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; to secure the national defense..."***

The National Science Foundation's FY 2023 Budget Request of $10.492 billion supports research across all fields of science, technology, engineering, and mathematics, and all levels of science, technology, engineering, and mathematics (STEM) education. NSF investments support the economic and national security interests of the Nation and development of a science and engineering workforce that draws on the talents of all Americans.

Over the past seven decades, NSF has funded research and researchers, innovations and innovators, and infrastructure that have garnered incredible benefits to the nation. The Internet, Google, Qualcomm, 3D printing, the economic theory underpinning spectrum auctioning and kidney exchanges, and even the polymerase chain reaction (PCR) testing technique that has been critical in the fight against COVID-19 have been supported by NSF investments. Many of the technologies and industries that are the focus of national conversations around competitiveness today, including artificial intelligence, quantum information science, advanced manufacturing, advanced wireless, and biotechnology, to name a few, are rooted in sustained NSF support for research at the frontiers of science and engineering.

As NSF looks to the future, the agency intends to strengthen at speed and scale its capacity to continue to produce breakthroughs, to innovate, to identify new industries, to accelerate the translation of research results to practice, and to cultivate the diverse workforce needed to power our country forward. NSF has the know-how and energy to help create a brighter future for our Nation. The NSF Director's vision expressed in **three pillars** that point to opportunities that we must seize:

1. **Strengthening Established NSF**
   For more than 70 years, NSF has been making investments that expand the frontiers of knowledge and technology. This will continue to be our central focus: to accelerate discovery and enhance state of the art research capabilities

2. **Bringing the "Missing Millions" into the STEM Workforce**
   The National Science Board (NSB) in its *Vision 2030*[1] report states, "Faster progress in increasing diversity is needed to reduce a significant talent gap" and they name that talent gap the "Missing Millions." NSB estimates that, for the S&E workforce to be representative of the U.S. population in FY 2030, the number of women in STEM must nearly double from the number in the 2020 U.S. S&E workforce, the number of Black or African Americans must more than double, and the number of Hispanic or Latinos must triple. These estimates are based on projections from the U.S. Census and Bureau of Labor Statistics, together with data from the National Center for Science

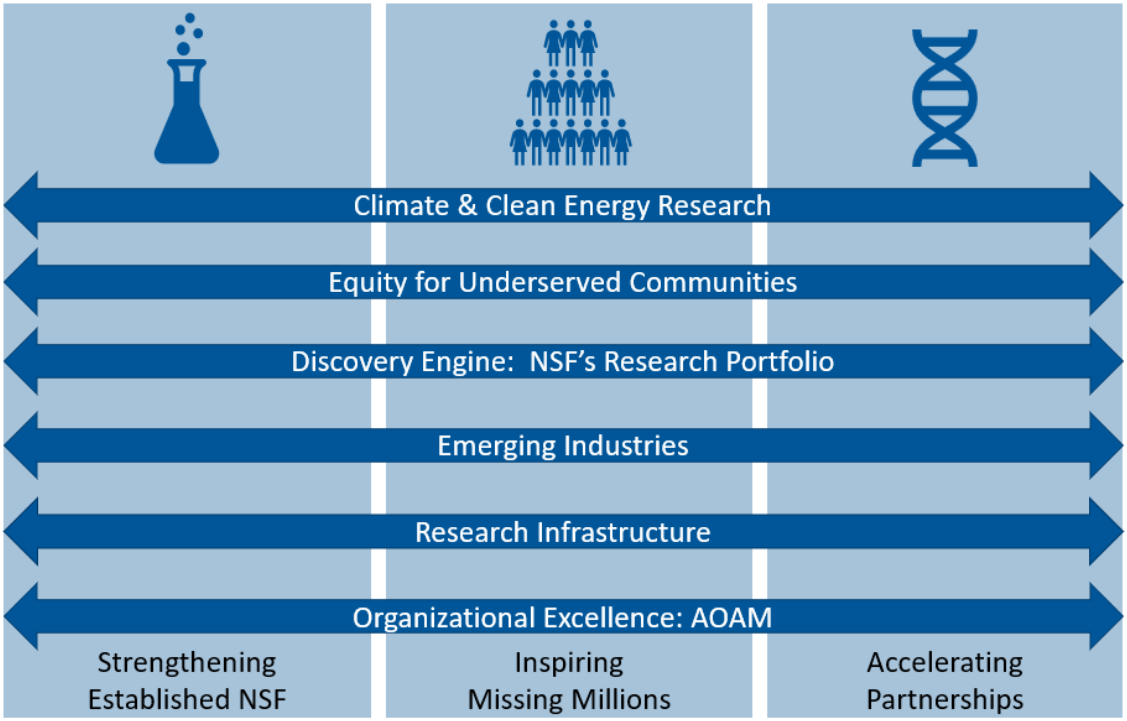
[1] www.nsf.gov/nsb/publications/2020/nsb202015.pdf

and Engineering Statistics (NCSES).

There is tremendous untapped STEM potential throughout the Nation. Every demographic and socioeconomic group in every geographic region of the country has talented people who can participate in STEM and contribute to the innovation enterprise. We plan to scale up existing pathways into STEM fields and create new tracks. NSF's commitment to finding talent provides opportunities that lead to a well-paid workforce and a vibrant U.S. economy.

3. **Accelerating Partnerships**
   Global competition for leadership and talent in science, engineering and technology is at an all-time high, inspiring and motivating us to accelerate our progress to be in the vanguard of discovery and innovation. For the U.S. to remain a global leader, we must continue to invest in breakthrough technologies and innovation, fostering partnerships, and nurturing talent, thereby encouraging the innovation that has been the source of our leadership over the past seven decades. To this end, NSF will accelerate its practices of not only pursuing direct partnerships with other agencies, private industry, philanthropy, and like-minded countries, but also fostering environments where partnerships thrive, thereby leveraging resources and delivering results.

These three pillars cross six themes in NSF's FY 2023 Budget Request — **Climate and Clean Energy Research, Equity for Underserved Communities, Discovery Engine, Emerging Industries, Research Infrastructure, and Organizational Excellence/Agency Operations and Award Management** — and align with the Administration's priorities of responding to the pandemic, tackling climate change, spurring economic recovery, innovating for equity, and ensuring national security & economic resilience. The themes, expanded upon below, appear repeatedly in the broad portfolio of fundamental research that is the heart of NSF's mission. They animate new efforts and connect existing efforts throughout the research portfolio. Most importantly, they point to opportunities NSF must seize.



STRATEGIC THEMES FOR FY 2023

NSF's six themes support the Administration's priorities and give shape to the organizing principles for the Fiscal Year 2023 discretionary budget request. These themes are:

Climate & Clean Energy

Accelerating climate research, understanding impacts of climate change, and developing solutions requires bold thinking, convergent approaches, and an overarching commitment to environmental equity, justice, and education. Action must be taken with urgency to advance knowledge, empower communities, and generate innovative technological solutions. Through FY 2023 investments, NSF will support a focus on taking aggressive action to tackle climate change and meet the urgent demands of the climate crisis while addressing the threat that the climate crisis poses to our economy. Of the total invested, focal areas include:

- **Clean Energy Technology (CET)** ($500.0 million) and NSF's clean-energy investments in high-risk, high-reward ideas from researchers across the science and engineering spectrum create broad new understanding and innovations that may increase energy efficiency, enhance sustainability, mitigate climate change, or lead to other societal benefits. NSF's investments in integrated clean energy research and education span longstanding programs as well as focused new solicitations and will continue to advance the fundamental science and engineering underlying clean energy technologies and infrastructure to continue to decrease energy prices and build our domestic supply chain. NSF also will support multidisciplinary research in areas such as affordable green housing and sustainable systems for clean water, clean transit, and other infrastructure.

- **U.S. Global Change Research Program (USGCRP)** ($913.40 million) continues to support research that contributes to the USGCRP goals to (1) advance scientific knowledge of the integrated natural and human components of the Earth system and (2) inform decisions by providing the scientific basis to inform and enable timely decisions on adaptation and mitigation. In FY 2023, NSF will continue to engage with other USGCRP agencies on priorities from intra-seasonal to centennial predictability, predictions, and projections; water cycle research; impacts of climate change on the nation's critical ecosystems, including coastal, freshwater, agricultural and forests systems; understanding the impacts of global change on the Arctic region and effects on global climate; and fundamental research on actionable science. In addition, NSF will seek greater integration of social-science research, methodologies, and insights into understanding and supporting responses to global change, improving computing capacity, and maintaining needed observational capabilities over time.

In FY 2023, NSF will enhance its investment in **greenhouse gas (GHG) research**, where NSF-funded projects will examine GHG flux measurements, study the coupled climate and dynamics of short-lived local pollutants and long-lived GHGs, and build understanding of methane production. NSF will also develop the **National Discovery Cloud (NDC) for Climate**, a new resource that will federate advanced compute, data, software and networking resources, democratizing access to a cyberinfrastructure ecosystem that is increasingly necessary to further climate-related S&E.

Equity for Underserved Communities

NSF is strongly committed to the development of a future-focused science and engineering workforce that draws on the talents of all Americans, wherever they are found. Increasing equity in underserved communities must cover a wide set of stakeholders, from individuals traditionally identified as underrepresented or underserved, to institutions of higher education that serve groups underrepresented in STEM, to those communities, lands and jurisdictions across the country that currently lack resources and opportunities for robust education, workforce development, and regional innovation.

In FY 2023, NSF intends to build on existing programs and develop new ones to strengthen and scale equity investments. For individuals, NSF will focus on groups that are underserved and underrepresented in STEM, but especially those who are extremely underrepresented in STEM (those with low presence and/or low visibility in NSF programs) as well as the relevant intersections or configurations of gender, race, ethnicity, and geographical location that comprise identity. For institutions, NSF will be more intentional in how we engage Minority Serving Institutions (MSIs) in our programs, starting with those classified as MSIs, but also focusing on the importance of MSI-bridge programs (funding open to all institutions that encourage participation by MSIs). For jurisdictions, NSF will expand support for individuals and institutions in EPSCoR jurisdictions to ensure geographic diversity.

NSF's commitment to finding talent provides opportunities that build strong STEM pathways that lead to a well-paid workforce and support the U.S. economy. To that end, the following programs are increased in the FY 2023 Budget Request to Congress.

- **Growing Research Access for Nationally Transformative Equity and Diversity (GRANTED)** ($50.0 million) is a new initiative that will improve the Nation's research support and service capacity at emerging and underserved research institutions. GRANTED will use a variety of mechanisms and programs to further NSF's reach in advancing the geography of innovation and engaging the Missing Millions. GRANTED activities will support the enhancement of research administration and post-award management as well as the implementation of effective practices for competitive proposal development, through mechanisms such as research-coordination networks (RCNs) and institutional partnership grants, ideas labs, and research enterprise hubs in different geographic regions. GRANTED funding in FY 2023 will focus on support for minority-serving institutions and aim to mitigate the barriers to competitiveness at underserved institutions within the Nation's research enterprise as NSF contributes to the Administration's priority on equity.

- **Alliances for Graduate Education and the Professoriate (AGEP)** ($14.0 million) program aims to increase the number of African American, Hispanic American, Native American Indian, Alaska Native, Native Hawaiian and Native Pacific Islander (or AGEP population) faculty in STEM at all types of institutions of higher education. The program funds projects that increase the understanding of institutional policies and practices to help doctoral candidates, postdoctoral scholars, and faculty improve their academic pathways to tenure and promotion in the STEM professoriate.

- **Centers of Research Excellence in Science and Technology (CREST)** ($41.0 million) enhance the research capabilities of minority-serving institutions (MSI) through the establishment of centers

that effectively integrate education and research. CREST promotes the development of new knowledge, enhancements of the research productivity of individual faculty, and an expanded presence of students historically underrepresented in STEM disciplines.

- The **Hispanic-Serving Institutions Program (HSI)** ($60.50 million) seeks to enhance the quality of undergraduate STEM education at HSIs and to increase retention and graduation rates of undergraduate students pursuing degrees in STEM fields at HSIs. The HSI program seeks to build capacity at HSIs that typically do not receive high levels of NSF grant funding.

- **Historically Black Colleges and Universities Excellence in Research (HBCU-EiR)** ($37.93 million) program supports projects that enable STEM and STEM education faculty to further develop research capacity at HBCUs and to conduct research.

- **Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)** ($48.50 million) is committed to enhancing the quality of undergraduate STEM education and research at HBCUs to broaden participation in the Nation's STEM workforce. HBCU-UP provides awards to develop, implement, and study evidence-based innovative models and approaches for improving the success of HBCU undergraduates so that they may pursue STEM graduate programs and/or careers.

- The **Louis Stokes Alliances for Minority Participation (LSAMP)** ($70.50 million) is an alliance-based program that works to increase the number of STEM baccalaureate and graduate degrees awarded to populations historically underrepresented in STEM disciplines.

- **NSF INCLUDES** ($50.50 million) is a comprehensive national initiative to enhance U.S. leadership in STEM discoveries and innovations focused on NSF's commitment to diversity, inclusion, and broadening participation in these fields. The vision of NSF INCLUDES is to catalyze the STEM enterprise to work collaboratively for inclusive change, resulting in a STEM workforce that reflects the population of the Nation.

- The **Tribal Colleges and Universities Program (TCUP)** ($23.0 million) provides awards to Tribal Colleges and Universities, Alaska Native-serving institutions, and Native Hawaiian-serving institutions to promote high quality STEM education, research, and outreach.

- **Established Program to Stimulate Competitive Research (EPSCoR)** ($247.25 million) provides strategic programs and opportunities that stimulate sustainable improvements to EPSCoR jurisdictions' R&D capacity and capability. EPSCoR aims to stimulate research that enhances jurisdictional competitiveness in NSF disciplinary and multidisciplinary research programs, especially those that drive economic growth and geographic diversity.

<u>Discovery Engine</u>

NSF funds groundbreaking research on vital problems and challenges. These efforts build and strengthen the scientific and societal bedrock upon which the Nation's future success and prosperity depend—both now and for decades to come.

NSF's support for innovative research helps to improve quality of life, enhance national security, and fuel American leadership in a wide range of technological and industrial sectors. NSF starts and fuels

dynamic collaborations and supports innovation in all areas of STEM education. NSF creates opportunity and broadens participation in America's science and engineering enterprise. Because NSF does all this and more simultaneously, it can integrate these approaches in its research portfolio to maximize benefits for our Nation where and when it is most needed.

For example, in FY 2023 NSF proposes to launch Global Centers to create an international center-level activity to address grand societal challenges. The program will seek partners from multiple sectors in the U.S. and abroad to leverage financial contributions and capabilities. The proposed activity will bring together interdisciplinary and international research teams to support use-inspired research. In FY 2023, the Global Centers activity is expected to facilitate the education and development of a globally engaged workforce to support the climate and clean energy disciplines.

NSF's research portfolio, through which both research and education opportunities are funded, is the endeavor for which the agency is best known. This research portfolio refers broadly to foundational research whose topics and goals are identified and driven by research communities and individual investigators who directly advance the frontiers of science. Resulting disciplinary or interdisciplinary proposals are submitted to a rigorous peer-review process through which NSF identifies and supports groundbreaking research concepts that are then implemented by tens of thousands of students and researchers in over 2,000 research institutions.

This budget strengthens established NSF programs. In FY 2023, NSF expects to

- Evaluate almost 50,000 proposals through the competitive merit review process and make approximately 13,500 **new competitive awards**, of which 11,500 are expected to be new research grants.

- Expand support for **fellowship programs.** Some of this increase will support activities dedicated to promoting equity in underserved communities. Touching all NSF directorates, this funding will invest in programs across the agency, such as Research and Monitoring for Postbaccalaureates in Biological Sciences (RaMP), Entrepreneurial Fellows, Atmospheric and Geospace Sciences Postdoctoral Research Fellowships (AGS-PRF), and MPS-ASCEND External Mentoring. In addition to the Discovery Engine theme, this funding includes, but is not limited to, support for the goals described in the Equity theme above.

- Fund 2,750 new **Graduate Research Fellowship Program** (GRFP) fellows and increase the GRFP stipend by $3,000 to $37,000 per year.

Emerging Industries for U.S. Competitiveness

As the U.S. faces intensifying global competition for science and technology leadership, NSF is ready to strengthen and scale investments in breakthrough technologies, innovation, and translation. A foundation of NSF's investment in Emerging Industries is also a focus on nurturing diverse talent. Building on NSF's deep relationships with over 2,000 of America's leading research institutions, we plan to harness the innovative spirit that exists in all corners of our country, which offers the potential for sustained leadership, and we must prepare a broader spectrum of students to be able to pursue the jobs of the future.

The President's Fiscal Year 2023 discretionary request advances the frontiers of research into the

future by focusing on the translation of research to the marketplace and making targeted investments in new industries.

- **The Directorate for Technology, Innovation, and Partnerships (TIP)** ($879.87 million), in close collaboration with all of NSF's directorates and offices, advances emerging technologies to address societal and economic challenges and opportunities; accelerates the translation of research results from the lab to market and society; and cultivates new education pathways leading to a diverse and skilled future technical workforce comprising researchers, practitioners, technicians, and entrepreneurs. Building on NSF's longstanding leadership in science and engineering research and education, TIP serves as a crosscutting platform that leverages, energizes, and rapidly advances use-inspired research and innovation. Further, TIP opens new possibilities for research and education by catalyzing strategic partnerships that link academia; industry, including startups and small businesses; federal, state, local, and tribal governments; nonprofits and philanthropic organizations; civil society; and communities of practice to cultivate 21st-century innovation ecosystems that give rise to future jobs and enhance the Nation's long-term competitiveness.

- **Advanced Manufacturing** ($421.51 million). Manufacturing is essential to almost every sector of the U.S. economy, spurring it forward by increasing productivity, enabling new products, and opening new industries. Advanced manufacturing uses innovative technologies to create products and processes with higher performance, fewer resources, and/or new capabilities. NSF programs accelerate advances in manufacturing materials, technologies, and systems through fundamental, multidisciplinary research that transforms manufacturing capabilities, methods, and practices. In FY 2023, NSF will continue investments in 1) future manufacturing that does not exist or is not possible today, or exists but is not yet viable for mass production; 2) workforce development through such programs as Advanced Technological Education, Faculty Early Career Development Program (CAREER), Engineering Research Initiation, Grant Opportunities for Academic Liaison with Industry, Sites and Supplements for both Research Experiences for Undergraduates and Research Experiences for Teachers programs, as well as in manufacturing engineering education in research projects; and 3) translation to practice that speeds the translation of fundamental discoveries into products and processes through its Engineering Research Centers, Industry-University Cooperative Research Centers, as well as the NSF Lab-to-Market Platform and other activities in TIP.

- **Advanced Wireless** ($168.56 million) networks and systems provide the backbone that connects users, devices, applications, and services that will continue to enrich America's economy. NSF has a proven track record of investing in fundamental research on wireless technologies. For example, today's fifth-generation ("5G") wireless networks and systems have been enabled by ground-breaking NSF-funded research on millimeter-wave capabilities, advanced antenna systems, and other novel algorithms and protocols dating back to 2004. NSF partners with other federal agencies and industry on such research. Looking forward to FY 2023 and beyond, NSF-supported research will innovate in areas critical to future generations of wireless networks and systems, such as new wireless devices, circuits, protocols, and systems; security and resilience; mobile edge computing; distributed machine learning, and inferences across mobile devices; and fine-grained and real-time dynamic spectrum allocation and sharing. This research will offer new insights capable of making wireless communication faster, smarter, more affordable, and more robust and secure—with profound implications for science and society.

- **Artificial Intelligence** ($734.41 million) is advancing rapidly and holds the potential to vastly transform our lives. NSF-funded research is now laying the seeds for advances in AI that will transform essentially every area of human endeavor, including science, education, energy, manufacturing, and agriculture. NSF's ability to bring together numerous fields of scientific inquiry uniquely positions the agency to lead the Nation in expanding the frontiers of AI. Additionally, through collaboration and coordination with the Office of Science and Technology Policy, NSF leadership is helping to drive and coordinate AI R&D efforts across the Federal Government. In FY 2023, NSF's AI investments include continued support for the National AI Research Institutes program to create national hubs for universities, federal and local agencies, industry, and nonprofit to advance AI research and workforce development. NSF's AI investments also support foundational research through directorate-level programs, and education and workforce development through efforts such as the CyberCorps®: Scholarship for Service (SFS), Computer Science for All, Innovative Technology Experiences for Students and Teachers programs, and the Data Science Corps programs.

- **Biotechnology** ($392.26 million) comprises the data, tools, research infrastructure, workforce capacity, and innovation that enable the discovery, use, and alteration of living organisms, their constituent components, and their biologically related processes. NSF has long supported the breadth of fundamental research that catalyzes the development of biotechnology. In FY 2023, NSF investments will include continued support for discovery of fundamental biological principles and the development of biotechnologies and other tools that permit measurement and use-inspired manipulation and design of living systems and their components; investments in bioinformatics, computational biology and artificial intelligence to support biotechnology; sustained support for synthetic and engineering biology to accelerate the design-build-test-learn cycle and leverage bio-inspired design to develop bio-machines, bio-based robots, and biomanufacturing technologies to address many of today's challenges; and investment in the biotech workforce through such programs as the Advanced Technological Education program at two-year institutions, sites and supplements for Research Experiences for Undergraduates and Research Experiences for Teachers, and the NSF Research Traineeship Program that prepares graduate students to conduct research in convergent areas and acquire skills that allow them to succeed in diverse employment settings.

- **Microelectronics and Semiconductors** ($145.69 million) are omnipresent in today's world, in transportation, communications, healthcare, manufacturing, and information technology. Yet, U.S.-led innovations in this area have slowed in recent decades, and the Nation is now facing historically unprecedented global competition. The overarching objective of NSF's investment in microelectronics and semiconductors is to develop new paradigms in semiconductor capabilities. Ongoing activities and new, complementary opportunities will leverage and create advances in materials, devices, circuits, architectures, and related software and applications. In FY 2023, NSF will invest in foundational research, both individual investigator projects and multidisciplinary teams; in use-inspired research to investigate new methods for device integration; in partnerships and infrastructure such as NSF Quantum Foundries; and in workforce development through programs such as CAREER, Research Experiences for Teachers, Non-Academic Research Internships for Graduate Students and NSF Innovation Corps (I-Corps™).

- **Quantum Information Science (QIS)** ($261.0 million) research will advance fundamental understanding of uniquely quantum phenomena that can be harnessed to promote information processing, transmission, and measurement in ways that classical approaches do less efficiently, or not at all. Current and future QIS applications differ from prior applications of quantum mechanics, such as lasers, transistors, and magnetic resonance imaging, by using distinct quantum phenomena that do not have classical counterparts. The development of these new applications will form the basis of one of the major technological revolutions of the 21st century. Building upon more than three decades of exploratory discovery, NSF investment in QIS will help propel the Nation forward as a leading developer of quantum technology. These investments are a key component of the National Quantum Initiative (NQI) and address the Administration's focus on helping build new industries. In FY 2023, NSF will invest in foundational quantum science advances, helping mature a relatively new field; in quantum computing, supporting investigators as they explore alternate quantum computing architectures; in cross-disciplinary teams of engineers, mathematicians, and physical scientists to explore emerging quantum network systems; in quantum sensing and metrology; and, through the Convergence Accelerator, in future applications that promote the rapid translation of basic quantum knowledge into the private sector.

Research Infrastructure

Research infrastructure (RI), from the scale of individual laboratories all the way up to major multi-user research facilities, is at the heart of the scientific endeavor. Definitions of RI have evolved significantly over the years as remote access and cyberinfrastructure have increasingly become critical parts of almost every tool in use by the research community. These attributes have become even more essential during the COVID-19 pandemic and are essential components of efforts to expand access to traditionally underserved groups and communities. Likewise, NSF investments in science and engineering have transformed discovery and innovation, giving rise to new and different forms of RI.

The Nation's science and engineering activities rely on instrumentation that is geographically and technically accessible, cost effective, and managed well. To meet the infrastructure needs of the entire community, NSF is dedicated to supporting activities that ensure that instrumentation and infrastructure can be designed, developed, acquired, or constructed across the Nation, through programs with focused oversight and investments. Moreover, a sizeable portion of NSF's resources is invested in the ongoing operations and maintenance (O&M) activities necessary to keep research infrastructure at the cutting edge, and available and accessible to those who use it to advance the boundaries of science.

The FY 2023 facilities O&M request continues to reflect a balance among multiple priorities. NSF divisions carefully allocate resources between research grants and O&M costs for research infrastructure. In addition to regular O&M needs to keep a facility functional, support for upgrades, significant periodic maintenance, and infrastructure renewal must also be addressed within Facilities O&M, which accounts for 10 percent of NSF's total request in FY 2023. NSF continues to explore ways to invest in research infrastructure, at all scales, to keep pace with changing technologies, increased demand by users, and expanding research opportunities.

The **Major Research Instrumentation (MRI)** program is responsible for catalyzing new knowledge and discoveries by helping STEM professionals acquire or develop the enabling instrumentation

needed at their institutions. MRI grants support instrumentation in all NSF-supported research disciplines. MRI makes awards of up to $4.0 million, for projects with total costs (including matching funding) as high as $6.0 million.

The American Innovation and Competitiveness Act (AICA) enacted in 2017, directed the agency to develop a strategy for supporting research infrastructure with a total project cost above the upper limit for the MRI program and below the **Major Research Equipment and Facilities Construction (MREFC)** threshold. NSF responded by introducing the **Mid-scale Research Infrastructure (Mid-scale RI)** program as one of NSF's Big Ideas. This dedicated funding line implements a high-priority, agency-wide mechanism that includes upgrades to major facilities as well as stand-alone projects.

The goals of the Mid-Scale RI program are to:

- Provide access to cutting-edge mid-scale research infrastructure, including instrumentation.
- Enable agile development and implementation of frontier scientific and engineering research infrastructure with a high potential to significantly advance the Nation's research capabilities.
- Train early-career scientists and engineers in the development and use of advanced research infrastructure.

In FY 2023, NSF will invest a total of $126.25 million in Mid-scale RI, split between two tracks, Mid-scale RI-1 ($50.0 million), funded through the Research & Related Activities account, and Mid-scale RI-2 ($76.25 million), funded through the MREFC account. Both use a biennial funding opportunity; the second solicitations for Mid-scale RI-1 (NSF-21-5055) and Mid-scale RI-2 (NSF-21-5376) were issued in FY 2021. Subject to availability of funding in FY 2023, Mid-scale RI-1 will support projects from the FY 2022 competition.

In FY 2021, NSF divested its four LC-130H aircraft used in South Pole support to the U.S. Air Force to improve the efficiency of their operational support. The first science support season under this new arrangement was successfully completed in February 2022. The aircraft will continue to be operated by the New York Air National Guard under the existing Memorandum of Agreement with the Department of Defense without any loss of continuity.

NSF Responsiveness to COVID-19 Impacts on Operating Facilities

Many operating facilities continued to experience impacts from COVID-19 in FY 2022, primarily the loss of science caused by having to suspend or reduce operations due to the pandemic; this loss of science does not generally result in NSF costs beyond the appropriated dollars except in a few cases. Additional NSF costs are being incurred by several major multi-user facilities due to quarantine, testing and COVID-19-mitigation protocols, and by Antarctic Facility Operations because of the extensive quarantine and transportation procedures required to assure that COVID-19 is not carried to the U.S. Antarctic facilities.

Major Research Equipment and Facilities Construction

Construction projects that require an investment of more than $100 million are supported in NSF's MREFC account. The FY 2023 Budget Request includes funding for four construction projects—the Antarctic Infrastructure Recapitalization program (formerly Antarctic Infrastructure Modernization for Science or AIMS), the two detector upgrades to operate at the High Luminosity-Large Hadron Collider

Upgrade (HL-LHC), the Vera C. Rubin Observatory, and the Regional Class Research Vessels (RCRV)—as well as Mid-scale RI-2, covering projects in the $20 million to $100 million range.

MREFC Account Funding, by Project

(Dollars in Millions)

	FY 2021 Actual	FY 2021 ARP Actual	FY 2022[1] Request	FY 2023 Request
Antarctic Infrastructure Recapitalization	$3.86	-	$90.00	$60.00
DKIST	9.38	8.95	-	-
HL-LHC Upgrade	28.74	-	36.00	33.00
Mid-scale Research Infrastructure	74.04	-	76.25	76.25
RCRV[2]	10.98	-	5.00	1.98
Vera C. Rubin Observatory	34.09	-	40.75	15.00
Dedicated Construction Oversight	0.17	-	1.00	1.00
Total	**$161.27**	**$8.95**	**$249.00**	**$187.23**

[1] A total of $260.21 million was carried forward from FY 2021 into FY 2022: $73.68 million for Mid-scale RI including $6.45 million in ARP funding, $115.84 million for AIMS, $14.05 million in ARP funding for RCRV, $46.74 million for the Rubin Observatory including $30.0 million in ARP funding, $553,350 in ARP funding for DKIST, $4.26 million for LHC, and $830,000 for Dedicated Construction Oversight.

[2] FY 2022 Request excludes $25.0 million in one-time funding for necessary expenses related to RCRV construction impacted by Hurricane Ida as provided in P.L. 117-43, the "Extending Government Funding and Delivering Emergency Assistance Act."

The COVID-19 pandemic constitutes an unforeseen event that was not within the control of the recipients managing the ongoing major facility construction projects. NSF has policies for responding to these unforeseen events that were established in advance of the COVID-19 pandemic, which subsequently have been further refined to support the current situation. As appropriate, re-baselining of several projects has taken place in FY 2021 and FY 2022, as the cost and schedule impacts of COVID-19 become better known for FY 2023 and beyond.

NSF manages all U.S. Antarctic activities as a single, integrated program, making Antarctic research possible for scientists supported by NSF and other U.S. agencies. Impacts of the COVID-19 pandemic on U.S. Antarctic Program (USAP) operations required construction activities at McMurdo Station to be suspended and caused a significant delay to overall AIMS completion. In the meantime, other investments in facilities and infrastructure on the continent have emerged as priorities that cannot be deferred until after completion of AIMS. As a result, the **Antarctic Infrastructure Recapitalization** (AIR) program was conceived as a portfolio of investments in infrastructure across the USAP stations that will subsume AIMS. On-ice AIMS construction will continue in FY 2023 with a focus on meeting near-term needs, and unfunded parts of AIMS will be considered for incorporation into the longer-term AIR program. Some FY 2023 funding ($60.0 million) will be used to fund adjusted AIMS scope, if necessary, and the remainder to transition to a broader recapitalization of NSF's Antarctic infrastructure.

The Large Hadron Collider is the world's largest and highest energy particle accelerator. Located near Geneva, Switzerland and operated by the European Organization for Nuclear Research (CERN), LHC can accelerate and collide counter-propagating bunches of protons at a total energy of 14 tera-electron volts. A Toroidal LHC ApparatuS (ATLAS) and Compact Muon Solenoid (CMS) are two general purpose detectors used by researchers to observe these collisions and analyze their characteristics.

In FY 2023, funding for **HL-LHC Upgrade** ($33.0 million) will support year three of the five-year project that began in FY 2020, prior to the onset of the COVID-19 pandemic. This investment will upgrade components of the ATLAS and CMS detectors, enabling them to function at much higher collision rates following an upgrade to the LHC to increase its luminosity. Pandemic impacts are likely to result in future, and not yet quantified, changes to upgrade plans.

The **Regional Class Research Vessels** ($1.98 million) are designed to meet the needs of researchers for work in coastal zones in support of biological, chemical, physical, and geological oceanography. The vessels will be capable of precise station-keeping for water column and sediment sampling, as well as supporting the use of remotely operated and autonomous vehicles. They will also enable virtual participation of shore-based scientists using telepresence/data presence technology, greatly expanding the potential user base. RCRV is the NSF-supported contribution to right-sizing and modernization of the U.S. Academic Research Fleet. The first of three vessels under construction is planned for delivery in 2023, with subsequent vessels being delivered six and twelve months thereafter. The project timeline has been lengthened by the impacts of the COVID-19 pandemic and damage caused by Hurricane Ida.

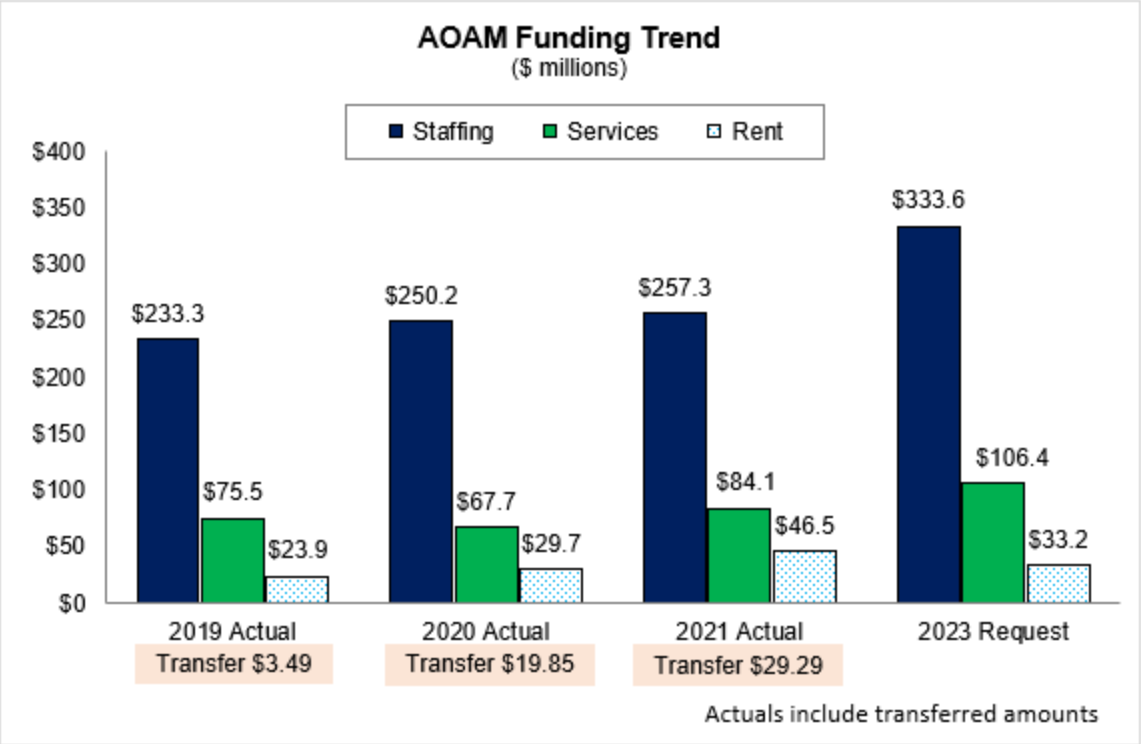
Vera C. Rubin Observatory ($15.0 million) will be an 8-meter-class wide-field optical telescope capable of carrying out surveys of the entire southern sky. It will collect nearly 40 terabytes of multi-color imaging data every night to produce the deepest, widest-field sky image ever. It will also issue alerts for moving and transient objects within 60 seconds of their discovery. FY 2023 will be the tenth year of funding, with project completion expected in FY 2024. Approximately two years of delay has accrued as the result of the COVID-19 pandemic.

Organizational Excellence - Agency Operations and Award Management (AOAM)

The $9.80 billion in research funding that NSF will support in FY 2023 is managed by the staff at NSF who enable research and steward the taxpayer investment. Investments in the Agency Operations and Award Management (AOAM) account provide the fundamental framework through which the Foundation's science and engineering research and education programs are administered. AOAM is the avenue by which NSF directly supports and responds to the Administration's management and performance priorities, including a growing research science and security framework vital to the well-being of the NSF-funded scientific enterprise. AOAM funds the essential services NSF needs to operate, and investments in the AOAM account continue to be an NSF priority.

In FY 2023, NSF requests a total of $473.20 million for AOAM, an increase of $88.68 million or 23 percent above FY 2021 Actuals for the AOAM account. Even with this large increase, NSF continues to operate as a lean agency with AOAM costs representing under 5 percent of NSF's total FY 2023 budget.

In the AOAM account, over three-quarters of the total AOAM funding covers NSF personnel and NSF's headquarters location in Alexandria, VA with the remaining quarter going to mission support services. Over the last several fiscal year budget requests, NSF reduced or held flat mission support services costs to accommodate the year-over-year increases in the fixed costs for staffing and rent while minimizing growth to the AOAM account in the Request. NSF then exercised its transfer authority to restore funding for those reduced activities.



The large increase in AOAM costs in FY 2023 is a course correction aimed at requesting the amount NSF estimates it needs and decreasing the reliance on the transfer authority to cover the full cost of doing business. The requested level also will enable NSF to continue standing up the new Directorate for Technology, Innovation and Partnerships, and to grow agency administration and operations, including additional staffing needs, to effectively and efficiently meet the needs of a $10.49 billion federal research agency. Further, NSF anticipates continuing to move toward a hybrid in-person/remote work environment and requests resources for the additional information technology and training for staff and supervisors necessary to achieve this approach. In addition, NSF requests increases to provide for strategic human capital management and changes at the NSF headquarters building to respond to COVID-19 impacts and the new hybrid work posture, continuing work to establish the effort for Science and Security, a return to a normal travel posture, and NSF-wide implementation of the Program Management Improvement Accountability Act (PMIAA) and other efforts to implement the policy requirements mandated by law, such as the American Innovation and Competitiveness Act (AICA), Digital Accountability and Transparency Act of 2014 (DATA Act), and Foundations for Evidence-Based Policymaking Act of 2018 (Evidence Act).

RESEARCH SECURITY STRATEGY AND POLICY UPDATE

NSF is expanding capabilities and competencies to protect the U.S. science and engineering enterprise through its Research Security Strategy and Policy activity. In January 2022, the National Science and Technology Council issued implementation guidance for National Security Presidential Memorandum 33 (NSPM-33) on National Security Strategy for United States Government-Supported Research and Development. NSF's overall activities respond to the JASON report, "Fundamental Research Security," which was commissioned by NSF and published in December 2019, as well as subsequent legislation passed by Congress. NSF participation in discussions with the U.S. research community and with international colleagues, and development of common frameworks for understanding research security is a major component of the NSF Research Security activity that is expected to continue to grow in FY 2023. NSF is commissioning a JASON study in FY 2022 to provide guidance on the establishment of a Research on Research Security funding program that is expected to begin in FY 2023. Specific activities for FY 2023 include the following:

- NSF is working together with other federal research agencies to establish uniform mechanisms for research investigators to provide agencies with consistent information on their appointments, activities, and sources of financial support; many of these mechanisms will be made available to the community during FY 2023.

- NSF will establish a Research on Research Security funding program in FY 2023 using guidance from a JASON study that will occur in FY 2022. NSF is seeking U.S. federal agency and non-profit organization partners to collaborate on this program. Primary goals of the program will include assessment of the characteristics that distinguish research security from research integrity, improving the quantitative understanding of the scale and scope of research security risks, developing methodologies to assess the potential impact of research security threats, and assessing the additional research security risks in an innovation system that includes more use-inspired research rather than staying well within the bounds of fundamental research.

- NSF has established new analytic capabilities to proactively identify conflicts of commitment, vulnerabilities of pre-publication research, and risks to the merit review system, and has published a System of Records Notice that will enable NSF to begin utilizing those capabilities in FY 2022 and FY 2023.

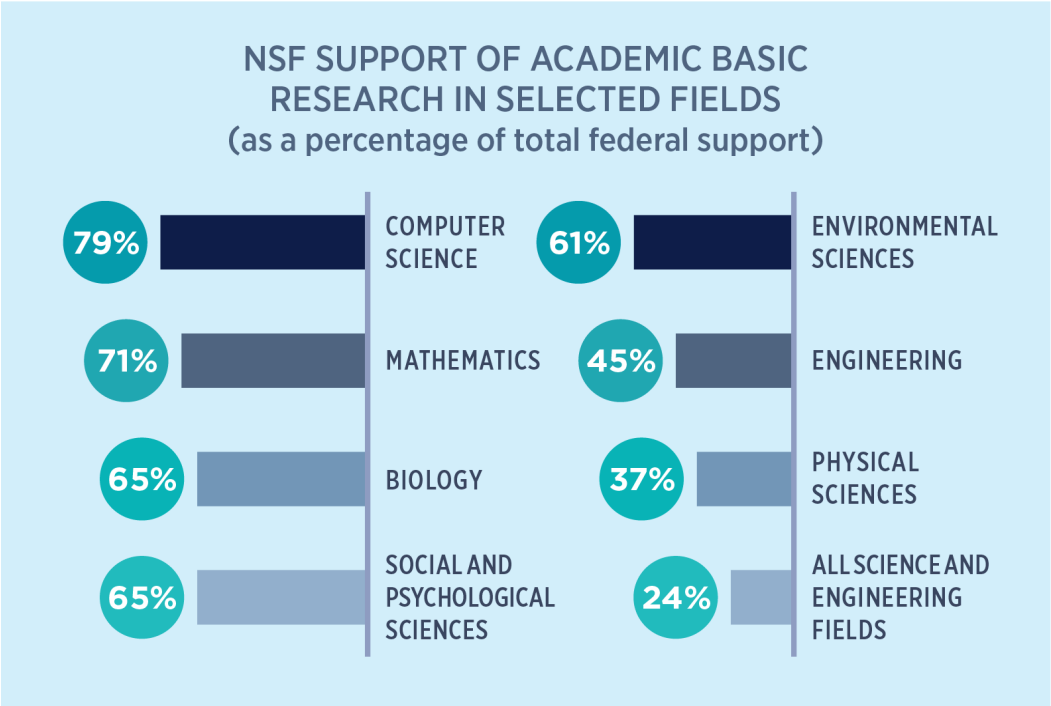
- To ensure clear understanding of research security issues, NSF disclosure requirements, and the tenets of beneficial international collaboration, NSF has developed training resources for staff that will continue to be refined in FY 2023.

- Through a partnership with the federal government interagency community, NSF is issuing a solicitation to develop training resources for the research community, which will be funded in late FY 2022 or early FY 2023.

ORGANIZATION AND ROLE IN THE FEDERAL RESEARCH ENTERPRISE

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

NSF's annual budget represents approximately 24 percent of the total federal budget for basic research conducted at U.S. colleges and universities. In many science and engineering fields, NSF is the primary source of federal academic support. In most major fields of science, NSF support of basic research at U.S. institutions is over 50 percent.



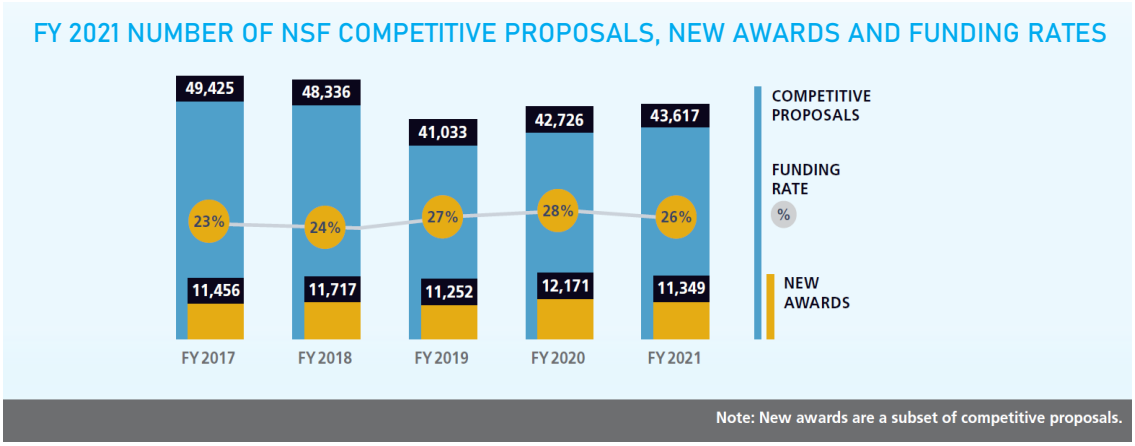
Note: Biology includes Biological Sciences and Environmental Biology. Biology and Psychological Sciences exclude National Institutes of Health.
Source: NSF/National Center for Science and Engineering Statistics, Survey of Federal Funds for Research & Development, FY 2019.

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, integrative activities, and international science and engineering. The 25-member National Science Board approves the overall policies of the Foundation.

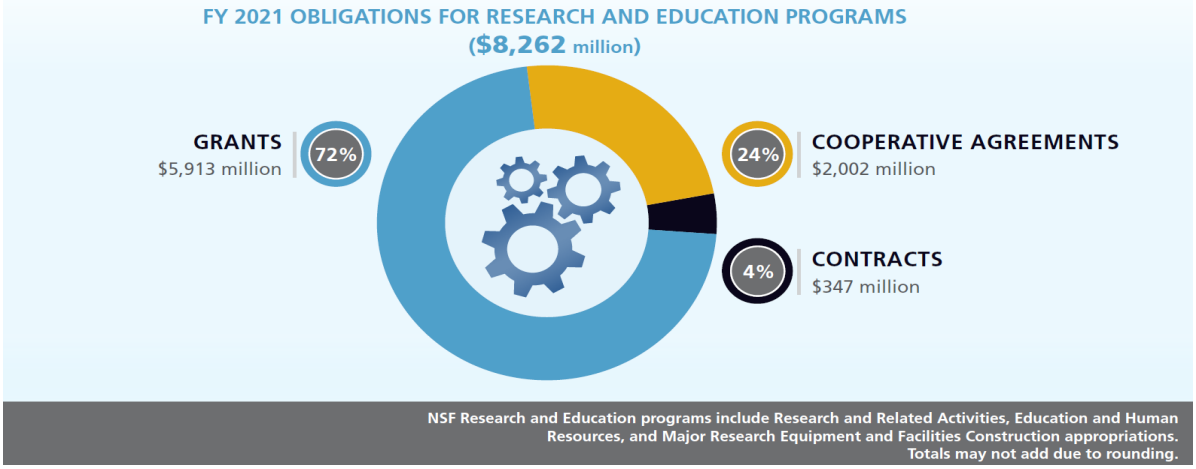
NSF BY THE NUMBERS

In FY 2023, NSF expects to evaluate almost 50,000 proposals through a competitive merit review process and approximately 13,500 new competitive awards, 11,500 of which are expected to be new research grants and the remainder contracts and cooperative agreements

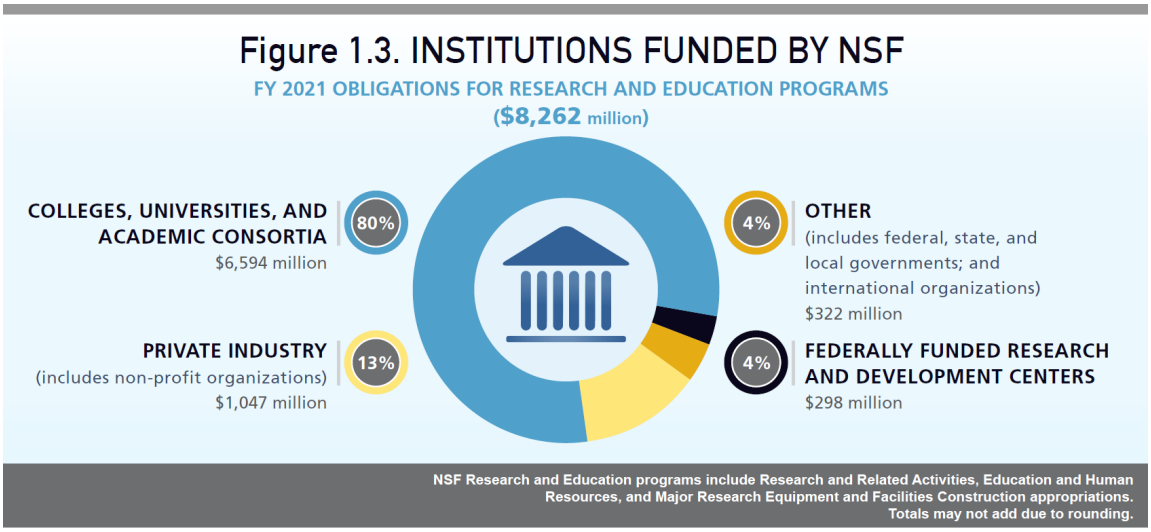
NSF continuously monitors key portfolio, proposal workload, and financial measures to understand short- and long-term trends and to help inform management decisions. The chart below presents a high-level, agency-wide estimate of funding rates, or proposal "success," as a comparison of the number of competitive proposals, new awards, and funding rate between FY 2017 and FY 2021. Estimates for FY 2023 can be found the Summary Tables chapter of this document.



The following two charts show the distribution of NSF's obligations by funding mechanism and institution type. While the data is based on FY 2021, the relative shares in FY 2023 are expected to be similar. As shown below, 96 percent of NSF's FY 2021 projects were funded using grants or cooperative agreements. NSF grants are either standard or continuing awards. That is, the award is made during one fiscal year for the full amount of the award or made over several years in increments. Cooperative agreements are used when the project requires substantial agency involvement during the project performance period (e.g., research centers, major multi-user research facilities). Contracts are used to acquire products, services, and studies required primarily for NSF or other government use.



Most NSF awards are to academic institutions. In FY 2021, 80 percent of support for research and education programs ($6,594.0 million) was awarded to 822 different colleges, universities, and academic consortia. Private industry, including small businesses and non-profit organizations, accounted for 13 percent ($1,047.0 million), and support to Federally Funded Research and Development Centers accounted for 4 percent, or $298.0 million. Other recipients (federal, state, and local governments; and international organizations) received 4 percent ($322.0 million) of support for research and education programs.

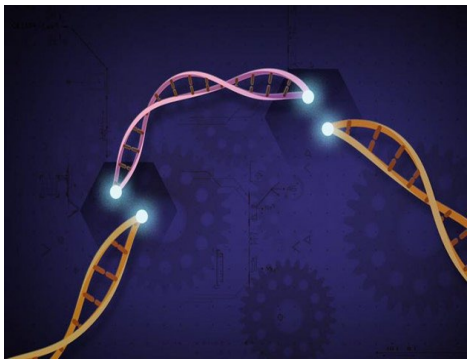


HIGHLIGHTS

For over 70 years, NSF has invested in fundamental research and education to fulfill its mission of promoting the progress of science and engineering. In doing so, NSF-supported research has connected the discovery and advancement of knowledge with the potential societal, economic, and educational benefits that are critical for continued U.S. prosperity. Below are a few examples of the important advances that NSF funding enables.

New CRISPR technologies enable development of climate and disease resistant crops

Over the past decade, huge leaps forward have been made in CRISPR—the gene editing technology that won the 2020 Nobel Prize in Chemistry. One of the most anticipated applications of CRISPR is the ability to strengthen the food supply by designing crops that are more robust, higher yield, and resistant to pests and climate change. NSF-funded researchers at the University of Maryland have made the next big step toward this goal. They've developed new techniques that not only expand the range of what CRISPR can do in plant genomes, but also allow these tools to operate on multiple parts of the genome simultaneously. By making it possible to imbue crops with multiple beneficial attributes at once, researchers are bringing us closer to a more resilient and sustainable food supply.



Scientists are expanding genome editing and engineering in plants to improve the efficiency of food production. *Credit: National Institutes of Health.*

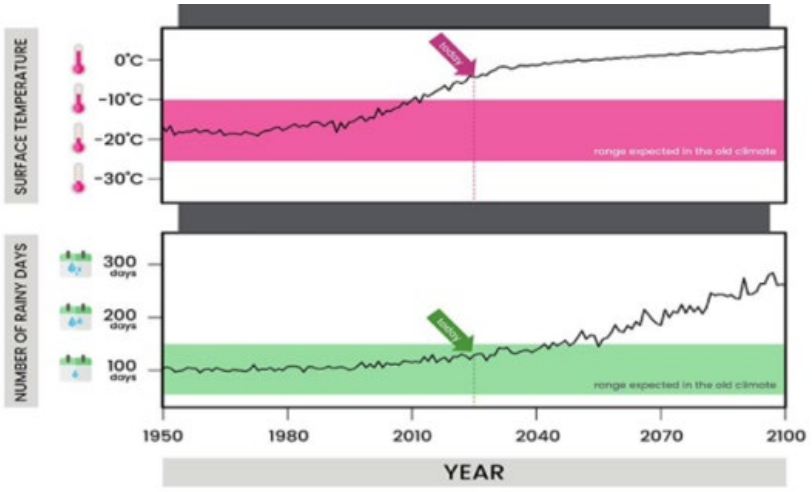
CyberCorps Scholarship for Service: Secure Embedded Systems

From large scale and high-profile ransomware attacks to more pervasive vulnerabilities in consumer technology and online systems, the need to strengthen the nation's cybersecurity workforce only continues to grow. To help accomplish that, Morgan State University (MSU), a Historically Black College and University (HBCU) in Baltimore, Maryland, has launched the Secured Embedded Systems Scholarship Program (SES2). Supported by funding through NSF's CyberCorps® Scholarship for Service and the American Rescue Plan, this is an initiative to recruit, mentor, and financially support cybersecurity students at every level of higher education. The program focuses on connected embedded systems—products that have network technology built in, such as baby monitors, smart cars, and even critical infrastructure like power grids. By focusing on this specific area, and by supporting participants ranging from pre- freshmen through doctorate students, MSU is building the next generation of cybersecurity professionals.

In the SES2 program, MSU students follow an innovative curriculum in secure embedded systems, experience challenging research opportunities, and receive peer and professional mentoring. *Credit: MSU.*

Fast-warming Arctic transitioning to new climate state

The Arctic is experiencing climate change at a rapid and dramatic pace, leading to significant uncertainty about what regional weather patterns will look like in the future. With NSF funding, researchers from the National Center for Atmospheric Research—the Nation's premier research center for meteorology, climate science, and atmospheric research, headquartered in Boulder, CO—are working to understand how changes in sea ice cover will affect the future of the Arctic environment. Sea ice plays a critical role in climate and meteorology by reflecting heat and light, but when light-colored Arctic ice melts, it is replaced by darker ocean water, which absorbs more heat and accelerates the changes taking place. By improving our ability to measure sea ice, researchers are enabling better climate models that will help us navigate the enormous changes in the Arctic and better understand what they mean for the global climate.



The Arctic is transitioning to a new climate state because of rapid warming. *Credit: Simmi Sinha/UCAR.*

Room-Temperature Superconductor

Researchers at the University of Rochester have set a new record in the quest to achieve superconductivity at room temperature. Superconducting materials have special properties—including zero electrical resistance—that could revolutionize technology at every level, from microscopic sensors to high-efficiency batteries to medical imaging and mag-lev trains. But until now, superconductivity has only been achieved at extremely low temperatures that are difficult and expensive to accomplish. Supported by NSF, the researchers squeezed a mixture of hydrogen, sulfur, and carbon to intense pressures to produce a tiny dot of superconducting material at 58 degrees Fahrenheit—the kind of temperatures seen in Rochester, NY in October and much easier to achieve than usual superconducting temperatures of hundreds of degrees below zero.

The goal of new research is to develop room temperature superconducting materials. Currently, extreme cold is required to achieve superconductivity, as demonstrated in this photo in which a magnet floats over a superconductor cooled in liquid nitrogen. *Credit: University of Rochester / Adam Fenster.*

Wireless research for universal and affordable rural broadband

Iowa State University researchers installed hardware to drive innovation in rural broadband connectivity. *Credit: Iowa State University/ Christopher Gannon.*

Iowa State University and the areas surrounding Ames, Iowa are the latest testbed for largescale wireless technology research that is extending the reach of broadband and other communications platforms. Known as the Wireless Living Lab for Smart and Connected Rural Communities, it is an $8 million public-private partnership funded by NSF, the U.S. Department of Agriculture, and an industry consortium that is exploring how cutting-edge communications technology can be deployed to enable highspeed, universal, and affordable rural broadband connectivity. With a special emphasis on agricultural applications in crop and livestock farms, the wireless research platform will be an extensive collaboration between researchers, students, communities, industry partners, and state and local governments, working together to connect the unconnected.

Sitting Bull College's Native American Prairie Ecosystems Research Center (PERC)

NSF's Tribal Colleges and Universities Program (TCUP) is a critical STEM pathway for broadening participation, strengthening science and engineering capabilities, and increasing STEM opportunities in tribal communities. At Sitting Bull College (SBC) in Fort Yates, North Dakota, PERC is leveraging diverse research expertise and local indigenous ecological knowledge to study challenges in prairie ecosystems and help design new solutions and approaches in soil science, water quality, wildlife and plant ecology, microbiology, molecular ecology, and engineering. SBC and PERC are leading the way in North Dakota as the primary center for tribal knowledge about the Great Plains region. PERC leverages the resources and faculty of SBC and local reservation communities to solve issues that arise in the community using practices that align with cultural traditions and have a direct impact on tribal communities in the Great Plans.

Sitting Bull College Fort Yates, North Dakota, US. *Credit: U.S Department of Interior.*

Eco-friendlier plastic

Plastic waste is a huge problem. Besides being made from petroleum, a non-renewable resource, most plastic products take a long time to break down, lingering for decades or even centuries in landfills and polluting water systems. Researchers at the FAMU-FSU College of Engineering—a joint engineering program between Florida A&M University and Florida State University—have made important progress on how industry could produce more sustainable plastics from renewable biomass. The researchers' breakthrough is in understanding how sustainable polymers behave when heated and cooled to their final shape. The team found that the polymers derived from biomass have properties very different from similar materials—rapid cooling and slow cooling each produce a different type of material, but mid-range cooling processes prevent the polymer from solidifying at all. Understanding the properties of these sustainable polymers could be a step toward revolutionizing how plastics are produced.

Principal Investigator Dr. Alamo with drawings of new polymer research that may revolutionize how plastics are processed. *Credit: FAMU-FSU.*

Synthetic biology startup helps fight COVID

NSF investments sometimes pay off in more ways than one. Take Ginkgo Bioworks as an example. It's a synthetic biology company whose founders received early funding from NSF as Graduate Research Fellows in the early 2000s and then in 2009 through the Small Business Innovation Research (SBIR) program based on research conducted at an NSF Engineering Research Center. Today, Ginkgo Bioworks operates a cell programming platform intended to make biology "easier to engineer" and is valued at billions of dollars—hardly a small business anymore. But when the COVID-19 outbreak began in March of 2020, they knew that beating the pandemic would require scaling up efforts throughout the biotech community. They committed $25.0 million of their resources for use by companies and laboratories developing diagnostic tools, drugs, vaccines, and therapeutics—at no cost to the users. They also stepped up to help coordinate matching resources to researchers, including private funding and R&D information. Ginkgo Bioworks shows how NSF investments keep paying off and can deliver returns to society when we need them most.

Image of a laboratory that designs and builds custom microbes and was supported through an SBIR grant. *Credit: Gingko Bioworks.*

Societal Experts Action Network helps community leaders save lives

How can state and local leaders and decision-makers draw on the vast research in social and behavioral sciences to help make better policy in their communities and effectively navigate an emergency like the COVID-19 pandemic? To respond to this need, the National Academies of Sciences, Engineering, and Medicine teamed up with NSF to assemble a network of scientists dedicated to helping local leaders translate decades of research into human behavior into clear and helpful guidance for public health and safety. Known as SEAN, the Social Experts Action Network, it's a compilation of accessible resources that local leaders and officials can use to keep their communities informed about COVID-19 and deploy evidence-based approaches for handling the public health emergency.

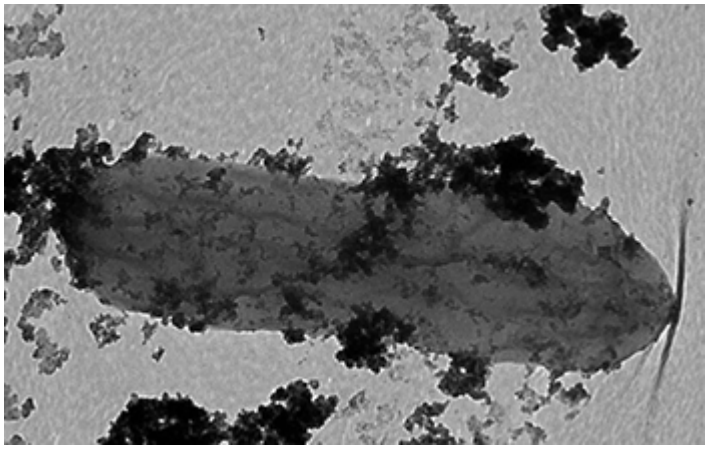
Members of La Colaborativa, a Massachusetts non-profit that used science to help address vaccine hesitancy in their local community. *Credit La Colaborativa / Darlene DeVita.*

New NSF Long-Term Ecological Research site will study dynamic and diverse relationships between urban nature and people

Scientists affiliated with a new NSF-funded LTER site based in Minneapolis-St. Paul will examine how socioeconomic disparities, pollution, habitat loss and climate change interact to affect the environment in the Twin Cities. *Credit: Michael Hicks.*

Mayors and city councils spend a lot of time thinking about the systems that their towns and cities rely on. It can be an intricate network of infrastructure, from roads and the water supply to electric grids and sewers. But there are also ecological and environmental systems to consider—rivers and streams, parks, waterfronts, green space, and even individual gardens and yards are all part of the anatomy of cities and towns. With funding from NSF, researchers at the Minneapolis-St. Paul Urban Long-Term Ecological Research Program (LTER) are studying urban nature to better understand these environments and how they interact with the complex matrix of infrastructure and social systems that make up urban areas. This research will provide long-term environmental data collection, analysis, and interpretation to examine, among many issues, the interface between climate change and social disparities. Just as civil engineers help local governments improve infrastructure and services that residents depend on, this research is going to expand the understanding of urban ecology to help city planners strengthen the benefits of natural landscapes that are important to the Twin Cities and their residents. All data are publicly accessible across the LTER network and beyond.

How 'Iron Man' bacteria could help protect the environment



This Geobacter cell is speckled with cobalt minerals that would be toxic to many organisms. *Credit: Hunter Dulay.*

Researchers at Michigan State University have shown that microbes found in soil and sediment, known as *Geobacter*, are capable of a feat that could help reclaim a valuable natural resource and soak up toxic pollutants. The researchers found that *Geobacter* microbes were resistant to the toxic effects of cobalt. Cobalt is a metal used in lithium-ion batteries—it is rare and valuable, and toxic to living things, including humans and microbes. When *Geobacter* microbes encountered rust containing cobalt, they were able to extract the cobalt without it penetrating their cells and causing harm. Cobalt nanoparticles instead formed a protective layer around the microbes. The research is an exciting proof-of-concept that *Geobacter* microbes could be an important tool for cleaning up a range of toxic metals and for efficiently reclaiming valuable resources like cobalt.

Dark Energy Survey releases the most precise look at the universe's evolution

DES photographed the night sky using the Dark Energy Camera on the Victor M. Blanco 4-meter telescope at the Cerro Tololo Inter-American Observatory in Chile, a program of NSF's NOIRLab. *Credit: Reidar Hahn, Fermilab.*

Results from the Dark Energy Survey (DES), a collaboration with the U.S. Department of Energy and funded by several U.S. and international partners, are giving researchers new insights into some of the universe's most mysterious phenomena. While we can't see dark energy or dark matter directly, we can watch as it shapes the structure and motion of galaxies through gravitational effects. The DES mapped more than 226 million galaxies over seven years—creating the largest and most precise map of the universe ever made—which is allowing astronomers to see the influence of dark energy and dark matter on a massive scale and with new precision. The DES is part of a new era of astronomy powered by massive surveys of the sky, and with the help of supercomputers (and even artificial intelligence), DES and similar projects are enabling huge leaps forward in our understanding of the structure of the universe.

New filtering method promises safer drinking water

Most people know that adding fluoride to public water systems helps promote healthy teeth and prevent tooth decay. But in some places, the problem isn't too little fluoride in the water, it's too much. Where fluoride occurs naturally in water systems, communities must be careful to limit the level of fluoride in drinking water in order to avoid health problems that can arise from prolonged exposure to excess fluoride. Until now, removing excess fluoride has required expensive high-pressure filtration systems or burdensome water treatment methods. But with funding from NSF's Small Business Innovation Research program—known as America's Seed Fund, researchers at Tufts University have developed a new, inexpensive filtering technology inspired by biology that can separate fluoride with twice the selectivity of other methods. Their novel and affordable polymer membranes can help protect community water systems and support public health throughout the nation and around the globe.

A new filtering method promises safer drinking water for tens of millions of people. *Credit: Jenny Downing.*