresented minorities, women, first-generation/low-income students, and/or veterans.

Evaluation Framework

NSF has engaged the Science Technology Policy Institute (STPI) to conduct a program evaluation feasibility study for the SaTC program. This evaluation feasibility study will examine the baseline portfolio of SaTC investments and identify metrics to measure progress of goals as part of an impact assessment.

This feasibility study will be conducted to develop a plan for an impact assessment of the SaTC investment. The approach outlined below will be followed:

- Meetings will be held with the SaTC WG and SaTC management to examine the past and current portfolio of awards, including an assessment of the components of the portfolio by technical and scientific content. In addition, various recommendations from federal advisory boards and stakeholder communities on how to structure future cybersecurity investments will be synthesized.
- A roadmap will be refined to help NSF track progress toward its major scientific objectives (e.g., discovery of the root causes of threats and attacks and continuous investment in transformational approaches that improve the security of cyberspace; development of a systematic scientific approach to cybersecurity, including discovery of laws and principles). This effort may entail workshops with the stakeholder community to define the major research questions and research goals for SaTC.

Based on the results of the workshops and related activities (stated above), a third party contractor and NSF will develop the appropriate plan for assessing progress across NSF's SaTC activities.

The initial contract for the evaluation feasibility study was put into place and a kick-off meeting was held during the fourth quarter of FY 2012. Work is ongoing to establish an evaluation framework, which will be in place by the end of FY 2013.

Additionally, in FY 2012, NSF and the Organizational Assessment Group of the U.S. Office of Personnel Management (OPM) worked together to assess the extent to which the SFS program achieved its major goals. The OPM evaluation team conducted focus groups, administered surveys to the different stakeholders of the SFS program (e.g., students, graduates, PIs, faculty, agency supervisors, hiring officials and recruiters), and also conducted a workforce analysis to project the federal hiring demands

for computer professionals. The evaluation is expected to be completed in October 2013. In FY 2013, NSF and OPM plan to look for ways to increase the marketing of the SFS program to agencies and expand the internship opportunities for students. A competency gap analysis of competencies needed once on the job is underway.

CATALYZING ADVANCES IN UNDERGRADUATE STEM EDUCATION (CAUSE)

Overview

A diverse and globally engaged U.S. science, technology, engineering and mathematics (STEM) workforce, able to innovate and well prepared for the changing scientific landscape, is crucial to the national health and economy. Yet there is rising concern that the numbers of graduates earning STEM degrees will not meet the demand for workers with STEM skills that is driven by technological innovation. Furthermore, the engagement of U.S. citizens from underrepresented groups in STEM is still alarmingly low. The National Science Foundation (NSF) is committed to serving a leadership role across the U.S. government in addressing these critical challenges and achieving important goals for increasing the numbers of STEM professionals. The cross-agency priority goal in STEM Education states, "…the Federal Government will work with education partners to improve the quality of science, technology, engineering and math (STEM) education at all levels to help increase the number of well-prepared graduates with STEM degrees by one-third over the next 10 years, resulting in an additional one million graduates with degrees in STEM subjects."[1] Likewise, the Committee on Science, Technology, Engineering, and Mathematics Education (CoSTEM) has identified undergraduate STEM education as a priority.[2]

The opportunities for increasing the numbers of STEM graduates have been analyzed in recent national reports. The President's Council of Advisors on Science and Technology (PCAST) report, *Engage to Excel*, and the National Academies report, *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads*, underscore the lack of persistence of STEM students from all groups in the first two years of college. Further, the PCAST report recommends widespread implementation of evidence-based teaching practices, including the integration of discovery-based laboratories as having strong potential to enhance retention.[3] The National Research Council report, *Discipline-based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering*, provides an analysis of effective practices and a research agenda for continuing to build the STEM education knowledge base.

In alignment with the Administration's bold reorganization of STEM education, NSF will become the government–wide leader for undergraduate STEM education in FY 2014. NSF's new Catalyzing Advances in Undergraduate STEM Education (CAUSE) program is a natural evolution and consolidation of the Foundation's ongoing efforts to couple STEM disciplinary expertise with education research expertise to better understand and improve undergraduate STEM learning and persistence of students from all groups and to support STEM workforce development. CAUSE provides coherence across all NSF undergraduate education programs to maximize the effectiveness of NSF investments in improving the STEM learning experiences of all undergraduates. In addition, the CAUSE framework allows for incorporation of undergraduate improvement goals shared across federal agencies.

CAUSE is built upon a knowledge base informed by decades of work on STEM undergraduate education. It integrates education research with frontier science and engineering research to develop an innovative STEM workforce. Using a principle-based framework and investment strategy, CAUSE establishes four guiding principles for NSF's undergraduate portfolio:

- *NSF investments in undergraduate education will be focused, strategic investments centered on addressing the challenges in U.S. undergraduate education.* The greatest obstacle relative to the

[1] http://goals.performance.gov/goals_2013

[2] Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education Investments: Progress Report (February 2012) www.whitehouse.gov/sites/default/files/microsites/ostp/nstc_federal_stem_education_coordination_report.pdf

[3] From the PCAST report, *Engage to Excel*: "Retaining more students in STEM majors is the lowest-cost, fastest policy option to providing the STEM professionals that the nation needs for economic and societal well-being. (p. i.)

development of U.S. STEM talent is student retention. The U.S. lags behind much of the world in college degree attainment and production of STEM scientists and engineers as only 40 percent of U.S. students who start in STEM majors finish.

- *The CAUSE portfolio will be established through collaboration among all directorates.* Creating this unified portfolio will entail sunsetting and consolidating existing programs, incorporating goals from programs outside of NSF as appropriate, reviewing new programs for alignment with the CAUSE framework, increasing NSF-wide planning and coordination, and developing common metrics and expectations for outcomes.
- *CAUSE will be informed by input from multiple sources, including the STEM disciplines and education research.* Input from experts and leaders in the STEM fields will be integral to the development of CAUSE and will improve the NSF undergraduate investment.
- *Development and future growth of the CAUSE portfolio will be based on demonstrated impact and effectiveness of NSF investments.* Evaluation and assessment of NSF's investments in undergraduate education is essential and will inform decisions aimed at increasing the net funding available for improvement of undergraduate education.

Total Funding for CAUSE

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
-	-	**$123.08**

Goals

To maximize impact on STEM undergraduate education, a research and development-based planning matrix will be used to build coherence and complementarity in education investments across NSF and to inform strategic planning. CAUSE investments will align with the following three goals:

- Improve STEM learning and learning environments.
- Broaden participation in STEM and increase institutional capacity.
- Build the STEM workforce of tomorrow.

Approach

The goals of CAUSE will be pursued through three investment strategies:

- *Foundational research.* These investments focus on core research questions–such as how learners move towards expertise in a discipline, or best learn about concepts that are interdisciplinary – that are foundational for the improvement of teaching, learning, engagement, and retention and for serving as a basis for development, adoption/adaptation, and implementation of models, prototypes, and innovations.
- *Design-based research.* These investments support iterative approaches to design, implementation, analysis, and revision, including prototyping and building and refining models.
- *Scale-up and effectiveness studies.* These investments focus on the potential for leveraging NSF's investments in foundational and design and development research. Key goals include the scaling of successful efforts on learning and learning environments, broadening participation, workforce preparation, and employing emerging technologies.

These funding strategies clarify the unique federal role in research and development in undergraduate STEM education and underscore the importance of leveraging these investments.

Scope

CAUSE is an NSF-wide investment that incorporates funding from established programs in the EHR directorate and other NSF directorates funded though the Research and Related Activities (R&RA) account. It is created by consolidating three Division of Undergraduate Education (DUE) programs: STEM Talent Expansion Program (STEP), Widening Implementation and Demonstration of Evidence-based Reforms (WIDER), and Transforming Undergraduate Education in STEM (TUES); several R&RA programs: BIO's Transforming Undergraduate Biology Education (TUBE); ENG's Research in Engineering Education and Nanotechnology Undergraduate Education (NUE); GEO's Geosciences Education and Opportunities for Enhancing Diversity in the Geosciences (OEDG); and the cross-NSF program, Climate Change Education (CCE).

NSF will fund a range of project types from foundational research to scaling and effectiveness studies. Funding will be available for individual investigators and research teams with expertise cutting across one or more STEM disciplines and STEM education research, including discipline-based education research and the social and behavioral sciences. The intent of CAUSE is to build on NSF's unique strengths across the STEM disciplines and STEM education to focus sustained research on the goals described above. Such research is inherently interdisciplinary in nature. Aligned with the funding strategy will be the development of robust indicators and metrics to gauge progress towards these goals.

Organizational Structure

CAUSE leadership will be provided by an Assistant Director (AD) Council; comprised of ADs designated by the Director and chaired by the EHR AD. EHR is charged with implementing CAUSE across all directorates and working with internal and external program evaluation experts to help develop a set of metrics by which program progress can be evaluated over time.

Investment Framework

CAUSE Funding by Directorate

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	-	-	$2.50
Education and Human Resources	-	-	97.08
Engineering	-	-	12.60
Geosciences	-	-	10.90
Total	**-**	**-**	**$123.08**

Totals may not add due to rounding.

FY 2013

In FY 2013, the CAUSE AD Council will make recommendations to NSF leadership regarding governance, the framework for investment in undergraduate STEM education, and the timeline and roadmap for CAUSE implementation.

Key governance issues include:

- Discuss how reviewing and funding recommendations will be managed in FY 2013 and FY 2014, including how directorate contributions will be viewed (e.g., aimed to specific disciplinary needs, funds combined for the purpose of making awards at the initiative level, etc.).
- Discuss relationship to CoSTEM reports and other agencies' capabilities.
- Discuss how evaluation and assessment of the holistic STEM undergraduate education portfolio will be defined, mapped, and monitored for the intended impacts according to the three CAUSE goals.
- Establish a program officer implementation team to report to the AD Council.

To solidify and articulate NSF's framework for investment in undergraduate STEM education across the agency, the CAUSE AD Council will refine the proposed investment framework detailed above. Current programs and projects will be incorporated into the framework as a basis for achieving portfolio coherence beginning with FY 2013 awards (including analysis of projects by discipline).

A timeline and roadmap that spans the directorates will allow for synchronization of solicitations, common text, and narratives for FY 2014. Staff expertise in undergraduate STEM education and discipline-based educational research will be reviewed, with hiring proposed as appropriate. Coordination of PI meetings, processes for setting CAUSE priorities and special emphases, including plans for explaining the merger/integrated program to the multiple communities involved, also will be guided by the CAUSE AD Council.

FY 2014 Request

The FY 2014 requested funding will allow for awards in foundational research, design-based implementation, and scale-up effectiveness studies. The size and duration of the awards will be determined by the strength of the evidence behind the proposed intervention/project and resources necessary to achieve the desired outcomes. Based on lessons learned in the initial implementation of CAUSE, future adjustments will be made to the program, including size and duration of awards.

Evaluation Framework

The success of this framework will depend upon the development of realistic, robust metrics and indicators for gauging progress toward the larger national goals outlined above, notably improving retention among STEM undergraduates and broadening participation in STEM fields.

These metrics and indicators will be tailored to the three investment strategies and aligned with the CAUSE goals. While the specific metrics and indicators will need additional consideration, NSF's recent experience in this area points to a number of promising approaches.

Potential Assessment Framework: NSF CAUSE Investment

Investment Strategy	Potential Measure/Indicator	Relationship to Desired Outcome
Foundational Research	• Strategic monitoring of approaches and investment mechanisms, beginning with pre-award activities (development of logic models aligned with framework, issuance of announcements/solicitations; community response) • Identification of discipline-specific gaps in the literature and baseline evidence	Will enable strategic NSF investment to create knowledge underpinnings in areas of specific need (e.g., research on the teaching and learning of computer science at the undergraduate level), and complementary investment based in EHR or R&RA directorates as appropriate that are aligned within the CAUSE Framework.

Design-Based Research	• Evidence of activities that promote design of solutions to issues and discipline-specific STEM challenges and test those solutions under local or ideal conditions (e.g., efficacy studies).	Creates a set of tested models and prototypes that allow for strategic investment in efforts at scale.
Scale-up and effectiveness	• Partnerships and leveraging activities that take effective design and development efforts to scale and look at impact on particular groups, in particular contexts, etc.	Well designed and evidence-based approaches are implemented at scale for direct impact on improving retention and broadening participation in undergraduate education.

MAJOR INVESTMENTS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) GRADUATE EDUCATION

Overview

The U.S. federal government invests significantly to support science, technology, engineering, and mathematics (STEM) graduate education through traineeships and fellowships, along with a substantial investment through faculty research grants where graduate students are supported as research assistants.[1] To underscore the importance of these investments, the FY 2014 Budget Request introduces a coherent and streamlined NSF investment strategy for the preparation of tomorrow's science and engineering (S&E) workforce. This plan builds on the ideas generated through the strategic planning process of the National Science and Technology Council's Committee on Science, Technology, Engineering, and Mathematics Education (Co-STEM) and on-going interagency discussions of mechanisms for improved effectiveness.

Approach

NSF will provide leadership in developing a more coherent and streamlined strategy for investing in graduate STEM education through a national fellowship program and a new traineeship program.

The NSF strategy for building human capital in graduate education has centered on the NSF Graduate Research Fellowship (GRF) and the Integrative Graduate Education and Research Traineeship (IGERT) programs managed in the Division of Graduate Education (DGE). GRF invites applications from the Nation's most promising students in any STEM field, thereby identifying and supporting the disciplines that are foundational to tomorrow's science and engineering (S&E). With this FY 2014 request, the GRF program will be expanded into a National Graduate Research Fellowship program (NGRF) to incorporate features and opportunities that allow fellows to gain specialized experiences and training in key STEM areas. IGERT will evolve into a new program, NSF Research Traineeships (NRT) that will allow for institutional traineeship program applications that will incorporate plans for transforming aspects of graduate programs and experiences at those institutions, and that will focus on specific areas of need for both the federal government and the STEM enterprise.

Investment Framework

National Graduate Research Fellowship Program

The goal of NGRF is to help build the U.S. S&E human capital necessary to ensure the Nation's leadership in advancing S&E and innovation. NGRF will select, recognize, and financially support graduate students with demonstrated high potential for excellence in STEM and potential for excelling in their ultimate chosen career.

NGRF will support outstanding graduate students in disciplines where there is significant national need and in areas of particular interest to mission agencies. NGRF awardees would be offered the opportunity to compete for targeted opportunities through which they will be able to develop specialized expertise in critical areas. Such targeted opportunities may involve, for example, internships in industry or government laboratories, work on projects of interest to federal agencies, specialized or advanced training, or international experiences. This set of options build upon the structures currently in place within the GRF program, such as Graduate Research Opportunities Worldwide (GROW) and the Engineering Innovation Fellows program. This model allows NSF to maintain the high standards and broad scope of the GRF program while adding targeted opportunities to meet evolving federal priorities

[1] At NSF, about 40,000 graduate students are supported annually at a level of about $1 billion. These dollars are distributed across traineeships (6-8 percent), fellowships (10-15 percent), and research assistantships in individual grants and centers (80 percent).

and emerging workforce needs. This approach will provide flexibility and access to opportunities for students at different stages of their graduate career, while leveraging the federal investment in these students.

The NGRF program will be managed within the current general GRF framework, including consultation with all NSF directorates and other agencies to help ensure the most effective practices are used and suitable targeted opportunities are provided. The stipend, duration, and cost-of-education allowance will be the same as the current GRF.

NGRF Funding by Directorate

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Education and Human Resources	$109.24	$109.64	$162.57
International and Integrative Activities	88.50	88.50	162.57
Total	**$197.74**	**$198.14**	**$325.14**

Totals may not add due to rounding.

Funding for NGRF increases by $127.0 million above the FY 2012 Enacted for a total investment of $325.14 million. This 64 percent increase aligns with the Administration's commitment to coherence and efficiency of investment in STEM graduate education activities across the federal government and will allow for an increase of approximately 700 fellows bringing the total estimated number of new fellows awarded in FY 2014 to 2,700.

NSF Research Traineeships Program

In FY 2014, NSF will challenge the STEM graduate education community to build "NSF Research Traineeships" projects through the NRT program. These projects will design and implement traineeships programs in emphasis areas that align with national priorities where new areas of science are emerging rapidly. NRT will also provide a mechanism for learning about the implementation and impact of innovative graduate traineeship programs or graduate education policies. The program will build on what has been learned through IGERT, the Graduate STEM Fellows in K-12 Education (GK-12) program, and in other relevant NSF-sponsored efforts. NRT will seek transformative approaches to graduate education that keep pace with the transformation of science in emerging fields and in specialized areas.

NRT Funding by Directorate[1]
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$3.25	$3.25	$3.25
Computer and Information Science and Engineering	5.20	4.20	5.69
Education and Human Resources	31.01	31.20	26.33
Engineering	10.68	7.00	4.44
Geosciences	6.39	6.39	3.64
Mathematical and Physical Sciences	4.53	3.48	3.69
Social, Behavioral, and Economic Sciences	4.30	4.30	3.03
International and Integrative Activities	0.07	-	5.00
Total	**$65.43**	**$59.82**	**$55.07**

Totals may not add due to rounding.

[1] The FY 2012 Actul and the FY 2012 Enacted/FY 2013 Annualized CR funding levels represent investments made through IGERT. In FY 2014, $33.71 million is for continuing IGERT commitments. The remaining $21.36 million is for new NRT investments.

A total investment of $21.36 million for NRT aligns with the Administration's commitment to more coherence in STEM graduate education activities across the federal government. This will allow for a significant launch of the new NRT program in FY 2014 with particular focus areas to be identified in FY 2013. NRT will encourage much stronger and documented efforts at innovation and new design in graduate programs to support growth and trainees within this targeted emphasis area.

Evaluation Framework

The evaluation framework for both NGRF and NRT is outlined in the table below.

	Potential Measure/Indicator	**Desired Outcome**

Program Development	• Development of coherent solicitations for a fellowship and traineeships program
	• Implementation of effective collaboration across NSF directorates and federal agencies in graduate fellowships and traineeship investment
	• Identification of agreed-upon outcomes of federal investments in graduate students and graduate education
	• Development of targeted opportunities for NGRF and areas of research focus for NRT
		• Graduate STEM fellowship and traineeship investments that:
		  • Serve missions of federal agencies
		  • Provide clarity and efficiency for applicants for fellowship support
		  • Provide opportunities for training for work in areas of national needs
		• A successful initial step in considering frameworks for graduate education investment that can be applied across fellowship, traineeship and research assistantship investments.

Student Development	• Metrics will include:
	  • student educational decisions;
	  • degree attainment;
		• Diverse population of students who are well prepared for:
		  • a range of career options and potential

	• student preparation in identified areas of national need; and • performance of groups under-represented in STEM. • Quality of education and career development, comparing student experiences based on funding mechanism.	changes in career paths; • work in areas of national need/missions of federal agencies; and • national leadership in STEM in the private and public sectors.
Career Impact	• Metrics will include information concerning: • career trajectories; • range of career paths; • productivity appropriate for careers; and • leadership roles in public and private sectors.	• Diverse workforce that: • makes significant contributions through a range of careers; • conducts research at the frontiers of S&E; • develops innovations of high impact; and • provides national leadership in the public and private sectors.

NATIONAL SCIENCE FOUNDATION CENTERS

NSF supports a variety of centers programs that contribute to the Foundation's mission and vision. Centers exploit opportunities in science, engineering, and technology in which the complexity of the research program or the resources needed to solve the problem require the advantages of scope, scale, duration, equipment, facilities, and students. Centers are a principle means by which NSF fosters interdisciplinary research.

NSF Centers
(Dollars in Millions)

	Program Initiation	Number of Centers in FY 2012	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Centers for Analysis & Synthesis	1995	4	$26.29	$26.32	$26.40	$0.08	0.3%
Centers for Chemical Innovation	1998	14	26.03	24.00	33.25	9.25	38.5%
Engineering Research Centers	1985	20	70.36	70.00	70.50	0.50	0.7%
Materials Centers	1994	24	49.56	44.35	56.00	11.65	26.3%
Nanoscale Science & Engineering Centers	2001	13	33.47	31.48	12.87	-18.61	-59.1%
Science & Technology Centers[1]	1987	17	50.02	50.75	71.71	20.96	41.3%
Science of Learning Centers	2003	6	21.94	20.37	19.00	-1.37	-6.7%
Totals		**98**	**$277.66**	**$267.27**	**$289.73**	**$22.46**	**8.4%**

Totals may not add due to rounding.

[1] Six of the 17 Science and Technology Centers supported in FY 2012 are from the FY 2002 cohort. These centers received extensions to their periods of performance in FY 2012 but no additional funding.

Description of Major Changes

Centers for Analysis and Synthesis - BIO

The Socio-Environmental Synthesis Center (SESYNC) uses a variety of approaches to synthesize scientific information, data, and knowledge to advance the understanding of environmental complexity. Emerging environmental challenges are anticipated and managed through the active involvement of environmental and social scientists. Approaches include discussions between scientists and policy makers, working groups from the broad socio-environmental community, and an array of computational and technical service providers. The FY 2014 Request is $6.0 million (no change from FY 2012 Enacted).

The iPlant Collaborative provides a cyberinfrastructure to enable new conceptual advances in plant sciences through integrative, computational thinking. iPlant focuses on grand challenge questions in the plant sciences, including innovative approaches to education, outreach, and the study of social networks. The FY 2014 Request is $12.0 million (no change from FY 2012 Enacted).

The National Evolutionary Synthesis Center (NESCENT) promotes the synthesis of information, concepts, and knowledge to address significant, emerging, or novel questions in evolutionary science and its applications. NESCENT funds graduate students engaged in center synthesis activities; supports activities to expand the conceptual reach of the center; and initiates a formalized, three-tiered assessment of the center that includes milestones for reporting on the impact of center activities. The FY 2014

Request is $4.40 million (-$1.10 million below FY 2012 Enacted) as NSF funding ramps down. FY 2014 is expected to be the final year of funding for NESCENT.

The National Institute for Mathematical and Biological Synthesis (NIMBIOS) supports creative solutions to complex problems at the interface between mathematics and biology. The center is designing education programs aimed at the mathematics/biology interface, thereby building the capacity of mathematically competent, biologically knowledgeable, and computationally adept researchers needed to address the vast array of challenging questions in this century of biology. The FY 2014 Request is $4.0 million (+$1.18 million over FY 2012 Enacted) as the center ramps up cyberinfrastructure capabilities and services.

Centers for Chemical Innovation (CCI) - MPS

The CCI program is designed to address major, long-term fundamental chemical research challenges attracting broad scientific and public interest as well as to provide a rich environment for education, outreach, and innovation. In 2012, managing directors and education/outreach staff from five Phase II CCIs established a Leadership Network as a forum to discuss common challenges and coordinate activities across centers. As a result of this meeting, the CCIs are increasing their engagement with minority-serving organizations. Another meeting is planned for fall 2013 to share scientific progress on Grand Challenges. These activities will continue in FY 2014. In addition, NSF Division of Chemistry staff are developing metrics and collecting data in preparation for the first CCI program evaluation scheduled for FY 2017.

The CCI program is structured as a two-phase competition. Phase I centers, which are funded for three years, may compete for larger Phase II awards, which are funded for five years with the opportunity to be renewed for an additional five years. The FY 2014 Request is $33.25 million (+$9.25 million above FY 2012 Enacted). This will support the following:

- Up to eight Phase II awards. This includes six ongoing Phase II CCIs and up to two new and/or renewing Phase II CCIs. At $4.0 million per center per year, FY 2014 funding for Phase II centers will range from $24.0 million (ongoing centers only; no new/renewing centers) to $32.0 million (eight ongoing and new/renewing centers).
- Up to six Phase I awards: The three centers initiated in FY 2012 and the one to three centers to be initiated in FY 2013 will be eligible for Phase II status in FY 2014. No new Phase I competition is planned for FY 2014. As all Phase I centers are funded as standard grants up to $1.75 million, FY 2014 funding for Phase I centers will range from zero (no Phase I awardees are selected in FY 2013) to $5.25 million (three Phase I awardees are selected in FY 2013).

Engineering Research Centers (ERC) – ENG

NSF Engineering Research Centers (ERCs) enable innovation through partnerships, bridging the intellectual curiosity of discovery-focused university research and the engineered systems and technology opportunities of industry research. The centers also educate a technology-enabled workforce with hands-on, real-world experience. These characteristics catalyze the development of marketable technologies to generate wealth and address grand challenges. ERCs are investigating intelligent electric power grid systems to provide electricity from renewable sources, devising healthcare innovations through tissue engineering and microelectronics research, creating sensing systems that improve the prediction of tornados, and demonstrating intelligent robotic systems to assist people who are elderly or disabled in daily tasks.

ERCs face two renewal reviews, one in year three to determine if they are structured effectively, and another in year six to determine if they are making an impact, delivering on goals, and positioning themselves for more challenging tasks to warrant further support. The ERC program periodically commissions program-level evaluations by external evaluators such as SRI International; the Science and

Technology Policy Institute (STPI); and ABT Associates to determine the effectiveness of ERC graduates in industry and the benefits of ERC membership to industry and others. A recent update of a past survey of the 35 ERCs that have graduated from NSF support after 10 years finds that 29 (83 percent) are self-sustaining with strong financial support and most ERC features in place.

The FY 2014 Request is $70.50 million (+$500,000 over FY 2012 Enacted). Building on the long-standing ERC program model, NSF will maintain funding for the existing portfolio of 17 ERC's and support three new centers as part of the Class of 2014 for a total of 20 ERCs. The FY 2014 ERC competition will include tracks for both traditional Generation-3 ERC's and for the second class of Nanosystems ERC's (NERCs). The anticipated outcome of the competition is to make a combination of Generation-3 ERC awards and focused NERC awards dependent upon the quality of the proposals and relationship to areas of national need and grand challenges.

Materials Centers – MPS

Materials Research Science and Engineering Centers (MRSECs) advance materials research and provide students with an interdisciplinary education, including global experiences. These centers address fundamental research problems of intellectual and strategic importance that will advance U.S. competitiveness and the development of new technologies.

The MRSEC program will continue to support the Materials Research Facilities Network (MRFN), which links the instrumentation and subject matter expertise of MRSECs to the larger materials-related community as well as encourages MRSEC-to-MRSEC collaborations. The MRFN network will be used to nucleate new Materials Innovation Platforms (MIP). These Platforms will be networked to address instrument and technique development capabilities and capacity for discovery of new materials.

The MRSEC program will also continue to support the interaction of MRSEC Education Coordinators with the NSF Directorate for Education and Human Resources' (EHR) Division of Research on Learning in Formal and Informal Settings (ERL) to formulate methodologies for standardizing outreach program assessment and evaluation. In addition, the program will continue to support the interaction of the Georgia Institute of Technology MRSEC with DRL to increase training opportunities for students with disabilities through the Research in Disabilities Education (RDE) program. MRSECs also interact with minority serving institutions (MSIs) through the Partnership for Research and Education in Materials (PREM) program. In FY 2014, there will be 14 active PREM awards, 13 of which are connected to MRSECs.

The FY 2014 Request is $56.0 million (+$11.65 million over the FY 2012 Enacted). This will support 18 MRSECs. The Materials Centers program holds triennial competitions. In the FY 2014 competition, 14 current centers are expected to re-compete, along with about 70 new applicants. Nine awards are expected to be made. This will reduce the number of centers in this class from 14 to 9 in keeping with the advice from the 2007 NRC report, which recommended increasing award size. Nine centers awarded during the last competition in FY 2011 will also continue to be funded. The FY 2014 request is higher than the FY2013 year estimate because there was forward funding in FY 2012 towards the mortgage of continuing awards in FY 2013.

Nanoscale Science and Engineering Centers (NSEC) – ENG

Nanotechnology, which addresses the smallest of scales, is projected to be one of the largest drivers of technological innovation for the next decade and beyond. This potential was recognized in the National Nanotechnology Initiative, particularly in the burgeoning area of nanomanufacturing. Research at the nanoscale through NSF-funded NSECs aims to advance the development of the ultra-small technology that will transform electronics, materials, medicine, environmental science, and many other fields. Each center has an extended vision for research. Together they provide coherence and a long-term outlook to

U.S. nanotechnology research and education and also address the social and ethical implications of such research. NSEC funding supports education and outreach programs from K-12 to the graduate level, which is designed to develop a highly skilled workforce, advance pre-college training, and further public understanding of nanoscale science and engineering. These centers have strong partnerships with industry, national laboratories, and international centers of excellence, which puts in place the necessary elements to bring discoveries in the laboratory to real-world, marketable innovations and technologies.

The FY 2014 Request is $12.87 million (-$18.61 million below the FY 2012 Enacted). This will support five continuing NSECs. The decrease in funding is chiefly due to six centers that will receive their final year of NSF support in FY 2013. Investments in NSECs will continue to decrease as the program no longer needs as much support due to center graduations and a transition to NERCs (see the ERC section above). The five existing centers are expected to be supported through the end of their current award cycles. No new NSEC competitions are planned.

Science and Technology Centers: Integrative Partnerships (STCs) - multi-directorate

The Science and Technology Centers: Integrative Partnerships (STC) program advances interdisciplinary discovery and innovation in science and engineering through the integration of cutting-edge research, excellence in education, targeted knowledge transfer, and the development of a diverse workforce. The STC portfolio reflects NSF-supported disciplines. Examples of investments include: engineering of biological systems; energy-efficient electronics; global and regional environmental systems − sustainability and change; new ways of handling the extraction, manipulation, and exchange of information; cyber security; and new materials for optical and electronic applications. STCs engage the Nation's intellectual talent and collaborate with partners in academia, industry, national laboratories, and government. STCs strengthen the caliber of the Nation's science, technology, engineering, and mathematics (STEM) workforce through intellectually challenging research experiences for students, postdoctoral fellows, researchers, and educators and advance public scientific understanding through partnerships with K-12 and informal education communities.

The FY 2014 Request is $71.71 million (+$20.96 million over FY 2012 Enacted). This will support 16 existing STCs – up to five from the 2013 cohort, five from the 2010 cohort, and six from the 2005/2006 cohort; and the administrative costs ($1.30 million) associated with management and oversight of the program. Awards are usually made for five years, with possible renewal for an additional five years. Support ranges from $4.0 million to $5.0 million per year, except for the class of 2005/2006 centers as they ramp down in preparation for sunset in FY 2014.

Science of Learning Centers (SLC) - multi-directorate

The Science of Learning Centers (SLC) program supports six large-scale, long-term centers that create the intellectual, organizational, and physical infrastructure needed for the advancement of Science of Learning research. It supports research that harnesses and integrates knowledge across multiple disciplines to create a common groundwork of conceptualization, experimentation, and explanation that anchor new lines of thinking and inquiry towards a deeper understanding of learning. The SLC program goal is to advance the frontiers of all the sciences of learning through integrated research; to connect the research to specific scientific, technological, educational, and workforce challenges; to enable research communities to capitalize on new opportunities and discoveries; and to respond to new challenges. The SLC portfolio represents synergistic, exciting research efforts that address many different dimensions of learning.

Each SLC's scientific and other activities are reviewed each year through a site visit review. In 2009, a Committee of Visitors (COV) review of the Science of Learning Centers reported it to be "a major success." In addition, an extensive program level evaluation will be conducted in 2013.

The first cohort of four SLCs was funded in FY 2004. One center was decommissioned in its second year due to its failure to show adequate progress. Support for the three remaining centers in this cohort -- Pittsburgh Science of Learning Center (PSLC), Learning in Formal and Informal Environments (LIFE), and the Center of Excellence for Learning in Education, Science and Technology (CELEST) – will end in FY 2014. The second cohort of three SLCs was funded in FY 2006. Of this cohort, support for the Visual Language and Visual Learning Center (VL2) will end in FY 2014 and support for the Temporal Dynamics of Learning Center (TDLC) and the Spatial Intelligence and Learning Center (SILC) will end in FY 2015.

The Directorate for Social, Behavioral, and Economic Sciences (SBE) initiated external discussion on the future of the SLC program and the science it supports. Following its May 2010 Advisory Committee (A/C) meeting, SBE established a subcommittee under the A/C to explore future directions for the Science of Learning. The subcommittee held one workshop at NSF in October 2012 and held a second workshop in February 2013; a report on findings will be presented at the May 2013 A/C meeting.

The FY 2014 Request is $19.0 million (-$1.37 below FY 2012 Enacted). This will support six SLCs. SBE will continue to oversee management of all six centers, with co-funding from the NSF Directorates for Biological Sciences, Computer and Information Science and Engineering, and Engineering. Since 2012, NSF's funding for the centers has started ramping down as the centers approach the end of their award periods.

Estimates for Centers Participation in 2012

(Dollars in Millions)

	Number Participating Institutions	Number Partners	Total FY 2012 NSF Support	Total Leveraged Support	Number Participants
Centers for Analysis & Synthesis	679	63	$26	$10	1,686
Centers for Chemical Innovation	85	67	$33	$4	591
Engineering Research Centers	621	252	$70	$125	3,964
Materials Centers	382	332	$56	$43	5,813
Nanoscale Science & Engineering Centers	593	544	$13	$47	3,500
Science & Technology Centers	227	581	$72	$56	2,629
Science of Learning Centers	53	220	$19	$33	971

No. of Participating Institutions: All academic institutions participating in activities at the centers.

No. of Partners: The total number of non-academic participants, including industry, states, and other federal agencies at the centers.

Total Leveraged Support: Funding for centers from sources other than NSF.

Number of Participants: The total number of people who use center facilities, not just persons directly support by NSF.

Centers Supported by NSF in FY 2012

Center	Institution	State
Centers for Analysis and Synthesis		
National Evolutionary Synthesis Center	Duke, NC State U, U of N. Carolina	NC
National Institute for Mathematical & Biological Synthesis	U of Tennessee-Knoxville	TN
Plant Science Cyberinfrastructure Collaborative	U of Arizona	AZ
SocioEnvironmental Synthesis Center	U of Maryland	MD
Centers for Chemical Innovation		
Chemistry at the Space-Time Limit (phase II)	U of California-Irvine	CA
Center for Aerosol Impacts on Climate and Environment (phase I)	U of California-San Diego	VA
Center for Chemical Evolution (phase II)	Georgia Institute of Technology	GA
Center for Enabling New Technologies through Catalysis (phase II)	U of Washington	WA
Center for Multiscale Theory and Simulation (phase I)	U Chicago	IL
Center for Nanostructured Electronic Materials (phase I)	U of Florida	FL
Center for Stereoselective C-H Functionalization (phase II)	Emory U	GA
Center for Sustainable Materials Chemistry (phase II)	Oregon State U	OH
Center for Sustainable Nanotechnology (phase I)	U of Wisconsin-Madison	WI
Center for Sustainable Polymers (phase I)	U of Minnesota-Twin Cities	MN
Center for Sustainable Renewable Feedstocks (phase I)	U of California-Santa Barbara	CA
CO2 as a Sustainable Feedstock (phase I)	Brown U	RI
Powering the Planet (phase II)	California Institute of Tech	CA
Quantum Information Center for Quantum Chemistry (phase I)	Purdue U	IN
Engineering Research Centers		
Biomimetic Microelectronic Systems	U of Southern California	CA
Biorenewable Chemicals	Iowa State U	IA
Center for Ultra-wide-area Resilient Electric Energy Transmission Network (CURENT)	U of Tennessee Knoxville	TN
Collaborative Adaptive Sensing of the Atmosphere	U of Mass-Amherst	MA
Compact and Efficient Fluid Power	U of Minnesota	MN
Extreme Ultraviolet Science and Technology	Colorado State	CO
Future Renewable Electric Energy Delivery & Mgmt. Systems	North Carolina State U	NC
Integrated Access Networks	U of Arizona	AZ
Mid-IR Tech for Health and the Environment	Princeton	NJ
Nanosystems ERC for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST)	North Carolina State U	NC
Nanosystems ERC for Nanomanufacturing Systems for Mobile Computing and Energy Technologies (NASCENT)	U of Texas	TX
Nanosystems ERC for Translational Applications of Nanoscale Multiferroic Systems (TANMS)	U of California-Los Angeles	CA
Quality of Life Technology	Carnegie Mellon/U of Pittsburgh	PA
Quantum Energy and Sustainable Solar Technologies (QESST)	Arizona State U	AZ
Re-inventing the Nation's Urban Water Infrastructure	Stanford University	CA
Revolutionizing Metallic Biomaterials	North Carolina A&T U	NC
Sensorimotor Neural Engineering	U of Washington	WA
Smart Lighting	Rensselaer Polytechnic Institute	NY
Structured Organic Composites	Rutgers	NJ
Synthetic Biology	U of California-Berkeley	CA
Materials Centers		
Brandeis Materials Research Science and Engineering Center	Brandeis U	MA
Princeton Center for Complex Materials	Princeton	NJ
Center for Emergent Materials	Ohio State U	OH
Cornell Center for Materials Research	Cornell	NY
Center for Materials Science and Engineering	Massachusetts Institute of Tech	MA
Center for Multifunctional Nanoscale Materials Structures	Northwestern	IL
Quantum and Spin Phenomena in Nanomagnetic Structures	U of Nebraska	NE

Center for Nanoscale Science	Pennsylvania State	PA
Center for Nanostructured Interfaces	U of Wisconsin	WI
Center for Interface Structures and Phenomena	Yale	CT
Center for Photonics and Multiscale Nanomaterials	U. Michigan	MI
Center for Science and Engineering of Materials	California Institute of Tech	CA
Liquid Crystals Materials Research Center	U of Colorado-Boulder	CO
Laboratory for Research on the Structure of Matter	U of Pennsylvania	PA
Materials Research Center	U of Chicago	IL
Materials Research Science and Engineering Center	Harvard	MA
Materials Research Science and Engineering Center	Georgia Institute of Tech	GA
Materials Research Science and Engineering Center	New York U	NY
Materials Research Science and Engineering Center	U of California-Santa Barbara	CA
Materials Research Science and Engineering Center	U of Minnesota	MN
Materials Research Science and Engineering Center	U. Utah	UT
Materials Research Science and Engineering Center on Polymers	U of Massachusetts	MA
Renewable Energy Materials Science and Engineering Center	Colorado School of Mines	CO
Triangle Materials Research Science and Engineering Center	Duke	NC
Nanoscale Science and Engineering Centers		
Affordable Nanoengineering of Polymer Biomedical Devices	Ohio State	OH
Center for Environmental Implications of Nanotechnology (CEIN)	Duke	NC
Center for Integrated and Scalable Nanomanufacturing	U of California-Los Angeles	CA
High Rate Nanomanufacturing	Northeastern, U of New Hampshire, U of Mass-Lowell	MA, NH
Integrated Nanomechanical Systems	U of California-Berkeley, Cal Tech, Stanford, U of California-Merced	CA
Molecular Function at the Nano/Bio Interface	U of Pennsylvania	PA
Nanotechnology in Society Network: Center at ASU	Arizona State U	AZ
Nanotechnology in Society Network: Center at UCSB	U of California-Berkeley	CA
Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems	U of Illinois-Urbana Champaign	IL
National Nanomanufacturing Network: Center for Hierarchical Manufacturing	U of Massachusetts-Amherst	MA
Predictive Toxicology Assessment & Safe Implementation of Nanotechnology in the Environment (CEIN)	U of California-Los Angeles	CA
Probing the Nanoscale	Stanford, IBM	CA
Templated Synthesis and Assembly at the Nanoscale	U of Wisconsin-Madison	WI
Science and Technology Centers		
An NSF Center for the Study of Evolution in Action	Michigan State U	MI
Center of Adv. Materials for the Purification of H2O with Systems[1]	U of Illinois-Urbana Champaign	IL
Center for Biophotonics Science and Technology[1]	U of California-Davis	CA
Center for Coastal Margin Observation and Prediction	Oregon Health and Science U	OR
Center for Dark Energy Biosphere Investigations	U of Southern California	CA
Center for Energy Efficient Electronics Science	U of California-Berkeley	CA
Center for Embedded Networked Sensing[1]	U of California-Los Angeles	CA
Center for Integrated Space Weather Modeling[1]	Boston U	MA
Center for Layered Polymeric Systems	Case Western Reserve U	OH
Center for Microbial Oceanography: Research and Education	U of Hawaii-Manoa	HI
Center for Multi-Scale Modeling of Atmospheric Processes	Colorado State U	CO
Center for Remote Sensing of Ice Sheets	U of Kansas	KS
Emergent Behaviors of Integrated Cellular Systems	MIT	MA
Emerging Frontiers of Science Information	Purdue U	IN
National Center for Earth Surface Dynamics[1]	U of Minnesota-Twin Cities	MN
Center on Materials and Devices for Info. Technology Research[1]	U of Washington	WA
Team for Research in Ubiquitous Secure Technology	U of California-Berkeley	CA
Science of Learning Centers		
Center for Excellence for Learning in Education, Science, & Tech.	Boston U	MA
Pittsburgh Science of Learning Center - Studying Robust Learning	Carnegie Mellon	PA

with Learning Experiments in Real Classrooms		
LIFE Center - Learning in Formal and Informal Environments	U of Washington	WA
Spatial Intelligence and Learning Center	Temple	PA
The Temporal Dynamics of Learning Center	U of California-San Diego	CA
Visual Language and Visual Learning	Gallaudet	DC

[1] These STCs from the FY 2002 cohort received extensions to their periods of performance in FY 2012 but no additional funding.

MERIT REVIEW PROCESS IMPROVEMENTS

Overview

The merit review process is one of NSF's critical business functions. Effective merit review recognizes high-quality research including high-risk, high-payoff or potentially transformative ideas, empowers NSF to support such proposals, and retains the confidence and trust of NSF's external stakeholders. NSF's current approach to merit review relies on NSF staff making funding recommendations advised by *ad hoc* (mail) reviews and face-to-face panels. This process is time-and resource-intensive.

NSF's merit-review programs face extraordinary pressures as proposal numbers grow. Competition for funding has increased significantly since 2000; the number of research proposals evaluated increased by 80 percent and funding rates dropped dramatically. Workload has increased for researchers, reviewers, and NSF staff. These systemic stresses may be prompting some researchers to submit fewer innovative ideas. The workload of panel reviewers and the travel time involved means that some experts are reluctant or unable to serve on review panels held at NSF. The growth in the number of review panels has led to a steady growth of 9 percent per year between FY 2007 and FY 2012 in NSF's travel-related obligations. In FY 2011, the direct cost to NSF of holding face-to-face panels, excluding salary, was over $38.0 million. To mitigate some of the stresses on NSF's merit review system, a number of critical investments, described below, have been identified.

Total Funding for Merit Review Process Improvements

(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
-	-	**$4.09**

Goals

The goals of NSF's Merit Review Process Improvement activities are:

- Reduce the amount of staff time, per proposal, required to conduct merit review;
- Reduce the average time burden placed on individual reviewers;
- Increase the number of qualified individuals who participate in the review process;
- Reduce the per-proposal cost of the review process; and
- Improve the ability of institutions to submit successful proposals.

Approach

NSF looked at the merit review processes used by other research funding agencies; discussed the benefits and drawbacks of different possible approaches with researchers and university administrators on numerous NSF Advisory Committees; talked with reviewers; and consulted with the National Science Board (NSB). Based on this, significant improvements in workload and cost of could be achieved by focused investments in information and communications technology, personnel, increased use of automation, training, and outreach to institutions. In addition, the aging technologies that NSF uses to support its merit review processes constitutes a risk to one of NSF's critical lines of business. The principal components of this plan are separated into two phases, a first phase that can be pursued economically in FY 2014 and a second phase that will require a greater investment at a later date:

Phase 1

- Deployment of personnel and infrastructure to support use of virtual meeting technologies for panels;
- Outreach to individual institutions to help increase proposal success rates and reduce the submission of non-competitive proposals; and
- Assessment of impacts of improvements in merit review processes.

Phase 2

- Deployment of a more capable infrastructure to support the identification, selection, and recruitment of reviewers and to manage the receipt of reviews; and
- Increased use of automation in the preliminary processing of proposals.

The efforts to further improve NSF's merit review process are led by staff within the Office of International and Integrative Activities in collaboration with staff in the research directorates, the Office of Information and Resource Management, and the Office of Budget, Finance, and Award Management.

Use of Virtual Meeting Technologies for Merit Review

The predominant review method used has become the review panel, convened at NSF, where a set of experts assemble to evaluate proposals. The travel costs associated with review panels are an increasing budget burden. Recently, NSF has experimented with using virtual meeting technologies to hold synchronous virtual review panels including teleconferences, commercial video-conferencing technologies, and "virtual world" software. This investment expands NSF's use of virtual review panels and will restrain the growth in panel costs, broaden the range of reviewers participating in panels, and reduce the average workload of individual reviewers. The investment includes:

- Infrastructure to enable NSF to conduct a significant fraction of review panels as virtual panels;
- Development of online training for moderators and reviewers; and
- Collection of feedback from participants to continually improve the efficacy of virtual panels.

Demand Management

The rate at which submitted proposals to NSF are funded varies widely between institutions and by a factor of three among the top 100 institutions. Reducing this variation would improve the workloads of researchers submitting proposals, of reviewers, and of NSF staff. NSF plans a program of enhanced outreach that is tailored to individual institutions. The outreach will include:

- A discussion of statistics describing the institution's proposal submission rate, success rate, and participation in the merit review process; a comparison to other institutions; and an exploration of possible reasons for anomalies;
- A discussion of the institution's policies on proposal submission and impacts on proposers and reviewers; and
- Assistance in the design of mentoring programs for the faculty on proposal preparation and review.

The outreach will propagate best practices; encourage networking between institutions; and improve flow of ideas between NSF and the research community. The potential return on investment for NSF is significant; even a 1 percent reduction in overall proposal pressure corresponds to a reduction in staff workload that is similar to adding five or six new staff members. Reductions in the number of proposals that institutions must submit to support their faculty members' research programs benefits both their faculty and staff.

Assessments of Impacts of Merit Review Pilot Activities

In FY 2013 - 2014, NSF staff will undertake pilot activities to test achieving further efficiencies. NSF will engage an external party to conduct surveys of NSF reviewers; investigators and panel moderators to assess workload; the impacts of the technologies used; and the quality of feedback provided to proposers.

These will be used to assess the impacts of the pilot activities to be included in NSF's report to the NSB on the merit review process.

Technological Support for the Management of Reviewers and Reviews

This future investment aims to reduce the NSF staff time used in identifying potential reviewers and communicating with reviewers, and to improve the return rate for *ad hoc* reviews. It involves the following set of enhancements to NSF's eBusiness:

- Replace outdated and expensive client-server technology with modern, web-based technology;
- Develop and deploy a more sophisticated database of reviewers with enhanced search features;
- Enhance Research.gov so that researchers and other experts can volunteer online to serve as reviewers;
- Enhance tools to identify possible reviewers to include automatic suggestions of potential reviewers based on matching key criteria such as proposal topics, reviewer expertise, and review history;
- Deploy an automated tool that flags potential conflicts of interest; and
- Add an eBusiness system module that tracks review requests and responses, and that automatically sends reminders about outstanding requests to reviewers and NSF staff.

Increased Automation of the Preliminary Processing of Proposals

Although NSF's current online submission system performs some automatic checks of the structure and content of submitted proposals, many of the proposal preparation requirements are not automatically checked. NSF staff manually checks proposals for compliance, detracting from the time available for other parts of the merit review process. In the future, NSF will ameliorate this situation by deploying an enhanced automated compliance checker based on a relatively general rules engine. This will involve:

- Revision of proposal preparation criteria to simplify implementation as business rules in an automated, rule-based compliance checking system;
- Enhancements to FastLane to check for compliance with high-value business rules;
- Requirements definition, development, testing, and initial deployment of the expanded compliance checking functionality in the online proposal submission system; and
- Ongoing maintenance of the expanded compliance checking system.

Investment Framework

Merit Review Process Improvements Funding Estimates
(Dollars in Millions)

Activity	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Virtual Meeting Technologies	-	-	$3.79
Impact Assessment	-	-	0.30
Total	**-**	**-**	**$4.09**

Totals may not add due to rounding.

Demand Management-related activities, primarily staff costs and travel, are funded by the Agency Operations and Award Management (AOAM) account. For information on associated staffing and travel costs, see the AOAM chapter.

FY 2012 – FY 2013

Use of Virtual Meeting Technologies for Merit Review
In FY 2012 NSF initiated an assessment of several technological and organizational approaches to virtual meetings and began developing training modules for NSF staff and reviewers. In FY 2013 NSF will: conduct a pilot activity with a goal of at least 5 percent of review panels being wholly virtual; conduct a smaller scale pilot activity using asynchronous virtual panel technology; develop online training tools; and assess the impacts of the use of virtual panels. The FY 2013 investment includes a modest scale-up of NSF's network infrastructure, enhanced desktop equipment, and cloud-based virtual meeting services.

Demand management
In FY 2013, a pilot activity with outreach to ten institutions will be conducted using existing staff.

Assessments of Impacts of Merit Review Pilot Activities
In FY 2013, a baseline survey of reviewers, investigators, and panel moderators will be conducted.

Increased automation of the preliminary processing of proposals
Using existing staff resources in FY 2013, NSF will revise its proposal preparation criteria to simplify implementation in an automated rule-based compliance checking system; enhance FastLane to implement additional high priority business rules; and begin planning for a more robust business rules system.

FY 2014 Request

Use of virtual meeting technologies for merit review
Use of virtual panels at scale with at least 15 percent of review panels being virtual panels. The funds requested will support spending on infrastructure (including cloud services) and contract services to provide user support to NSF staff and reviewers. A more functional, semi-automated system will be created to support asynchronous virtual panels. The activities supported by FY 2014 funding include the continued scale up of NSF's in-house network infrastructure, conference room upgrades, enhanced desktop equipment, and cloud-based virtual meeting services.

Demand Management
Undertake a program of targeted outreach to approximately 100 different institutions per year.

Assessments of Impacts of Merit Review Pilot Activities
In FY 2014, a follow-on survey of reviewers, investigators, and panel moderators will be conducted.

FY 2015 and Beyond

Use of virtual meeting technologies for merit review
Support for virtual panels will continue with a target that at least 25 percent of panels are virtual.

Demand management
Continue a program of targeted outreach to approximately 100 different institutions per year.

Assessments of Impacts of Merit Review Pilot Activities
In FY 2015, a follow-on survey of reviewers, investigators, and panel moderators will be conducted.

Technological support for the management of reviewers and reviews
In FY 2015, begin requirements definition, development, testing, and initial deployment of a modernization of NSF eBusiness systems to support streamlined management of the review process. In FY 2016 - FY 2017, complete deployment of the modifications to NSF eBusiness systems.

Increased automation of the preliminary processing of proposals
In FY 2015, begin requirements definition, development and initial testing of an automated proposal compliance checking system with an estimated FY 2016 deployment.

Evaluation Framework

Use of virtual meeting technologies for merit review
NSF will track the number, size, duration and cost of virtual panels. It will compare per-proposal review costs of virtual and in-person panels, and collect feedback from virtual panel participants and moderators. This feedback will be discussed with Advisory Committees. NSF will make agency-wide statistical comparisons of merit review indicators for virtual and in-person panels, including statistics on the success rates of demographic groups of investigators and the various classes of proposing institutions. NSF will examine trends in the number of individual panelists used and their average workload.

Demand management
NSF will solicit feedback from institutions visited and will examine the rate of submissions and proposal funding in years following outreach and compare with baseline data.

Assessments of Impacts of Merit Review Pilot Activities
Surveys will be used to assess the impacts of Merit Review pilot activities undertaken by NSF.

Technological support for the management of reviewers and reviews
NSF will collect data on the staff time spent identifying, selecting, recruiting, and obtaining reviews from reviewers. Pre- and post-deployment data will be compared.

Increased automation of the preliminary processing of proposals
NSF will collect feedback from NSF staff on early prototypes and after the initial deployment. Feedback from submitting institutions will be collected during a pilot deployment. The feedback will be used as input to the final stages of development and deployment, and help determine efficacy and accuracy.

NSF EVALUATION CAPABILITY

Overview

Evaluation must be central to NSF's decision-making and the agency must have capacity to operate from a basis of evidence in policy decisions. In FY 2014 NSF will expand and coordinate program evaluation, and collection and management of NSF programmatic data through an expansion of NSF's Evaluation Capability.

At NSF, evaluation activities have traditionally been initiated and managed locally, within the directorate of the program being evaluated, with little centralized coordination. Although the distributed approach allows for the input of local program knowledge, there are significant advantages to building evaluation capacity centrally in order to promote rigor, integrate evaluation into performance measurement, and ensure that the results of evaluations are consistently used to inform decisions. Centralized coordination of evaluation activities also provides the opportunity to oversee theme evaluations that encompass multiple programs and consolidate data collection activities. This is particularly important for agency-wide programs involving multiple directorates, or programs with similar goals that are dispersed across the organization.

NSF is implementing a multi-stage approach to enhancing this capability: establishing mechanisms for Foundation-wide leadership and coordination in program evaluation; providing expert support and resources for data collection, integration and management; and improving directorate/office evaluation capacity. The Evaluation Capability, established within the Office of International and Integrative Activities (OIIA) in FY 2011, will be strengthened and augmented, with a national search for a leader underway in FY 2013 and additional staff to be added in FY 2014. Expert centralized support and adequate resources for data collection, study and survey design, and management will be put in place. These actions will allow NSF to more consistently evaluate the impacts of its investments, to make more data-driven decisions, and to establish a culture of evidence-based planning and policy-making.

NSF's evaluation efforts will be comprehensive yet flexible enough to capture the impact and return on investment in three main areas.

- ***Investments in fundamental science and engineering*** in general and specific areas, is critical. The largest proportion of NSF funding goes to support basic research across all science and engineering disciplines and their interdisciplinary connections, including basic research about STEM education.
- ***Investments in people,*** directly through human capital programs such as the National Graduate Research Fellowship Program, CAREER, Career-Life Balance, Research Experiences for Undergraduates (REU), and programs in EHR's Human Resource Development Division (HRD), and indirectly by supporting research done by students, post-docs, and faculty.
- ***Strategic investments*** that combine the outcomes of investments in research and people and often address areas of national priority such as sustainability, innovation, and advanced manufacturing. It is important to have a data and evaluation strategy that is flexible enough to accommodate complex activities.

Goals

The Evaluation Capability will provide expanded leadership, expertise, and resources to:

- Encourage a culture of evidence-based planning and policy making that routinely articulates program goals, milestones and metrics.
- Enable consistent evaluation of the impact of NSF investments with a high degree of rigor and independence.
- Develop and implement a coordinated framework for evaluating NSF-wide investments that is consistent with agency strategic and performance plans.

- Coordinate and consolidate data collection activities and storage to make data more useful for guiding decision making and evaluation.
- Use the results of evaluation to inform decisions.

Investment Framework

Evaluation Capability Funding
(Dollars in Millions)

Activity	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Data Collection, Study Design, and Management	-	-	5.50
Total	**-**	**-**	**$5.50**

Totals may not add due to rounding.

FY 2014 Request

NSF's approach will be to first expand expert centralized support and adequate resources to facilitate in-house developmental activities such as logic-modeling, feasibility studies, portfolio analysis, and gap analysis. Staff will also manage evaluations that are conducted by contractors. The new Evaluation Capability leadership will recommend and establish policies and best practices that will promote rigor, transparency, and independence. In FY 2014 evaluations for two to three major NSF activities that cross organizational boundaries will be initiated. The programs chosen will either be major NSF-wide programs or strategic investments. These initial evaluations are intended to supply models of how an NSF-wide approach that facilitates comparisons across programs can provide valuable information to guide decision-making. The specific evaluations or data collections to begin in FY 2014 will be based on both needs for decision making and what can be learned about how we evaluate the three types of science investments made by NSF (fundamental science, people, and strategic). The Evaluation Capability staff will collaborate with the performance improvement staff in the Budget Division on the strategic monitoring of key Foundation-wide programs, with the evaluation of strategic investments being an important component. Preparing for the consolidation of data collection and storage with the continuation of pilots that are currently under way will also provide an NSF-wide paradigm. The Evaluation Capability staff will be responsible for assessing the pilots for bringing data in-house, recommending a course for the future, and establishing a business plan for any changes that are recommended.

NSF PUBLIC ACCESS INITIATIVE

Overview

NSF will launch a Public Access Initiative that will make the results of NSF-funded research broadly available with minimal barriers. NSF's public access policy will accelerate progress in scientific research, encourage citizens to become scientifically literate, and foster creative partnerships with the private sector. Building on progress made in FY 2012 and FY 2013, during FY 2014 NSF will design and test system architecture to manage a subset of NSF-supported research products (at a minimum, journal articles, conference proceedings, and book chapters). During FY 2014 NSF will also pursue capabilities that will capture relevant information from the public access system for seamless inclusion in NSF's reporting and proposal systems. The appropriate organizational structure and unit within the Foundation with operational responsibility will be identified.

Pursuant to the memorandum recently released by OSTP, *Increasing Access to the Results of Federally Funded Scientific Research*[1], NSF intends to articulate a policy and develop plans that will require recipients of NSF funding to deposit a copy of their work in a proposed public access system and to manage the data resulting from their NSF awards. Conditions of deposit are likely to vary, depending on the nature of the product (data or publications), publishers' policies, and the length of time before the publication will be made available free of charge. NSF will consult widely with stakeholders during FY 2013 and FY 2014, before final award terms and policies are established.

Total Funding for
NSF Public Access Initiative
(Dollars in Millions)

FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
-	-	**$2.50**

Goals

NSF will work with concerned communities to establish a mechanism for NSF-funded investigators to make the products of their work available to the public. In order to do this, NSF will:

1. **Consult as needed with stakeholders, both inside and outside NSF.** NSF will work closely with stakeholders (scientists, universities, professional associations, private and public research sponsors and philanthropies, and publishers) to articulate public access policies that balance the concerns of all groups.

2. **Establish policies and make changes to NSF agreements with awardees that will enable public access and ensure compliance**. Procedures, terms and conditions for proposals, awards, and reporting are contained in the *Proposal and Award Policies and Procedures Guide (PAPPG)*. Updates and revisions to the PAPPG to align public access requirements with NSF policies and procedures will be made according to the required schedule with appropriate announcements in the Federal Register.

[1] www.whitehouse.gov/blog/2013/02/22/expanding-public-access-results-federally-funded-research

3. **Establish a publicly-accessible system architecture through which NSF-funded investigators can make their work available**. The requirements and specifications for this system will be developed during the FY 2013-FY 2014 planning phase. Consultations with stakeholders inside and outside of NSF, including scientific communities, professional societies, curatorial and stewardship institutions, publishers, and other stakeholder groups, will provide more specificity concerning attributes of the eventual repository system. NSF expects to consider carefully the merits of leveraging the existing PubMed Central (PMC) infrastructure built by the National Institutes of Health (NIH) and forging an interagency service that meets Administration priorities.[2] The roles of other federally funded infrastructure (e.g., Department of Energy's Office of Scientific and Technical Information (OSTI) new dataset registering service) will also be considered.

   The first implementation of the architecture will focus on peer-reviewed scientific papers, as required by the recent OSTP Memorandum on increasing access to the results of federally funded research.[3] Later implementation stages will address other kinds of research products, including data, for which there are fewer established frameworks.

4. **Establish mechanisms to integrate with NSF's internal data systems and externally-facing proposal and reporting systems, in a way that creates as little burden on awardees and investigators as possible**. How NSF integrates relevant information into its administrative and reporting systems will depend on the eventual system architecture. Because the technology will be fluid and all systems will be updated, this technology development and maintenance will be an ongoing need after the initial build-out.

Investment Framework

The NSF Public Access Initiative will have two structural elements: a planning process, comprising a steering committee and subcommittees focused respectively on publications and data and, eventually, a dedicated organizational unit, which will be directly responsible for administering the repository system. This unit will be advised by a working group made up of representatives from across the Foundation.

In FY 2013 and FY 2014, NSF will undertake planning and development activities including, but not limited to, the plans required by the OSTP memorandum, *Increasing Access to the Results of Federally Funded Scientific Research*, and will establish a process for determining which organization will be designated with responsibility for this activity. This will be pursued through a small working group composed of representatives from the Office of Information and Resource Management (OIRM) and the Office of Budget, Finance, and Award Management (BFA), individuals with relevant expertise recruited from the program directorates and offices, and other units of the Foundation as appropriate. This responsibility is expected to require two full-time equivalents (a newly-created position for a lead of the activity with one additional position for support functions). The lead official will oversee contracts and Memorandum of Understandings (MOUs) for piloting, testing, and services and will coordinate the design and requirements discussions associated with the contract. This will include articulating overall requirements for the initial roll out and for subsequent and potentially more complex implementations, monitoring the performance of the system and its uptake within the scientific community, and updating the system capabilities as necessary. These individuals will also coordinate the interface between the information in the Public Access system and other administrative units in the Foundation and will participate in discussions with the NSF Policy Office and various consultative activities. These may include coordination with publishers, professional societies, curatorial and stewardship institutions, and other organizations that manage the information and data infrastructure. During the early years, travel

[2] www.ncbi.nlm.nih.gov/pmc/
[3] www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf

will be required. Associated with this will be a standing working group with membership drawn from the NSF science staff to foster communication and information exchange.

In addition, the Division of Information Systems will develop and build appropriate technology to link the content from the repository with NSF's internal proposal and reporting systems. Other units of the Foundation, notably the Office of Legislative and Public Affairs (OLPA), the Office of the General Counsel (OGC), and the NSF Policy Office will contribute through efforts of public outreach and for updates to the PAPPG. The program directorates and offices may also undertake Public Access outreach activities with their respective communities at their discretion. Program directorates and offices will also be engaged to ensure that they have a role in developing, testing, and evaluating the system.

Public Access Initiative Funding and Estimates

(Dollars in Millions)

Activity	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Goal 1, Stakeholder Consultation	-	-	$1.25
Goal 2, NSF Policy Changes	-	-	-
Goal 3, Public Data Repository	-	-	0.50
Goal 4, Internal NSF System Changes	-	-	0.75
Total	**-**	**-**	**$2.50**

Totals may not add due to rounding.

FY 2014 Request

A key activity in 2014 will be developing and testing the first implementation of the NSF Public Access system. This will include: (1) integration of relevant elements with the NSF internal and external systems; (2) identifying appropriate partners based on consideration of alternatives, capabilities, and requirements; (3) extensive testing prior to launch (anticipated in FY 2015), which will require implementing appropriate interagency agreements or third-party contracts; (4) defining the nature of post-launch monitoring; and (5) developing and evaluating system metrics, which include both performance and usage metrics. In this first implementation (FY 2015), NSF anticipates that only peer-reviewed papers will be accommodated within the system. After it is clear that the system works effectively for these kinds of works, NSF will begin to consider other kinds of work products, to take place in FY 2015 and beyond. Implementation of plans for managing data may require more extensive study and more time.

Preparation for a successful launch in FY 2015 will also necessitate coordination with the NSF Policy Office and with OLPA to ensure that relevant changes have been appropriately communicated with relevant constituencies. All of the programs across the Foundation will be impacted, therefore, coordination with the staff in the directorates and offices, and with senior management through working groups will be critical for effective communication and implementation with awardees.

Anticipated FY 2014 investments:

- Staffing, travel, and outreach;
- Ongoing contract for external repository services; and
- Ongoing development and maintenance of technology for interface between repository and NSF systems.

FY 2015 and Beyond

Beyond 2014, NSF expects to launch the system, monitor its use, and expand it strategically based on performance and usage metrics, as well as responses from the research community and other stakeholders. When the system is functioning robustly, NSF will begin the process of adding additional types of research products and additional functionality. Within two years of the launch for first implementation, NSF will revisit and update the plan and evaluate the project from the perspective of its support for the research process. This effort will engage directorates and offices, the NSB, OSTP, other agencies, and stakeholder groups.

SELECTED CROSSCUTTING PROGRAMS

NSF crosscutting programs include interdisciplinary programs and programs that are supported by multiple directorates. For full funding data about Selected Crosscutting programs discussed here, see the Summary Tables chapter. Examples of major crosscutting activities include the following:

ADVANCE
In FY 2014, ADVANCE will fund transformative efforts to address the systemic barriers to women's full participation in academic science, technology, engineering, and mathematics (STEM) with funding of $16.63 million, a decrease of $1.32 million below the FY 2012 Enacted level of $17.95 million. Although there is a program reduction, a major focus in 2014 will be broadening the spectrum of institutions participating in the program, to include more undergraduate and minority serving institutions and community colleges, thereby increasing the participation and advancement of women across higher education in academic science and engineering careers. ADVANCE also participates in NSF's Career Life Balance (CLB) initiative; a ten-year initiative that integrates family-friendly practices into NSF's programs.

Catalyzing Advances in Undergraduate STEM Education (CAUSE)
The FY 2014 Request includes $123.08 million for a new undergraduate education program CAUSE that incorporates funding from established programs in the EHR directorate and other NSF directorates funded though the Research and Related Activities (R&RA) account. It is created by consolidating three Division of Undergraduate Education (DUE) programs: STEM Talent Expansion Program (STEP), Widening Implementation and Demonstration of Evidence-based Reforms (WIDER), and Transforming Undergraduate Education in STEM (TUES); several R&RA programs: BIO's Transforming Undergraduate Biology Education (TUBE); ENG's Research in Engineering Education and Nanotechnology Undergraduate Education (NUE), GEO's Geosciences Education and Opportunities for Enhancing Diversity in the Geosciences (OEDG); and the cross-NSF program, Climate Change Education (CCE). The FY 2014 funding will allow for awards in foundational research, design-based implementation, and scale-up effectiveness studies. For more information, see the CAUSE narrative in this chapter.

Cyberlearning Transforming Education (CTE)
The FY 2014 Budget Request includes $30.08 million for CTE, a decrease of $1.0 million below the FY 2012 Enacted level of $31.08 million. Funding for CTE is provided by the Directorates for Computer and Information Science and Engineering (CISE), Social, Behavioral, and Economic Sciences (SBE), and Education and Human Resources (EHR). Through CTE, NSF seeks to integrate advances in technology with advances in what is known about how people learn. Of particular interest are technological advances that allow more personalized learning experiences, draw in and promote learning among those in populations not served well by current educational practices, allow access to learning resources anytime and anywhere, and provide new ways of assessing capabilities. It is expected that cyberlearning research will shed light on how technology can enable new forms of educational practice and that broad implementation of its findings will result in a more actively-engaged and productive citizenry and workforce.

Enhancing Access to the Radio Spectrum (EARS)
NSF's FY 2014 Budget Request provides $50.0 million for EARS, an increase of $35.0 million above the FY 2012 Enacted level of $15.0 million (the first year of the EARS program was in FY 2012). EARS' purpose is to fund interdisciplinary research that can enhance the efficiency with which radio spectrum is used, and/or lead to improved access to wireless services for all Americans. The increased support for EARS in FY 2014 is a ramp-up that is consistent with the 2010 NSF supported workshop report,

Enhanced Access to the Radio Spectrum: A Path Forward[1], which highlighted the need for research on new and innovative ways to utilize the spectrum more efficiently. EARS is a collaboration among the Directorates for Computer and Information Science and Engineering (CISE), Engineering (ENG), and Mathematical and Physical Sciences (MPS).

Ethics Education in Science and Engineering (EESE)
NSF's FY 2014 Budget Request provides $2.44 million for EESE, a decrease of $310,000 below the FY 2012 Enacted level of $2.75 million. The EESE program aims to deepen the understanding of ethical dilemmas in science and engineering, and provide cutting edge, effective research and educational materials to train the next generation of scientists and engineers. It funds research and educational projects that improve ethics education in all fields of science and engineering supported by NSF. Although the primary focus is on improving ethics education for graduate students in NSF-funded fields, advanced undergraduates benefit as well. Funding for EESE is provided by BIO, CISE, ENG, GEO, SBE, and IIA.

Faculty Early Career Development (CAREER)
The FY 2014 Budget Request provides $223.73 million for the CAREER program, an increase of $17.38 million over the FY 2012 Enacted level of $206.35 million. This will support approximately 500 new CAREER awards, which support exceptionally promising college and university junior faculty who are committed to the integration of research and education and who are most likely to become the leaders in their fields. In December 2012, the CAREER Coordinating Committee convened a special Advisory Committee (AC) to examine CAREER and to provide strategic advice on the scope and direction of the program. A report from the committee is anticipated by the end of FY 2013. CAREER also participates in NSF's Career Life Balance (CLB) initiative; a ten-year initiative that integrates family-friendly practices into NSF's programs.

Graduate Fellowships and Traineeships
The FY 2014 Request provides $380.21 million for NSF's graduate fellowship and traineeship programs. This funding will enable NSF to support an estimated 7,200 graduate students, including 2,700 new graduate research fellows in FY 2014 as part of the expanded National Graduate Research Fellowship (NGRF) program, which will include new targeted opportunities to enable students to develop specialized expertise in critical areas.

- In FY 2014, NGRF will represent a flagship STEM graduate fellowship program for the federal government at a level of $325.14 million, an increase of $127.0 million over the FY 2012 Enacted level of $198.14 million. Funding for the program is divided equally between the Education and Human Resources account and the Research and Related Activities account. Through this expanded program, NSF will be able to award approximately 700 additional fellows bringing the total estimated number of new fellowships awarded in FY 2014 to 2,700. NGRF will provide fellows up to three years of support over a five-year period. For more information see the Major Investments in Science, Technology, Engineering, and Mathematics (STEM) Graduate Education narrative in this chapter. NGRF also participates in NSF's Career Life Balance (CLB) initiative; a ten-year initiative that integrates family-friendly practices into NSF's programs.

[1] www.nsf.gov/mps/ast/nsf_ears_workshop_2010_final_report.pdf

National Graduate Research Fellowship Program

	Total Number of Fellows	Number of New Fellows	Projected Fellows on Tenure[1]
FY 2013 Estimate	7,800	2,000	4,200
FY 2014 Estimate	8,900	2,700	6,200

[1]Fellowship tenure status is the period of time during which fellows actively utilize the fellowship award to pursue an advanced degree in the science, technology, engineering, or mathematics fields supported by NSF.

- In FY 2014, NSF will challenge the community to expand innovation in graduate education through the NSF Research Traineeships (NRT) program, the successor to the Integrative Graduate Education and Research Traineeship (IGERT) program. Funding at a level of $55.07 million is requested for NRT and will support an estimated 1,000 graduate students in FY 2014. $33.71 million of the requested funding is for continuing IGERT awards made in prior years and the remaining $21.36 million will support the design and implementation of traineeship programs in areas where new science is emerging and will introduce new approaches to preparing graduate students for a range of career options. For more information see the Major Investments in Science, Technology, Engineering, and Mathematics (STEM) Graduate Education narrative in this chapter.
- No funding is requested in FY 2014 for the NSF Graduate STEM Fellows in K-12 Education (GK-12) program as it was terminated.

Long-Term Ecological Research (LTER)

The FY 2014 Request provides $27.59 million, an increase of $190,000 above the FY 2012 Enacted level of $27.40 million. LTER supports fundamental ecological research that requires data collection over long time periods and often at large spatial scales. This program supports a loosely coordinated network of more than two dozen field sites that focus on: 1) understanding ecological phenomena that occur over long temporal and broad spatial scales; 2) creating a legacy of well-designed, long-term ecological experiments; 3) conducting major syntheses and theoretical efforts; and 4) providing information to identify and to address environmental problems. LTER projects represent a diversity of habitats in continental North America, the Caribbean, Pacific Ocean, and the Antarctic, including coral reefs, arid grasslands, estuaries, lakes, prairies, various forests, alpine and Arctic tundra, urban areas, and agroecosystems. The increased support for LTER in FY 2014 covers planned periodic increases to cover higher costs as sites are renewed. Funding for LTER is provided by BIO, GEO, and SBE.

In FY 2012, NEON infrastructure was co-located at eleven LTER sites. NEON is a continental-scale infrastructure facility providing standardized physical and data resources to researchers and educators. LTER is a network of long-term research projects aimed at understanding ecological processes in a wide range of ecosystems. Ongoing research at LTER sites may take advantage of data generated using NEON infrastructure. In addition, the co-location of NEON infrastructure at LTER sites will stimulate new research that builds on the long history of LTER research by enhancing the ability to extend site-based knowledge to regional and continental scales.

Research Experiences for Teachers (RET)

The FY 2014 Request for NSF's RET program totals $6.95 million, a decrease of $30,000 below the FY 2012 Enacted level of $6.98 million. Funding will provide pre-service and in-service K-12 teachers, and community college faculty with discovery-based learning experiences. The professional development gained by the participants through this unique experience has enriched their performance in the classroom and their guidance of students in science and engineering. Funding for RET is provided by BIO, CISE, ENG, GEO, and MPS.

Research Experiences for Undergraduates (REU)

In FY 2014, $79.18 million in funding is requested for the Research Experiences for Undergraduates (REU) Sites and Supplements program, an increase of $13.19 million over the FY 2012 Enacted level of $65.99 million. $10.00 million of this additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.* The request for FY 2014 reflects the importance of undergraduate research experiences in building students' interest and competence in STEM disciplines, and aligns with the Administration's focus on improving undergraduate STEM education. REU grants involve students at all stages of undergraduate education, including the freshman and sophomore levels, which enhances retention and graduation rates in STEM. REU Supplements allow students to join research projects that are supported by NSF research grants. REU Sites support cohorts of students to conduct research within STEM disciplines or on topics that cut across disciplines. Most of the students in an REU Site come from outside the host institution. This feature enables the program to involve students in research who might not otherwise have the opportunity, particularly students from institutions where research activities are limited. The REU program encourages partnerships between community colleges and baccalaureate degree-granting institutions to provide research opportunities for community college STEM students and faculty. Funding for REU is provided by BIO, CISE, ENG, GEO, MPS, and SBE.

Research in Undergraduate Institutions (RUI)

The FY 2014 Request for NSF's RUI program totals $39.95 million, or $200,000 below the FY 2012 Enacted level of $40.15 million. The RUI activity supports research by faculty members of predominantly undergraduate institutions through the funding of (1) individual and collaborative research projects, (2) the purchase of shared-use research instrumentation, and (3) Research Opportunity Awards for work with NSF-supported investigators at other institutions. Funding for RUI is provided by BIO, CISE, GEO, MPS, and SBE.

NATIONAL NANOTECHNOLOGY INITIATIVE (NNI)

NNI Funding

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$54.07	$56.10	$57.10
Computer and Information Science and Engineering	13.89	17.75	14.00
Education and Human Resources	2.50	-	2.50
Engineering	183.22	166.37	174.75
Geosciences	0.85	0.85	0.30
Mathematical and Physical Sciences	209.99	183.16	181.56
Social, Behavioral and Economic Sciences	1.67	1.67	0.60
International and Integrative Activities	0.10	0.10	0.10
Total, NNI	**$466.29**	**$426.00**	**$430.91**

Totals may not add due to rounding.

NSF's contribution to the multiagency National Nanotechnology Initiative (NNI) encompasses the systematic understanding, organization, manipulation, and control of matter at the atomic, molecular, and supramolecular levels in the size range of about 1 to 100 nanometers. Novel materials, devices, and systems – with their building blocks designed on the scale of nanometers – open up new directions in science, engineering, and technology with potentially profound implications for society. With the capacity to control and manipulate matter at this scale, science, engineering, and technology are realizing revolutionary advances in areas such as catalysts for industry; individualized pharmaceuticals; new drug delivery systems; order-of-magnitude faster computer chips; more resilient materials and fabrics; and sustainable development for water and energy resources utilization.

FY 2014 NNI Funding

NSF supports nanoscale science and engineering throughout all the research and education directorates as a means to advance discovery and innovation and integrate various fields of research. NNI enables increased interdisciplinarity at atomic and molecular levels for about 5,000 active awards with full or partial contents on nanoscale science and engineering (NSE). About 10,000 students and teachers will be educated and trained in nanoscale science and engineering in FY 2014. NSF contributes to the goals and eight program component areas (PCAs) outlined in the NNI Strategic Plan (www.nano.gov). Increases of $1.63 million in the Nanomanufacturing PCA and $1.91 million in the Nanomaterials PCA will be dedicated to research on breakthrough materials and advanced manufacturing as part of the Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS) NSF-wide investment, which coordinates and synchronizes activities across four main areas – breakthrough materials, advanced manufacturing, robotics, and smart systems – and allows interdependencies and common research elements to surface. Three Nanosystems Engineering Research Centers (NERC), with a total estimated budget of approximately $55.0 million for five years, were established in September 2012 and started full operation in FY 2013. Partnerships of new NERCs with small businesses in the areas of nanomanufacturing and commercialization will be strengthened while maintaining about the same level of NSF investment. In FY 2014 the agency continues its contributions to translational innovation programs, including Grant Opportunities for Academic Liaison with Industry (GOALI); Industry/University Cooperative Research Centers (I/UCRC); the NSF Innovation Corps (I-Corps) program; and the two subcomponents of Partnerships for Innovation (PFI) – Accelerating Innovation Research (AIR) and

Building Innovation Capacity (BIC). The NSF Small Business Innovation Research (SBIR) program has an ongoing nanotechnology topic with subtopics for nanomaterials, nanomanufacturing, nanoelectronics and active nanostructures, nanotechnology for biological and medical applications, and instrumentation for nanotechnology. Overall, NNI funding in the FY 2014 Request will increase by $4.91 million, or 1.2 percent, over the FY 2012 Enacted.

A portion of NSF's FY 2014 NNI funding is for the NNI Signature Initiatives. FY 2014 funding for the Nanoelectronics for 2020 and Beyond Signature Initiative is $42.83 million, which is distributed in the Fundamental Nanoscale Phenomena and Processes, Nanomaterials, and Nanoscale Devices PCAs. These three PCAs also include FY 2014 funding of $31.67 million for the Nanotechnology for Solar Energy Collection and Conversion Signature Initiative. In addition, FY 2014 funding of $23.40 million for Sustainable Nanomanufacturing is contained within the Nanomanufacturing PCA, funding of $7.0 million for Nanotechnology for Sensors and Sensors for Nanotechnology Signature Initiative within Nanoscale Devices and Systems PCA, and funding of $20.0 million for Nanotechnology Knowledge Infrastructure across all PCAs.

In FY 2014, NSF will continue its funding for the Environmental, Health and Safety (EHS) PCA at $28.96 million, representing nearly seven percent of its overall NNI budget. Requests for research are primarily directed at environmental, health, and safety implications and methods for reducing the respective risks of nanotechnology development.

NSF sponsored an international study on long-term research entitled "Nanotechnology Research Directions for Societal Needs in 2020" (NSF/WTEC 2010, Springer, available on www.nsf.gov/nano and www.wtec.org/nano2/). It provides assessment of nanotechnology development in the last ten years (2000-2010) and a long-term vision of the field in the next decade (2010-2020). This study evaluates the outcomes as recommended by the first report "Nanotechnology Research Directions: A vision for the next decade" (1999), adopted as an official document of the National Science and Technology Council (NSTC).

Fundamental Nanoscale Phenomena and Processes

The FY 2014 Request includes $148.78 million, an increase of $2.49 million over the FY 2012 Enacted, for fundamental research and education. Special emphasis will be on:

- Novel phenomena, quantum control, selfassembling, and basic engineering processes at the nanoscale – to discover and understand phenomena and design processes specific at the nanoscale, including new phenomena in materials, mechanics, chemistry, biology, electronics, and optics. Potential applications include quantum information systems, novel products by multiscale selfassembling, and new devices and sensors for industry and environmental monitoring. A new focus will be on understanding complex and emerging behavior of nanosystems, and creating nanomaterials and nanosystems by computational design.
- Biosystems at the nanoscale – to support study of biologically-based or -inspired systems that exhibit novel properties and potential applications. Potential applications include improved drug delivery; biocompatible nanostructured materials for implantation; exploiting of functions of cellular organelles; devices for research in genomics; proteomics and cell biology; food and plant systems; and nanoscale sensory systems, such as miniature sensors for early detection of cancer. A focus will be on the understanding of structure and function and simulation of cells, tissues, and nervous systems.
- Converging science and engineering at the nanoscale – to support the convergence of nanotechnology with information technology, modern biology, and social sciences – potentially reinvigorating discoveries and innovation in almost all areas of the economy. Examples are the nano-biology interface, the nano-information interface, and nano-neurosciences.

- Multi-scale, multi-phenomena theory, modeling, and simulation at the nanoscale – to support theory, modeling, large-scale computer simulation and new design tools, and infrastructure in order to understand, control, and accelerate development in new nanoscale regimes and systems. A special focus will be on simulations with atomic precision, time resolution of chemical reactions, and for domains of engineering and biological relevance.
- NNI Signature Initiatives – to support the NNI Signature Initiatives, as well as planning for nanotechnology for regenerating the human body and nanostructured catalysts for green manufacturing.
- Advanced Manufacturing Technologies – to support research in the Directorate for Engineering (ENG) and the Directorate for Computer and Information Science and Engineering (CISE) on advanced manufacturing technologies. A portion of this funding supports CISE's participation in the Nanoelectronics for 2020 and Beyond Signature Initiative.

Nanomaterials
The FY 2014 Request includes $80.71 million, an increase of $1.91 million over the FY 2012 Enacted level, for discovery of novel nanoscale and nanostructured materials, and improving the comprehensive understanding of the properties of nanomaterials (ranging across length scales and including interface interactions). A special focus will be design and synthesis, in a controlled manner, of nanostructured materials with targeted properties. Research on the discovery, understanding, and control of materials at the nanoscale will be critical to the development and success of innovative technologies, including advances in electronics in science and engineering beyond Moore's Law, catalysts, energy, healthcare, and manufacturing.

Nanoscale Devices and Systems
The FY 2014 Request includes $51.08 million, a decrease of $1.35 million from the FY 2012 Enacted level, for R&D that applies the principles of nanoscale science and engineering to create novel, or to improve existing, devices and systems. A research focus will be on the architecture and emerging behavior of nanosystems, and on nanomanufacturing of active nanostructures and nanosystems. Nanoelectronics beyond silicon nanotechnology and complementary metal-oxide superconductors (CMOS) research will explore the ultimate limits to scaling of features and alternative physical principles for devices employed in sensing, storage, communication, and computation. The research activity in this area will help develop innovative technologies, including replacing electron charge as information carrier, bottom-up device assembly technologies at the atomic and molecular levels, and new system architectures using nanoscale components. Another focus will be on building biosystems and to regenerate the human body. An additional area of emphasis will be nano-informatics for better communication and nanosystem design.

Instrumentation Research, Metrology, and Standards for Nanotechnology
The FY 2014 Request includes $11.98 million for R&D to create new tools needed to advance nanotechnology research and commercialization. Special challenges are developing tools for measuring and restructuring matter with atomic precision, for time resolution of chemical reactions, and for domains of biological and engineering relevance. Another focus is on developing on-line process instrumentation for nanoscale characteristics.

Nanomanufacturing
The FY 2014 Request includes an increase of $1.63 million above the FY 2012 Enacted level, to $49.40 million, to support new concepts for high-rate synthesis and processing of nanostructures, nanostructured catalysts, nanobiotechnology methods, fabrication methods for devices, and assembling them into nanosystems and then into larger scale structures of relevance to industry and to the medical field. R&D is aimed at enabling scaled-up, reliable, cost effective manufacturing of nanoscale materials, structures, devices, and systems. Advanced semiconductor and optical device design, fabrication and processing, for

application in biomedical, alternative energy, communications, computing and sensing systems, will be pursued both through support of the centers and the core programs. The NNI Signature Initiative on Sustainable Nanomanufacturing will support processes and techniques for continuous and scalable nanomanufacturing with a focus on three classes of sustainable materials—high-performance structural carbon-based nanomaterials, optical metamaterials, and cellulosic nanomaterials. CISE will support fabrication of new reconfigurable, evolvable, adaptive hardware architectures and the use of heterogeneous systems that can dynamically change via software mechanisms and architectures capable of combating error-prone devices at the nanoscale. The Foundation will continue to support four NSECs (Nanoscale Science and Engineering Centers) that focus on manufacturing at the nanoscale. Those centers and the National Nanotechnology Infrastructure Network (NNIN) have strong partnerships with industry, national laboratories, and international centers of excellence, which puts in place the necessary elements to bring discoveries in the laboratory to real-world, marketable innovations and technologies. The NSECs with a focus on nanomanufacturing are: the Center for Hierarchical Manufacturing (CHM), the Center for Scalable and Integrated Nanomanufacturing (SINAM), the Center for High-rate Nanomanufacturing (CHN), and the Center for Nano-Chemical-Electrical-Mechanical Manufacturing Systems (Nano-CEMMS). NSF also supports the National Nanomanufacturing Network (NNN), which includes the NSF NSECs and non-NSF centers in collaboration with the Department of Defense (DOD), National Institute of Standards and Technology (NIST), and industry partners in an alliance to advance nanomanufacturing strength in the U.S. The FY 2014 Request increase is primarily associated with an additional funding for research on sustainable nanomanufacturing.

Major Research Facilities and Instrumentation Acquisition

The FY 2014 Request includes $28.69 million for user facilities, acquisition of major instrumentation, and other activities that develop, support, or enhance the scientific infrastructure required for the conduct of nanoscale science, engineering, and technology research and development. It also supports ongoing operations of the National Nanotechnology Infrastructure Network (NNIN), the Network for Computational Nanotechnology (NCN), NNN, and the National High Magnetic Field Laboratory (NHMFL). The networks had about 190,000 users in FY 2012. The investment will support facilities for ongoing NSECs. In addition, the FY 2014 Request will support planned growth supplements to the first class of three new NERCs funded in FY 2012.

Environmental, Health, and Safety

The FY 2014 Estimate includes $28.96 million for research primarily directed at environmental, health, and safety (EHS) implications and methods for reducing the prospective risks of nanotechnology development. NSF, the Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), and the European Union (EU) will continue collaboration on development of a joint solicitation for nanotechnology EHS. A focus will be on implications of the next generation of nanotechnology products and productive processes, as well as public participation in nanotechnology-related activities. Research on both implications and applications of nanotechnology will address the sources of nanoparticles and nanostructured materials in the environment (in air, water, soil, biosystems, and working environments), as well as the non-clinical biological implications. Research on the safety of manufacturing nanoparticles is included in seven NSECs and NNIN. Environmental implications of nanotechnology, including development of new measurement methods for nanoparticle characterization and toxicity of nanomaterials will be investigated in two dedicated multidisciplinary centers (Centers for Environmental Implications of Nanotechnology at UCLA and Duke University). These centers aim to conduct fundamental research on the interactions between nano-particles and -materials and the living world at all scales. An essential element of this will be research on methods and instrumentation for nano-particle detection, characterization, and monitoring, including interactions of nano-materials with cellular constituents, metabolic networks and living tissues, bioaccumulation and its effects on living systems, and the impacts of nanostructures dispersed in the environment.

Education and Societal Dimensions

The FY 2014 Request includes $31.31 million for research and other activities that address the broad implications of nanotechnology for society, including education and social aspects, such as:

- Education-related activities, such as development of materials for schools, curriculum development for nanoscience and engineering, development of new teaching tools, undergraduate programs, technical training, and public outreach ($27.06 million). Two networks for nanotechnology education with national outreach will be supported.
- Research directed at identifying and quantifying the broad implications of nanotechnology for society, including social, economic, workforce, educational, ethical, and legal implications ($4.25 million). The application of nanoscale technologies will stimulate far-reaching changes in the design, production, and use of many goods and services. NSF also supports a project to embed humanists and social scientists for greater collaboration in nanoscience around the world, providing a model for future integration of ethicists and social scientists into nanotechnology R & D laboratories.

Coordination with Other Agencies

The NSF program is coordinated with 25 departments and agencies through the NSTCs subcommittee on Nanoscale Science, Engineering and Technology (NSET). Examples of specific coordination efforts are: Sustainable Nanomanufacturing (with NIST, Department of Energy (DOE), EPA, Intelligence Community (IC), National Institutes of Health (NIH), National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Department of Agriculture USDA/FS); Nanoelectronics (with NIST, DOD, DOE, IC/DNI, NASA) Environmental issues (with EPA, USDA/NIFA, Consumer Product Safety Commission (CPSC)); Solar energy conversion (with DOE, , IC/DNI, National Aeronautics and Space Administration (NASA), NIST, NSF, USDA/NIFA); NSECs, NNIN and NCN centers and networks (DOD, NASA, DOE, NIH); nano-sensors (with NIH, and USDA) simulations in nanoelectronics (DOD/NASA); research and training activities (DOD/NIH); NSF awards supplements for student participation in the Sandia National Lab "National Institute for Nano-Engineering" Summer Scholars Program. Joint workshops are sponsored on nanotechnology research directions and grantees conferences with all NNI agencies.

NNI by Program Component Area

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
1. Fundamental Nanoscale Phenomena & Processes	$167.59	$146.29	$148.78
2. Nanomaterials	78.83	78.80	80.71
3. Nanoscale Devices & Systems	62.63	52.43	51.08
4. Instr. Research, Metrology, & Standards for Nanotech	13.06	12.05	11.98
5. Nanomanufacturing	44.37	47.77	49.40
6. Major Research Facilities & Instrumentation Acquisition	38.78	28.53	28.69
7. Environmental Health & Safety	24.20	30.01	28.96
8a. Education	31.43	24.79	27.06
8b. Societal Dimensions (ELSI)	5.40	5.33	4.25
Total, NNI	**$466.29**	**$426.00**	**$430.91**

Totals may not add due to rounding.

NETWORKING AND INFORMATION TECHNOLOGY RESEARCH AND DEVELOPMENT (NITRD)

Total Funding for NITRD
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$99.00	$99.00	$99.00
Computer and Information Science and Engineering [1]	937.11	865.23	950.25
Education and Human Resources	9.50	9.50	9.50
Engineering	18.30	18.30	19.80
Geosciences	20.00	22.98	24.00
Mathematical and Physical Sciences	101.25	93.75	94.15
Social, Behavioral, and Economic Sciences	31.09	29.51	30.70
Total	**$1,216.25**	**$1,138.27**	**$1,227.40**

Totals may not add due to rounding.

[1] FY 2012 Actual includes obligations $71.59 million over the enacted level for CISE due to recoveries of prior year unpaid obligations that were reobligated in FY 2012.

The National Science Foundation is a primary federal agency supporting the Networking and Information Technology Research and Development (NITRD) program. NSF's NITRD portfolio includes all research, infrastructure, and education investments in the Directorate for Computer and Information Science and Engineering (CISE), as well as contributions from all directorates across the agency, enabling investments in every NITRD Program Component Area (PCA). NSF's Assistant Director for CISE is co-chair of the NITRD Subcommittee of the National Science and Technology Council's Committee on Technology. In addition, NSF works in close collaboration with other NITRD agencies and participates at the co-chair level in five of the seven PCA Coordinating Groups and all of the Senior Steering Groups.

NSF's FY 2014 Request continues strong support for NITRD at a level of $1.23 billion, a 7.8 percent increase over the FY 2012 Enacted level. NITRD activities represent approximately 16 percent of NSF's FY 2014 budget. CISE's support comprises 77.4 percent of NSF's NITRD activities.

Several NSF-wide investments, both new and continuing, are reflected in various NITRD PCAs:

- Advanced Manufacturing investments encompass research in nanotechnology, cyber-physical systems, and robotics, as well as expanded industry/university cooperation. Activities are supported in High End Computing Research and Development (R&D), High End Computing Infrastructure and Applications (I&A), and High Confidence Software and Systems.
- The Comprehensive National Cybersecurity Initiative (CNCI) supports activities in Cybersecurity and Information Assurance.
- Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS) expands advanced manufacturing technologies research in the Cyber-Physical Systems (CPS) program, and the National Robotics Initiative (NRI) to accelerate advances in 21st century smart engineered systems. CEMMSS will begin to establish a scientific basis for engineered systems interdependent with the physical world and social systems, synthesize multi-disciplinary knowledge to model and simulate systems in their full complexity and dynamics, and develop a smart systems technology framework. CEMMSS supports activities in High End Computing R&D; High Confidence Software and Systems; Human-Computer Interaction and Information Management; Software Design and Productivity; and Social, Economic, and Workforce Implications of IT and IT Workforce Development.

- Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21), designed to develop and deploy comprehensive, integrated, sustainable, and secure cyberinfrastructure to accelerate research and new functional capabilities in computational and data-intensive science and engineering, primarily supports investments in six program component areas: High End Computing R&D; High End Computing I&A; Large Scale Networking; Human-Computer Interaction and Information Management; Software Design and Productivity; and Social, Economic, and Workforce Implications of IT and IT Workforce Development.
- Enhancing Access to the Radio Spectrum (EARS), which invests in wireless communication, spectrum sharing, and mobile computing, as well as the development of wireless testbeds, is supported in Large Scale Networking, High End Computing R&D, and High End Computing I&A.
- The National Robotics Initiative (NRI), a cross-agency initiative engaging four U.S. agencies (NSF, National Aeronautics and Space Administration, National Institutes of Health and the U.S. Department of Agriculture) provides U.S. leadership in robotics science and engineering research and education aimed at the development of co-robots, which work cooperatively with humans in application domains, such as advanced manufacturing, emergency response, and assistive healthcare. Activities are supported in Human-Computer Interaction and Information Management; High Confidence Software and Systems; and Social, Economic, and Workforce Implications of IT and IT Workforce Development.
- Secure and Trustworthy Cyberspace (SaTC) aligns NSF cybersecurity investments with the President's national cybersecurity strategy, *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program*. SaTC supports scientific foundations, induces change, maximizes research impact, and accelerates transitions to practice. SaTC supports activities in Cybersecurity and Information Assurance.
- The Science, Engineering, and Education for Sustainability (SEES) investment supports activities in High End Computing R&D; Large Scale Networking; Software Design and Productivity; and Social, Economic, and Workforce Implications of IT and IT Workforce Development.

FY 2014 NSF Investments by Program Component Area (PCA)
The following information focuses on FY 2014 NSF investments, both new and continuing, by PCA.

Large Scale Networking (LSN) ($136.34 million) CISE and ENG will support research in new wireless communications, spectrum sharing architectures and services, and mobile computing, as well as development of wireless testbeds as part of EARS. A portion of NSF's investment in CIF21 will address broadband applications and research on end-to-end performance from the desktop to major scientific and computational facilities.

Cybersecurity and Information Assurance (CSIA) ($114.28 million) CSIA includes support for the CNCI and for NSF's SaTC program. CISE investments in SaTC, in partnership with EHR, ENG, MPS, and SBE, aim to support scientific foundations, induce change, maximize research impact, and accelerate transition to practice.

High-End Computing R&D (HEC R&D) ($113.57 million) Support is provided for CISE's nanotechnology research, including participation in the National Nanotechnology Initiative. HEC R&D also includes support for NSF's investment in SEES, focusing on research that will develop the theory and design principles to effectively tackle energy versus computation and communication tradeoffs and the development of new theory, algorithms, and design principles to optimize energy-computational performance in computing and communications systems. HEC R&D also includes support for CIF21 to develop new functional capabilities in support of highly parallel computing and BIGDATA analytics, as well as research on technical and economic models for flexible spectrum access, real-time auctions, and on-demand spectrum services as part of EARS. MPS, through the Division of Materials Research, will

support research on quantum effects and their use for information science, potentially leading to new paradigms for high-end computing.

High-End Computing Infrastructure and Applications (HEC I&A) ($248.44 million) HEC I&A includes increased efforts by CISE's Division of Advanced Cyberinfrastructure (ACI) to develop software and algorithms for high-end computing systems. It also includes MPS and ENG investments in new computational methods, algorithms, robust software, and other computational tools to support researchers in the mathematical and physical sciences and engineering. The CISE investment in computational infrastructure as part of CIF21 is reflected here, as well as the development of wireless testbeds that support experimentation with new wireless technology services as part of EARS. GEO supports EarthCube, a CIF21 investment that sustains cyberinfrastructure for the geosciences. HEC I&A also includes investments in innovative partnerships and collaborations between universities and industries, including the Industry/University Cooperative Research Centers program (I/UCRC); GEO's support for operations and maintenance for the NCAR Wyoming Supercomputer facility; and BIO's support for development of pioneering informatics tools and resources that have the potential to transform research in biology.

High Confidence Software and Systems (HCSS) ($103.27 million) CISE and ENG will increase investments in NRI and in CPS as part of CEMMSS as well as continue investments in Smart and Connected Health. As development of the next generation of robotics proceeds, complete confidence in the systems supporting those that work beside, or cooperatively with, people in application domains, such as advanced manufacturing, emergency response, and healthcare, become increasingly important. High confidence surgical robots and medical devices are central to high quality healthcare and building trust in robotic aids. CISE and ENG will support advanced manufacturing technologies research in cyber-physical systems, such as smart infrastructure that will blend traditional concrete-and-steel physical infrastructure systems with cyber-infrastructure systems such as computers, networks, and sensors. BIO's support for HCSS will expand and enhance access to the national resource of digital biological and paleontological data, and the Bio/computation Evolution in Action CONsortium (BEACON) Center established to study the power of evolutionary processes and to transfer those discoveries from biology into computer science and engineering design.

Human Computer Interaction and Information Management (HCI&IM) ($299.90 million) HCI&IM includes CISE support for the National Robotics Initiative, part of CEMMSS, as well as support for Smart and Connected Health. As part of the next generation of robotics, co-robot systems will be characterized by their flexibility and resourcefulness. They will use a variety of modeling or reasoning approaches, and use real-world data in real-time, demonstrating a level of intelligence and adaptability seen in humans and animals. Research in Smart and Connected Health will focus on human-centered intelligent information systems and tools that collect, mine, synthesize, protect, and share appropriate data and knowledge with healthcare organizations, practitioners, caregivers, and individuals to enable effective, safe, and well-informed decision-making by all stakeholders. HCI&IM also includes NSF investments in CIF21 related to BIGDATA analytics and visualization tools, and the development of mid-scale pilots and prototypes toward a comprehensive, scalable data infrastructure. BIO investments in HCI&IM will facilitate discovery through tools that integrate the published literature with the expanding universe of digital data collections, expand capacity for understanding through virtual environments, and make it practical for scientists to search vast collections of biological images simply and quickly. MPS investments will focus on the provision of new automated data-analysis pipelines that will provide initial reference images for the data-rich radio interferometers that are just coming on line, with analysis tools and guidance for those scientists who need to interact with the data in order to achieve image fidelities beyond those that can be delivered using automated processing techniques. SBE will continue investments to increase the benefit of computer technologies to scientists, as well as non-science users, facilitate opportunities for SBE researchers to understand human behavior and cognition and the effectiveness of virtual organizations in

the context of 21st century networked society (via CIF21) and focus on research that advances the core scientific and technological means of managing, analyzing, visualizing, and extracting information from large data sets.

Software Design and Productivity (SDP) ($89.61 million) SDP support reflects increased investment in CIF21 with a focus on software sustainability, and new research on smart systems as part of CEMMSS. ENG's support for this PCA is primarily associated with the CPS and NRI components of the CEMMSS investment. CISE will make investments in the Software Institutes for Sustained Innovation (SI^2) program to catalyze new thinking, paradigms, and practices in developing and using software that is robust, reliable, usable, and sustainable under the CIF21 umbrella. BIO support for SDP includes support for the interagency and international Collaborative Research in Computational Neuroscience program. BIO funds research involving the development of software and other computational tools to advance biological knowledge, as well as computational innovations. SDP also includes support for SBE's National Center for Science and Engineering Statistics (NCSES) to continue exploration of new methods to enhance data collections, analysis, and sharing capabilities, which will help NCSES better serve its role of providing information on the science and engineering enterprise. In addition, SBE will continue to partner with CISE in exploring the emerging interface between computer science and social and behavioral science.

Social, Economic, and Workforce (SEW) Implications of IT and IT Workforce Development ($121.99 million) As part of NRI, SEW research in CISE will focus on human-centered research in developing service robots, requiring significant advances in human-robot interaction. In addition, CISE's continued emphasis on Smart and Connected Health focuses on, for example, improvements in safe, effective, efficient, and patient-centered proactive and predictive health and wellness technologies. This also reflects CISE support for BIGDATA and e-science collaboration tools as part of CIF21, and support for cyberlearning and on-line education programs. Research in cyberlearning will integrate advances in technology with learning, design new technologies for integration in learning environments, and evaluate their use. EHR will continue to study the impact of information and communication technology on educational practice, new approaches to using technology in education, application and adaptation of technologies to promote learning in a variety of fields and settings, the effects of technology of learning, and efforts that advance teaching and learning opportunities utilizing cyberinfrastructure. These efforts also will support science, technology, engineering, and mathematics education for the cyber-workforce through workforce programs and research and development in learning sciences. BIO support for SEW focuses on advancing the Nation's ability to incorporate and apply biological knowledge to economic development and other issues of societal importance. SBE will continue to support the social, economic, and workforce aspects of information technology, focusing on the nature and dynamics of IT impacts on technical and social systems.

NITRD Funding by Program Component Area

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Large Scale Networking	$127.55	$121.76	$136.34
Cybersecurity and Information Assurance	99.20	98.49	114.28
High End Computing R&D	109.59	102.98	113.57
High End Computing Infrastructure and Applications[1]	329.27	249.96	248.44
High Confidence Software and Systems	88.36	84.67	103.27
Human-Computer Interaction and Info Management	270.62	291.98	299.90
Software Design and Productivity	85.20	78.26	89.61
Social, Economic, and Workforce	106.46	110.17	121.99
Total	**$1,216.25**	**$1,138.27**	**$1,227.40**

Totals may not add due to rounding.

[1] FY 2012 Actual includes obligations $71.59 million over the enacted level for CISE due to recoveries of prior year unpaid obligations that were reobligated in FY 2012.

U.S. GLOBAL CHANGE RESEARCH PROGRAM (USGCRP)

Total Funding for USGCRP

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Biological Sciences	$89.00	$89.00	$91.00
Geosciences	217.10	217.10	205.15
Mathematical and Physical Sciences	5.03	5.03	7.00
Social, Behavioral and Economic Sciences	22.23	22.23	23.23
Total	**$333.36**	**$333.36**	**$326.38**

Totals may not add due to rounding.

Climate and global change effects on the U.S. through impacts on the environment, natural resources, and the economy are pervasive. Global change encompasses a wide range of planetary- and regional-scale changes in the Earth's natural and human systems. These changes involve atmospheric and ocean circulation and composition, the water cycle, biogeochemical cycles, land and sea ice, biological diversity, marine and terrestrial ecosystem health, resource and land use, urbanization, economic development, and more. The U.S. Global Change Research Program (USGCRP) provides the Nation and the world with the scientific knowledge necessary for understanding and predicting climate change and environmental responses, managing risk, and anticipating opportunities that may result from changes in climate and climate variability. Research conducted through the USGCRP (www.globalchange.gov) builds on the scientific advances of recent decades and deepens our understanding of how the interplay between human and natural systems affects the climate system, and how the changing climate impacts those systems. The USGCRP involves thirteen U.S. agencies in a concerted interagency program of basic research, comprehensive observations, integrative modeling, and new approaches for translating scientific information for use by decision-makers. NSF provides support for a broad range of fundamental research activities that provide a sound scientific basis for climate-related policy and decisions.

The Earth's climate is determined by highly complex interactions between and among the atmosphere, hydrosphere, cryosphere, geosphere, and biosphere – all significantly influenced by human activities. NSF programs address these components by investing in: fundamental discovery that utilizes the full range of intellectual resources of the scientific community; research infrastructure that provides advanced capabilities; and innovative educational activities. NSF strongly encourages interdisciplinary approaches, and focuses on fundamental Earth system processes and the consequences of change. High priorities for the agency include: data acquisition and information management activities necessary to support, and disseminate the results of, global change research; the enhancement of models designed to improve our understanding of Earth system processes and of feedbacks between ecosystems and the physical climate; the development of new, innovative Earth observing instruments and networks; the development of advanced analytic research methods; and preparation of a scientific workforce equipped to deal with the complexities of global change. NSF also supports fundamental research on the processes used by organizations to identify and evaluate policies for mitigation, adaptation, and other responses to varying environmental conditions. NSF-supported research on the science of impacts, vulnerability and resilience as well as the enhancement and development of a range of climate and process models will continue to make an important contribution to climate assessment activities.

FY 2014 Areas of Emphasis

NSF's FY 2014 investment in USGCRP decreases by $6.98 million, or 2.1 percent, below the FY 2012 Enacted Level. NSF's USGCRP investments reflect two major integrated NSF initiatives, the Science, Engineering, and Education for Sustainability (SEES) and the Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21). The major USGCRP foci in FY 2014 include:

Improving our knowledge of Earth's past and present climate variability and change – NSF investments include activities to document and understand long-term climate cycles across the globe, as well as to better understand the natural variability of climate and the processes responsible for climate changes using a range of paleoclimate and instrumental data and modeling approaches. NSF also supports activities to improve our understanding of the frequency and intensity of extreme climate events in the past and how those may be manifested in the future. Upgrading and expanding critical environmental observing systems and ensuring data quality and access are integral parts of NSF's investments that will be supported under the CIF21 portfolio.

Improving our understanding of natural and human forces of climate change – NSF activities in this area span a broad range of disciplines and topics that seek to better understand the physical, geological, chemical, biological, and human components of the Earth system and their interactions. Examples of major foci include fundamental research on all aspects of the carbon cycle, the water cycle, atmospheric composition and greenhouse gas processes, marine and terrestrial ecosystems, and ocean and atmospheric circulations that both drive and respond to climate and global change. Human drivers of change include urbanization, population growth, and economic development. NSF has a strong commitment to fostering new interdisciplinary research approaches that allow exploration of the interdependencies across these areas. Such efforts will be enhanced with the sustainability focus under the SEES portfolio.

Improving our capability to model and predict future conditions and impacts – NSF-supported research will examine major feedback processes between the climate and natural and human systems and will incorporate these into the next generation Community Earth System Model (CESM). High priority will be given to developing more complete representations of coupled interactive atmospheric chemistry, terrestrial and marine ecosystems, biogeochemical cycling, and middle atmospheric processes. NSF will continue to devote significant resources to advancing climate modeling capabilities from global and centennial to regional and decadal scales. In addition, NSF is encouraging the development of ecosystem and water models at regional scales, as well as models that integrate human system components such as risk, vulnerability, and decision-making. These efforts will depend on new computational resources and tools that will be developed through the CIF21 efforts.

Assessing the Nation's vulnerability to current and anticipated impacts of climate change – A key focus of the USGCRP is developing better means of assessing the impacts of climate change and the vulnerability and resilience of both human and natural systems to those changes, particularly in highly sensitive regions such as the Arctic. NSF supports the basic research that underpins the National Climate Assessment effort, particularly in developing the range of models needed for these assessments. NSF will support fundamental research regarding the science of adaptation, defined as the adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects. This research ranges from developing the theoretical framework for evaluating adaptation options (and avoiding unintended consequences of adaptation choices) to risk assessment and decision making. Through SEES, NSF will continue interdisciplinary research (including human factors) in water sustainability, biodiversity, ocean acidification, and vulnerable areas such as the Arctic.

Providing climate information and decision support tools – NSF supports basic research on how humans impact climate and other natural systems, how people respond to changing natural conditions, and how human and natural systems engage in complex interactions across multiple spatial, temporal, and

organizational scales. Support will continue for basic research on decision making under uncertainty associated with climate change, as well as for developing and testing decision-support tools that can be used by stakeholders to improve their decision making processes.

USGCRP Funding by Program Component Area

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request
Integrated Observations	$81.36	$81.36	$78.00
Multidisciplinary Earth and Human System Understanding	198.19	198.19	194.85
Integrated Modeling	39.31	39.31	37.78
Science of Adaptation and Science to Inform Adaptation Decision	10.00	10.00	15.75
Communication and Education	4.50	4.50	-
Total	**$333.36**	**$333.36**	**$326.38**

Totals may not add due to rounding.

PERFORMANCE

NSF PERFORMANCE FRAMEWORK

Introduction

Per the GPRA Modernization Act, this chapter contains basic information about NSF's mission, strategic plan, and priority goals, as well as NSF's Annual Performance Plan for FY 2014 and Annual Performance Report for FY 2012. Information about NSF's performance can be found on the federal site performance.gov, which is updated quarterly with information about Agency and Cross-Agency Priority Goal achievement, and on the NSF site in the Performance and Financial Highlights Report.[1] NSF's site also includes NSF's Annual Financial Report[2], published in November 2012, which includes a preliminary discussion of NSF's FY 2012 performance. As anticipated in that report, NSF achieved most of its goals in FY 2012. Three of NSF's 18 goals were not achieved.

The Overview chapter of this Request highlights NSF's priorities for key program investments and organizational efficiencies. NSF's Performance Plan for FY 2014 underscores these priorities. In FY 2014, NSF will monitor six "key program investments" with a common set of milestones and indicators to ensure that critical targets are met. This performance goal represents a more comprehensive approach than our previous goals in FY 2011-2013 that focused on two specific investments.

The FY 2014 Performance Plan also highlights the increased emphasis on NSF leadership in STEM education. NSF has set two goals which build on previous Priority Goals and help define its leadership role in science, technology, engineering, and mathematics (STEM) undergraduate and graduate education: the implementation of Catalyzing Advances in Undergraduate STEM Education (CAUSE) and the expansion of the Graduate Research Fellowship program to include a wide range of career development opportunities.

The FY 2014 Plan also includes goals that focus on responsible stewardship of research resources (Research Infrastructure Investments), efficiency (Virtual Merit Review Panels, Modernize Financial Systems, Data-driven Management Reviews), and inclusion (Diversity and Inclusion, Career-Life Balance).

Mission Statement

The NSF Act of 1950 (Public Law 81-507) states the Foundation's mission: "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes."

For information about NSF's organizational structure and scope of responsibilities, see the Overview chapter of this Request.

Strategic Plan and Performance Goals

NSF's Strategic Plan, *Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years (FY) 2011-2016*[1], lays out three strategic goals—Transform the Frontiers, Innovate for Society, and Perform as a Model Organization—that relate directly to this mission. This goal structure enables NSF to link its investments to longer-term outcomes. To bridge the gap between these strategic

[1] www.nsf.gov/about/performance
[2] www.nsf.gov/pubs/2013/nsf13002/nsf13002.pdf

goals and measurable outputs, the Strategic Plan establishes a set of performance goals (also called strategic objectives) for each strategic goal:

Strategic Goal	**Strategic Objectives / Performance Goals**
Transform the Frontiers (T) emphasizes the seamless integration of research and education as well as the close coupling of research infrastructure and discovery.	T-1: Make investments that lead to emerging new fields of science and engineering and shifts in existing fields. T-2: Prepare and engage a diverse science, technology, engineering, and mathematics (STEM) workforce motivated to participate at the frontiers. T-3: Keep the United States globally competitive at the frontiers of knowledge by increasing international partnerships and collaborations. T-4: Enhance research infrastructure and promote data access to support researchers' and educators' capabilities and to enable transformation at the frontiers.
Innovate for Society (I) points to the tight linkage between NSF programs and societal needs, and it highlights the role that new knowledge and creativity play in economic prosperity and society's general welfare.	I-1: Make investments that lead to results and resources that are useful to society. I-2: Build the capacity of the nation's citizenry for addressing societal challenges through science and engineering. I-3: Support the development of innovative learning systems.
Perform as a Model Organization (M) emphasizes the importance to NSF of attaining excellence and inclusion in all operational aspects.	M-1: Achieve management excellence through leadership, accountability, and personal responsibility. M-2: Infuse learning as an essential element of the NSF culture with emphasis on professional development and personal growth. M-3: Encourage and sustain a culture of creativity and innovation across the agency to ensure continuous improvement and achieve high levels of customer service.

Agency Priority Goals

NSF has set three priority goals for accomplishment in FY 2012 and FY 2013. These goals cover the range of programmatic activities that NSF supports, from basic research to training of the science and engineering workforce to education of the general public.

The information on the following pages about the FY 2012-2013 Goals is also available on NSF's performance.gov page. For more information about FY 2012 activities, see performance.gov or the Annual Performance Report.

FY 2012-FY 2013 NSF Agency Priority Goals		
Goal Short Title	**Impact Statement**	**Goal Statement**
NSF Innovation Corps	Increase the number of entrepreneurs emerging from university laboratories.	By September 30, 2013, 80 percent of teams participating in the NSF Innovation Corps program will have tested the commercial viability of their product or service.
Access to Digital Products of NSF-Funded Research	Increase opportunities for research and education through public access to high-value digital products of NSF-funded research.	By September 30, 2013, NSF will have established policies for public access to high-value data and software in at least two data-intensive scientific domains.
Undergraduate Programs	Develop a diverse and highly qualified science and technology workforce.	By September 30, 2013, 80 percent of institutions funded through NSF undergraduate programs document the extent of use of proven instructional practices.

Cross-Agency Priority (CAP) Goals

Per the GPRA Modernization Act requirement to address Cross-Agency Priority Goals in the agency Strategic Plan, the Annual Performance Plan, and the Annual Performance Report, please refer to www.performance.gov. NSF currently contributes to the following CAP Goals:

- Science, Technology, Engineering, and Mathematics (STEM) Education. In support of the President's goal that the U.S. have the highest proportion of college graduates in the world by 2020, the federal government will work with education partners to improve the quality of science, technology, engineering and math (STEM) education at all levels to help increase the number of well-prepared graduates with STEM degrees by one-third over the next 10 years, resulting in an additional 1 million graduates with degrees in STEM subjects.
- Entrepreneurship and Small Business. Increase federal services to entrepreneurs and small businesses with an emphasis on 1) startups and growing firms and 2) underserved markets.
- Management goals applying to all agencies: Cybersecurity, Sustainability, Real Property, Improper Payments, Data Center Consolidation, Closing Skills Gaps, Strategic Sourcing.

FY 2012 ANNUAL PERFORMANCE REPORT

Each fiscal year the National Science Foundation is required to prepare three reports to provide financial management and program performance information to demonstrate accountability. This report, the Annual Performance Report (APR), includes the results of NSF's FY 2012 performance goals, including the agency's priority goals, related to the Government Performance and Results Act of 1993 (GPRA) and the GPRA Modernization Act of 2010. The other two reports are the Agency Financial Report (AFR), and the Performance and Financial Highlights Report. All three of these reports can be found on the Budget and Performance Page of the NSF web site (www.nsf.gov/about/performance/).

In FY 2012, NSF tracked progress toward its three strategic goals, using 15 performance targets, and towards three Priority Goals. All program activities within the agency were covered by the 15 targets used to monitor the three strategic goals. Out of the total of 18 goals in FY 2012, 15 were achieved and three were not achieved. Below is a tabular overview.

Strategic Goal	FY 2012 Performance Goal			Results
Transform the Frontiers	Goal 1	T-1.1	INSPIRE	Not Achieved
	Goal 2	T-2.1	***Priority Goal:*** Undergraduate Programs	Achieved
	Goal 3	T-2.2	Career-Life Balance	Achieved
	Goal 4	T-3.1	International Implications	Not Achieved
	Goal 5	T-4.1	Construction Project Monitoring	Not Achieved
	Goal 6	T-4.2	***Priority Goal***: Access to Digital Products	Achieved
Innovate for Society	Goal 7	I-1.1	***Priority Goal:*** Innovation Corps	Achieved
	Goal 8	I-1.2	Industrial and Innovation Partnerships	Achieved
	Goal 9	I-2.1	Public Understanding and Communication	Achieved
	Goal 10	I-2.2	K-12 Scale-up	Achieved
	Goal 11	I-3.1	Innovative Learning Systems	Achieved
Perform as a Model Organization	Goal 12	M-1.1	Model EEO Agency	Achieved
	Goal 13	M-1.2	IPA Performance Plans	Achieved
	Goal 14	M-1.3	Performance Management System	Achieved
	Goal 15	M-2.1	Assess Developmental Needs	Achieved
	Goal 16	M-3.1	Financial System Modernization	Achieved
	Goal 17	M-3.2	Time To Decision	Achieved
	Goal 18	M-3.3	Virtual Panels	Achieved

INSPIRE: Integrated NSF Support Promoting Interdisciplinary Research and Education
EEO: Equal Employment Opportunity
IPA: Intergovernmental Personnel Act

This section presents the results for each performance goal in its strategic context, with reference to strategic goals, objectives, and targets from NSF's FY 2011-FY 2016 Strategic Plan (see the first section of this chapter). Multiple years of trend data are available for NSF's longest-standing quantitative performance measures, "time to decision" (Goal 17) and "construction project monitoring" (Goal 5). Other performance goals introduced in FY 2011 do not have historical data associated with them, with the exception of a few goals with activities that were being monitored before they were identified as performance goals.

A statement by the NSF Director verifying the reliability and completeness of the performance data in this report can be found in the FY 2012 Performance and Financial Highlights report at www.nsf.gov/about/history/annual-reports.jsp.

Strategic Goal 1: Transform the Frontiers

Strategic Objective/Performance Goal T-1: Make investments that lead to emerging new fields of science and engineering and shifts in existing fields.

Strategic Target: The NSF portfolio fully incorporates emerging areas with transformative potential, including those forming at disciplinary boundaries.

Goal T-1.1 INSPIRE (Integrated NSF Support Promoting Interdisciplinary Research and Education) (New in FY 2012)

Lead Organization: Office of the Director.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Strengthen support of unusually novel, potentially transformative, interdisciplinary research (IDR), through new funding mechanisms, systems, and incentives that facilitate and encourage IDR.	By September 30, 2012, • Track 1: Gather baseline data on NSF-supported IDR. • Track 2: Make 25 awards via the pilot CREATIV (Creative REsearch Awards for Transformative Interdisciplinary Ventures) mechanism.	One of two targets met. • Track 1: Not achieved. Baseline not established. A contract will be awarded to establish baseline in FY 2013. • Track 2: Achieved. 40 awards made totaling $29.1 million in FY 2012 funds.
Actual Results for Preceding Fiscal Years			
2010	Each directorate in the Research and Related Activities account will invest a minimum of $2.0 million per research division to leverage and facilitate activities that foster potentially transformative research.	$94.0 million.	Achieved: $138.44 million
2011	Produce an analysis of NSF's FY 2010 investments in activities undertaken to foster potentially transformative research.	Deliverable: One analysis.	Achieved: Report delivered in fourth quarter.

Discussion

INSPIRE addresses some of the most complicated and pressing scientific problems that lie at the intersections of traditional disciplines. INSPIRE is designed to strengthen NSF's support of interdisciplinary, potentially transformative research (PTR) by complementing existing efforts with a suite of new, highly innovative Foundation-wide activities and funding opportunities. For more information about INSPIRE's background, goals, design, and investment and evaluation framework, refer to the NSF-Wide Investments chapter.

Information on Unmet Target

Track 1 of INSPIRE seeks to make changes to NSF systems and practices that will facilitate identification, review, support, management, and tracking of IDR. NSF was unable to establish a baseline in FY 2012, but progress was made on in-house text-based classification and clustering methods.

Strategic Goal 1: Transform the Frontiers

Strategic Objective/Performance Goal T-2: Prepare and engage a diverse science, technology, engineering, and mathematics (STEM) workforce motivated to participate at the frontiers.

Strategic Target: NSF STEM workforce development programs, models, or strategies have rigorous evidence about the impact on diversity and innovation in the workforce.

Goal T-2.1 STEM Priority Goal: Undergraduate Programs

Lead Organization: Directorate for Education and Human Resources.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Develop a diverse and highly qualified science and technology workforce.	By September 30, 2013, 80 percent of institutions funded through NSF undergraduate programs document the extent of use of proven instructional practices.	In progress: FY 2012 milestones met[1].
Actual Results for Preceding Fiscal Years			
2010	Develop goals and metrics for NSF's programmatic investments in its FY 2010 Learning portfolio.	100 percent of programs (baseline: 80 percent).	Achieved: 100 percent of programs that received funding in FY 2010[2].
2011	NSF science, technology, engineering, and mathematics (STEM) workforce development programs at the graduate, professional, or early career level participate in evaluation and assessment systems. (Priority Goal)	Six programs.	Achieved: 12 programs[3].

Discussion

During FY 2012 a strategy was developed to use multiple mechanisms for institutions funded through NSF undergraduate programs to document the use of proven instructional practices by the end of FY 2013. A call for proposals was issued for projects to measure the use of evidence-based instructional practices in undergraduate courses at academic institutions. Thirty awards were made to institutions of higher education to develop mechanisms for measurement. Other activities undertaken in FY 2012 included soliciting information from the field, reviewing existing mechanisms used by awardees to submit data to NSF, and defining the parameters of the goal. An analysis was conducted to determine the number of academic institutions funded by NSF undergraduate programs. Planning activities resulted in an approach that will use multiple data collection mechanisms in FY 2013, including: baseline data submitted in proposals, information collected through monitoring systems, and data submitted in annual

[1] http://goals.performance.gov/goal_detail/NSF/388
[2] www.nsf.gov/about/budget/fy2012/pdf/add_perf_info_fy2012_request.pdf
[3] www.nsf.gov/about/budget/fy2013/FY2010-FY2011PriorityGoalReport.pdf

or final project reports. For further information, please refer to the page on performance.gov[1] associated with this priority goal.

Strategic Goal 1: Transform the Frontiers

Strategic Objective/Performance Goal T-2: Prepare and engage a diverse science, technology, engineering, and mathematics (STEM) workforce motivated to participate at the frontiers.

Strategic Target: NSF STEM workforce development programs, models, or strategies have rigorous evidence about the impact on diversity and innovation in the workforce.

Goal T-2.2 Career-Life Balance (New in FY 2012)

Lead Organization: Office of the Director.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Promote Career-Life Balance policies and practices that support more fully utilizing the talents of individuals in all sectors of the American population – principally women, underrepresented minorities and persons with disabilities.	By September 30, 2012, establish the FY 2012 baseline for number and value of award support provided to CAREER awardees and postdoctoral fellows intended to fund research technicians.	Achieved. Baseline established. 20 supplements were awarded to CAREER awardees, totaling $420,355 for FY 2012.

Discussion

Although women comprise a significant and growing fraction of the U.S. STEM talent pool, recent studies demonstrate the challenges that they face when attempting to balance the often extreme demands of career and life without adequate institutional support. Utilizing womens' talent and potential in STEM fields is critical to the Nation's future success in science and technology and to economic prosperity.

To address this challenge, NSF's Career-Life Balance (CLB) Initiative, a set of forward-looking policies and practices, will help to increase the placement, advancement, and retention of women in STEM disciplines, particularly women who are seeking tenure in academe. NSF aims to enhance existing – and implement new – gender-neutral, family-friendly policies, as it is important that our Nation's colleges and universities accommodate the needs of the largest-growing segment of our science and engineering workforce. The Foundation is pursuing an agency-level pathway approach across higher education and career levels (i.e., graduate students, postdoctoral students, and early-career scientists, and engineers). CLB seeks new and innovative ways in which NSF can partner with U.S. universities, colleges, and research institutions to help attract, nurture, and retain a much greater fraction of women engineers and scientists in the Nation's STEM workforce.

In FY 2012, NSF introduced CLB supports for technicians for CAREER awardees who need temporary help to continue research while facing the demands of child and/or elder dependent care. Twenty supplements were awarded in the first year of this program.

Strategic Goal 1: Transform the Frontiers

Strategic Objective/Performance Goal T-3: Keep the United States globally competitive at the frontiers of knowledge by increasing international partnerships and collaborations.

Strategic Target: NSF programs increasingly establish international partnerships that advance the frontiers of knowledge.

Goal T-3.1 International Implications

Lead Organization in FY 2012: Office of International Science and Engineering.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Increase proportion of new NSF solicitations, announcements, and Dear Colleague Letters that have international implications.	Increase proportion of new NSF solicitations, announcements, and Dear Colleague Letters that have international implications by 10 percent over FY 2011.	Not achieved. The proportion of proposal calls with international implications decreased from 20 percent to 17 percent.
Actual Results for Preceding Fiscal Years			
2011	Identify number of new NSF program solicitations, announcements, and Dear Colleague Letters with international implications.	Establish baseline.	Achieved. Baseline: 23 solicitations, announcements, and Dear Colleague Letters

Discussion

NSF has a system for program officers to indicate which solicitations, announcements, and Dear Colleague Letters (collectively, "proposal calls") have international implications in the internal clearance stages. In FY 2011, the Office of International Science and Education (now a part of the Office of International and Integrative Activities) conducted a baseline count of these materials. That year, NSF issued 116 proposal calls, of which 23 (20 percent) had international implications. The goal for FY 2012 was to increase the proportion of proposal calls with international implications by 10 percent over the FY 2011 baseline, to 22 percent.

In FY 2012, NSF issued 158 proposal calls, of which 27 (17 percent) had international implications. The 22 percent goal was not achieved. Although the number of proposal calls and the number of them with international implications both increased, the proportion actually decreased.

Information on Unmet Goal

The NSF Office of International and Integrative Activities is expanding its interactions with NSF program offices with the expectation of communicating the importance and value of increasing explicit references to international funding options in proposal calls.

Strategic Goal 1: Transform the Frontiers

Strategic Objective/Performance Goal T-4: Enhance research infrastructure and promote data access to enable transformation at the frontiers.

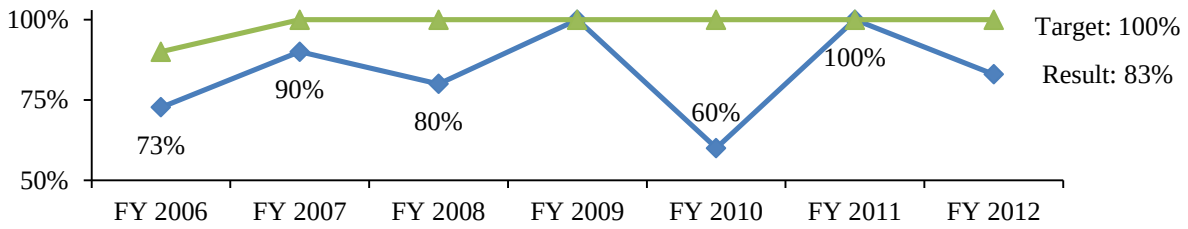
Strategic Target: NSF prioritizes and manages facility investments throughout their life-cycle in a transparent and effective way.

Goal T-4.1 Construction Project Monitoring

Lead Organization: Large Facilities Office, Office of Budget, Finance, and Award Management.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	For all MREFC facilities under construction, keep negative cost and schedule variance at or below 10 percent.	100 percent of construction projects that are over 10 percent complete	Not Achieved: 83 percent

Construction Project Monitoring Performance Trends, FY 2006-FY 2012



Discussion

The Major Research Equipment and Facilities Construction (MREFC) account supports the acquisition, construction, and commissioning of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. Performance of construction projects funded by the MREFC account is monitored using the Earned Value Management (EVM) system. EVM is an integrated management control system for assessing, understanding, and quantifying what a contractor or field activity is achieving with program dollars. Monitoring cost and schedule is a standard measure of performance for construction projects. Projects that are under 10 percent complete are not considered eligible for this goal because EVM data is less meaningful statistically in the very early stages of a project.

Six facilities under construction were over 10 percent complete at the end of FY 2012. Of those six, all had cost variances under 10 percent. One facility, the Advanced Technology Solar Telescope (ATST), was 15 percent behind schedule. Thus, five of six projects met the goal.

Information on Unmet Goal

The ATST site construction was delayed by more than two years while the State of Hawaii resolved a legal challenge to the proposed state land use permit. The legal challenge was resolved in early FY 2013, allowing site construction to commence. The project schedule will be rebaselined in FY 2013 and the FY 2013 performance report will report ATST's EVM construction performance relative to the new baseline.

Strategic Goal 1: Transform the Frontiers

Strategic Objective/Performance Goal T-4: Enhance research infrastructure and promote data access to support researchers' and educators' capabilities and to enable transformation at the frontiers.

Strategic Target: Ensure data generated by NSF's major multi-user facilities are widely accessible to the research community.

Goal T-4.2 Priority Goal: Access to Digital Products of NSF-Funded Research

Lead Organization in FY 2012: Directorate for Mathematics and Physical Sciences.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Increase opportunities for research and education through public access to high-value digital products of NSF-funded research.	By September 30, 2013, NSF will have established policies for public access to high-value data and software in at least two data-intensive scientific domains.	In progress: FY 2012 milestones met.[4]
Actual Results for Preceding Fiscal Years			
2011	Determine current data management practices at NSF-funded facilities.	Current data management practices documented for 100 percent of NSF-funded facilities.	Achieved: 17 of 17 facilities.

Discussion

The FY 2011 performance goal examined data management practices at NSF funded facilities to determine whether these facilities had policies regarding data access. NSF examined written policies from cooperative agreements, program plans, and major facility websites and determined that many NSF-funded large facilities, which represent their scientific domains, already encourage principal investigators to share access to data and software. FY 2013 activities will shift the focus from large facilities to other types of NSF investments.

For a fuller report on FY 2012 activities towards this Priority Goal, please refer to the "Progress and Next Steps" tab on this Priority Goal's page on performance.gov.[4]

[4] http://goals.performance.gov/goal_detail/NSF/387

Strategic Goal 2: Innovate for Society

Strategic Objective/Performance Goal I-1: Make investments that lead to results and resources that are useful to society.

Strategic Target: NSF investments underpin long-term solutions to societal challenges such as economic development, climate change, energy, and cyber-security.

Goal I-1.1 Priority Goal: Innovation Corps

Lead Organization: Directorate for Engineering.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Increase the number of entrepreneurs emerging from university laboratories.	By September 30, 2013, 80 percent of teams participating in the Innovation Corps program will have tested the commercial viability of their product or service.	Achieved. Annual rate: 93 percent.

Discussion
I-Corps was launched in 2011 with the first cohort of teams immersed in the rigorous Entrepreneurial Immersion curriculum in October 2011. In fiscal year 2012, the program was offered in October, January, March, and July. A total of 100 teams were accepted to the six-month program. The goal was for 80 percent of the teams to complete the program. Of the 46 teams in the program in FY 2012, 43 completed the program for an overall completion rate of 93 percent. Processes are in place to nurture future teams to retain the unexpected level of success of the early adopters who participated in the program's initial year.

Performance improvement activities were undertaken in FY 2012 in support of this goal. Stakeholder feedback meetings were held to monitor and improve processes, and two additional I-Corps options, I-Corps Nodes and I-Corps Sites, were initiated to broaden the program to larger numbers of teams and to offer the Entrepreneurial Immersion curriculum at more venues.

For a fuller report on FY 2012 activities towards this Priority Goal, please refer to the "Progress and Next Steps" tab on this Priority Goal's page on performance.gov.[5]

Quarterly results for Priority Goal

Fiscal Year Quarter	Target Value	Actual Value	Explanation Of Actual
2012-Q3	80 percent	90 percent	Of 21 teams enrolled, 19 completed the program.
2012-Q4	80 percent	96 percent	Of 25 teams enrolled, 24 completed the program.

[5] http://goals.performance.gov/goal_detail/NSF/389

Strategic Goal 2: Innovate for Society

Strategic Objective/Performance Goal I-1: Make investments that lead to results and resources that are useful to society.

Strategic Target: NSF investments underpin long-term solutions to societal challenges such as economic development, climate change, energy, and cyber-security.

Goal I-1.2 Industrial and Innovation Partnerships

Lead Organization: Directorate for Engineering.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Identify the number and types of partnerships entered into by Industrial & Innovation Partnerships (IIP) Division grantees.	• Count number of financial partnerships in FY 2010 and FY 2011 made by IIP program grantees. • Evaluate the potential to collect other types of partnership data in the future.	Achieved. See table below for results.
Actual Results for Preceding Fiscal Years			
2011	Industrial and Innovation Partnerships (IIP): Identify the number and types of grantee's partnerships.	Establish baseline for 2010.	Achieved. Baseline: 1,567 partnerships.

Discussion
Using the Directorate for Engineering's IIP division as the model to start the process of collecting data on diverse types of partnerships is intended as the beginning of a process to identify how the links between science, industry, and innovation transfer the long term impacts of NSF investments.

In FY 2012, the data collection system was redesigned and new data tools were available. As a result, the method used in 2011 was updated and the FY 2010 results re-baselined using the new data collection tool. The results shown below for FYs 2010 and 2011 were obtained using the new method.

Type of partnership	FY 2010	FY 2011
Sub-award partnerships	251	173
Consulting partnerships	178	162
Award partnerships	130	185
Supplement partnerships	179	192
I/UCRC partnerships	173	355
Total	**911**	**1,067**

Strategic Goal 2: Innovate for Society

Strategic Objective/Performance Goal I-2: Build the capacity of the nation's citizenry for addressing societal challenges through science and engineering.

Strategic Target: NSF's scientific literacy and public engagement programs are supported by rigorous evidence about learning outcomes.

Goal I-2.1 Public Understanding and Communication

Lead Organization: Division of Research on Learning in Formal and Informal Settings, Directorate for Education and Human Resources.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Establish a common set of evidentiary standards for programs and activities across the agency that fund public understanding and communication of science and engineering activities.	By September 30, 2012, deliver an internal report defining standards of evidence for the models used by the 16 programs identified in FY 2011 that fund public understanding and communication of science and engineering. Identify all programs across the agency that employ the models and strategies.	Achieved. Internal report of evidence standards and inventory produced. Nineteen programs identified.
Actual Results for Preceding Fiscal Years			
2011	Identify number of programs that fund activities that address public understanding and communication of science and engineering.	Establish baseline.	Achieved. Baseline: 16 programs

Discussion

In the internal report, two sets of standards of evidence for what works are recommended for adoption: one for practice and implementation activities and one for research and development activities. Each builds on current research. The report also provides information for design principles related to practice and implementation as evidentiary standards are relatively new to this field. The evidentiary standards recommended here will be refined following input received from NSF program officers during piloting in FY 2013 and FY 2014. The standards will also be updated within a few years to reflect developments in the field.

Strategic Goal 2: Innovate for Society

Strategic Objective/Performance Goal I-2: Build the capacity of the nation's citizenry for addressing societal challenges through science and engineering.

Strategic Target: NSF's K-12 STEM education investments are designed and tested for scale-up.

Goal I-2.2 K-12 Components

Lead Organization: Directorate for Education and Human Resources.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Establish a common set of evidentiary standards for programs across the agency that fund activities with K-12 components.	By September 30, 2012, • Identify the number of programs that fund activities with K-12 components. • Develop common standards of evidence for inclusion in future solicitations of the identified programs.	Achieved. Evidence standards and inventory have been documented. Fourteen programs were identified (3 deleted from the initial list and one added to the list).
Actual Results for Preceding Fiscal Years			
2011	Identify number of programs that fund activities with K-12 components.	Establish baseline.	Achieved. Baseline: 16 programs.

Discussion

There is increasing interest across the federal government not just to count the number of programs addressing K-12 education, but to examine the potential of projects for going to scale and moving beyond the initial site to be implemented successfully under typical conditions and with population groups that are broadly reflective of that intended for the scale-up setting (Draft Evidence Standards). A more accurate and complete list of NSF's K-12 programs is the first step in identifying the programs that have the capacity to establish the conditions that enable projects to go to scale.

The FY 2011 list of programs with an explicitly stated K-12 programmatic mission or a programmatic component directed explicitly at K-12 education was updated. Fourteen programs were identified:

1. CISE: Computing Education for the 21s Century
2. CISE/EHR/SBE: Cyberlearning: Transforming Education
3. EHR: Discovery Research K-12
4. EHR: Innovative Technology Experiences for Students and Teachers
5. EHR: Math and Science Partnership
6. EHR: Research and Evaluation on Education in S & E (REESE)
7. EHR: Advanced Technological Education (ATE)
8. EHR: Noyce Scholarship Program
9. ENG: Research Experiences for Teachers (Sites)
10. GEO: Geoscience Education
11. GEO: Opportunities for Enhancing Diversity in Geosciences (OEDG)
12. GEO: GEO Teach
13. SBE: Science of Learning Centers

14. Multiple: Climate Change Education (CCE) Phase II

Several different standards of evidence were reviewed and the standards best suited to the range of K-12 activities conducted across NSF were chosen (CoSTEM 2012, *Design Principles for Learning Investments and Engagement Investments*). A checklist was drafted based on these standards to potentially guide PIs, reviewers, and program officers as they develop or review proposals.

Strategic Goal 2: Innovate for Society

Strategic Objective/Performance Goal I-3: Support the development of innovative learning systems.

Strategic Target: NSF invests in innovative learning tools and structures that use emerging technologies and are tested for effectiveness and scalability.

Goal I-3.1 Innovative Learning Systems

Lead Organization: Directorate for Education and Human Resources.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Integrate common language about, or goals for, innovative learning research into the Cyberlearning, Data and Observation for STEM Education focus area of the Expeditions in Education (E2) investment, and into other programs across the agency that fund innovative learning tools, structures, and systems.	By September 30, 2012, write a synthesis report on NSF support of Innovative Learning Systems supporting common language for solicitations.	Achieved. Report written. See summary below.
Actual Results for Preceding Fiscal Years			
2011	Identify number of programs that fund the development of research-based innovative learning systems.	Establish baseline.	Achieved. Baseline: 150 awards across 28 distinct programs.

Discussion

This Goal's intent was to identify activities across the Foundation that contribute to the development of innovative learning systems. Such activities are not funded by any one program within NSF. In FY 2011, NSF's baseline for this area of research was determined using a latent semantic analysis tool to analyze awards made that fit into the general category of Research-Based Innovative Learning Systems (ILS). In FY 2011, 150 awards were identified, 95 percent of which were made by eight divisions within the EHR, Computer and Information Science (CISE), and Engineering (ENG) directorates. The awards corresponded to 28 distinct programs. In FY 2012, 138 total awards were identified within six directorates. The three largest contributors to the total were EHR (64), CISE (43) and ENG (17), with some awards in the Office of Cyberinfrastructure (now part of CISE), the Directorate for Social, Behavioral and Economic Sciences, and the Directorate for Geosciences. The awards corresponded to 30 distinct programs.

Strategic Goal 3: Perform as a Model Organization

Strategic Objective/Performance Goal M-1: Achieve management excellence through leadership, accountability, and personal responsibility.

Strategic Target: More effective management enables all staff to understand how their duties support the mission of the Foundation.

Goal M-1.1 Model EEO Agency

Lead Organization: Office of Diversity and Inclusion.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Perform activities necessary to attain essential elements of a model EEO agency, as defined by the Equal Employment Opportunity Commission (EEOC).	Attain four of six essential elements. Submit Diversity and Inclusion Strategic Plan to OPM by March 30, 2012.	Achieved: Four elements attained. Plan submitted by deadline.
Actual Results for Preceding Fiscal Years			
2011	Attain essential elements of a model Equal Employment Opportunity (EEO) program, as defined in Equal Employment Opportunity Commission (EEOC) requirements.	Three elements.	Achieved: Three elements obtained.

Discussion

For NSF to achieve model EEO agency status, it must meet and maintain each of the six criteria established by the Equal Employment Opportunity Commission (EEOC). The EEOC refers to these criteria as the "Essential Elements" of a Model Agency, which are:

A. Demonstrated commitment from agency leadership;
B. Integration of EEO into the agency's strategic mission;
C. Management and program accountability;
D. Proactive prevention of unlawful discrimination;
E. Efficiency; and
F. Responsiveness and legal compliance.

In FY 2012, NSF fully achieved and complied with five of the six essential elements towards attaining a model EEO Agency Program: elements A, B, D, E, and F.

EEOC Essential Element Definitions and NSF Activities

Essential Element	NSF Activities
A: Demonstrated commitment from agency leadership requires the agency head to issue a written policy statement ensuring a workplace free of discriminatory harassment and a commitment to equal employment opportunity.	NSF continued to fully achieve and comply with all of essential element A when it ensured EEO policy statements were current, communicated to all employees, and vigorously enforced by agency management.
B: Integration of EEO into the	NSF has continued to fully achieve and comply with all of essential

agency's strategic mission requires that the agency's EEO programs be organized and structured to maintain a workplace that is free from discrimination in any of the agency's policies, procedures or practices and supports the agency's strategic mission.	element B when it ensured the reporting structure for the EEO program provides the principal EEO official with appropriate authority and resources to effectively carry out a successful EEO program; the EEO Office has a regular and effective means of informing the agency head and senior management officials of the status of EEO programs; the EEO Office is involved in, and is consulted on, management/personnel action; and agency has committed sufficient human resources and budget allocations to its EEO programs to ensure successful operation.
C: Management and program accountability requires the Agency Head to hold all managers, supervisors, and EEO Officials responsible for the effective implementation of the agency's EEO Program and Plan.	NSF has made progress toward the achievement and compliance with essential element C. NSF has continued to fully achieve and comply with the EEO program officials advising and providing appropriate assistance to managers/supervisors about the status of EEO programs within each manager's or supervisor's area or responsibility. NSF is in progress toward the achievement of the measure of whether the Human Resources Director and the EEO Director meet regularly to assess whether personnel programs, policies, and procedures are in conformity with instructions contained in EEOC management directives regarding time-tables and schedules for Merit Promotion Program Policy, Employee Recognition Awards Program, and Employee Development/Training Programs. NSF is also beginning dialogue about when findings of discrimination are made, the agency explores whether or not disciplinary actions should be taken.
D: Proactive prevention requires that the Agency Head makes early efforts to prevent discriminatory actions and eliminate barriers to equal employment opportunity in the workplace.	NSF has continued to fully achieve and comply with all of essential element D when it conducts analyses to identify and remove unnecessary barriers to employment throughout the year; and encourages the use of alternative dispute resolution with involvement of senior management.
E: Efficiency requires that there are effective systems in place for evaluation of the impact and effectiveness of the agency's EEO Programs as well as an efficient and fair dispute resolution process.	NSF has continued to fully achieve and comply with all of essential element E when it provided sufficient staffing, funding, and authority to achieve the elimination of identified barriers; provided an effective complaint tracking and monitoring system to increase the effectiveness of the agency's EEO programs; provided sufficient staffing, funding, and authority to comply with the time frames in accordance with the EEOC regulations for processing EEO complaints of employment discrimination; provided an effective and fair dispute resolution process and effective systems for evaluating the impact and effectiveness of the agency's EEO complaint processing program; and implemented effective systems for maintaining and evaluating the impact and effectiveness of its EEO programs.
F: Responsiveness and legal compliance requires that federal agencies are in full compliance with EEO statutes and EEOC regulations, policy guidance, and other written instructions.	NSF has continued to fully achieve and comply with all of essential element F when the agency's system of management controls ensures that the agency completes all ordered corrective actions in a timely manner and submits its compliance report to EEOC within 30 days of such completion; and agency personnel are accountable for the timely completion.

Strategic Goal 3: Perform as a Model Organization

Strategic Objective/Performance Goal M-1: Achieve management excellence through leadership, accountability, and personal responsibility.

Strategic Target: More effective management enables all staff to understand how their duties support the mission of the Foundation.

Goal M-1.2 Intergovernmental Personnel Agreement (IPA) Performance Plans

Lead Organization: Division of Human Resources Management, Office of Information and Resource Management.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Include assignees on temporary appointment to NSF under the Intergovernmental Personnel Act (IPAs) under an NSF performance management system.	• By March 31, 2012, 95 percent of executive-level IPAs whose assignments have at least 90 days remaining will have performance plans in place. • By September 30, 2012, 90 percent of non-executive IPAs whose assignments have at least 90 days remaining will have performance plans in place.	• Achieved: 100 percent of executive-level IPAs had performance plans in place. • 92 percent of non-executive IPAs had performance plans in place.
Actual Results for Preceding Fiscal Years			
2011	Include temporary staff appointed under the Intergovernmental Personnel Act (IPAs) under NSF's performance management system.	As of July 1, 2011, • 80 percent of all IPAs have performance plans. • 90 percent of IPAs in executive-level positions have performance plans.	Achieved: 92 percent of all IPAs had performance plans. 90 percent of executive IPAs had performance plans in place.

Discussion

The Intergovernmental Personnel Act (IPA) mobility program (5 CFR part 334) provides the authority for NSF to bring in scientific staff for limited periods of time. IPA assignees are on detail to NSF and remain on the payroll of their home institution. Using the IPA authority to recruit active researchers infuses new talent and expertise into NSF and provides scientists and engineers with valuable information and knowledge to bring back to their home institutions. NSF's use of the IPA helps to maintain the Foundation's close association with the Nation's colleges and universities and the contributions made by NSF's IPA scientists furthers the agency's mission of supporting the entire spectrum of science and engineering research and education. This goal addresses human resource management challenges specific to NSF that were identified by Congress, the Office of Personnel Management, and NSF's Office of the Inspector General.

Before FY 2011, IPAs were not required to submit performance plans. In FY 2011, a performance goal to expand the coverage of NSF's performance management framework to include IPAs was set.

Including IPAs in an annual performance assessment affords supervisors and IPAs an opportunity to communicate on a regular basis around goal attainment and challenges. FY 2012 Federal Employee Viewpoint Survey (FEVS) results support the value of the new process. Scores in two related FEVS questions improved significantly between FY 2011 and FY 2012, the same time period where IPAs began receiving more formal performance reviews.

Federal Employee Viewpoint Survey results for NSF IPAs

	2011 (IPA)	2012 (IPA)	% Change
(19) In my most recent performance appraisal, I understood what I had to do to be rated at different performance levels (for example, Fully Successful, Outstanding).	48%	62%	+29%
(50) In the last six months, my supervisor/team leader has talked with me about my performance.	51%	74%	+45%

Strategic Goal 3: Perform as a Model Organization

Strategic Objective/Performance Goal M-1: Achieve management excellence through leadership, accountability, and personal responsibility.

Strategic Target: More effective management enables all staff to understand how their duties support the mission of the Foundation.

Goal M-1.2 Performance Management System

Lead Organization: Division of Human Resources Management, Office of Information and Resource Management.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Use findings from assessments to guide improvement of NSF's employee performance management systems.	By September 30, 2012, deliver an action strategy for improvement of one to three areas noted in NSF's SES or GWF PAAT or identified in NSF's FEVS results to the NSF CHCO.[6]	Achieved. Action strategy issued.

Discussion

NSF has two primary performance management systems for NSF employees, one that covers members of the Senior Executive Service (SES) and one that covers the General Workforce (GWF). In 2011, NSF administered OPM's Performance Appraisal Assessment Tool (PAAT) for both the SES and GWF performance management systems. The SES PAAT was submitted to OPM in September 2011, and NSF's SES performance management system was certified in January 2012. NSF can use the OPM review materials and internal review to identify potential areas of weakness and to develop a strategy for improving the SES performance management system in conjunction with a new government-wide approach to SES performance management. The GWF PAAT was submitted to OPM in December 2011. It is still under review at OPM. Feedback from OPM will be incorporated with related internal review processes to develop a strategy for improving the GWF performance management system.

In September of 2012, NSF issued an action strategy to the NSF CHCO entitled "Preliminary Plan for Taking Recommended Actions around NSF's GWF and SES Performance Management Systems – 9/30/12" based upon GWF PAAT and SES PAAT assessment recommendations that includes actions to: (1) strengthen supervisory plans; (2) institutionalize recurring training; and (3) better tie organizational performance results to the ratings and awards given to employees. Implementation of this plan is well under way.

The FEVS is a tool that measures employees' perceptions of whether, and to what extent, the conditions that characterize successful organizations are present in their agencies. The FEVS includes questions related to performance appraisal. The 2011 FEVS found that the percentage of NSF employees who understood what they had to do to be rated at different performance levels was lower than in previous

[6] Acronyms: SES, Senior Executive Service; GWF, General Workforce; PAAT, Performance Appraisal Assessment Tool; FEVS, Employee View Point Survey; CHCO, Chief Human Capital Officer

years. For the FEVS question "In my most recent performance appraisal, I understood what I had to do to be rated at different performance levels (for example, Fully Successful, Outstanding)":

- 2010 FEVS positive response rate: 68 percent.
- 2011 FEVS positive response rate: 63 percent.
- 2012 FEVS target: 65 percent. Positive response rate: 62 percent.
- 2013 FEVS target: 68 percent.

This goal addresses human resource management challenges specific to NSF that were identified by Congress, the Office of Personnel Management, and NSF's Office of the Inspector General.

Strategic Goal 3: Perform as a Model Organization

Strategic Objective/Performance Goal M-2: Infuse learning as an essential element of the NSF culture with emphasis on professional development and personal growth.

Strategic Target: NSF emphasizes learning for personal and professional development for all staff.

Goal M-2.1 Assess Developmental Needs

Lead Organization: Division of Human Resources Management, Office of Information and Resource Management.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Enhance NSF capabilities to provide training of staff for their current positions.	By September 30, 2012, design a structured curriculum which meets assessed needs for at least two types of NSF staff roles (e.g. leaders, program officers, administrative professionals, technical professionals).	Achieved. Designed curricula for supervisors, program officers, and administrative professionals.
Actual Results for Preceding Fiscal Years			
2011	Pilot process for assessing developmental needs and addressing them.	By March 31, 2011 commence survey of administrative support staff. By September 20, 2011, obtain contract support for assessment of non-administrative-support staff.	Achieved Achieved late: contract support obtained September 23, 2011.

Discussion
NSF's core values and strategic goals articulate the high priority that is placed on staff learning and development. This goal addresses a specific action identified in the Strategic Plan: "review current NSF learning opportunities and develop a plan for addressing gaps."

In FY 2011, the Division of Human Resource Management (HRM) developed and launched targeted needs analysis questionnaires designed to generate new learning needs data. In FY 2012, NSF completed its first agency-wide training needs assessment. NSF's Mission Critical Occupations: Administrative Professionals, Program Directors, and leadership occupations are all addressed independently in the needs assessment along with other critical administrative functions. Concurrently, NSF developed proposals for both a competitive Senior Leadership Development Program and a competitive Aspiring Leaders Program to identify and develop high-potential candidates for future leadership positions. The Program Officer training is also undergoing revisions to streamline and integrate different elements to improve the onboarding and continual development of this crucial NSF occupation. In FY 2013, NSF will compare its existing curricula to the needs outlined in the assessment and plan to fill any gaps.

In FY 2012, NSF created a structured curriculum entitled "Core Training From Art & Science" which includes a structured curriculum outline for three types of staff roles: (1) Core Training for Supervisors; (2) Core Training for Program Officers; and (3) Core Training for Administrative Professionals.

NSF is designing and developing tailored training courses as defined in the "Training Support for NSF Academy Management Plan." According to this plan, NSF will "develop an instructor guide that includes the sequence of delivery covering presentation materials, structure and elements of learner activities, and tests." Based upon these specific management plan criteria, NSF is scheduled to develop and complete the course work for these structured curricula in 2013.

Strategic Goal 3: Perform as a Model Organization

Strategic Objective/Performance Goal M-3: Encourage and sustain a culture of creativity and innovation across the agency to ensure continuous improvement and achieve high levels of customer service.

Strategic Target: NSF uses the innovation and creativity of our staff to improve agency processes and systems on a continuing basis.

Goal M-3.1 Grant-By-Grant Payments
Lead Organization: Division of Financial Management, Office of Budget, Finance, and Award Management.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Upgrade NSF's financial system.	By September 30, 2012, to support the iTRAK initiative, the Division of Financial Management (DFM) and the Division of Acquisition and Cooperative Agreements (DACS) will award a contract for the iTRAK financial system implementation and integration services.	Achieved. Contract awarded September 25, 2012.
Actual Results for Preceding Fiscal Years			
2011	Gather functional requirements for changes in current system processes that will accommodate the transition to a grant by grant payment method.	Documentation of functional requirements.	Achieved late: Functional requirements delivered first quarter of FY 2012.

Discussion
Financial system modernization efforts have been underway at NSF for several years. The iTRAK effort–a Foundation-wide effort to transition NSF from its legacy financial support systems to a fully integrated, commercial-off-the-shelf (COTS) financial management shared services solution—is central, but other modernization steps are required as prerequisites. Performance goals related to the activities were first developed in FY 2011 to measure one of these prerequisites, the gathering of requirements for the transition to a grant-by-grant payment method. This payment method is a prerequisite for the transition to a COTS financial management shared services solution.

In FY 2012, NSF selected a system integration contractor to implement the COTS solution.

Strategic Goal 3: Perform as a Model Organization

Strategic Objective/Performance Goal M-3: Encourage and sustain a culture of creativity and innovation across the agency to ensure continuous improvement and achieve high levels of customer service.

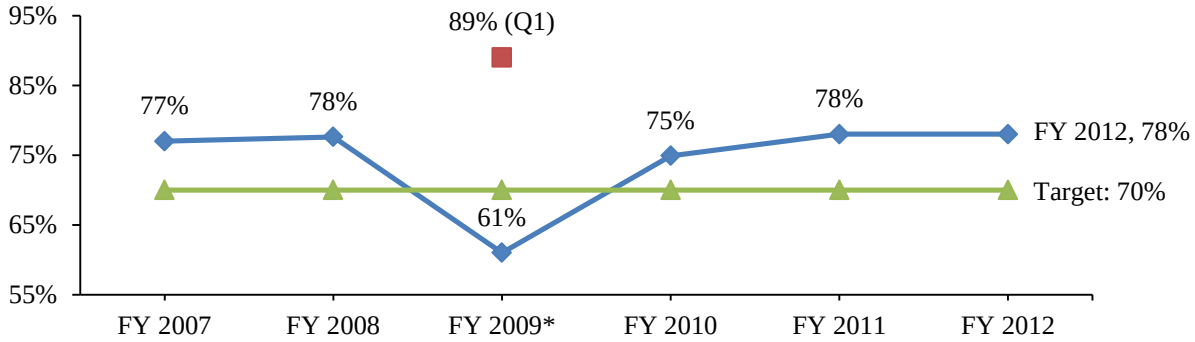
Strategic Target: NSF organizations achieve high levels of customer satisfaction.

Goal M-3.2 Time to Decision

Lead Organization: Office of the Director.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Inform applicants whether their proposals have been declined or recommended for funding within six months of deadline, target date, or receipt date, whichever is later.	70 percent.	Achieved. 78 percent.

Time to Decision Performance Trends, FY 2006-FY 2012



*In FY 2009, this goal was in effect only for the period October 1 through December 31, 2008 (Quarter 1, FY 2009). The goal was suspended for all actions taking place between January 1, 2009 and September 30, 2009 to allow for a greater number of proposals to be processed with the additional funds from the American Recovery and Reinvestment Act of 2009 (ARRA).

Time to decision or "dwell time" is the amount of time that passes between receipt of a proposal and notification to the principal investigator about the funding decision. One of the most significant issues raised in customer satisfaction surveys is the time it takes NSF to process proposals. Too long a time period inhibits the progress of research as it delays the funding process, but too short a time period may inhibit the merit review process. The six-month target seeks to strike a balance between the need of the investigator for timely action and the need of NSF for a credible and efficient merit review system.

The most relevant recent variations in performance took place in FY 2009 and FY 2010. In FY 2009, the goal was suspended after the first quarter to allow for a greater number of proposals to be processed with additional funds from ARRA. The goal was reinstated in FY 2010, when NSF exceeded this goal despite a significant increase in workload. Overall, staffing levels increased by 5.5 percent between FY 2008 and FY 2012, while proposal pressure increased by 10.0 percent.

Strategic Goal 3: Perform as a Model Organization

Strategic Objective/Performance Goal M-3: Encourage and sustain a culture of creativity and innovation across the agency to ensure continuous improvement and achieve high levels of customer service.

Strategic Target: NSF organizations achieve high levels of customer satisfaction

Goal M-3.3 Virtual Merit Review Panels (New in FY 2012)

Lead Organization: Office of the Director.

Fiscal Year	Goal Statement and Target	Target Measure, Milestone, or Deliverable	Result
2012	Expand the use of virtual merit review panels.	By September 30, 2012, develop guidelines and training modules for NSF staff on the use of virtual merit review panels.	Achieved. Training modules developed.

Discussion

NSF makes extensive use of panels of reviewers to evaluate proposals. The predominant practice is for the panelists to travel to a single location, usually NSF, and meet face-to-face for one to five days. In FY 2010, approximately 2,100 review panels were held. Of these, just over one quarter involved six or fewer panelists. Face-to-face panels impose a significant time burden on the reviewers, making some potential reviewers reluctant to participate. For example, panelists with young children may not be able to obtain two continuous days of childcare, or panelists in remote locations or foreign countries may find the amount of travel required prohibitive. It also causes NSF to incur significant travel costs.

As used in reference to this goal, the term "virtual panel" refers to a panel meeting in which the reviewers do not travel to a common location but instead participate via teleconference, videoconference or an online meeting technology. NSF has experimented with virtual panels at a small scale for several years. In FY 2011, approximately 2.2 percent of panels were virtual panels, and approximately one percent of proposals that were reviewed by panels were reviewed by virtual panels.

In FY 2012, administrative offices and program staff collaborated to develop the first of a planned set of four training modules for organizers of virtual panels at NSF. An internal web-site that provides guidance to NSF staff on when to choose a virtual panel and how best to implement such panels was also developed and numerous outreach activities were conducted to familiarize staff with the resources available to them. In FY 2012, 99 virtual panels were conducted.

FY 2014 PERFORMANCE PLAN

Goal ID	Goal Short Title	Lead organization	Goal Statement
1	Ensure that Key Program Investments are on track	OD	Meet critical targets for key FY 2014 program investments.
2	Ensure that infrastructure investments are on track	BFA SBE	Ensure program integrity and responsible stewardship of major research facilities and infrastructure.
3	Use Evidence to Guide Management Decisions	OIRM	Use evidence-based reviews to guide management investments.
4	Improve Undergraduate Education	EHR	Establish an NSF-wide undergraduate STEM education program that is evidence-based and evidence-building.
5	Enhance National Graduate Research Fellowships	EHR	Enhance the Graduate Research Fellowship program to provide a wider range of career development opportunities.
6	Promote Career-Life Balance Policies and Practices	OIIA	Promote policies and practices that support more fully utilizing the talents of individuals in all sectors of the American population, principally women, underrepresented minorities, and persons with disabilities.
7	Foster an Environment of Diversity and Inclusion	ODI	Foster an environment of diversity and inclusion while ensuring compliance with the agency's civil rights programs.
8	Modernize Financial System	BFA	Upgrade NSF's financial system.
9	Make Timely Award Decisions	OIIA BFA	Inform applicants whether their proposals have been declined or recommended for funding within 182 days, or six months, of deadline, target, or receipt date, whichever is later.
10	Enable Increased Use of Virtual Merit Review	OD	Improve the ability to use virtual merit review panels by incorporating technological innovations into review process.

NSF Performance Framework

NSF's FY 2014 Performance Plan reflects NSF's priorities as identified through the budget process. The major change from prior year plans is the development of a new performance framework for strategic monitoring of key program, infrastructure, and management investments.

Goals 1, 2, and 3 were created to provide a means by which NSF leadership can provide strategic monitoring and oversight of progress being made on the Foundation's most important activities: our priority program investments, research infrastructure investments, and key management initiatives. Each of these goals will be reviewed by senior management on a quarterly basis.

Goal 1: Key Program Investments

Fiscal Year	**2014**
Goal Statement	Meet critical targets for key program investments.
Indicator and Target Measure, Milestone, or Deliverable	Monitor the progress of the following investments using a common set of milestones and indicators: • CEMMS • CIF21 • I-Corps • INSPIRE • SaTC • SEES
Description	Major investments will be strategically monitored using a set of common metrics. These may include: • Contextual indicators, such as the investment's funding level. • Input indicators, such as date of release of solicitation, number of proposals received, numbers of reviews conducted. • Output indicators, such as number of awards, average and total amounts awarded, and funding rate. • Medium-term output and outcome indicators that funded projects are on track. • Activity-specific outcome indicators, e.g. those relating to programmatic long-term goals to change a given field. The central mechanism for this goal will be quarterly review meetings to discuss progress.
Trend Information	This is a new goal in FY 2014. Since FY 2012, the INSPIRE and I-Corps programs have been the subjects of performance goals. For more information on those goals, refer to the FY 2012 Annual Performance Report.
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Transform the Frontiers -1: Make investments that lead to emerging new fields of science and engineering and shifts in existing fields. Innovate for Society -1: Make investments that lead to results and resources that are useful to society. Innovate for Society -2: Build the capacity of the Nation's citizenry for addressing societal challenges through science and engineering.
Lead Organization	Office of the Performance Improvement Officer, Office of Budget, Finance, and Award Management.

Goal 2: Research Infrastructure Investments

Fiscal Year	**2014**
Goal Statement	Ensure program integrity and responsible stewardship of key research facilities and infrastructure.
Indicator and Target Measure, Milestone, or Deliverable	• Construction Project Monitoring: For all MREFC facilities under construction that are over 10 percent complete, keep negative cost and schedule variance at or below 10 percent. • Public Access to Data: Deploy the first implementation of the NSF public access system.
Description	This overarching goal monitors NSF-funded facilities and infrastructure at varying stages of their lifecycle. • NSF monitors the performance of projects funded by the Major Research Equipment and Facilities Construction (MREFC) account, monitoring cost and schedule, a standard measure of performance for construction projects. Projects that are under ten percent complete are not considered eligible for this goal because EVM data is statistically less meaningful in early stages. • NSF will launch a Public Access Initiative that will make the results of NSF-funded research broadly available with minimal barriers. NSF's public access policy will accelerate progress in scientific research, encourage citizens to become scientifically literate, and foster creative partnerships with the private sector. Building on progress made in FY 2012 and FY 2013, NSF will develop plans and pilots in FY 2014 for enhanced access to selected products of NSF funding, specifically peer-reviewed journal articles, and for inclusion of information about those products in NSF reporting and proposal systems. For more information, see the NSF-Wide Investments chapter.
Trend Information	While this is a new goal in FY 2014, NSF has tracked the first component, the performance of its construction projects, as a performance goal for over a decade. For more information about this component, see the FY 2012 Annual Performance Report.
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Transform the Frontiers -4: Enhance research infrastructure and promote data access to support researchers' and educators' capabilities and to enable transformation at the frontiers.
Lead Organization/s	Construction Project Monitoring: Office of Budget, Finance, and Award Management. Public Access Initiative: Directorate for Social, Behavioral, and Economic Sciences.

Goal 3: Data-driven Management Reviews

Fiscal Year	**2014**
Goal Statement	Use evidence-based reviews to guide management investments.
Indicator and Target Measure, Milestone, or Deliverable	PortfolioStat measures: • NSF's information technology governance boards will evaluate and prioritize proposed investments for FY 2016. • NSF will move toward a standardized computing environment, reducing purchase costs by $300,000 below FY 2012 levels by FY 2014. • Migration to cloud email provider will reduce costs by approximately $240,000 below FY 2012 levels by FY 2014. HRStat measures: • Develop a human capital management dashboard to report progress toward human capital (HC) goals and to monitor HC metrics, for use as an internal resource for informing investment decisions. • Establish a review process which culminates in quarterly reviews of HC metrics by senior management and which incorporates, to the extent possible, OPM's human capital accountability system requirements.
Description	This goal captures NSF's commitment to two government-wide processes, Portfolio Stat and HR Stat, which aim to ensure that decisions regarding resource investments are made through formal processes involving cross-agency decision-makers. Data regarding business need, cost, and risk-analysis will be provided. This approach to decision making promotes transparency and accountability through data driven decision-making. As directed in OMB M-12-10, "Implementing PortfolioStat," NSF will employ this new tool to assess the current maturity of its IT portfolio management process, make decisions on eliminating duplication, augment current CIO-led capital planning and investment control processes, and move to shared solutions in order to maximize the return on IT investments across the portfolio. NSF's Human Capital targets were informed by participation in the HRStat Pilot in FY 2013. NSF will build upon this experience through continued participation in FY 2014. The Human Capital Dashboard will align with the goals set out in current and future strategic plans; will incorporate human capital goals defined in the Federal Employee Viewpoint Survey action plan, and will integrate OPM's revised Human Capital Framework. The accompanying review process will update and formalize the review process piloted through HRStat in FY 2013 and incorporate the HC dashboards as a mechanism to track, monitor, and report on progress. NSF will hold at least two reviews during FY 2014.
Trend Information	This is a new goal in FY 2014, and a new approach to monitoring management investments. Since FY 2011, the Office of the CHCO has led three performance goals per year relating to human resources development. For more information about those goals, refer to the Annual Performance Reports for those years.

Goal 3: Data-driven Management Reviews (continued)

Fiscal Year	**2014**
Goal Statement	Use evidence-based reviews to guide management investments.
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Perform as a Model Organization -2: Infuse learning as an essential element of the NSF culture with emphasis on professional development and personal growth. Perform as a Model Organization-3: Encourage and sustain a culture of creativity and innovation across the agency to ensure continuous improvement and achieve high levels of customer service.
Lead Organization/s	Office of the CIO, Office of Information and Resource Management Office of the CHCO, Office of Information and Resource Management

Goal 4: Improve Undergraduate Education

Fiscal Year	**2014**
Goal Statement	Establish an NSF-wide undergraduate STEM education program that is evidence-based and evidence-building.
Indicator and Target Measure, Milestone, or Deliverable	By October 30, 2013, perform an environment scan/gap analysis of undergraduate education efforts across NSF using a principle-based framework, and make recommendations for addressing the gaps and overlaps. By December 31, 2013, issue a solicitation for the Catalyzing Advances in Undergraduate STEM Education (CAUSE) program. By September 30, 2014, conduct a portfolio analysis of CAUSE-funded projects to summarize the evidence base upon which they rest and the plans they have for building evidence.
Description	The America COMPETES Reauthorization Act of 2010 called for the creation of a committee under the National Science and Technology Council (NSTC) to coordinate federal programs and activities in support of STEM education. The NSTC's Committee on Science, Technology, Engineering, and Mathematics Education (CoSTEM) has identified undergraduate STEM education as a priority and increasing the number of STEM graduates as a goal. The President's Council of Advisors on Science and Technology (PCAST) report, *Engage to Excel*, and the National Academies report, *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads*, underscores the lack of persistence of STEM students from all groups in the first two years of college. To counteract this, the PCAST report recommends widespread implementation of evidence-based teaching practices, including the integration of discovery-based laboratory courses, as methods that have strong potential to enhance retention. NSF is committed to serving a leadership role in achieving important goals for production of STEM professionals. NSF's CAUSE program, to be launched in FY 2014, is a natural evolution and consolidation of the Foundation's ongoing efforts to couple STEM disciplinary expertise with education research expertise to better understand and improve undergraduate STEM learning and persistence of students from all groups. CAUSE will provide coherence across all NSF undergraduate education programs to maximize the effectiveness of NSF investments in improving the STEM learning experiences of undergraduates.

Goal 4: Improve Undergraduate Education (continued)

Fiscal Year	**2014**
Goal Statement	Establish an NSF-wide undergraduate STEM education program that is evidence-based and evidence-building.
Description (continued)	To maximize the effectiveness of CAUSE on STEM undergraduate education, a research and development-based planning matrix will be used to build coherence and complementarity in education investments across NSF and to inform strategic planning. The 2014 goal is to develop this matrix, align existing investments across the Foundation, and make recommendations on how to address gaps and overlaps. In addition, CAUSE will seek projects that are both based in available evidence and that plan to build evidence, and will document the portfolio on those dimensions in FY 2014. For more information about the CAUSE investment, please refer to the NSF-Wide Investments chapter.
Trend Information	CAUSE is built upon a knowledge base informed by decades of work on STEM undergraduate education. It builds upon NSF's FY 2011-2013 performance goals, including the FY 2012-FY 2013 Priority Goal that involved developing standards for gaining information about instructional practices across institutions receiving funding for undergraduate education from NSF. This information will continue to be gathered. The FY 2014 goal will provide added information on the overall investment strategy in undergraduate education and how NSF programs can be leveraged to improve instructional practices broadly.
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Transform the Frontiers -2: Prepare and engage a diverse science, technology, engineering, and mathematics (STEM) workforce motivated to participate at the frontiers.
Lead Organization	Directorate for Education and Human Resources

Goal 5: Enhance National Graduate Research Fellowships

Fiscal Year	2014
Goal Statement	Enhance the Graduate Research Fellowship program to provide a wider range of career development opportunities.
Indicator and Target Measure, Milestone, or Deliverable	The GRF Program will be enhanced to be a National Graduate Research Fellowship (NGRF) Program, a single program for applicants that will provide a wider range of career development opportunities.
Description	The FY 2014 Budget Request introduces a coherent and streamlined investment strategy for the preparation of tomorrow's science and engineering (S&E) workforce. The NSF GRF program will be expanded into a National Graduate Research Fellowship program (NGRF) to incorporate features and opportunities that allow fellows to gain specialized experiences and training in key STEM areas. Creating NGRF will include working across NSF and coordinating with other agencies to determine how NGRF can be enhanced to meet national needs. Achieving this performance goal will involve development of a single call for applications and single web portal for applicants to use, development of a set of targeted opportunities for fellows that align with identified workforce needs, and costs savings through a streamlined and online review process. This will occur in coordination with other agencies. For more information about this activity, please refer to the NSF-Wide Investments chapter.
Trend Information	This is a redesigned activity in FY 2014. The work of consolidating strategy development and administration for graduate fellowships will involve engagement across the Foundation, as well as engagement of other federal agencies, the academic community, and the ultimate employers of the students. The work with other federal agencies will include developing targeted opportunities that can help address national needs. This activity will serve as the first stage of developing a coherent, NSF-wide strategy to consider the multiple forms of support provided for graduate students.
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Transform the Frontiers-2: Prepare and engage a diverse science, technology, engineering and mathematics (STEM) workforce motivated to participate at the frontiers.

Goal 6: Career-Life Balance

Fiscal Year	2012	2013	2014
Goal Statement	Promote policies and practices that support more fully utilizing the talents of individuals in all sectors of the American population, principally women, underrepresented minorities, and persons with disabilities.		
Indicator and Target Measure, Milestone, or Deliverable	By September 30, 2012: Establish the FY 2012 baseline for number and value of award support provided to CAREER awardees and postdoctoral fellows intended to fund research technicians (Achieved for Career Awardees).	By September 30, 2013: • Establish the FY 2013 baseline for number and value of awards provided to ADVANCE institutions intended to fund dual career supports. • Increase the number and value of research technician award support provided to CAREER awardees and postdoctoral fellows by 10 percent over FY 2012.	By September 30, 2014: • Conduct a preliminary analysis of the first three years of the CLB Initiative that can be used formatively. • Conduct outreach activities to increase the awareness of the availability of CLB opportunities (within NSF and in communities where awareness is found to be low). • Collaborate with another federal agency to promote career-life balance by developing new ways of partnering with higher education.
Description	NSF's Career-Life Balance (CLB) Initiative — an ambitious, ten-year initiative — will build on the best of career-life balance practices among individual NSF programs to expand them NSF-wide. Using a comprehensive, pathway approach across the educational and career continuum, this agency-level effort will help attract, retain, and advance graduate students, postdoctoral students, and early-career researchers in STEM fields. In FY 2014, CLB will provide additional support (supplements) for research technicians (or equivalent) for early career awardees (CAREER, postdoctoral fellows, and NGRF) who need temporary support to continue research while facing dependent care demands (e.g., child and/or elder care); and for dual career hiring and workforce re-entry (ADVANCE). CLB will continue to pursue partnerships with sister federal agencies, professional associations and societies, private foundations, and with institutions of higher education (the Foundation's primary, direct stakeholders) to systematically change the cultural barriers underpinning this issue. A preliminary analysis of the first three years will be conducted and used to inform future directions.		

Goal 6: Career-Life Balance (continued)

Fiscal Year	2012	2013	2014
Goal Statement	Promote policies and practices that support more fully utilizing the talents of individuals in all sectors of the American population, principally women, underrepresented minorities, and persons with disabilities.		
Trend Information	In FY 2012, NSF introduced CLB supports for technicians for CAREER awardees who need temporary help to continue research while facing the demands of child and/or elder dependent care. A Dear Colleague Letter was sent to the Principal Investigators of the CAREER program in late FY 2012 that yielded CLB support to 20 Principal Investigators. The potential outcome of doubling or tripling the base number of supplements is anticipated with the announcement of CLB opportunities occurring earlier in FY 2013. Additionally, while the first year of the CLB Initiative supported only CAREER awardees, the support for CLB in FY 2013 expands to include selected postdoctoral programs, the Graduate Research Fellowship Program, and a new emphasis on dual career opportunities through the Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)- Institutional Transformation program track.		
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Transform the Frontiers -2: Prepare and engage a diverse science, technology, engineering, and mathematics (STEM) workforce motivated to participate at the frontiers.		
Lead Organization/s	Office of International and Integrative Activities		

Goal 7: Diversity and Inclusion

Fiscal Year	2012	2013	2014
Goal Statement	To foster an environment of diversity and inclusion while ensuring compliance with the agency's civil rights programs.		
Indicator and Target Measure, Milestone, or Deliverable	• Attain four of six essential elements of a model EEO agency. (FY 2011 baseline: three elements.) • Submit Diversity and Inclusion Strategic Plan to OPM by March 30, 2012. (Achieved)	• Attain five of six essential elements of a model EEO agency. • Assist in implementation of at least one ODI action within NSF's D&I Strategic Plan.	• Attain six of six essential elements of a model EEO agency. • Assist in implementation of one ODI action within NSF's D&I Strategic Plan. • Perform two compliance desk reviews under the applicable anti-discrimination laws.
Description	NSF's diversity and inclusion goal has several components. • For NSF to achieve model EEO agency status, it must meet and maintain each of the six criteria established by the EEOC. The EEOC refers to these criteria as the "Essential Elements" of a Model Agency, which are: 1. Demonstrated commitment from agency leadership; 2. Integration of EEO into the agency's strategic mission; 3. Management and program accountability; 4. Proactive prevention of unlawful discrimination; 5. Efficiency; and 6. Responsiveness and legal compliance. No federal agency has ever attained Model EEO status. NSF's activities have been aimed towards attainment of Model EEO status for several years. • The Office of Diversity and Inclusion (ODI) will work collaboratively with the NSF Chief Human Capital Officer (CHCO) and the Office of Human Resource Management in implementing NSF's first D&I Strategic Plan focusing on specific areas in which potential barriers exist. ODI will continue to identify processes and mechanisms for gathering and incorporating workforce input, which includes holding information sessions with applicable parties and gathering comments and/or suggestions. • Title IX of the Education Amendments of 1972 (hereinafter Title IX) prohibits discrimination based on gender in any educational program or activity receiving federal financial assistance. ODI works collaboratively with the Department of Education in processing and resolving complaints filed under Title IX.		

Goal 7: Diversity and Inclusion (continued)

Fiscal Year	2012	2013	2014
Goal Statement	Foster an environment of diversity and inclusion while ensuring compliance with the agency's civil rights programs.		
Description (continued)	Additionally, ODI's compliance program includes desk and on-site reviews to ensure recipients are in compliance under Title IX. NSF also has implementing regulations to ensure that educational programs that receive NSF funds are free of gender discrimination and harassment. (45 C.F.R. § 618). NSF's regulations under Title VI of the Civil Rights Act of 1964 incorporates NSF's Title IX compliance responsibilities, which require the agency to conduct periodic review of recipient practices to determine if they are in compliance. NSF has adopted a philosophy that involves serving as a resource to grantees while maintaining a balance of identifying and reporting on "career-life" best practices and ensuring full compliance. NSF's process will involve educating its stakeholders on the roles and responsibilities under Titles IX and VI as well as NSF's specific compliance process, which includes a strong communication strategy to all stakeholders, inclusive of NSF's internal staff and grantees. For compliance reviews, NSF will use collaborative approaches that are modeled specifically for its programs and adopted from effective proven models for conducting annual desk and site reviews as part of its risk assessment as well as its Business Systems Review processes. Similar to these models, NSF's compliance process will involve making neutral selections for review, which may include the amount of financial assistance, the location and size of the institution, the demographic composition of the science and math programs granted, the potential impact of a review, and the recentness of a compliance review; engaging and collaborating with recipients; assisting in ensuring basic compliance; and focusing on best practices. NSF's compliance model will also involve conducting desk reviews to gather preliminary compliance information in which participants will be selected based on neutral criteria referenced earlier. NSF will request information needed to evaluate whether a recipient's policies, procedures, and practices are consistent with Title IX and Title VI requirements, NSF's regulations, and other relevant guidelines.		
Trend Information	NSF has been tracking its progress towards Model EEO Agency status as a performance goal since FY 2011. In FY 2011, four of six elements were attained. In FY 2012, five of six elements were attained.		
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Perform as a Model Organization -1: Achieve management excellence through leadership, accountability, and personal responsibility.		
Lead Organization	Office of Diversity and Inclusion, Office of the Director		

Goal 8: Financial System Modernization

Fiscal Year	2011	2012	2013	2014
Goal Statement	Upgrade NSF's financial system.			
Indicator and Target Measure, Milestone, or Deliverable	Gather functional requirements for changes in current system processes that will accommodate the transition to a grant by grant payment method (achieved late).	By September 30, 2012, to support the iTRAK initiative, the Division of Financial Management (DFM) and the Division of Acquisition and Cooperative Agreements (DACS) will award a contract for the iTRAK financial system implementation and integration services (achieved).	By September 30, 2013, to support the transition to the grant-by-grant payment process known as the Award Cash Management $ervice (ACM$), DFM will reconcile 100 percent of the grantee's reported cash on hand balances as of December 31, 2012 with NSF's general ledger.	Manage cost and schedule variance of the iTRAK system integrator within +/- 10 percent of the baseline.
Description	"iTRAK" is the Foundation-wide effort to transition NSF from its legacy financial support systems to a fully integrated, commercial-off-the-shelf (COTS) financial management shared services solution. Financial system modernization efforts have been underway at NSF for several years. While the iTRAK effort is central, other modernization steps are required as prerequisites, such as the transition of financial processing of grants from a pooled system (quarterly reporting of expenditures by institution) to a grant-by-grant payment process (where grant funds are requested and reported on an individual grant level). This payment method is a prerequisite for the transition to a COTS financial management shared services solution. The FY 2011 target for this goal was the documentation of functional requirements to transition to a real-time payment method.			
Trend Information	NSF has been tracking its progress towards upgrading its financial systems as a performance goal since FY 2011. The FY 2011 goal was achieved several months late. The FY 2012 goal was achieved on time.			
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Perform as a Model Organization -3: Encourage and sustain a culture of creativity and innovation across the agency to ensure continuous improvement and achieve high levels of customer service.			
Lead Organization	Office of Budget, Finance, and Award Management			

Goal 9: Customer Service: Time To Decision

Fiscal Year	2010	2011	2012	2013	2014
Goal Statement	Inform applicants whether their proposals have been declined or recommended for funding within 182 days, or six months, of deadline, target, or receipt date, whichever is later.				
Indicator and Target Measure, Milestone, or Deliverable	70 Percent (achieved: 75 Percent)	70 Percent (achieved: 78 Percent)	70 Percent (achieved: 78 Percent)	70 Percent (on track)	70 Percent
Description	Time-to-decision or "dwell time" is the amount of time that passes between receipt of a proposal and notification to the principal investigator about the funding decision. One of the most significant issues raised in customer satisfaction surveys is the time it takes NSF to process proposals. Too long a time period inhibits the progress of research as it delays the funding process, but too short a time period may inhibit the merit review process. The six-month target balances the need of the investigator for timely action and the need of NSF for a credible and efficient merit review system. Monitoring the merit review process with the time-to-decision metric is an ongoing practice at NSF.				
Trend Information	NSF has been tracking this measure as a performance goal for over a decade. For additional information and trend data, refer to the Annual Performance Report. FY 2010 result: 75 percent FY 2011 result: 78 percent FY 2012 result: 78 percent				
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Perform as a Model Organization-3: Encourage and sustain a culture of creativity and innovation across the agency to ensure continuous improvement and achieve high levels of customer service.				
Lead Organization/s	Office of International and Integrative Activities Office of Budget, Finance, and Award Management				

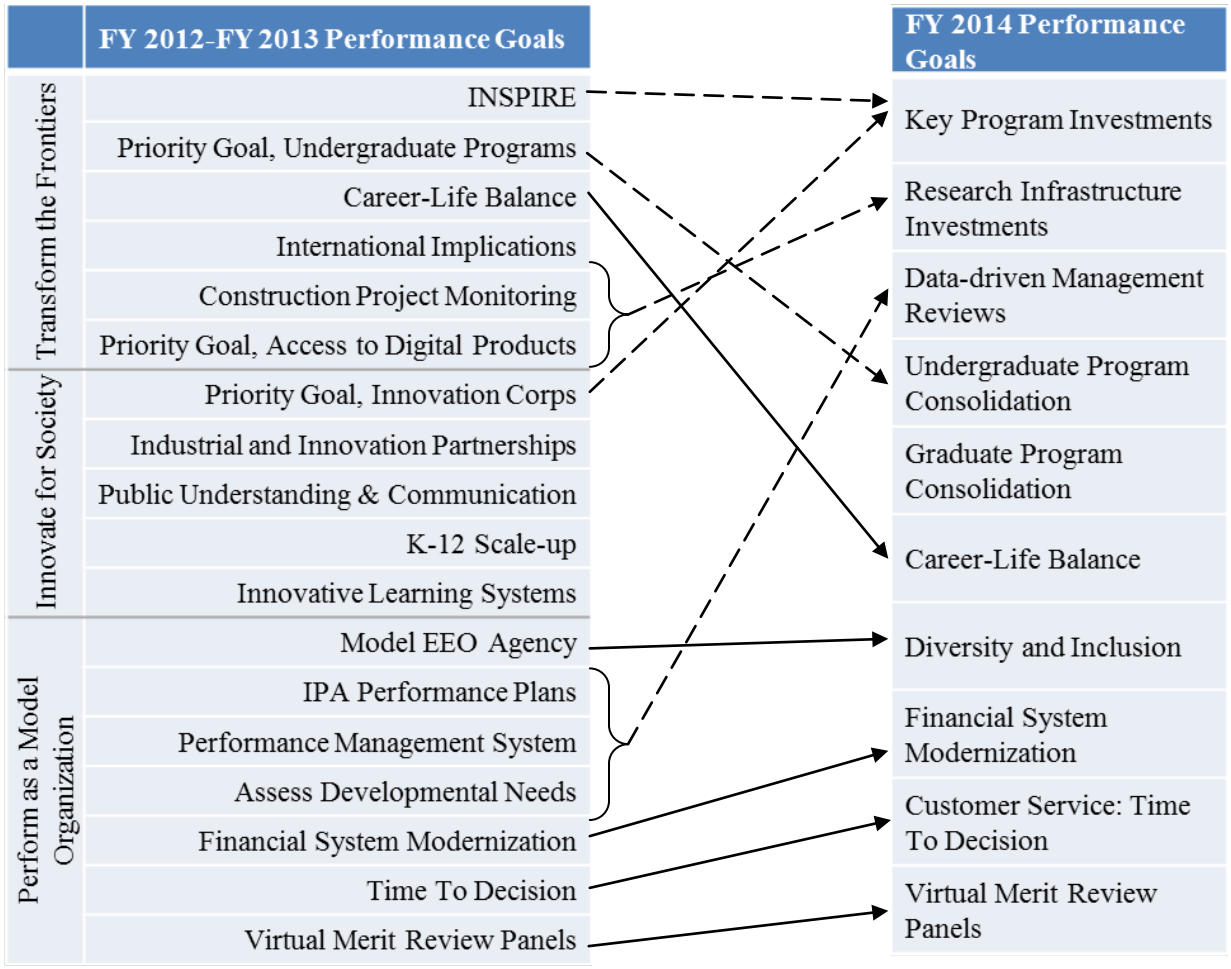
Goal 10: Virtual Merit Review Panels

Fiscal Year	2012	2013	2014
Goal Statement	Incorporate technological innovations into the merit review process by expanding the use of virtual merit review panels.		
Indicator and Target Measure, Milestone, or Deliverable	By September 30, 2012, develop guidelines and a training module for NSF staff on the use of virtual merit review panels (achieved).	As a pilot activity, 5 percent of merit review panels will be wholly virtual panels.	15 percent of merit review panels will be wholly virtual panels.
Description	The merit review process is NSF's most critical business function. Exploiting the use of IT in the merit review process has the potential to broaden participation, reduce reviewer burden, and reduce per-proposal cost of the review process. For more information about this activity, see the NSF-Wide Investments Chapter. NSF makes extensive use of panels of reviewers to evaluate proposals. As used here, the term "virtual panel" refers to a panel meeting in which the reviewers do not travel to a common location but instead participate via teleconference, videoconference, or an online meeting technology. A wholly virtual panel is defined as one in which 100 percent of the panelists participating in a particular panel shall be participating remotely. The predominant practice is for the panelists to travel to a single location, usually NSF, and meet face-to-face for one to five days. In FY 2010, approximately 1,800 review panels were held. Face-to-face panels impose a significant time burden on the reviewers, making some potential reviewers reluctant to participate. For example, panelists with young children may not be able to obtain two continuous days of childcare, or panelists in remote locations or foreign countries may find the amount of travel required prohibitive. It also causes NSF to incur significant travel costs.		
Trend Information	This activity began as a performance goal in FY 2012, when administrative offices and program staff collaborated to develop the first of a planned set of four training modules for organizers of virtual panels at NSF. An internal web-site that provides guidance to NSF staff on when to choose a virtual panel and how best to implement such panels was also developed and numerous outreach activities were conducted to familiarize staff with the resources available to them.		
Strategic Goal Linkage, FY 2011-FY 2016 Strategic Plan	Perform as a Model Organization-3: Encourage and sustain a culture of creativity and innovation across the agency to ensure continuous improvement and achieve high levels of customer service.		
Lead Organization	Chief Technology Officer, Office of the Director		

Development of NSF Performance Goals, FY 2012-FY 2014

In FY 2014, NSF will be operating under the Strategic Plan that is currently under development and is anticipated for release in FY 2014. NSF took this opportunity to reexamine, consolidate, and reorganize its set of performance goals. This approach captures all areas of NSF investment and is designed to be compatible with any strategic framework under consideration for the forthcoming strategic plan.

The following schematic illustrates the evolution of NSF's performance goals between the current framework and the FY 2014 framework featured in this Budget Request.



Key

→ Goal substantially unchanged over time.

- - - → Goal consolidated or evolved from earlier stage.

2012-2013 goals not connected to a 2014 goal are being addressed through changing agency practices or activities and will be described in the FY 2013 Annual Performance Report.

OTHER INFORMATION

Management Reviews
Each quarter, NSF senior leadership reviews progress towards all performance goals of the agency in a data-driven review meeting led by the Chief Operating Officer and Performance Improvement Officer. While focus is on the quarterly performance of the priority goals, all organizational goals are discussed.

Alignment of Human Capital Efforts with Organizational Performance
NSF requires all employees, executives, and the general workforce, to set individual goals aligned with the Foundation's mission and strategic goals in order to drive individual and organizational performance. An FY 2011 audit showed 100 percent of NSF's 76 SES performance plans provide a clear link to organizational goals and 100 percent of the sampled general workforce plans reviewed linked all critical elements to the agency mission or goals. NSF provides training and makes tools and templates available for all supervisors and employees on linking performance plans to agency mission as well as on the policies, processes, requirements, timeframes, and assistance available for preparations of plans and appraisals.

NSF also directly aligns its strategic human capital and accountability efforts to the goals identified in the NSF Strategic Plan. Agency performance goals currently outline specific human capital goals. In FY 2014, NSF will more directly tie human capital objectives to individual mission related performance goals where appropriate. NSF is currently participating in the OPM HRStat pilot and is making use of the HRStat process to increase, identify, and report on indicators of goal achievement. The process is increasing reliance on data and evaluative indicators in the overall decision making process.

Strategies and Collaborations
No one standard strategy is used across NSF for achievement of goals. Goal leaders at NSF choose strategies tailored to their stakeholders' needs and their institutional capabilities. In general, NSF goals involve testing the impacts of new activities or new approaches to existing activities, so feedback mechanisms are built in. Use of analysis, evidence, and evaluation findings is also at the discretion of each individual goal leader, as is the decision to collaborate with other agencies or external entities or to invest in contract support for their activities. Performance at NSF is reviewed quarterly by NSF's Performance Improvement Officer, who reports on goal progress to NSF senior management.

NSF employs a balanced set of performance indicators, milestones, and measures. Due to the nature of NSF investments, the two mission-oriented goals, *Transform the Frontiers* and *Innovate for Society*, tend to be output- or outcome-based. The management-oriented goal, *Perform as a Model Organization*, contains efficiency and customer-service measures, but also output and outcome measures relating to long-term activities such as financial system modernization and strategic human capital management.

Evaluations and Research
Evaluations at NSF are currently performed at the discretion of the individual directorate, office, or program being evaluated. For discussion of how NSF uses planned, current, and recently completed evaluations in its program decisions, refer to individual directorate and office chapters. A list of the evaluations completed in FY 2012 follows. For more details about how the results of these specific evaluations are being used to shape agency decisions, see the chapter of the sponsoring directorate. In FY 2014 NSF will expand and coordinate program evaluation and collection and management of NSF programmatic data; for more information, see the NSF-Wide investments chapter section on NSF's Evaluation Capability.

List External Evaluations Completed in FY 2012

DIR	Program, Topic, or Area Evaluated	Name of Evaluation	Contractor	Link to report
EHR	Research Experiences for Undergraduates	Research Experiences for Undergraduates: Data Mining Study	Beyond the Bottom Line	No link available
	Centers of Research Excellence in Science and Technology	Summative Evaluation of the Centers of Research Excellence in Science and Technology Program	Global Evaluation and Applied Research Solutions, Inc.	No link available
	ADVANCE	Quantitative Evaluation of the ADVANCE Program	Westat	No link available
ENG	Nanotechnology Undergraduate Education	Analysis of Reports of the Nanotechnology Undergraduate Engineering Program	Manhattan Strategy Group	No link available
GEO	Geodesy	A Foundation for Innovation: Grand Challenges in Geodesy	University Navstar Consortium (UNAVCO)	www.unavco.org/pubs_reports/pubs_reports.html
	Earth Sciences	New Research Opportunities in Earth Sciences	National Research Council	www.nap.edu/catalog.php?record_id=13236
	Hydrologic Sciences	Challenges and Opportunities in Hydrologic Sciences	National Research Council	www.nap.edu/catalog.php?record_id=13293
	Paleobiology, Paleoclimate, Stratigraphy	Transitions: The Changing Earth-Life System -- Critical Information for Society from the Deep Past	(workshop)	www.sepm.org/CM_Files/ConfSumRpts/TRANSITIONSfinal.pdf
	Paleobiology, Paleontology	Conservation Paleobiology -- Opportunities for the Earth Sciences	(workshop)	www.conservationpaleobiology.org/files/CP_Workshop_Report_Oct_2012.pdf
	Sedimentary basin geothermal sources	Tracking An Energy Elephant: Science And Engineering Challenges For Unlocking The Geothermal Potential Of Sedimentary Basins	(workshop)	www.sedheat.org/
	Antarctic Science & Logistics	More and Better Science in Antarctica Through Increased Logistical Effectiveness	USAP Blue Ribbon Panel	www.nsf.gov/od/opp/usap_special_review/usap_brp/rpt/antarctica_brochure_final.pdf
MPS	Underground Science	An Assessment of the Science Proposed for the Deep Underground Science and Engineering Laboratory (DUSEL)	National Academies of Science	http://sites.nationalacademies.org/DEPS/physicsandastronomy/index.htm?selectedYear=2011

Advisory Committees and Committees of Visitors

Each directorate and office has an external advisory committee that typically meets twice a year to review and provide advice on program management, discuss current issues, and review and provide advice on the impact of policies, programs, and activities in the disciplines and fields encompassed by the directorate or office. In addition to directorate and office advisory committees, NSF has several committees that provide advice and recommendation on specific topics: astronomy and astrophysics; environmental research and education; equal opportunities in science and engineering; direction, development, and enhancements of innovations; polar programs; advanced cyberinfrastructure; international and integrative activities; the agency's merit review processes; and business and operations.

Committees of Visitors (COVs) are subcommittees of NSF directorate advisory committees. COV reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the outputs and outcomes generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals. COV reviews are conducted at regular intervals of approximately three years for programs and offices that recommend or award grants, cooperative agreements, and/or contracts and whose main focus is the conduct or support of NSF research and education in science and engineering. Approximately one-third of NSF's divisions are assessed each year.

A COV typically consists of up to 20 external experts, selected to ensure independence, programmatic coverage, and geographic balance. COV members come from academia, industry, government, and the public sector. They meet for two or three days to review and assess program priorities, program management, and award accomplishments or outcomes. Each COV prepares a report and the division or program that is being reviewed must prepare a response to the COV recommendations. These reports and responses are submitted to the parent advisory committee and to the Director of NSF. All reports and responses are public and posted on NSF's website at: www.nsf.gov/od/oia/activities/cov/covs.jsp.

In FY 2012, seven directorates and offices convened 18 Committees of Visitors (COVs). A list of the COVs performed is provided below. The chapters of the directorates and offices also contain information on these COVs.

List of FY 2012 Committees of Visitors Meetings

Directorate	Division	Program or Cluster
BIO	Environmental Biology	
EHR	Research on Learning in Formal and Informal Settings	• Discovery Research K-12 • Research & Evaluation on Education in Science & Engineering (REESE) • Research on Gender in Science & Engineering • Research in Disabilities Education
	Undergraduate Education	• Advanced Technological Education • NOYCE Scholarships
	Graduate Education	Graduate Research Fellowships

Directorate	Division	Program or Cluster
ENG	Chemical, Bioengineering, Environmental and Transport Systems	
	Civil, Mechanical and Manufacturing Innovations	
GEO	Atmospheric & Geospace Sciences	Lower Atmospheric Facilities Oversight Section
	Earth Sciences	Deep Earth Processes Section
	Ocean Sciences	• Integrative Programs Section • Marine Geosciences Section • Ocean Section
MPS	Physics	
SBE	Office of Multidisciplinary Activities	
OIIA	Experimental Program to Stimulate Competitive Research (EPSCoR)	

Data Verification and Validation

It is NSF's practice to follow Government Accountability Office (GAO) guidance and engage external contractors to conduct an independent validation and verification (V&V) review of its annual performance information, data, and processes. The guidance from GAO indicates that agencies should "…describe the means the agency will use to verify its performance data…" and "…provide confidence that [their] performance information will be credible." [1] NSF will continue this process in FY 2013 and FY 2014.

In FY 2012, IBM Global Business Services (IBM) assessed the validity of NSF data and verified the reliability of the methods used to collect, process, maintain, and report that data, and reviewed NSF's information systems based on GAO standards for application controls. IBM's FY 2012 report concluded:

> *Overall, IBM verifies that NSF relies on sound business practices, internal controls, and manual checks of system queries to ensure accurate performance reporting. NSF maintains adequate documentation of its processes and data to allow for an effective V&V review. Based on the V&V assessment, IBM has confidence in the systems, policies, and procedures used by NSF to calculate results for its performance measures that contained targets. NSF continues to take concerted steps to improve the quality of their systems and data. IBM confirms NSF's commitment to ensuring the accuracy of its reported GPRA results, and the reliability of its processes for collecting, processing, maintaining, and reporting data for its performance goals*[2].

Data Sources, Limitations, and Intended Use

The data and information required to measure progress towards NSF's performance goals in FY 2011 and later years fall into three broad categories.

- NSF automated administrative systems. Performance monitoring can be a valuable secondary function of such systems. In FY 2011, reporting included data from systems that:
  - store and approve publications such as solicitations announcements, and Dear Colleague Letters;

[1] GAO, The Results Act: An Evaluator's Guide to Assessing Agency Annual Performance Plans, GAO/GGD-10.1.20 (Washington, D.C.: April 1998), pp. 40-41.

[2] IBM Global Business Services, *National Science Foundation Performance Measurement Verification and Validation Report, Fiscal Year 2012*. October 25, 2012.

  - collect transactional data about proposal and award management;
  - perform financial transactions;
  - store human resources data; and
  - permit keyword search of abstract or full texts of proposals and awards.
  - The data were used either directly or for achieving milestones that involve the writing of a report. While not all goals require a high level of accuracy, data from these systems are highly reliable.
- Reports on internal activities. Milestone achievement is often determined from review of records of certain activities and events. Records of this sort tend to be compiled from review of the evidence provided by goal leaders.
- Data requests of external parties. Qualitative or quantitative information is solicited directly from awardees.

Management Challenges
A discussion of agency management challenges can be found in the FY 2012 Agency Financial Report, www.nsf.gov/pubs/2013/nsf13002.

Burden Reduction/Unnecessary Plans and Reports to Congress
The GPRA Modernization Act 2010 requires that agencies identify which of the plans and reports they provide to Congress are outdated or duplicative of other required plans and reports. The complete list of reports that NSF suggested for consolidation or elimination can be found on performance.gov.

Lower-Priority Program Activities
The 2014 Cuts, Consolidations, and Savings (CCS) Volume of the President's Budget identifies the lower-priority program activities under the GPRA Modernization Act (31 U.S.C. 1115(b)(10)). The public can access the CCS volume at: www.whitehouse.gov/omb/budget.

Use of Non-Federal Parties
No non-federal parties were involved in preparation of this Annual Performance Report.

Classified Appendices Not Available to the Public
None

TECHNICAL INFORMATION

FY 2014 APPROPRIATIONS LANGUAGE

National Science Foundation

RESEARCH AND RELATED ACTIVITIES

For necessary expenses in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), and the Act to establish a National Medal of Science (42 U.S.C. 1880-1881); services as authorized by 5 U.S.C. 3109; maintenance and operation of aircraft and purchase of flight services for research support; acquisition of aircraft; and authorized travel; $6,212,290,000, to remain available until September 30, 2015, of which not to exceed $520,000,000 shall remain available until expended for polar research and operations support, and for reimbursement to other Federal agencies for operational and science support and logistical and other related activities for the United States Antarctic program: *Provided*, That receipts for scientific support services and materials furnished by the National Research Centers and other National Science Foundation supported research facilities may be credited to this appropriation.

EDUCATION AND HUMAN RESOURCES

For necessary expenses in carrying out science, mathematics and engineering education and human resources programs and activities pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services as authorized by 5 U.S.C. 3109, authorized travel, and rental of conference rooms in the District of Columbia, $880,290,000, to remain available until September 30, 2015.

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

For necessary expenses for the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including authorized travel, $210,120,000, to remain available until expended.

AGENCY OPERATIONS AND AWARD MANAGEMENT

For agency operations and award management necessary in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); services authorized by 5 U.S.C. 3109; hire of passenger motor vehicles; not to exceed $8,280 for official reception and representation expenses; uniforms or allowances therefor, as authorized by 5 U.S.C. 5901-5902; rental of conference rooms in the District of Columbia; and reimbursement of the Department of Homeland Security for security guard services; $304,290,000: *Provided*, That contracts may be entered into under this heading in fiscal year 2014 for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year.

OFFICE OF INSPECTOR GENERAL

For necessary expenses of the Office of Inspector General as authorized by the Inspector General Act of 1978, as amended $14,320,000, to remain available until September 30, 2014, of which not to exceed $400,000, shall remain available until September 30, 2015.

OFFICE OF THE NATIONAL SCIENCE BOARD

For necessary expenses (including payment of salaries, authorized travel, hire of passenger motor vehicles, the rental of conference rooms in the District of Columbia, and the employment of experts and consultants under section 3109 of title 5, United States Code) involved in carrying out section 4 of the National Science Foundation Act of 1950, as amended (42 U.S.C 1863) and Public Law 86-209 (42 U.S.C. 1880 et seq.), $4,470,000: *Provided,* That not to exceed $2,500 shall be available for official reception and representation expenses.

ADMINISTRATIVE PROVISION

Not to exceed 5 percent of any appropriation made available for the current fiscal year for the National Science Foundation in this Act may be transferred between such appropriations, but no such appropriation shall be increased by more than 15 percent by any such transfers. Any transfer pursuant to this section shall be treated as a reprogramming of funds under section 504 of this Act and shall not be available for obligation except in compliance with the procedures set forth in that section.

Summary of FY 2014 Budgetary Resources by Account

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2013 Annualized CR Amount	Change Over FY 2013 Annualized CR Percent
RESEARCH AND RELATED ACTIVITIES					
Appropriation	$5,719.00	$5,754.00	$6,212.29	$458.29	8.0%
Unobligated Balance Available Start of Year	2.38	18.38		-18.38	
Unobligated Balance Available End of Year	-18.38				
Adjustments to Prior Year Accounts[2]	85.30				
Subtotal, R&RA	5,788.30	5,772.38	$6,212.29	$439.91	7.6%
Transferred to/from Other Funds[3]	-30.00	-	5.00	5.00	
Total Budgetary Resources	$5,758.30	$5,772.38	$6,217.29	$444.91	7.7%
EDUCATION AND HUMAN RESOURCES					
Appropriation	$829.00	$834.07	$880.29	$46.22	5.5%
Unobligated Balance Available Start of Year	0.22	5.17		-5.17	
Unobligated Balance Available End of Year	-5.17				
Adjustments to Prior Year Accounts[2]	6.49				
Total Budgetary Resources	$830.54	$839.24	$880.29	$41.05	4.9%
MAJOR RESEARCH EQUIPMENT & FACILITIES CONSTRUCTION					
Appropriation	$167.06	$168.08	$210.12	$42.04	25.0%
Unobligated Balance Available Start of Year	0.88	0.69		-0.69	
Unobligated Balance Available End of Year	-0.69				
Adjustments to Prior Year Accounts[2]	0.83				
Subtotal, MREFC	168.08	168.77	210.12	41.35	24.5%
Transferred to/from Other Funds[3]	30.00	-	-	-	
Total Budgetary Resources	$198.08	$168.77	$210.12	$41.35	24.5%
AGENCY OPERATIONS AND AWARD MANAGEMENT					
Appropriation	$299.40	$301.23	$304.29	$3.06	1.0%
Unobligated Balance - Expired	-0.10				
Total Budgetary Resources	$299.30	$301.23	$304.29	$3.06	1.0%

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore these accounts were operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2]Adjustments include upward and downward adjustments to prior year obligations.

[3]In FY 2014, the Administration proposes to transfer $5.0 million from the Department of Justice to the National Science Foundation for a forensic science grant program to establish forensic science research centers. In FY 2012, NSF transferred $30.0 million from Research and Related Activities to Major Research Equipment and Facility Construction, per P.L. 112-55.

Summary of FY 2014 Budgetary Resources by Account

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2013 Annualized CR Amount	Change Over FY 2013 Annualized CR Percent
NATIONAL SCIENCE BOARD					
Appropriation	$4.44	$4.47	$4.47	$0.00	0.0%
Unobligated Balance - Expired	-0.07				
Total Budgetary Resources	$4.37	$4.47	$4.47	-	-
OFFICE OF INSPECTOR GENERAL					
Appropriation	$14.20	$14.29	$14.32	$0.03	0.2%
Unobligated Balance Available Start of Year - ARRA	1.84	1.15		-1.15	
Unobligated Balance - Expired	-0.07				
Unobligated Balance Available End of Year - ARRA	-1.15				
Total Budgetary Resources	$14.82	$15.44	$14.32	-$1.12	-7.3%
TOTAL DISCRETIONARY, NATIONAL SCIENCE FOUNDATION	$7,105.41	$7,101.53	$7,630.78	$529.25	7.5%
EDUCATION AND HUMAN RESOURCES, H-1B					
Appropriation, Mandatory (H1-B Non-Immigrant Petitioner Fees)	$128.99	$100.00	$100.00	$0.00	0.0%
Unobligated Balance Available Start of Year	60.93	99.31	75.00	-24.31	
Unobligated Balance Available End of Year[2]	-99.31	-75.00			
Adjustments to Prior Year Accounts[3]	3.55				
Total Budgetary Resources	$94.16	$124.31	$175.00	$50.69	40.8%
DONATIONS					
Mandatory Programs (Special or Trust Fund)	$47.24	$25.00	$25.00	$0.00	0.0%
Unobligated Balance Available Start of Year	52.34	42.13		-42.13	
Unobligated Balance Available End of Year	-42.13				
Adjustments to Prior Year Accounts[3]	0.07				
Total Budgetary Resources	$57.52	$67.13	$25.00	-$42.13	-62.8%
TOTAL, NATIONAL SCIENCE FOUNDATION	$7,257.09	$7,292.97	$7,830.78	$579.94	8.0%

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore these accounts were operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2]In FY 2013 the unobligated balance available at the fiscal year end is estimated to be approximately $75.0 million which will carry over into FY 2014.

[3]Adjustments include upward and downward adjustments to prior year obligations.

NSF FY 2014 Funding by Program

(Dollars in Millions)

PROGRAM	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
BIOLOGICAL SCIENCES					
MOLECULAR AND CELLULAR BIOSCIENCES	$125.63	$125.79	$136.39	$10.60	8.4%
INTEGRATIVE ORGANISMAL SYSTEMS	212.43	212.33	225.37	13.04	6.1%
ENVIRONMENTAL BIOLOGY	142.55	142.56	148.97	6.41	4.5%
BIOLOGICAL INFRASTRUCTURE	126.46	126.18	133.65	7.47	5.9%
EMERGING FRONTIERS	105.22	105.52	116.20	10.68	10.1%
Total, BIO	$712.28	$712.38	$760.58	$48.20	6.8%
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING					
ADVANCED CYBERINFRASTRUCTURE	$283.84	$211.64	$221.35	$9.71	4.6%
COMPUTING & COMMUNICATION FOUNDATIONS	179.03	179.13	200.46	21.33	11.9%
COMPUTER & NETWORK SYSTEMS	212.36	212.50	238.87	26.37	12.4%
INFORMATION & INTELLIGENT SYSTEMS	176.58	176.50	200.42	23.92	13.6%
INFORMATION TECHNOLOGY RESEARCH	85.35	85.46	89.15	3.69	4.3%
Total, CISE	$937.16	$865.23	$950.25	$85.02	9.8%
ENGINEERING					
CHEMICAL, BIOENGINEERING, ENVIRONMENTAL & TRANSPORT SYSTEMS	$171.51	$171.45	$185.30	$13.85	8.1%
CIVIL, MECHANICAL & MANUFACTURING INNOVATION	203.59	203.58	224.02	20.44	10.0%
ELECTRICAL, COMMUNICATIONS & CYBER SYSTEMS	106.74	106.73	117.90	11.17	10.5%
INDUSTRIAL INNOVATION & PARTNERSHIPS	187.79	193.41	225.45	32.04	16.6%
SBIR/STTR	[146.86]	[152.76]	[177.15]	[24.39]	[16.0%]
ENGINEERING EDUCATION & CENTERS	123.93	120.00	126.25	6.25	5.2%
EMERGING FRONTIERS IN RESEARCH & INNOVATION	30.99	31.00	32.20	1.20	3.9%
Total, ENG	$824.55	$826.17	$911.12	$84.95	10.3%

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore these accounts were operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders based on the FY 2012 Current Plan. The annualization of P.L. 112-175 is reflected in the adjustment at the account level.

NSF FY 2014 Funding by Program
(Dollars in Millions)

PROGRAM	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
GEOSCIENCES					
ATMOSPHERIC & GEOSPACE SCIENCES	$258.65	$258.66	$266.61	$7.95	3.1%
EARTH SCIENCES	183.43	183.50	191.20	7.70	4.2%
INTEGRATIVE & COLLABORATIVE EDUCATION AND RESEARCH	91.30	91.21	93.71	2.50	2.7%
OCEAN SCIENCES	351.79	351.90	377.44	25.54	7.3%
POLAR PROGRAMS	436.20	435.87	464.90	29.03	6.7%
[U.S. Antarctic Logistical Support]	[67.52]	[67.52]	[67.52]	-	-
Total, GEO	$1,321.37	$1,321.14	$1,393.86	$72.72	5.5%
MATHEMATICAL AND PHYSICAL SCIENCES					
ASTRONOMICAL SCIENCES	$234.72	$234.55	$243.64	$9.09	3.9%
CHEMISTRY	234.03	234.06	253.65	19.59	8.4%
MATERIALS RESEARCH	294.40	294.55	314.63	20.08	6.8%
MATHEMATICAL SCIENCES	237.72	237.77	244.54	6.77	2.8%
PHYSICS	277.44	277.37	289.02	11.65	4.2%
MULTIDISCIPLINARY ACTIVITIES	30.37	30.64	40.64	10.00	32.6%
Total, MPS	$1,308.70	$1,308.94	$1,386.12	$77.18	5.9%
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES					
SOCIAL AND ECONOMIC SCIENCES	$97.26	$97.18	$102.51	$5.33	5.5%
BEHAVIORAL AND COGNITIVE SCIENCES	92.47	92.69	97.43	4.74	5.1%
MULTIDISCIPLINARY ACTIVITIES	28.22	28.23	30.65	2.42	8.6%
NATIONAL CENTER FOR SCIENCE AND ENGINEERING STATISTICS	36.23	36.15	41.76	5.61	15.5%
Total, SBE	$254.19	$254.25	$272.35	$18.10	7.1%

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore these accounts were operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders based on the FY 2012 Current Plan. The annualization of P.L. 112-175 is reflected in the adjustment at the account level.

NSF FY 2014 Funding by Program
(Dollars in Millions)

PROGRAM	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
INTERNATIONAL AND INTEGRATIVE ACTIVITIES					
EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCoR)	$150.85	$150.90	$163.58	$12.68	8.4%
INTEGRATIVE ACTIVITIES	197.80	198.69	321.16	122.47	61.6%
MAJOR RESEARCH INSTRUMENTATION (MRI)	[90.00]	[90.00]	[90.00]	-	-
INTERNATIONAL SCIENCE AND ENGINEERING	49.95	49.85	51.88	2.03	4.1%
Total, IIA	$398.60	$399.44	$536.62	$137.18	34.3%
U.S. ARCTIC RESEARCH COMMISSION	$1.45	$1.45	$1.40	-$0.05	-3.8%
Total, RESEARCH AND RELATED ACTIVITIES	$5,758.30	$5,689.00	$6,212.29	$493.29	8.6%
FY 2013 Adjustment[2]		65.00			
Total, RESEARCH AND RELATED ACTIVITIES	$5,758.30	$5,754.00	$6,212.29		
EDUCATION AND HUMAN RESOURCES					
RESEARCH ON LEARNING IN FORMAL AND INFORMAL SETTINGS	$273.23	$272.43	$277.87	$5.44	2.0%
UNDERGRADUATE EDUCATION	190.54	190.65	226.97	36.32	19.1%
GRADUATE EDUCATION	237.37	236.29	245.15	8.86	3.7%
HUMAN RESOURCE DEVELOPMENT	129.41	129.63	130.30	0.67	0.5%
Total, EDUCATION AND HUMAN RESOURCES	$830.54	$829.00	$880.29	$51.29	6.2%
FY 2013 Adjustment[3]		5.07			
Total, EDUCATION AND HUMAN RESOURCES[4,5]	$830.54	$834.07	$880.29		

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore these accounts were operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders based on the FY 2012 Current Plan. The annualization of P.L. 112-175 is reflected in the adjustment at the account level.

[2]This budget line is included to adjust for two items specific to the FY 2013 continuing resolution: first is $35.0 million for the 0.612 percent increase provided by the continuing resolution; second is an adjustment for the $30.0 million transfer executed in FY 2012 from the Research and Related Activities account to the Major Research Equipment and Facility Construction account that is not included in the FY 2013 continuing resolution calculation.

[3]This budget line is included to adjust for an item specific to the FY 2013 continuing resolution: $5.07 million for the 0.612 percent increase provided by the continuing resolution.

[4]Excludes $94.16 million in obligations in FY 2012 and an estimated $100.0 million in receipts from H-1B Nonimmigrant Petitioner Fees in FY 2013 and FY 2014.

[5]Beginning in FY 2014, EHR proposes to move three programs across EHR divisions. Cybercorps: Scholarships for Service (SfS) program moves into the Division of Graduate Education from the Division of Undergraduate Education. Project and Program Evaluation (PPE) and Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) move from Division of Research on Learning to the Division of Graduate Education.

NSF FY 2014 Funding by Program
(Dollars in Millions)

PROGRAM	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request	Change Over FY 2012 Enacted Amount	Percent
MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION	$198.08	$197.06	$210.12	$43.07	25.8%
FY 2013 Adjustment[6]		-28.98			
Total, MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION	$198.08	$168.08	$210.12		
AGENCY OPERATIONS AND AWARD MANAGEMENT	$299.30	$299.40	$304.29	$4.89	1.6%
FY 2013 Adjustment[7]		1.83			
Total, AGENCY OPERATIONS AND AWARD MANAGEMENT	$299.30	$301.23	$304.29		
NATIONAL SCIENCE BOARD	$4.37	$4.44	$4.47	$0.03	0.7%
FY 2013 Adjustment[8]		0.03			
Total, NATIONAL SCIENCE BOARD	$4.37	$4.47	$4.47		
OFFICE OF INSPECTOR GENERAL	$14.12	$14.20	$14.32	$0.12	0.8%
FY 2009 ARRA FUNDS	0.70				
FY 2013 Adjustment[9]		0.09			
Total, OFFICE OF INSPECTOR GENERAL	$14.82	$14.29	$14.32		
NATIONAL SCIENCE FOUNDATION	$7,105.41	$7,076.14	$7,625.78	$592.69	8.4%

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore these accounts were operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders based on the FY 2012 Current Plan. The annualization of P.L. 112-175 is reflected in the adjustment at the account level.

[6]This budget line is included to adjust for two items specific to the FY 2013 continuing resolution: first is $1.02 million for the 0.612 percent increase provided by the continuing resolution; second is an adjustment for the $30.0 million transfer executed in FY 2012 from the Research and Related Activities account to the Major Research Equipment and Facility Construction account that is not included in the FY 2013 continuing resolution calculation.

[7]This budget line is included to adjust for an item specific to the FY 2013 continuing resolution: $1.83 million for the 0.612 percent increase provided by the continuing resolution.

[8]This budget line is included to adjust for an item specific to the FY 2013 continuing resolution: $0.03 million for the 0.612 percent increase provided by the continuing resolution.

[9]This budget line is included to adjust for an item specific to the FY 2013 continuing resolution: $0.09 million for the 0.612 percent increase provided by the continuing resolution.

OBJECT CLASSIFICATION

NSF Consolidated Obligations

(Dollars in Millions)

Object Class Code	Standard Title	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request
11.1	Full-time permanent	$154	$157	$161
11.3	Other than full-time permanent	13	13	14
11.5	Other personnel compensation	2	2	2
11.8	Special personal service payment	-	1	1
	Total personnel compensation	169	173	178
12.1	Civilian personnel benefits	45	45	46
21.0	Travel and transportation of persons	27	27	27
23.1	Rental payments	26	27	31
23.3	Communications, utilities, and miscellaneous charges	3	2	2
24.0	Printing and Reproduction	-	-	-
25.1	Advisory and assistance services	170	171	159
25.2	Other services	22	21	20
25.3	Purchases of goods and services from Government accounts	46	41	45
25.4	Operation and maintenance of facilities	370	371	359
25.5	Research and development contracts	7	7	7
26.0	Supplies and materials	6	6	6
31.0	Equipment	3	5	3
32.0	Land and Structures	-	-	-
41.0	Grants, subsidies, and contributions	6,363	6,460	6,871
	Total, Direct obligations[2]	$7,257	$7,356	$7,754

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2]Includes mandatory obligations, but excludes obligations for reimbursable accounts.

NSF REIMBURSABLE ACTIVITY

Reimbursements for the Research and Related Activities Appropriation and the Education and Human Resources Appropriation are realized from other federal agencies that have entered into interagency agreements with the Foundation. NSF enters into agreements (including Memoranda of Understanding) with other U.S. government agencies, as authorized by the NSF Act, 42 U.S.C. 1870 (c) and the Economy Act: 31 U.S.C. 1535, under which NSF assumes some responsibility for activities supported by these agencies. These activities can include jointly funded projects and programs, support of research operations and logistics, and access to NSF supported research facilities.

Reimbursements by Agency
(Dollars in Millions)

DEPARTMENT/AGENCY	FY 2012 Actual
DEFENSE	
Air Force	$13.9
Army	$6.7
Other DoD (DARPA, NSA & Intelligence)	$15.6
Subtotal, DoD	$36.2
Agriculture	$0.5
Commerce (Including Census, NOAA, & NIST)	$10.4
Education	$0.4
Energy	$8.4
Environmental Protection Agency	$1.7
Health & Human Services	$22.1
Homeland Security	$1.2
NASA	$12.6
National Archives	$0.5
State	$0.5
Transportation	$5.2
OTHER (less than $500,000)	$1.0
TOTAL REIMBURSEMENTS	**$100.8**

Totals may not add due to rounding

Consistent with applicable legislation and GAO decisions, agreements include reimbursement for costs that are incurred in the management and administration of these awards.

In FY 2012, the largest portion of NSF's reimbursable activity came from joint activities with the Department of Defense (35.9 percent), the Department of Health and Human Services (21.9 percent), National Aeronautics and Space Administration (12.5 percent), Department of Commerce (including Census, National Oceanic and Atmospheric Administration, and National Institute of Standards and Technology) (10.3 percent), the Department of Energy (8.3 percent), the Department of Transportation (5.2 percent). Reimbursable activities with the Department of Defense were largely for the management of the National Center for Atmospheric Research (NCAR). Reimbursable activities with the Department of Health and Human Services are for non-medical biological research such as the Human Frontiers Science Program and the Macromolecular Structure Database (MSD) program.

NSF Personnel Summary of Permanent Appointments

Statutory Pay Systems	FY 2012 Actual Appointments
ES	74
AD	339
GS/GM-15	85
GS/GM-14	157
GS/GM-13	141
GS-12	114
GS-11	85
GS-10	11
GS-9	69
GL-9	1
GS-8	27
GS-7	72
GS-6	5
GS-5	7
GS-4	-
Subtotal, GS/GM	774
Total, Permanent Appointments	1,187
Average Salary	$117,391

All data are for permanent appointments.

EXPLANATION OF FY 2012 CARRYOVER INTO FY 2013 BY ACCOUNT

The National Science Foundation's (NSF) total unobligated balance of $166.83 million from the FY 2012 Discretionary and Mandatory accounts consist of amounts described below.

DISCRETIONARY

Within the **Research and Related Activities (R&RA)** account, NSF carried over $14.81 million into FY 2013. Obligation of these funds is expected by the end of the third quarter of FY 2013.

- Office of Polar Programs (OPP): OPP carried over $6.04 million of no-year funds that were recovered from several awards and contracts from prior years.

- Directorate for Engineering (ENG): ENG carried over $6.0 million of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) FY 2012 funds into FY 2013.

- Office of Integrative Activities (OIA): OIA carried over $890,000 in the Science and Technology Centers (STCs) line to support the STC Summary Panel and the five strategic planning workshops related to the new STC centers cohort in FY 2013.

- National Coordination Office/Networking and Information Technology Research and Development (NCO/NITRD): NCO/NITRD carried over $120,000 of operational funds to continue government procurements and operations.

- The remaining $1.76 million was recovered from several awards and contracts from various programs throughout NSF that were not ready for obligation in FY 2012.

Within the **Education and Human Resources (EHR)** account, NSF carried over $960,000 (2-year: $330,000 and no-year: $630,000) into FY 2013 for awards and contracts that were not ready for obligation in FY 2012. Obligation of these funds is expected by the end of the third quarter of FY 2013.

Within the **Major Research Equipment and Facilities Construction (MREFC)** account, $690,000 was carried over into FY 2013; however, the obligation of these no-year funds may be spread over several years.

- NSF carried over $510,000 for the Atacama Large Millimeter Array (ALMA) into FY 2013. The FY 2012 appropriation provided $3.0 million for ALMA construction, which represents the final amount necessary to complete funding for the 11-year project, totaling $499.26 million. The remaining $510,000 in FY 2012 MREFC will be obligated in FY 2013 to complete construction.

- NSF carried over $180,000 for South Pole Station Modernization (SPSM) for closing-out costs.

AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 (ARRA)

Within the **Office of Inspector General ARRA** account, $1.15 million was carried over from FY 2012 into FY 2013. These multi-year funds are intended explicitly for ARRA oversight. These funds were obligated during the first quarter of FY 2013.

INCOMING INTERAGENCY REIMBURSABLE AGREEMENTS

- R&RA: Incoming two-year interagency funds were carried over into FY 2013 in the amount of $3.57 million. Obligation of these funds is expected by the end of the third quarter of FY 2013.

- EHR: Incoming two-year interagency funds were carried over into FY 2013 in the amount of $4.21 million. Obligation of these funds is expected by the end of the third quarter of FY 2013.

MANDATORY

Within the **H-1B Nonimmigrant Petitioner** account, $99.31 million was carried over into FY 2013, which consists of $19.31 million in Innovative Technology Experiences for Students and Teachers (ITEST) and $80.0 million in NSF Scholarship in Science, Technology, Engineering, and Mathematics (S-STEM) and includes $69.61 million in third quarter H-1B receipts (received in August 2012) and $18.88 million in fourth quarter receipts (received in November 2012). Since NSF receives the largest quarterly payment of H-1B visa fees in August, there is insufficient time to obligate the receipts on awards before the end of the fiscal year. These resources will allow both ITEST and S-STEM to support awards through the third quarter of FY 2013.

Within the **Donations** account, $42.13 million was carried over into FY 2013. Donations were received from foreign governments, organizations, and individuals to fund various cooperative efforts in science, research, and education.

Discretionary and Mandatory Accounts
Distribution of FY 2012 Carryover into FY 2013
(Dollars in Millions)

Discretionary Accounts	Discretionary and Mandatory Accounts	Incoming Interagency Reimbursables	Total FY 2013 Carryover from FY 2012
Research and Related Activities	$14.81	$3.57	$18.38
Education and Human Resources	0.96	4.21	5.17
Major Research Equipment and Facilities Construction	0.69	-	0.69
Office of Inspector General (ARRA)	1.15	-	1.15
Subtotal	**17.61**	**7.78**	**25.39**
Mandatory Accounts			
H-1B Non-Immigrant Petitioner	99.31	-	99.31
Donations (Special or Trust Fund)	42.13	-	42.13
Subtotal	**141.44**	-	**141.44**
TOTAL	**$159.05**	**$7.78**	**$166.83**

Totals may not add due to rounding.

PHYSICIANS' COMPARABILITY ALLOWANCE (PCA) WORKSHEET

Department: National Science Foundation

Table 1

		PY 2012 (Actual)	CY 2013 (Estimates)	BY 2014* (Estimates)
1) Number of Physicians Receiving PCAs		0	1	1
2) Number of Physicians with One-Year PCA Agreements		0	1	1
3) Number of Physicians with Multi-Year PCA Agreements		0	0	0
4) Average Annual PCA Physician Pay (without PCA payment)		0	$176,547	$176,547
5) Average Annual PCA Payment		0	$22,000	$22,500
6) Number of Physicians Receiving PCAs by Category (non-add)	Category I Clinical Position	0	0	0
	Category II Research Position	0	0	0
	Category III Occupational Health	0	1	1
	Category IV-A Disability Evaluation	0	0	0
	Category IV-B Health and Medical Admin.	0	0	0

*FY 2013 data will be approved during the FY 2014 Budget cycle.

7) If applicable, list and explain the necessity of any additional physician categories designated by your agency (for categories other than I through IV-B). Provide the number of PCA agreements per additional category for the PY, CY and BY.

N/A

8) Provide the maximum annual PCA amount paid to each category of physician in your agency and explain the reasoning for these amounts by category.

NSF employs one physician in the occupational health category. This position has been covered by a PCA agreement since November 2006. The incumbent was placed in Leave Without Pay status for active duty military service beginning in August 2009. Under NSF's PCA Plan, a PCA is not paid during LWOP. NSF intends to resume PCA coverage of this position upon his expected return in October 2012. The maximum PCA amount previously paid was $21,588. The 2009 PCA amount represented a modest increase from the previous year and balanced the combined PCA and salary of competing organizations utilizing physicians with comparable qualifications.

9) Explain the recruitment and retention problem(s) for each category of physician in your agency (this should demonstrate that a current need continues to persist).

NSF's one PCA covered position is Head of the Polar Environment, Health and Safety Office in the Office of Polar Programs. The OPP physician serves as the chief medical officer of the U.S. Antarctic Program which NSF manages on behalf of the nation pursuant to Presidential Memorandum 6646. The responsibilities of this physician include overseeing medical practices and facilities at three land-based medical clinics in Antarctica and Arctic Ocean waters, and at remote field stations in Antarctica and Greenland. The OPP physician is also responsible for workplace safety at these locations and for developing sound environmental, safety, and medical aspects of research and operations supported by NSF and conducted in the polar regions. These duties require the attention of a physician with outstanding management ability and extensive operational experience. Offering a physicians' comparability allowance is essential to attracting

and retaining a qualified individual. Prior to obtaining PCA authority, OPP experienced considerable difficulty hiring a high quality candidate possessing the unique qualifications for this position.

10) Explain the degree to which recruitment and retention problems were alleviated in your agency through the use of PCAs in the prior fiscal year.

NSF's use of a PCA allowed the agency to offer compensation commensurate with the experience, background, and salary requirements of the best qualified pool of applicants. NSF was able to attract and retain a physician who previously received a PCA at another Federal agency.

11) Provide any additional information that may be useful in planning PCA staffing levels and amounts in your agency.

NSF has no plans to increase the use of PCA beyond the current level of one.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

November 5, 2012

Pam Hammett
Chief, Executive and Visiting Personnel Branch
Division of Human Resource Management
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Dear Ms. Hammett,

This is to advise you that the proposed FY 2013 Physicians' Comparability Allowance (PCA) plan for the National Science Foundation is consistent with the policy on comparability based on data presented. The National Science Foundation's plan will be effective through September 30, 2013.

We appreciate the effort you and your staff have taken to prepare this PCA plan.

Sincerely,

Paul Shawcross
Acting Deputy Associate Director
Energy, Science, and Water Division
Office of Management and Budget

QUANTITATIVE DATA TABLE

NATIONAL SCIENCE FOUNDATION

Research and Development Special Analysis

(Dollars in Millions)

	FY 2012 Actual	FY 2012 ARRA[1]	FY 2012 Total	FY 2012 Enacted/ Annualized FY 2013 CR [2,3]	FY 2014 Request[3]
Support of R&D					
Conduct of Research and Development					
Basic Research	$4,652.38	-	$4,652.38	$4,731.14	$5,109.13
Applied Research	517.40	-	517.40	510.97	608.40
Subtotal, Conduct of R&D	5,169.78	-	5,169.78	5,242.11	5,717.53
R&D Facilities					
Land, Building and Fixed Equipment	15.89	-	15.89	15.31	16.42
Major Equipment	519.68	-	519.68	462.27	505.88
Subtotal, R&D Facilities & Major Equipment	535.57	-	535.57	477.58	522.30
Total, Support of R&D	5,705.35	-	5,705.35	5,719.69	6,239.83
Non-Investment Activities	592.81	0.70	593.51	607.82	608.53
Education and Training	806.55	-	806.55	748.63	777.42
TOTAL	$7,104.71	$0.70	$7,105.41	$7,076.14	$7,625.78

Totals may not add due to rounding.

[1]$1.84 million in unobligated FY 2009 ARRA funds were carried over into FY 2012. The remaining unobligated balance of $1.15 million was subsequently carried over into and obligated during the first quarter of FY 2013.

[2]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[3]The data in these tables differ slightly from corresponding data in the *Analytical Perspectives* volume of the President's Budget, as they reflect information that was not available when the data for *Analytical Perspectives* were provided by NSF.

QUANTITATIVE DATA TABLE

RESEARCH AND RELATED ACTIVITIES

Research and Development Special Analysis

(Dollars in Millions)

	FY 2012 Actual	FY 2012 ARRA	FY 2012 Total	FY 2012 Enacted/ Annualized FY 2013 CR [1,2]	FY 2014 Request[2]
Support of R&D					
Conduct of Research and Development					
Basic Research	$4,560.71	-	$4,560.71	$4,628.49	$4,964.13
Applied Research	358.00	-	358.00	325.87	366.40
Subtotal, Conduct of R&D	4,918.71	-	4,918.71	4,954.36	5,330.53
R&D Facilities					
Land, Building and Fixed Equipment	15.89	-	15.89	15.31	16.42
Major Equipment	320.75	-	320.75	294.19	295.76
Subtotal, R&D Facilities & Major Equipment	336.64	-	336.64	309.50	312.18
Total, Support of R&D	5,255.35	-	5,255.35	5,263.86	5,642.71
Non-Investment Activities	238.49	-	238.49	253.61	251.16
Education and Training	264.46	-	264.46	236.53	318.42
TOTAL	$5,758.30	-	$5,758.30	$5,754.00	$6,212.29

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2]The data in these tables differ slightly from corresponding data in the *Analytical Perspectives* volume of the President's Budget, as they reflect information that was not available when the data for *Analytical Perspectives* were provided by NSF.

QUANTITATIVE DATA TABLE

EDUCATION AND HUMAN RESOURCES

Research and Development Special Analysis

(Dollars in Millions)

	FY 2012 Actual	FY 2012 ARRA	FY 2012 Total	FY 2012 Enacted/ Annualized FY 2013 CR [1,2]	FY 2014 Estimate[2]
Support of R&D					
Conduct of Research and Development					
Basic Research	$91.67	-	$91.67	$102.65	$145.00
Applied Research	159.40	-	159.40	185.10	242.00
Subtotal, Conduct of R&D	251.07	-	251.07	287.75	387.00
R&D Facilities					
Land, Building and Fixed Equipment	-	-	-	-	-
Major Equipment	0.85	-	0.85	-	-
Subtotal, R&D Facilities & Major Equipment	0.85	-	0.85	-	-
Total, Support of R&D	251.92	-	251.92	287.75	387.00
Non-Investment Activities	36.53	-	36.53	34.22	34.29
Education and Training	542.09	-	542.09	512.10	459.00
TOTAL	$830.54	-	$830.54	$834.07	$880.29

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

[2]The data in these tables differ slightly from corresponding data in the *Analytical Perspectives* volume of the President's Budget, as they reflect information that was not available when the data for *Analytical Perspectives* were provided by NSF.

QUANTITATIVE DATA TABLE

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

Research and Development Special Analysis

(Dollars in Millions)

	FY 2012 Actual	FY 2012 ARRA	FY 2012 Total	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request
Support of R&D					
Conduct of Research and Development					
Basic Research	-	-	-	-	-
Applied Research	-	-	-	-	-
Subtotal, Conduct of R&D	-	-	-	-	-
R&D Facilities					
Land, Building and Fixed Equipment	-	-	-	-	-
Major Equipment	$198.08	-	$198.08	$168.08	$210.12
Subtotal, R&D Facilities & Major Equipment	198.08	-	198.08	168.08	210.12
Total, Support of R&D	198.08	-	198.08	168.08	210.12
Non-Investment Activities	-	-	-	-	-
Education and Training	-	-	-	-	-
TOTAL	$198.08	-	$198.08	$168.08	$210.12

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

QUANTITATIVE DATA TABLE

AGENCY OPERATIONS AND AWARD MANAGEMENT

Research and Development Special Analysis

(Dollars in Millions)

	FY 2012 Actual	FY 2012 ARRA	FY 2012 Total	FY 2012 Enacted/ FY 2013 Annualized CR[1]	FY 2014 Request
Support of R&D					
Conduct of Research and Development					
Basic Research	-	-	-	-	-
Applied Research	-	-	-	-	-
Subtotal, Conduct of R&D	-	-	-	-	-
R&D Facilities					
Land, Building and Fixed Equipment	-	-	-	-	-
Major Equipment	-	-	-	-	-
Subtotal, R&D Facilities & Major Equipment	-	-	-	-	-
Total, Support of R&D	-	-	-	-	-
Non-Investment Activities	$299.30	-	$299.30	$301.23	$304.29
Education and Training	-	-	-	-	-
TOTAL	$299.30	-	$299.30	$301.23	$304.29

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

QUANTITATIVE DATA TABLE

OFFICE OF INSPECTOR GENERAL

Research and Development Special Analysis

(Dollars in Millions)

	FY 2012 Actual	FY 2012 ARRA[1]	FY 2012 Total	FY 2012 Enacted/ Annualized FY 2013 CR[2]	FY 2014 Request
Support of R&D					
Conduct of Research and Development					
Basic Research	-	-	-	-	-
Applied Research	-	-	-	-	-
Subtotal, Conduct of R&D	-	-	-	-	-
R&D Facilities					
Land, Building and Fixed Equipment	-	-	-	-	-
Major Equipment	-	-	-	-	-
Subtotal, R&D Facilities & Major Equipment	-	-	-	-	-
Total, Support of R&D	-	-	-	-	-
Non-Investment Activities	$14.12	$0.70	$14.82	$14.29	$14.32
Education and Training	-	-	-	-	-
TOTAL	$14.12	$0.70	$14.82	$14.29	$14.32

Totals may not add due to rounding.

[1]$1.84 million in unobligated FY 2009 ARRA funds were carried over into FY 2012. The remaining unobligated balance of $1.15 million was subsequently carried over into and obligated during the first quarter of FY 2013.

[2]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.

QUANTITATIVE DATA TABLE

NATIONAL SCIENCE BOARD

Research and Development Special Analysis

(Dollars in Millions)

	FY 2012 Actual	FY 2012 ARRA	FY 2012 Total	FY 2012 Enacted/ Annualized FY 2013 CR[1]	FY 2014 Request
Support of R&D					
Conduct of Research and Development					
Basic Research	-	-	-	-	-
Applied Research	-	-	-	-	-
Subtotal, Conduct of R&D	-	-	-	-	-
R&D Facilities					
Land, Building and Fixed Equipment	-	-	-	-	-
Major Equipment	-	-	-	-	-
Subtotal, R&D Facilities & Major Equipment	-	-	-	-	-
Total, Support of R&D	-	-	-	-	-
Non-Investment Activities	$4.37	-	$4.37	$4.47	$4.47
Education and Training	-	-	-	-	-
TOTAL	$4.37	-	$4.37	$4.47	$4.47

Totals may not add due to rounding.

[1]A full-year 2013 appropriation was not enacted at the time the budget was prepared. Therefore this account was operating under a continuing resolution (P.L. 112-175). The amounts shown for FY 2013 are placeholders and reflect an annualization of P.L. 112-175 at the account level.