

**FY 2005 PERFORMANCE HIGHLIGHTS**

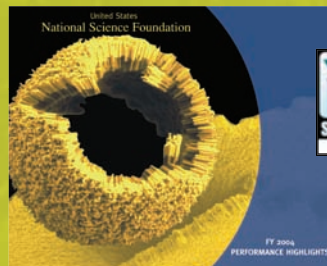
**On the cover:**

This image is a representation of a "Beehive Pool" fractal, a region in the complicated geometric object introduced by mathematician Benoit Mandelbrot in the 1970s to study certain equations. Fractals are self-similar structures containing patterns within patterns. Fractal-like structures can be found in nature, in clouds, shorelines, and other seemingly random phenomena. The National Science Foundation (NSF) is one of the major supporters of mathematical sciences. NSF's strong role in supporting mathematics is a crucial one as mathematics provides the backbone for advances in other technical, engineering and health-related areas as well as a broad basis for industrial and technological development.

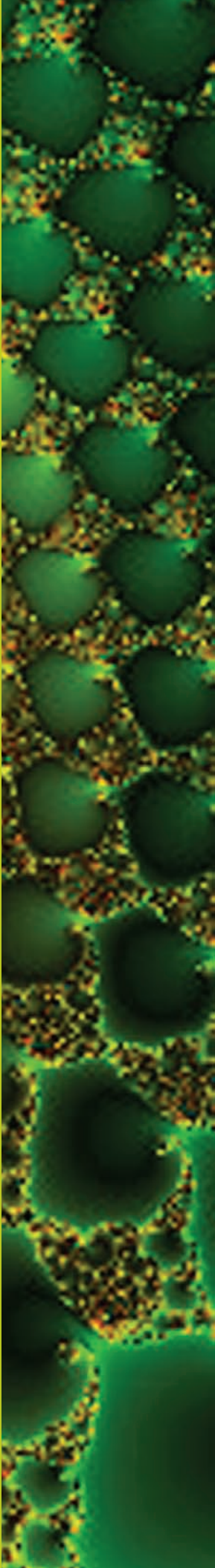
*Credit:* Frances Griffin

**For more information:**

[www.nsf.gov/news/mmg/mmg\\_disp.cfm?med\\_id=51856&from=search\\_list](http://www.nsf.gov/news/mmg/mmg_disp.cfm?med_id=51856&from=search_list)



*Silver Award*  
2004 VISION AWARDS  
Annual Report Competition  
League of American  
Communications Professionals



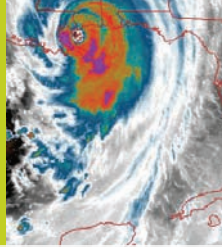
## Statutory Mission

To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense; and for other purposes.

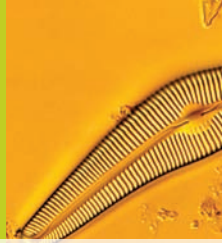
## Vision

Enabling the Nation's future through discovery, learning and innovation. NSF investments—in people, in their ideas, and in the tools they use—will catalyze the progress in science and engineering needed to establish world leadership and secure the Nation's security, prosperity, and well-being.

NSF by the Numbers	
\$5.48 billion	FY 2005 Budget (obligations)
4%	NSF's share of total annual federal spending for research and development
48%	NSF's share of federal funding for nonmedical basic research at academic institutions
42,000	Proposals evaluated in FY 2005 through a competitive merit review process
9,800	Competitive awards funded in FY 2005
41,000	Scientists and engineers who evaluate proposals for NSF in a given year
246,000	Proposal reviews done in FY 2005
41,000	Students supported by NSF Graduate Research Fellowships since 1952
195,000	People (researchers, postdoctoral fellows, trainees, teachers, and students) NSF supports directly



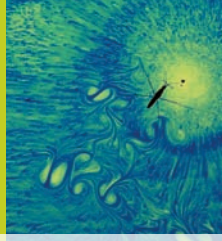
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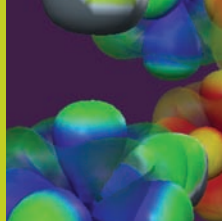
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**Right:** Mark Edlund and a team of American and Mongolian scientists are collecting, cataloging, and preserving diatom specimens from a remote lake in north-central Mongolia. Diatoms are a large group of microscopic algae that grow as single cells or small colonies. The sample pictured was taken as part of a Mongolian-American international partnership to survey the diatom flora of Hovsgol National Park in north-central Mongolia.

Diatoms are an important part of the primary producer community in most aquatic habitats. They often live within narrow environmental conditions and can act as bioindicators for changes in pollution, water temperature, nutrient levels, and salinity. Diatoms are incredibly valuable as a tool for water quality monitoring, and they are one of the primary tools used in paleoecology, a discipline that uses fossil organisms to decipher environmental history.

Dr. Edlund received a three-year postdoctoral National Science Foundation International Research Fellow Award. He chose Lake Hovsgol and the surrounding region because it is one of the most pristine large lakes on Earth and therefore globally significant as a natural laboratory for the study of ecology and evolution. The lake is estimated to be more than 1.6 million years old.

Credit: Mark B. Edlund, Ph.D.

For more information:

[www.nsf.gov/news/mmg/  
mmg\\_disp.cfm?med\\_  
id=51744&from=search\\_list](http://www.nsf.gov/news/mmg/mmg_disp.cfm?med_id=51744&from=search_list)



## FROM THE DIRECTOR

“America’s leadership depends more and more on the quality of our new ideas, the vitality of our science and engineering workforce, and the innovative use of new knowledge generated through research and education. With today’s intense global competition for ideas and talent to achieve comparative advantage and capture market opportunities worldwide, we must sustain our momentum of leadership.”

**Arden L. Bement, Jr., Ph.D.**



**Arden L. Bement, Jr.**  
Director

In recognition of the important contributions made by science and technology in World War II, Congress created the National Science Foundation (NSF) in 1950 to promote and advance America's postwar science and engineering enterprise. Today, science and technology are the driving force for progress and prosperity in a global economy. Only by advancing the frontiers of science and engineering can the nation develop the knowledge and innovative technologies needed to address new challenges and ensure America's economic future and social well being.

In FY 2005, NSF received nearly 42,000 proposals and funded 9,800 awards to 1,700 colleges, universities, and other research collaborations throughout the country. The discoveries resulting from NSF investments are both exciting and transformative. As an example, as part of NSF's Cyber Trust Program, Bill Sanders at the University of Illinois and his colleagues at four universities are addressing the challenge of designing, building, and validating a secure cyberinfrastructure for the next-generation electric power grid. The project will create technologies that will convey critical information to grid operators despite cyber attacks and accidental failures. The investigators expect that the solutions created will be adaptable for use in other critical infrastructure systems. The research will also help meet a major homeland security challenge. At the San Diego Supercomputer Center, work by J. Andrew McCammon and his colleagues has led to a new understanding of the behavior of molecules inside cells and how they might react to the presence of prospective drugs. This work has revealed a path for the development of new treatments for diseases, including for one of today's most devastating epidemics. These are just two examples of recent basic research breakthroughs that contribute important societal benefits.

Underlying the Foundation's programmatic activities is a commitment to organizational excellence and sound financial management. In FY 2005, NSF received its eighth consecutive unqualified "clean" opinion from an independent audit of the financial statements, with no material weaknesses reported. NSF successfully achieved 18 of 21 performance goals, and again exceeded its principal customer service goal of informing at least 70 percent of applicants about funding decisions within 6 months. On the President's Management Agenda scorecard, NSF achieved "Green" status in four of the five primary initiatives. All NSF programs evaluated by OMB's Program Assessment Rating Tool (PART) in the summer of 2005—and in prior years—are among the 15 percent governmentwide that have received the highest "Effective" rating. Moreover, that NSF was rated second best federal workplace in the most recent survey of federal employees clearly reflects the level of dedication and innovation that defines both the staff and management at NSF who make organizational excellence a reality.

I invite you to read more about the Foundation's accomplishments in this report as well as in NSF's *Performance and Accountability Report* for FY 2005. To learn more about the discoveries that are emerging every day, many of which will enhance our future in profound and extraordinary ways, visit [www.nsf.gov/discoveries](http://www.nsf.gov/discoveries).

A handwritten signature in black ink that reads "Arden L. Bement, Jr." The signature is written in a cursive, slightly stylized font.

Arden L. Bement, Jr.  
March 2006



Moreover, not since World War II have advances in science and technology been more vital to national security. New technology such as advanced ad-hoc networking to enable more rapid first responder capability is critical for homeland security and combating global terrorism. NSF's pursuit of these new frontiers is key to maintaining a high standard of living and economic prosperity for generations to come.

### **Ideas. Tools. People. Organizational Excellence.**

To achieve its mission of advancing the frontier of science and engineering, NSF invests in four strategic areas: Ideas, Tools, People, and Organizational Excellence.

**Ideas:** Investments in ideas are aimed at the frontiers of science and engineering, to ensure that America maintains its global leadership. They build the intellectual capital and fundamental knowledge that drive technological innovation, spur economic growth, and increase national security and welfare. They also seek answers to fundamental questions about the origin and the nature of the universe and humankind.

**Tools:** NSF investments provide state-of-the art tools and facilities that boost the overall productivity of the research and education enterprise. The strategy is to invest in wide-ranging instrumentation, multi-user facilities, distributed networks, digital libraries, and computational infrastructure that add unique value to research and are accessible and widely shared among researchers across the nation.

**People:** Leadership in today's knowledge economy requires world-class scientists and engineers and a national workforce that is scientifically, technically, and mathematically strong. Investments in people aim to improve the quality and reach of science, engineering, and mathematics education and enhance student achievement. In FY 2005, NSF investments supported 195,000 people, including researchers, postdoctoral associates, teachers, and students at every level across all the science and engineering disciplines. Embedded in all NSF programs are efforts to build a more inclusive, globally engaged workforce that reflects the strength of the nation's diverse population.

<b>People Involved in NSF Activities (estimated numbers for FY 2005)</b>	
Senior Researchers	32,000
Other Professionals	12,000
Postdoctoral Associates	6,000
Graduate Students	27,000
Undergraduate Students	33,000
K-12 Students	11,000
K-12 Teachers	74,000
<b>TOTAL</b>	<b>195,000</b>

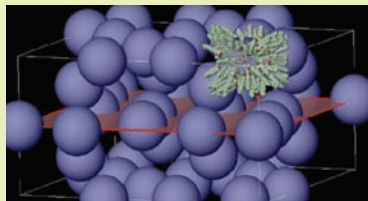
**Organizational Excellence:** Excellence in management underpins all of the Foundation's activities. NSF strives to maintain an agile, innovative organization that fulfills its mission through leadership in the core business processes—such as financial management and electronic government—with a results-oriented workforce that operates in a continuous learning environment.

### **A Catalyst for Innovation**

NSF does not conduct research or operate laboratories or facilities except for the South Pole Station and other Antarctic program facilities. Instead, NSF is a catalyst for innovation, seeking and funding the best ideas and the most capable people and making it possible for them to pursue new knowledge, discoveries, and innovation.

Ninety percent of NSF funding is allocated through a merit-based competitive process that is critical to fostering the highest standards of excellence. NSF's merit review process is recognized throughout the federal government as the gold standard for responsible use of public funds. Reviewers focus on two primary criteria: the intellectual merit of the proposed activity and its broader impact—how

## MOLECULAR SELF-ASSEMBLY



The National Science Foundation is enabling research into one of the most promising areas in science: the effort to understand—and to duplicate or even improve synthetically—the way that atoms and molecules in nature arrange themselves into various arrays with a host of specific functions. This kind of “bottom-up” programmed self-fabrication of materials is a key goal of nanoscience and may revolutionize manufacturing.

In one striking example of such research, scientists at the University of Pennsylvania created spherical branching molecules that assemble themselves into groups of precisely structured building blocks totaling about 250,000 atoms. The illustration above shows two layers of these self-assembled nanostructures that form a complex lattice with a repetitive arrangement of 30 ball-like molecules, each represented as a blue sphere. (Each spherical molecule actually more closely resembles the tree-like shape shown in green and red at top right.) The spherical molecules form a liquid crystal material that may help build nanostructures for molecular electronics or photonics materials. Each repetitive unit of 30 spheres occupies a rectangular volume nearly 20 nanometers (billionths of a meter) by 10 nanometers.

For more information:

[www.nsf.gov/od/lpa/news/03/pr0322.htm](http://www.nsf.gov/od/lpa/news/03/pr0322.htm)

well it promotes teaching, training, and learning and what its potential benefit to society is. Reviewers also consider how well the proposed activity fosters the integration of research and education and attracts a diverse set of participants, particularly those from underrepresented groups. In FY 2005, 41,000 members of the science and engineering research and education community volunteered their time to serve as external reviewers, helping NSF conduct nearly 250,000 merit-based reviews.

In FY 2005, NSF awarded nearly 10,000 new grants from about 42,000 proposals to nearly 1,700 colleges, universities, and other public institutions throughout the country. With about one in four proposals funded, the level of competition is such that nearly \$2 billion of proposals are declined, even though they received ratings equal to funded proposals. These declined proposals represent a rich portfolio of lost opportunities at the frontiers of science and engineering with an untold impact on the Nation’s future economic growth.

### Where Discoveries Begin

NSF supports cutting-edge research that yields new discoveries over time. These discoveries are essential for maintaining America’s competitive edge in science and engineering. They lead to new technologies that benefit society and improve the quality of life for all citizens.

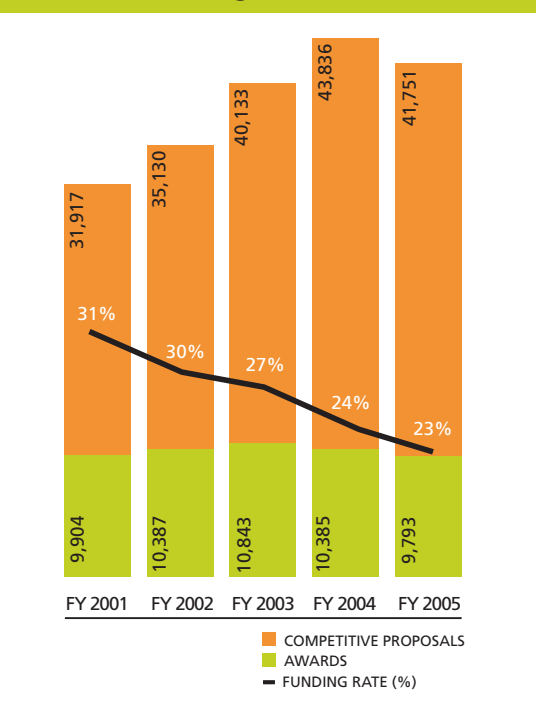
The examples that appear in sidebars throughout this report illustrate the impact and success of NSF’s investments in discovery, learning, and innovation. The results of many NSF-supported projects appear long after the initial investment; the discoveries highlighted here are the outcome of long-term support of research and education projects that emerged and were reported in FY 2005.

### Commitment to Excellence

NSF is widely acknowledged as a well-managed, results-oriented agency with a reputation for responsible stewardship of the Nation’s investments in science and engineering. The Foundation has a long record of success in leveraging its agile, motivated workforce, management processes, and technological resources to enhance productivity and effectiveness. Historically, about 95 percent of NSF’s budget supports the conduct of research and education, with administrative overhead accounting for only about 5 to 6 percent.

NSF’s commitment to excellence is evident in a number of achievements in FY 2005. The President’s Management Agenda (PMA) is a governmentwide effort to improve the management, performance, and accountability of federal agencies. In FY 2005, NSF was one of only three agencies to achieve four or more “Green” successful ratings in the five primary PMA initiatives. NSF also achieved a “Green” rating for the agency’s Improper Payments initiative. In the Office of Management and Budget’s (OMB’s) annual review of federal programs using the Program Assessment Review Tool (PART), all NSF programs under the current strategic plan, including those evaluated for the FY 2005 budget year, have received the highest “Effective” rating. Finally, in a second survey of

Number of NSF Competitive Proposals and Awards, and Funding Rates





federal employees conducted by the Partnership for Public Service and the American University Institute for the Study of Public Policy Implementation, NSF once again was ranked as one of the top two federal government workplaces.

As accomplishments move us forward, new demands evolve. Workload and workload complexity remain a challenge, as the number of proposals received has increased more than 40 percent since FY 2000. This has been accompanied by an increase in multidisciplinary, collaborative projects and international activities, as well major research facility projects. In addition, meeting new external administrative, oversight, and accountability requirements is another burden on the Foundation's limited resources.

NSF is currently engaged in its fourth year of a business analysis to address the fundamental challenges facing the agency. During FY 2005, the study supported several PMA initiatives and emphasized opportunities in merit review and award management and oversight. As part of the business analysis, NSF is conducting an administration functions study to investigate the impact of rapidly changing work processes, shifts in workload, and advances in technology on the ability to efficiently perform its administrative duties. The results of this analysis will lead to development of a long-term business plan that will ensure that the Foundation continues to operate efficiently and effectively.

President's Management Agenda Scorecard	Baseline	Status	Progress
	9/30/01	12/30/05	
Strategic Management of Human Capital	●	●	●
Competitive Sourcing	●	●	●
Improving Financial Performance	●	●	●
Expanded Electronic Government	●	●	●
Budget and Performance Integration	●	●	●
Other Agency Initiative: Eliminating Improper Payments	N/A	●	●
<small>Note: Green represents success, yellow is for mixed results, and red is for unsatisfactory. Ratings are issued quarterly by the Office of Management and Budget. N/A indicates not applicable</small>			

**Right:** As part of his research on fluid mechanics, John Bush, a mathematician at the Massachusetts Institute of Technology (MIT), conducted dye studies to determine the nature of the propulsion mechanism of the water strider (*Geris remigis*), a common water-walking insect. In the past, it was believed that water striders develop momentum using the tiny waves they generate as they flap their legs across the water's surface. With support from the National Science Foundation, Bush and his team of researchers used high-speed video and blue-dyed water to track the movement of water striders. Bush's studies show that the water strider propels itself by driving its central pair of legs in a sculling motion. In order for it to move, it must transfer momentum to the underlying fluid.

Fluid mechanics is responsible for most of the transport and mixing that takes place in the environment, in industrial processes, in vehicles, and in living organisms. Fluid flow of blood makes life possible by transporting oxygen, carbon dioxide, nutrients, and heat through the body. In the environment, fluid motion is responsible for moving atmospheric pollutants and smog from place to place and for weather patterns. Efficient fluid motion reduces the energy required to power aircraft, ships, and automobiles, and to pump oil through pipelines. In industrial processes, fluid mechanics often controls production rates, product uniformity, and pollutant emissions. The ultimate goal of research in fluid mechanics is to enable prediction of fluid behavior, which directly leads to better design of products such as aircraft engines, pharmaceuticals and biomedical devices, and air conditioning and ventilation systems.

Credit: John Bush, MIT

For more information:

[www.nsf.gov/news/mmg/mmg\\_disp.cfm?med\\_id=51972&from=search\\_list](http://www.nsf.gov/news/mmg/mmg_disp.cfm?med_id=51972&from=search_list)

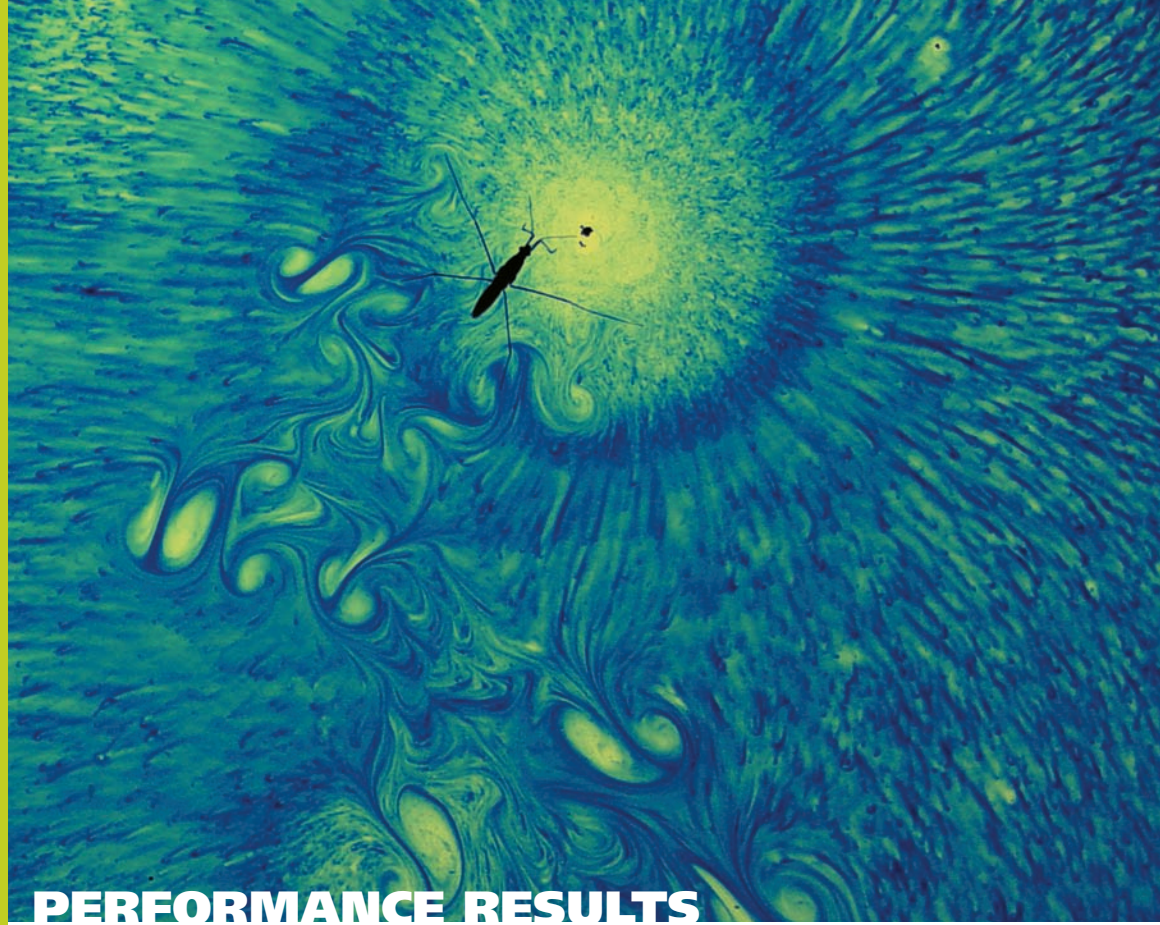
For more information:

*NSF FY 2003–2008 Strategic Plan*  
[www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=nsf04201](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf04201)

*NSF FY 2005 Performance and Accountability Report*  
[www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=nsf0601](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf0601)

*President's Management Agenda*  
[www.whitehouse.gov/results/agenda/scorecard.html](http://www.whitehouse.gov/results/agenda/scorecard.html)

*Program Assessment Rating Tool (PART)*  
[www.expectmore.gov](http://www.expectmore.gov)



## PERFORMANCE RESULTS

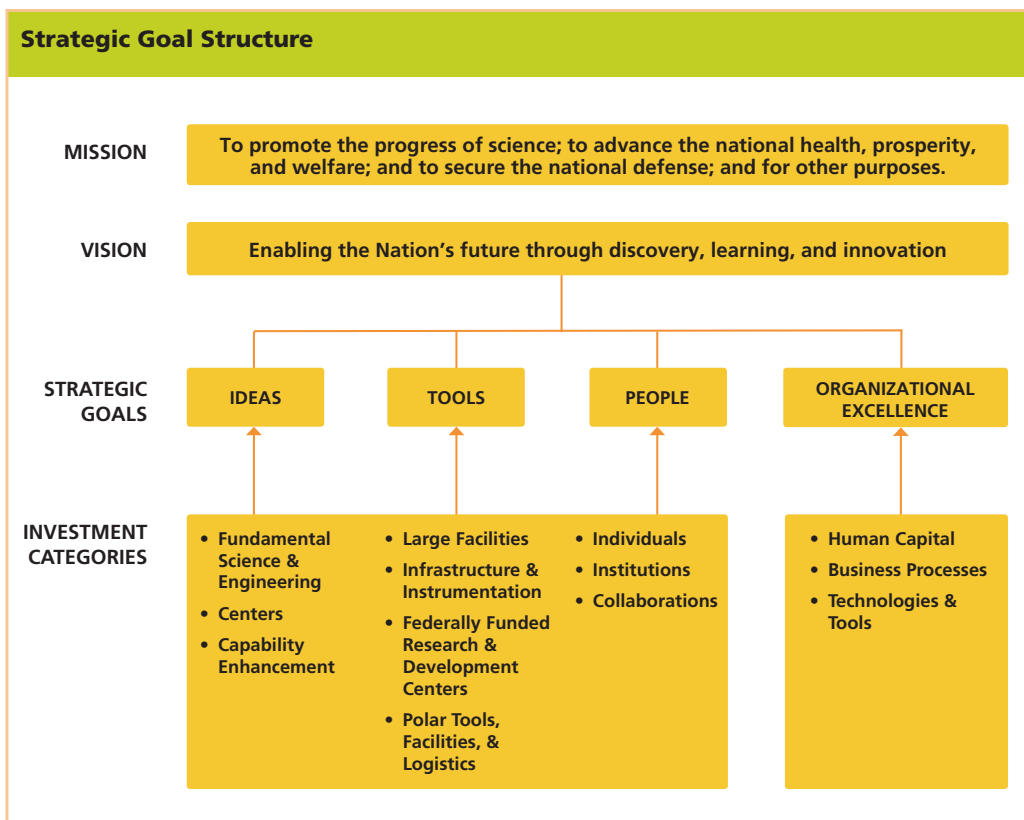
NSF's leadership in advancing the frontiers of science and engineering research and education is demonstrated, in part, through internal and external performance assessments. The results of our performance assessment process provide our stakeholders and the American taxpayer with vital information about the return on NSF investments.

Performance assessment at NSF is guided by the Government Performance and Results Act of 1993 (GPRA), OMB's Performance Assessment Rating Tool (PART), and NSF's *FY 2003–2008 Strategic Plan*. GPRA requires federal agencies to develop a strategic plan, establish annual performance goals, and report on the progress made toward achieving those goals.

NSF's Strategic Plan outlines the Foundation's programmatic framework and goal structure, which is depicted in the Strategic Goal Structure chart on page 9. NSF has four overarching Strategic Outcome Goals: Ideas, Tools, People, and Organizational Excellence. The Ideas, Tools, and People goals are aligned with a set of investment categories. The Organizational Excellence goal focuses on NSF's administrative and management activities and the five PMA initiatives.

### PART Evaluations

In 2002, OMB developed the PART as a systematic method for assessing the performance of program activities across the federal government. Each year, about 20 percent of an agency's programs must undergo PART review. Four NSF programs were evaluated for the 2005 assessment year: Facilities, Individuals, Information Technology and Research, and Nanoscale Science and Engineering. Each program received the highest overall rating of "Effective." All programs and priority areas under NSF's current strategic plan, including the four evaluated for the 2005 assessment year, have received the highest rating of "Effective." Of the nearly 800 federal programs that have been evaluated to date, only 15 percent have been assessed as effective. These outstanding results reflect the importance of NSF's competitive awards process in ensuring quality, relevance, and performance—all key components of the Administration's Research and Development (R&D) Investment Criteria.



## Assessing Long-Term Research

For NSF, linking outcomes to annual investments is difficult because results from investments in basic research and education can be unpredictable. Science and engineering research projects can generate discoveries in an unrelated area, and it can take years to recognize discoveries and their impact. NSF has developed an alternative OMB-approved assessment process based on external expert evaluation. The academic research community has used external expert evaluation for many years. NSF itself has used external expert panels for decades and, over time, has developed a comprehensive process for conducting external evaluations.

NSF has integrated the GPRA and PART processes with its long-standing external expert evaluation process through Advisory Committees (ACs) and Committees of Visitors (COVs). The Foundation relies on the judgment of these external experts to maintain high standards of program management, provide advice for continuous improvement of performance, and ensure openness to the research and education community served by the Foundation.

COVs are responsible for evaluating one-third of NSF's programs each year. COV reports address many aspects of the Administration's R&D criteria and serve as important input for the Advisory Committee for GPRA Performance Assessment (AC/GPA), which is responsible for conducting an annual evaluation of NSF's Strategic Outcome Goals. In addition, COV reports provide important information for evaluation of NSF's PART programs.

## ROBOTS IN OPERATING ROOMS



A team of National Science Foundation-funded engineers and surgeons at Robotic Surgical Tech, Inc., have developed a robotic surgical assistant known as "Penelope." Through the use of a robotic arm, voice-recognition technology, and artificial intelligence techniques, Penelope can respond to a surgeon's request for an instrument—often by anticipating the surgeon's needs and having the instruments ready in advance. The robot can also keep track of what has been used so far, helping to ensure that nothing is accidentally left inside the patient. Penelope made its clinical debut in June 2005 at New York-Presbyterian/The Allen Pavilion, where it participated in a simple excision of a small benign cyst.

For more information:

[www.nsf.gov/discoveries/disc\\_summ.jsp?cntn\\_id=100673&org=NSF](http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=100673&org=NSF)

## GLOBAL BIODIVERSITY



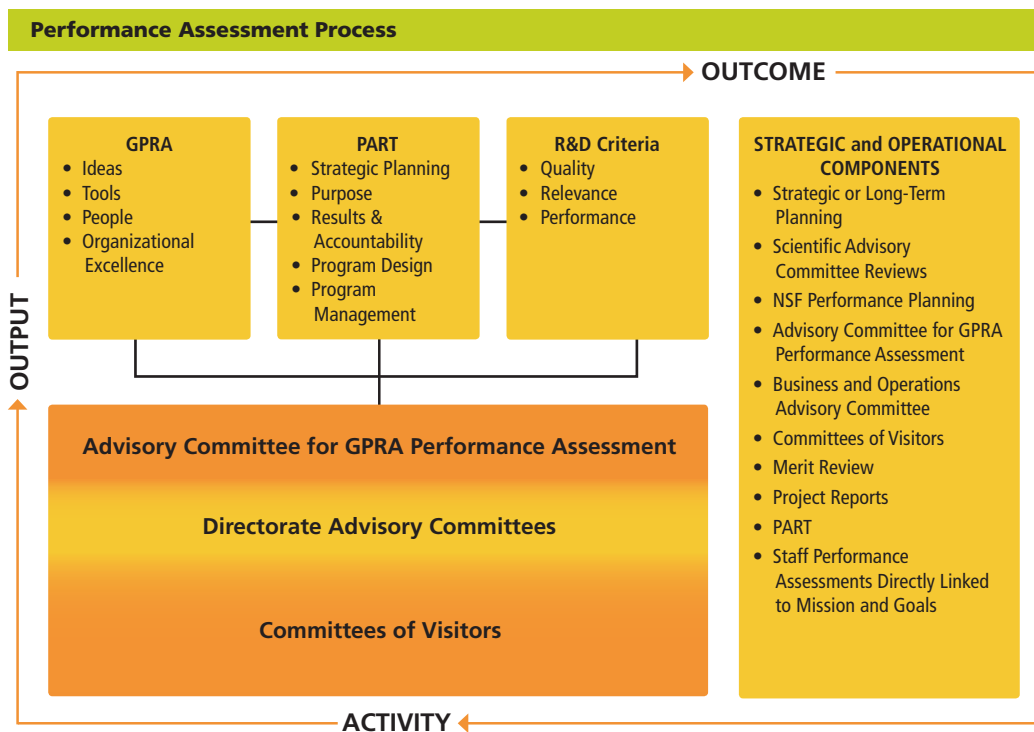
February 2004 marked the online debut of the National Science Foundation-supported Global Biodiversity Information Facility (GBIF), a database of scientific information on worldwide biodiversity. The Web portal gives access to more than 130 sources of information about the world's natural history collections, herbaria, and other databases at the click of a mouse.

Users can search the database by location, type of organism by scientific or common name, or other observational data and retrieve lists sorted by country. One important goal of the project is to digitize and make available data on organisms—often collected by researchers from developed countries—originating in developing countries, where such databases are generally scarce. In all, the GBIF provides access to more than 77 million records.

For more information:

[www.gbif.org](http://www.gbif.org)

NSF's program assessment process is depicted in the chart below.



GPRA: The Government Performance and Results Act of 1993; PART: Program Assessment Rating Tool; R&D: Research and Development

## FY 2005 Performance Scorecard

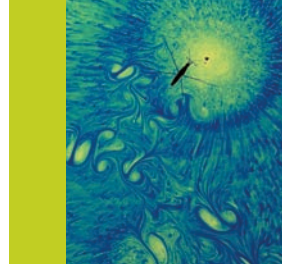
For FY 2005, NSF's performance goals fall into two broad areas: Strategic Outcome Goals and Other Performance Goals.

**Strategic Outcome Goals** focus on the long-term results of NSF grants and programs. They represent what the Foundation seeks to accomplish with its investments in science and engineering research and education. The results from NSF awards illustrate the success of the Foundation's investments. In a transparent public process, the AC/GPA uses input from grantee project reports, COV reports, and highlights from NSF-funded research to assess the Foundation's annual progress toward achieving each of the long-term Strategic Outcome Goals.

**Other Performance Goals** include performance measures included in NSF's PART evaluations as well as award size, duration, and time-to-decision goals related to agency effectiveness and efficiency.

In FY 2005, NSF achieved 18 of 21 performance goals (86 percent), including all four Strategic Outcome Goals. A list of NSF's FY 2005 performance goals and results begins on the next page. For a more comprehensive discussion, see NSF's *FY 2005 Performance and Accountability Report*.

FY 2001 to FY 2005 Performance Results: Goals Achieved					
	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Strategic Outcome Goals	4 of 5 (80%)	4 of 4 (100%)	4 of 4 (100%)	4 of 4 (100%)	4 of 4 (100%)
Other Performance Goals	11 of 18 (61%)	14 of 19 (74%)	10 of 16 (63%)	23 of 26 (88%)	14 of 17 (82%)
<b>TOTAL</b>	<b>15 of 23 (65%)</b>	<b>18 of 23 (78%)</b>	<b>14 of 20 (70%)</b>	<b>27 of 30 (90%)</b>	<b>18 of 21 (86%)</b>



FY 2005 PERFORMANCE GOALS AND RESULTS		
PERFORMANCE AREA	PERFORMANCE GOAL/INDICATOR	RESULT
<b>STRATEGIC OUTCOME GOAL 1: IDEAS</b> —Discovery across the frontier of science and engineering, connected to learning, innovation, and service to society.		
<b>IDEAS</b> Strategic Outcome Goal	<p>NSF will demonstrate significant achievement for the majority of the following performance indicators:</p> <ul style="list-style-type: none"> <li>• Enable people who work at the forefront of discovery to make important and significant contributions to science and engineering knowledge.</li> <li>• Encourage collaborative research and education efforts across organizations, disciplines, sectors, and international boundaries.</li> <li>• Foster connections between discoveries and their use in the service of society.</li> <li>• Increase opportunities for underrepresented individuals and institutions to conduct high-quality, competitive research and education.</li> <li>• Provide leadership in identifying and developing new research and education opportunities within and across science and engineering fields.</li> <li>• Accelerate progress in selected high-priority science and engineering areas by creating new integrative and cross-disciplinary knowledge and tools and by providing people with new skills and perspectives.</li> </ul> <p><b>Explanation of result:</b> Assessments by external experts determined that NSF has demonstrated significant achievement in each of the performance indicators associated with this goal.</p>	●
Research Award Size	Maintain the average annual size of new research grants at \$140,000.	●
Research Award Duration	Increase the average duration of new research grants to 3.0 years. <b>Explanation of result:</b> The FY 2005 result was 2.96 years.	●
Multidisciplinary: Multi- Investigator Nanoscale Proposals	Foster collaboration among investigators in Nanoscale Science and Engineering (NS&E) by maintaining the percentage of multi-investigator NS&E proposals at 75 percent.	●
Information Technology Research (ITR)	Ensure that ITR grantees are meaningfully and effectively collaborating across disciplines of science and engineering. <b>Performance measure:</b> Qualitative assessment by external experts, the ITR Committee of Visitors.	●
<b>STRATEGIC OUTCOME GOAL 2: TOOLS</b> —Broadly accessible state-of-the-art science and engineering facilities, tools, and other infrastructure that enable discovery, learning, and innovation.		
<b>TOOLS</b> Strategic Outcome Goal	<p>NSF will demonstrate significant achievement in the majority of the following indicators:</p> <ul style="list-style-type: none"> <li>• Expand opportunities for U.S. researchers, educators, and students at all levels to access state-of-the-art science and engineering facilities, tools, databases, and other infrastructure.</li> <li>• Provide leadership in the development, construction, and operation of major, next-generation facilities and other large research and education platforms.</li> <li>• Develop and deploy an advanced cyberinfrastructure to enable all fields of science and engineering to fully utilize state-of-the-art computation.</li> <li>• Provide for the collection and analysis of the scientific and technical resources of the United States and other nations to inform policy formulation and resource allocation.</li> <li>• Support research that advances instrument technology and leads to the development of next-generation research and education tools.</li> </ul> <p><b>Explanation of result:</b> Assessment by external experts determined that NSF has demonstrated significant achievement in each of the performance indicators associated with this goal.</p>	●

**FIREFLIES, NEURONS, AND THE MILLENNIUM BRIDGE**



National Science Foundation-supported mathematicians have helped solve the strange case of the Millennium Bridge. This sleekly designed, pedestrian-only suspension bridge was the first new bridge constructed across London's Thames River in more than 100 years.

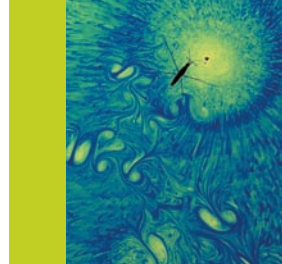
The large crowds that tried the bridge encountered swaying motions much larger than architects and engineers had anticipated or could explain. Steven Strogatz (Cornell University), Edward Ott (University of Maryland), and their collaborators in the United Kingdom and Germany recently advanced a convincing solution. Drawing on mathematical ideas originally used to describe the collective synchronization of independent biological oscillators such as fireflies and neurons, the researchers were able to explain how pedestrians were spontaneously falling into step with the bridge's small vibrations, thus amplifying those vibrations well beyond what the standard engineering analyses had predicted. Their analysis even explained the curious fact that the Millennium Bridge was steady with 150 pedestrians but swayed when foot traffic exceeded 160.

The bridge was closed for several months after the June 2001 opening while experiments were conducted and dampers were installed between the bridge deck and the supporting piers to tame side-to-side motion. The refitted bridge is now a model of stability and has become a well-used landmark.

For more information:

[www.news.cornell.edu/stories/Nov05/Strogatz.millennium.lg.html](http://www.news.cornell.edu/stories/Nov05/Strogatz.millennium.lg.html)

FY 2005 PERFORMANCE GOALS AND RESULTS		
PERFORMANCE AREA	PERFORMANCE GOAL/INDICATOR	RESULT
Construction and Upgrading of Facilities	Keep negative cost and schedule variances at less than 10 percent of the approved project plan for 90 percent of construction, acquisition, and upgrading projects. <b>Explanation of result:</b> In FY 2005, 79 percent of facilities (15 of 19) achieved this goal.	●
Operation and Management of Facilities	Keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time for 90 percent of operational facilities.	●
Nanotechnology Network Users	Support at least 4,000 users of the National Nanofabrication Users Network/National Nanotechnology Infrastructure Network (NNUN/NNIN) and the Network for Computational Nanotechnology sites.	●
NNIN Nodes	Support the national nanotechnology infrastructure by maintaining at least 14 National Nanotechnology Infrastructure Network nodes.	●
Information Technology Research (ITR)	Support significant research on software design and quality; scalable information infrastructure, high-end computing, and the socio-economic impacts of information technology. Also, support IT workforce development. <b>Explanation of result:</b> According to the ITR Committee of Visitors report, NSF achieved this goal.	●
<b>STRATEGIC OUTCOME GOAL 3: PEOPLE—A diverse, competitive, and globally engaged U.S. workforce of scientists, engineers, technologists, and well-informed citizens.</b>		
PEOPLE  Strategic Outcome Goal	NSF will demonstrate significant achievement in the majority of the following performance indicators: <ul style="list-style-type: none"> <li>Promote greater diversity in the science and engineering workforce through increased participation of underrepresented groups in NSF activities.</li> <li>Support programs that attract and prepare U.S. students to be highly qualified members of the global science and engineering workforce; programs should include opportunities for international study, collaborations, and partnerships.</li> <li>Develop the Nation's capability to provide K–12 and higher education faculty with opportunities for continuous learning and career development in science, technology, engineering, and mathematics.</li> <li>Promote public understanding and appreciation of science, technology, engineering, and mathematics and build bridges between formal and informal science education.</li> <li>Support innovative research on learning, teaching, and education that provides a scientific basis for improving science, technology, engineering, and mathematics education at all levels.</li> </ul> <b>Explanation of result:</b> Assessment by external experts determined that NSF has demonstrated significant achievement for a majority of the performance indicators associated with this goal.	●
U.S. Students Receiving Fellowships	Increase the number of recipients of Graduate Research Fellowships (GRF), Integrative Graduate Education and Research Traineeships, or Graduate Teaching Fellows in K–12 Education from 3,681 in FY 2004 to 4,600 in FY 2005.	●



FY 2005 PERFORMANCE GOALS AND RESULTS		
PERFORMANCE AREA	PERFORMANCE GOAL/INDICATOR	RESULT
Graduate Fellowships: Broadening Participation	Increase the number of GRF applicants from groups that are underrepresented in the science and engineering workforce from the FY 2004 level of 1,099.	●
CAREER Award: Broadening Participation	Increase the number of applicants for CAREER (Faculty Early Career Development) awards from minority-serving institutions from the FY 2004 level of 82.	●
Nanoscale Proposals with Female Principal Investigators	Ensure that at least 25 percent of the Nanoscale Science and Engineering proposals include at least one female principal investigator (PI) or co-PI.	●
Nanoscale Proposals with Minority Investigators	Increase the percentage of NS&E proposals with at least one minority principal or co-principal investigator from the FY 2004 level of 12 percent to 13 percent. (Minority is defined as Hispanic/Latino, African American, Native Hawaiian and other Pacific Islander, and American Indian and Alaska Native.) <b>Explanation of result:</b> NSF was not successful for this goal. We will continue our efforts to encourage minorities to submit proposals to this area. The performance goal was set at an approximate target level, and the deviation from that level is slight. The result had no effect on overall program or activity performance.	●
<b>STRATEGIC OUTCOME GOAL 4: ORGANIZATIONAL EXCELLENCE</b> —An agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.		
<b>ORGANIZATIONAL EXCELLENCE</b> Strategic Outcome Goal	NSF will demonstrate significant achievement in the majority of the following performance indicators: <ul style="list-style-type: none"> <li>• Operate a credible, efficient merit review system.</li> <li>• Utilize and sustain broad access to new and emerging technologies for business application.</li> <li>• Develop a diverse, capable, motivated staff that operates with efficiency and integrity.</li> <li>• Develop and use performance assessment tools and measures to provide an environment of continuous improvement in NSF's intellectual investments as well as its management effectiveness.</li> </ul>	●
Time-to-decision	For 70 percent of proposals, inform applicants about funding decisions within 6 months of deadline or target date, or receipt of data, whichever is later.	●
Time-to-decision: Nanoscale Science and Engineering	For 70 percent of proposals submitted to the Nanoscale Science and Engineering Program, inform applicants about funding decisions within 6 months of proposal receipt or deadline date, while maintaining a credible and efficient competitive merit review system.	●
Time-to-decision: Individuals	For 70 percent of proposals submitted to the Individuals Program, inform applicants about funding decisions within 6 months of proposal receipt or deadline date, while maintaining a credible and efficient competitive merit review system.	●

**Right:** In the spring of 2007, scientists from more than 100 countries will embark on an intensive, coordinated campaign of multidisciplinary scientific observations, research, and analysis in the arctic and antarctic regions as part of the International Polar Year (IPY) 2007–2008. The research is expected to dramatically expand our understanding of the polar regions—including their relationship to the global ecosystem—and to provide unprecedented insight into how societies in high northern latitudes are coping with environmental change. The National Science Foundation (NSF), which manages the U.S. Antarctic Program and chairs the Interagency Arctic Research Policy Committee, is the lead federal agency for the IPY. Shown in this photograph is a North Pole Arctic ice jumble. The constantly moving ice cover of the arctic ocean begins to break up in the spring, causing enormous sheets of ice to collide with one another and pile up like frozen waves.

*Credit:* Peter West, NSF

For more information:

<http://www.nsf.gov/news/overviews/arcticantarctic/index.jsp>



## FINANCIAL HIGHLIGHTS

For more information:

*NSF Budget Requests*  
[www.nsf.gov/about/budget/](http://www.nsf.gov/about/budget/)

*PMA Improper Payments Initiative*  
[www.whitehouse.gov/omb/financial/fia/improv\\_accuracy\\_fed\\_payments.pdf](http://www.whitehouse.gov/omb/financial/fia/improv_accuracy_fed_payments.pdf)

*Department of Treasury  
Metric Tracking System*  
[www.fido.gov/mts/cfo/public/200510/](http://www.fido.gov/mts/cfo/public/200510/)

“The Foundation’s leadership in advancing the frontiers of science and engineering research and education is fueled by a commitment to forward-thinking administration and management processes. We pursue excellence and innovation in our business practices, just as in the research and education we support. The core values that enable our success include teamwork, mutual respect, integrity, creativity, responsibility, initiative, professionalism, and last but not least, a sense of humor. Above all we value our people, recognizing their expertise and trusting their judgment.”

**Thomas N. Cooley**



**Thomas N. Cooley**  
Chief Financial Officer

### **From the Chief Financial Officer**

I am pleased to join NSF Director Dr. Arden L. Bement, Jr. in presenting the National Science Foundation's *Performance Highlights* for FY 2005.

NSF has a strong tradition as an efficient and effective organization, and builds continuously on its legacy of excellence. Our core business operations are based on the principles of effective internal controls and timely access to reliable financial data.

NSF's electronic communications and processing systems are at the forefront of e-government, providing streamlined functions within the agency, as well as to our research and education communities. A few notable achievements of the past year include the following:

- Recognized as the first agency to earn a "Green" rating for financial performance on the President's Management Agenda (PMA) scorecard and sustaining this rating for 14 consecutive quarters.
- Achieved "Green" ratings for the PMA's Budget and Performance Integration initiative and for the Improper Payments initiative.
- Recognized by the Department of the Treasury and the Office of Management and Budget for achieving one of the highest agency marks on Treasury's Financial Management Scorecard and the governmentwide Chief Financial Officer (CFO) Council's financial management metrics.
- Our *Performance Highlights* report was named one of the top government annual reports by the League of American Communications Professionals for the fourth consecutive year.

In addition, I am pleased to report that the agency received its eighth consecutive unqualified "clean" audit opinion indicating that the financial statements were fairly stated in all material respects. The Auditors' Report included two reportable conditions. We take seriously our commitment to maintaining quality management practices and have already initiated improvements in these areas. More detailed information on our annual audit can be found in NSF's *FY 2005 Performance and Accountability Report*.

For NSF, excellence in financial management has enabled the agency to pursue critical investments in science and engineering research and education. Underlying all of these efforts is our guiding mission: to promote progress in science and engineering in order to help ensure the Nation's security, prosperity, and well being. Our success reflects the quality, integrity, and professionalism of the NSF staff. Our successes are a result of their collective outstanding performance.

A handwritten signature in black ink that reads "Thomas N. Cooley". The signature is fluid and cursive.

Thomas N. Cooley  
March 2006

EXPLORING THE WORLD

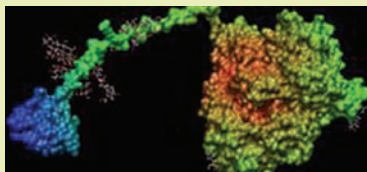


NSF supports a variety of informal science educational projects that reach millions of children and adults through films, museum exhibits, innovative television programs, radio shows, and web-based resources. *Peep and the Big Wide World* (PEEP) is a daily television series for 3- to 5-year-olds that teaches science to preschoolers. Research indicates PEEP viewers are more scientifically grounded than children who don't tune in. When presented with materials to manipulate and explore, fans are more likely to initiate explorations and use problem-solving strategies to solve the problems that they initiate. The series also provides parents with web-based and other outreach activities to extend science learning. *Forces of Nature* is a National Geographic film made with NSF support that showcases the awesome spectacle of earthquakes, volcanoes, and severe storms. The film follows scientists on their quest to understand what triggers these natural disasters.

For more information:

[www.nsf.gov/news/now\\_showing/tv/peep.jsp](http://www.nsf.gov/news/now_showing/tv/peep.jsp)

ETHANOL



To develop efficient large-scale conversion of biomass into ethanol to provide a clean-burning and renewable fuel source, researchers at the National Renewable Energy Laboratory simulated the action of the enzyme cellulase on cellulose using the CHARMM (Chemistry at HARvard Molecular Mechanics) code, a versatile community code for simulating biological reactions. The binding domain is in blue, the glycosylated linker in green, and the catalyst domain in orange and yellow. San Diego Supercomputer Center researchers are enhancing CHARMM to perform the largest ever simulation of a scientific problem, which will yield significant economic and environmental benefits.

For more information:

[www.sdsc.edu/Press/2005/10/101305\\_biomass.html](http://www.sdsc.edu/Press/2005/10/101305_biomass.html)

Financial Highlights

In FY 2005, NSF maintained its record of excellence in financial management even as we, along with other federal agencies, faced an increasing need for accountability to the American taxpayer. We continued to build on our record of leadership in government business practices, particularly in electronic business and grants management. We further improved our financial management and sustained our “Green” ratings in both the PMA and the Department of the Treasury’s Financial Management scorecards. In addition, NSF achieved one of the top scores in the governmentwide CFO Council’s financial management metrics.

NSF’s high quality, responsive electronic communications and processing systems are the backbone of our operations and the key to our success in conducting business with the research and education communities we serve. One of our top priorities is to offer reliable, useful, and timely financial information to NSF managers so that they can make informed decisions and ensure ongoing accountability to our stakeholders. NSF’s three primary data systems—the Financial Accounting System, the Executive Information System, and ReportWeb—provide comprehensive financial, budgetary, merit review, and awards management data to NSF decision makers.

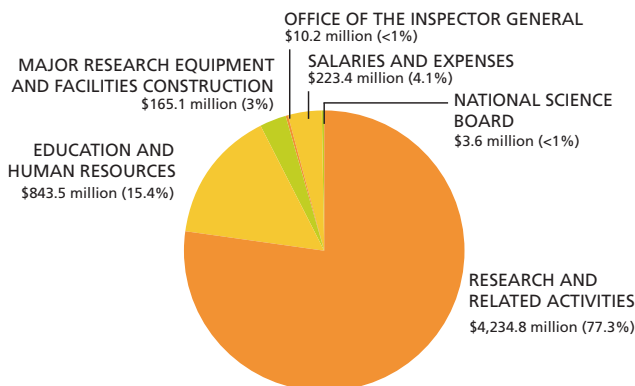
NSF prepares annual financial statements in conformity with generally accepted accounting principles of the United States and subjects them to an independent audit to ensure their reliability in assessing performance. In FY 2005, NSF received its eighth unqualified “clean” audit opinion. An unqualified audit opinion is a measure of the fair presentation of our financial statements.

The Foundation prepares a Balance Sheet, Statement of Net Cost, Statement of Changes in Net Position, Statement of Budgetary Resources, and Statement of Financing. Supplementary statements prepared include Budgetary Resources by Major Budgetary Accounts, Intragovernmental Balances, Deferred Maintenance, and Stewardship Investments.

The following pages feature highlights of NSF’s FY 2005 financial condition. Details of our assets and liabilities appear on page 17. The statement on Stewardship Investments is shown on page 19. A more detailed discussion of NSF’s financial performance and a complete set of financial statements, accompanying notes, and the audit opinion can be found in NSF’s *FY 2005 Performance and Accountability Report*.

NSF is funded primarily through six congressional appropriations that totaled \$5.5 billion in FY 2005, as shown on the chart below. NSF appropriations funded four strategic outcome goals: Ideas, Tools, People, and Organizational Excellence. Organizational Excellence focuses on the administrative and management activities that enable NSF to achieve its programmatic activities and mission. Funding for Organizational Excellence has been allocated among Ideas, Tools, and People to capture the (net) cost of each of these outcome goals, shown on the statement on page 18.

FY 2005 Budget Obligations by Account (\$5,480 million)





COMMUNICATING IN  
THREE DIMENSIONS

While most ancient cultures recorded civil matters and business transactions by inscribing characters on 2-dimensional sheets, new evidence shows that Peru's original inhabitants used a 3-dimensional system of knotted strings to track business transactions and affairs of state. National Science Foundation-supported anthropologist Gary Urton and database developer Carrie Brezine of Harvard University report that their computer analysis of 21 of the knotted objects, known as khipu, revealed distinct patterns that help confirm the textile devices were used for record keeping and to communicate affairs of state throughout the sprawling empire of the Inka—a spelling Urton prefers because it is closer to the native Peruvian language. Seven of the objects appeared to contain cumulative numerical data.

Deciphering the khipu information also helps explain how the vast Inka bureaucracy, which ruled the Andes from 1425 to 1532, stayed so organized without ever developing a system of 2-dimensional writing. According to Urton, khipu were used to record the information deemed most important to the state, which often included accounting and other data related to censuses, finance, and the military. In this regard, the discovery that khipu were used as ledger books reveals a new consonance between the Inka and other ancient cultures.

• For more information:

[www.nsf.gov/news/news\\_summ.jsp?cntn\\_id=104350&org=NSF&from=news](http://www.nsf.gov/news/news_summ.jsp?cntn_id=104350&org=NSF&from=news)

Information about *Net Cost* is taken from NSF's Statement of Net Cost for Years Ended September 30, 2005 and 2004. Information about *Stewardship Investments* is taken from NSF's FY 2005 Stewardship Investments statement. Both can be found in the financial statements of NSF's *FY 2005 Performance and Accountability Report*.

**FY 2005 Net Cost of Investment Categories  
(Amounts in Thousands)**

<b>IDEAS</b>	
Fundamental Science & Engineering Centers	\$ 2,327,110
Capability Enhancement	176,183
	<u>202,855</u>
Total Ideas Program Costs	2,706,148
Less: Earned Revenue	<u>119,826</u>
<b>Net Ideas Program Costs</b>	<b><u>2,586,322</u></b>
<b>TOOLS</b>	
Large Facilities	531,911
Infrastructure & Instrumentation	321,155
Polar Tools, Facilities, & Logistics	312,784
Federally Funded Research & Development Centers	<u>209,570</u>
Total Tools Program Costs	1,375,420
Less: Earned Revenue	<u>324</u>
<b>Net Tools Program Costs</b>	<b><u>1,375,096</u></b>
<b>PEOPLE</b>	
Individuals	894,227
Institutions	179,356
Collaborations	<u>379,489</u>
Total People Program Costs	1,453,072
Less: Earned Revenue	<u>6,316</u>
<b>Net People Program Costs</b>	<b><u>1,446,756</u></b>
<b>Net Cost of Operations</b>	<b>\$ <u>5,408,174</u></b>



**Stewardship Investments: Research and Human Capital  
(Amounts in Thousands) (Unaudited)**

	2005	2004	2003	2002	2001
<b>RESEARCH AND HUMAN CAPITAL ACTIVITIES</b>					
Basic Research	\$ 3,564,093	\$ 3,494,302	\$ 3,519,159	\$ 3,092,060	\$ 2,692,243
Applied Research	291,169	209,225	218,152	193,788	211,421
Education and Training	1,386,952	1,224,058	867,489	767,734	704,949
Non-Investing Activities	292,426	268,298	196,363	183,887	170,757
<b>Total Research and Human Capital Activities</b>	<b>\$ 5,534,640</b>	<b>\$ 5,195,883</b>	<b>\$ 4,801,163</b>	<b>\$ 4,237,469</b>	<b>\$ 3,779,370</b>
<b>INPUTS, OUTPUTS, AND/OR OUTCOMES</b>					
<b>Research and Human Capital Activities</b>					
<u>Investments In</u>					
Universities	\$ 3,970,851	\$ 3,705,751	\$ 3,310,365	\$ 2,919,897	\$ 2,631,405
Industry	223,563	196,260	178,000	185,062	162,176
Federal Agencies	143,316	107,212	144,792	106,458	125,823
Small Business	193,199	200,995	186,400	144,844	130,977
Federally Funded R&D Centers	1,003,711	985,665	981,606	881,208	728,989
	<b>\$ 5,534,640</b>	<b>\$ 5,195,883</b>	<b>\$ 4,801,163</b>	<b>\$ 4,237,469</b>	<b>\$ 3,779,370</b>
<u>Support To</u>					
Scientists	\$ 454,053	\$ 477,970	\$ 427,304	\$ 394,144	\$ 355,261
Postdoctoral Programs	162,132	175,680	163,239	148,334	128,499
Graduate Students	538,233	546,084	475,315	402,620	362,820
	<b>\$ 1,154,418</b>	<b>\$ 1,199,734</b>	<b>\$ 1,065,858</b>	<b>\$ 945,098</b>	<b>\$ 846,580</b>
<b>Outputs and Outcomes</b>					
<u>Number Of</u>					
Awards Actions	22,000	23,000	23,000	21,000	20,000
Senior Researchers	32,000	31,000	30,000	28,000	27,000
Other Professionals	12,000	15,000	12,000	11,000	10,000
Postdoctoral Associates	6,000	6,000	6,000	6,000	6,000
Graduate Students	27,000	29,000	27,000	26,000	25,000
Undergraduate Students	33,000	35,000	32,000	32,000	31,000
K-12 Students	11,000	14,000	14,000	11,000	11,000
K-12 Teachers	74,000	86,000	85,000	84,000	83,000

NSF's mission is to support basic scientific research and research fundamental to the engineering process as well as science and engineering education programs. Toward this end, NSF's Stewardship Investments fall principally into the categories of Research and Human Capital. In Research, most NSF funding is devoted to basic research, with a relatively small share going to applied research. This funding supports both the conduct of research and the necessary supporting infrastructure, including state-of-the-art instrumentation, equipment, computing resources, and multi-user facilities such as digital libraries, observatories, and research vessels and aircraft. NSF's Human Capital investments focus principally on education and training, toward a goal of creating of a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens. NSF supports activities to improve formal and informal science, mathematics, engineering, and technology education at all levels, as well as public science literacy projects that engage people of all ages in life-long learning. The decrease in the number of people involved in NSF activities in FY 2005 reflects decreased funding for programmatic activities related to science and engineering education.

**Right:** A research team from Indiana University excavated fossils of early humans in Gona, in the Afar region of Ethiopia. These National Science Foundation-supported anthropologists believe the fossils come from nine individuals of the species *Ardipithecus ramidus* who lived between 4.3 and 4.5 million years ago.

While biomolecular evidence helps us to date the timing of major events in the evolution of apes and humans, there is no substitute for fossils when trying to picture the anatomy and behavioral capabilities of our early relatives. The late Miocene-early Pliocene is a particularly important era as it was roughly at that time that our ancestors and those of the chimpanzee parted company. Each new fossil helps to tell a bit more of the story of these early stages in human origins.

Several Ethiopian dig sites have yielded hominid fossils from that time period. The Gona site was previously known for the excavation of the oldest stone tools ever discovered. Plant and animal fossils indicate that these early humans lived in a low-lying area with swamps, springs, streams, and volcanic centers, with a mosaic of woodlands and grasslands.

Credit: Sileshi Semaw, Indiana University



## APPENDIXES

For more information:

[www.nsf.gov/news/news\\_summ.jsp?cntn\\_id=100729](http://www.nsf.gov/news/news_summ.jsp?cntn_id=100729)

For more information:

Office of the Director  
[www.nsf.gov/od/](http://www.nsf.gov/od/)

National Science Board  
[www.nsf.gov/nsb/](http://www.nsf.gov/nsb/)

### Appendix 1:

#### DESCRIPTION OF NSF DIRECTORATES AND MANAGEMENT OFFICES

The **Directorate for Biological Sciences (BIO)** provides support for research to advance understanding of the underlying principles and mechanisms governing life. Research ranges from the study of the structure and dynamics of biological molecules, such as proteins and nucleic acids, through cells, organs, and organisms, to studies of populations and ecosystems. It encompasses all processes that are internal to the organism as well as those that are external, and includes temporal frameworks ranging from measurements in real time, through individual life spans, to the full scope of evolutionary time. BIO plays a major role in support of research resources for the biological sciences including multi-user instrumentation, living stock centers, systematics collections, biological field stations, and computerized databases, including sequence databases for plants and micro-organisms. As part of the National Plant Genome Initiative (NPGI), BIO plays a major role through support for research infrastructure to enable a broad community and for research to understand the structure, organization, and function of plant genomes.

The **Directorate for Computer and Information Science and Engineering (CISE)** supports research on the foundations of computing and communications devices and their usage, research on computing and networking technologies and software, and research to increase the capabilities of humans and machines to create, discover, and reason with knowledge by

advancing the ability to represent, collect, store, organize, locate, visualize, and communicate information. CISE supports a range of activities in education and workforce that complement these efforts.

The **Directorate for Education and Human Resources (EHR)** supports activities promoting excellence in U.S. science, technology, engineering, and mathematics (STEM) education at all levels and in all settings (both formal and informal). The goal of these activities is to develop a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians, and educators, as well as a well-informed citizenry with access to the ideas and tools of science and engineering. Support is provided for individuals to pursue advanced study, for institutions to build their capacity to provide excellent STEM education, and for collaborations to strengthen STEM education at all levels by fostering alliances and partnerships among colleges, universities, school districts, and other institutions in the public and private sectors.

The **Directorate for Engineering (ENG)** supports research and education activities contributing to technological innovation that is vital to the nation's economic strength, security, and quality of life. ENG invests in fundamental research on engineering systems, devices, and materials, and the underpinning processes and methodologies that support them. Emerging technologies—nanotechnology, information

technology, and biotechnology—comprise a major focus of ENG research investments. ENG also makes critical investments in facilities, networks, and people to ensure diversity and quality in the nation's infrastructure for engineering education and research.

The **Directorate for Geosciences (GEO)** supports research in the atmospheric, earth, and ocean sciences. Basic research in the geosciences advances our scientific knowledge of the Earth and advances our ability to predict natural phenomena of economic and human significance, such as climate change, weather, earthquakes, fish-stock fluctuations, and disruptive events in the solar-terrestrial environment. GEO also supports the operation of national user facilities.

The **Directorate for Mathematical and Physical Sciences (MPS)** supports research and education in astronomical sciences, chemistry, materials research, mathematical sciences, and physics. Major equipment and instrumentation such as telescopes and particle accelerators are provided to support the needs of individual investigators. MPS also supports state-of-the-art facilities that enable research at the cutting edge of science and research opportunities in totally new directions.

The **Directorate for Social, Behavioral, and Economic Sciences (SBE)** supports research and education to build fundamental scientific knowledge about human cognition, language, social behavior, and culture and on economic, legal, political, and social systems, organizations, and institutions. To improve understanding of the science and engineering enterprise, SBE also supports science resources studies that are the nation's primary source of data on the science and engineering enterprise.

The **Office of Cyberinfrastructure (OCI)** coordinates and supports the acquisition, development, and provision of state-of-the-art cyberinfrastructure resources, tools, and services essential to the conduct of 21st century science and engineering research and education. OCI supports cyberinfrastructure such as supercomputers, high-capacity mass-storage systems, system software suites and programming environments, scalable interactive visualization tools, productivity software libraries and tools, large-scale data repositories and digitized scientific data management systems, networks of various reach and granularity, and an array of software tools and services that hide the complexities and heterogeneity of contemporary cyberinfrastructure while providing broad access and enhanced usability. OCI supports the preparation and training of current and future generations of researchers and educators to use cyberinfrastructure to further their research and education goals, while also supporting the scientific and engineering professionals who create and maintain these IT-based resources and systems and who provide essential customer services to the national science and engineering user community.

The **Office of International Science and Engineering (OISE)** serves as the focal point, both within and outside NSF, for international science and engineer-

ing activities. OISE promotes the development of an integrated, Foundation-wide international strategy and manages international programs that are innovative, catalytic, and responsive to a broad range of NSF interests. OISE also supports programs that provide international research experiences to students and young investigators, preparing them for full participation in the global research enterprise. In addition, OISE manages NSF's cooperative relationships with partner countries around the world and scientific international organizations.

The **Office of Polar Programs (OPP)**, which includes the U.S. Polar Research Programs and U.S. Antarctic Logistical Support Activities, supports multidisciplinary research in the Arctic and Antarctic regions. These geographic frontiers—premier natural laboratories—are the areas predicted to be the first affected by global change. They are vital to understanding past, present, and future responses of Earth systems to natural and man-made changes. Polar Programs support provides unique research opportunities ranging from studies of Earth's ice and oceans to research in atmospheric sciences and astronomy.

The **Office of Budget, Finance, and Award Management (BFA)** is headed by the Chief Financial Officer, who has responsibility for budget, financial management, grants administration, and procurement operations and related policy. Budget responsibilities include the development of the Foundation's annual budget, long range planning, and budget operations and control. BFA's financial, grants, and other administrative management systems ensure that the Foundation's resources are well managed and that efficient, streamlined business and management practices are in place. NSF has been acknowledged as a leader in the federal research administration community, especially in its pursuit of a paperless environment that provides more timely, efficient awards administration.

The **Office of Information and Resource Management (OIRM)** provides human capital management, information technology solutions, continuous learning opportunities, and general administrative services to the NSF community of scientists, engineers, and educators. OIRM also provides logistical support functions for NSF staff as well as the general public. It is responsible for recruiting, staffing, and other human resource service requirements for all NSF staff and visiting personnel. OIRM is responsible for the management of NSF's physical infrastructure and conference facilities; the administration of its sophisticated technology infrastructure, and the dissemination of information about NSF programs to the external community through the agency's website. It is also responsible for delivery of the hardware, software, and support systems necessary to manage the Foundation's grant-making process and to maintain advanced financial and accounting systems.

**OPENING THE WORLD OF SCIENCE TO THE BLIND**

The goal of the Tactile Graphics Project is to provide K–12, undergraduate, and graduate students who are blind with the opportunity to succeed. With support from the National Science Foundation, a multidisciplinary team from the University of Washington is developing ways to convert the information contained in graphic images that are crucial to understanding mathematics, engineering, and science into accessible formats.

The research team generated models to classify images by type (for example, bar charts, line graphs, or illustrations) so that the most appropriate image processing algorithms could be applied. The researchers will incorporate the image processing and classification algorithms into the Tactile Graphics Assistant, a software program that will support transcribers in producing effective tactile graphics for people who are blind.

For more information:  
[www.cs.washington.edu/homes/ladner/tactile/tactile.html](http://www.cs.washington.edu/homes/ladner/tactile/tactile.html)

**VLA PROBES SECRETS OF MYSTERIOUS MAGNETAR**



A giant flash of energy in December 2004 from a supermagnetic neutron star thousands of light-years from Earth may shed new light on these stars. The blast was the brightest outburst ever seen coming from an object beyond our solar system.

While the intense burst faded quickly, the Very Large Array (VLA) telescope tracked the explosion's afterglow for weeks and produced a wealth of information. The VLA, one of the world's premier astronomical radio observatories, consists of 27 large radio antennas. When the data from these 82-foot antennas are combined, researchers get a detailed, ultra-high resolution image of the heavens. The VLA is one of several radio telescopes supported by the National Science Foundation.

For more information:  
[www.nsf.gov/news/news\\_summ.jsp?cntn\\_id=103004](http://www.nsf.gov/news/news_summ.jsp?cntn_id=103004)

**Appendix 2:  
 FY 2005 EXECUTIVE STAFF AND OFFICERS**

**NSF Executive Staff**

**Office of the Director**

Arden L. Bement, Jr., Director  
 Kathie L. Olsen, Deputy Director<sup>1</sup>  
 Thomas Windham, Senior Advisor for Science and Engineering Workforce

**National Science Board**

Warren M. Washington, Chair  
 Diana S. Natalicio, Vice Chair  
 Michael P. Crosby, Executive Officer

**Office of Equal Opportunity Programs**

Ronald D. Branch, Director

**Office of the General Counsel**

Lawrence Rudolph, General Counsel

**Office of Inspector General**

Christine C. Boesz, Inspector General

**Office of Integrative Activities**

Nathaniel G. Pitts, Director

**Office of Legislative and Public Affairs**

Curtis Suplee, Director

**Office of Cyberinfrastructure**

Deborah Crawford, Director (Acting)

**Office of International Science and Education**

Kathryn Sullivan, Director (Acting)

**Office of Polar Programs**

Karl A. Erb, Director

**Directorate for Biological Sciences**

Mary E. Clutter, Assistant Director

**Directorate for Computer and Information Science and Engineering**

Peter A. Freeman, Assistant Director

**Directorate for Education and Human Resources**

Donald E. Thompson, Assistant Director (Acting)<sup>2</sup>

**Directorate for Engineering**

Richard Buckius, Assistant Director (Acting)<sup>3</sup>

**Directorate for Geosciences**

Margaret S. Leinen, Assistant Director

**Directorate for Mathematical and Physical Sciences**

Michael S. Turner, Assistant Director

**Directorate for Social, Behavioral and Economic Sciences**

David W. Lightfoot, Assistant Director

**Office of Budget, Finance and Award Management**

Thomas N. Cooley, Director

**Office of Information and Resource Management**

Anthony A. Arnolie, Director

**NSF Officers**

**Chief Financial Officer**

Thomas N. Cooley  
 Office of Budget, Finance, and Award Management

**Chief Information Officer**

George O. Strawn  
 Office of Information and Resource Management

**Chief Human Capital Officer**

Anthony A. Arnolie  
 Office of Information and Resource Management

**NSF Affirmative Action Officer**

Ronald D. Branch  
 Office of Equal Opportunity Programs

<sup>1</sup> Replaced Joseph Bordogna in August 2005.  
<sup>2</sup> Replaced Judith Ramaley in December 2004.  
<sup>3</sup> Replaced John A. Brighton in August 2005.



## Appendix 3:

### NATIONAL SCIENCE BOARD MEMBERS DURING FY 2005

**Warren M. Washington, Chair**

Senior Scientist and Head,  
Climate Change Research Section  
National Center for Atmospheric Research

**Diana S. Natalicio, Vice Chair**

President  
The University of Texas at El Paso

**Dan E. Arvizu**

Director  
National Renewable Energy Laboratory

**Barry C. Barish**

Linde Professor of Physics  
California Institute of Technology

**Steven C. Beering**

President Emeritus  
Purdue University

**Ray M. Bowen**

Former President  
Texas A&M University

**G. Wayne Clough**

President  
Georgia Institute of Technology

**Kelvin K. Droegemeier**

Weathernews Chair of Applied Meteorology  
Director, Center for Analysis and Prediction of Storms  
Director, Sasaki Institute, University of Oklahoma

**Delores M. Etter**

Professor, Electrical Engineering  
United States Naval Academy

**Nina V. Fedoroff**

Willaman Professor of Life Sciences  
Director, Life Sciences Consortium  
Director, Biotechnology Institute  
The Pennsylvania State University

**Kenneth M. Ford**

Director  
Institute for Human and Machine Cognition  
University of West Florida

**Daniel E. Hastings**

Associate Director  
Engineering Systems Division  
Massachusetts Institute of Technology

**Elizabeth Hoffman**

President  
University of Colorado System

**Louis J. Lanzerotti**

Distinguished Professor of Physics  
New Jersey Institute of Technology

**Alan I. Leshner**

CEO  
American Association for the Advancement  
of Science

**Jane Lubchenco**

Wayne and Gladys Valley Professor of Marine Biology  
Distinguished Professor of Zoology  
Oregon State University

**Douglas D. Randall**

Professor of Biochemistry  
Director, Interdisciplinary Program on  
Plant Biochemistry-Physiology  
University of Missouri

**Michael G. Rossmann**

Hanley Distinguished Professor of Biological Sciences  
Department of Biological Sciences  
Purdue University

**Daniel Simberloff**

Nancy Gore Hunger Professor of  
Environmental Science  
Department of Ecology and Evolutionary Biology  
University of Tennessee

**Jon C. Strauss**

President  
Harvey Mudd College

**Kathryn D. Sullivan**

President and CEO  
Center of Science and Industry (COSI)

**JoAnne Vasquez**

Past President  
National Science Teachers' Association

**John A. White, Jr.**

Chancellor  
University of Arkansas–Fayetteville

**Mark S. Wrighton**

Chancellor  
Washington University

**Arden L. Bement, Jr.**

*Member Ex Officio*  
Director  
National Science Foundation

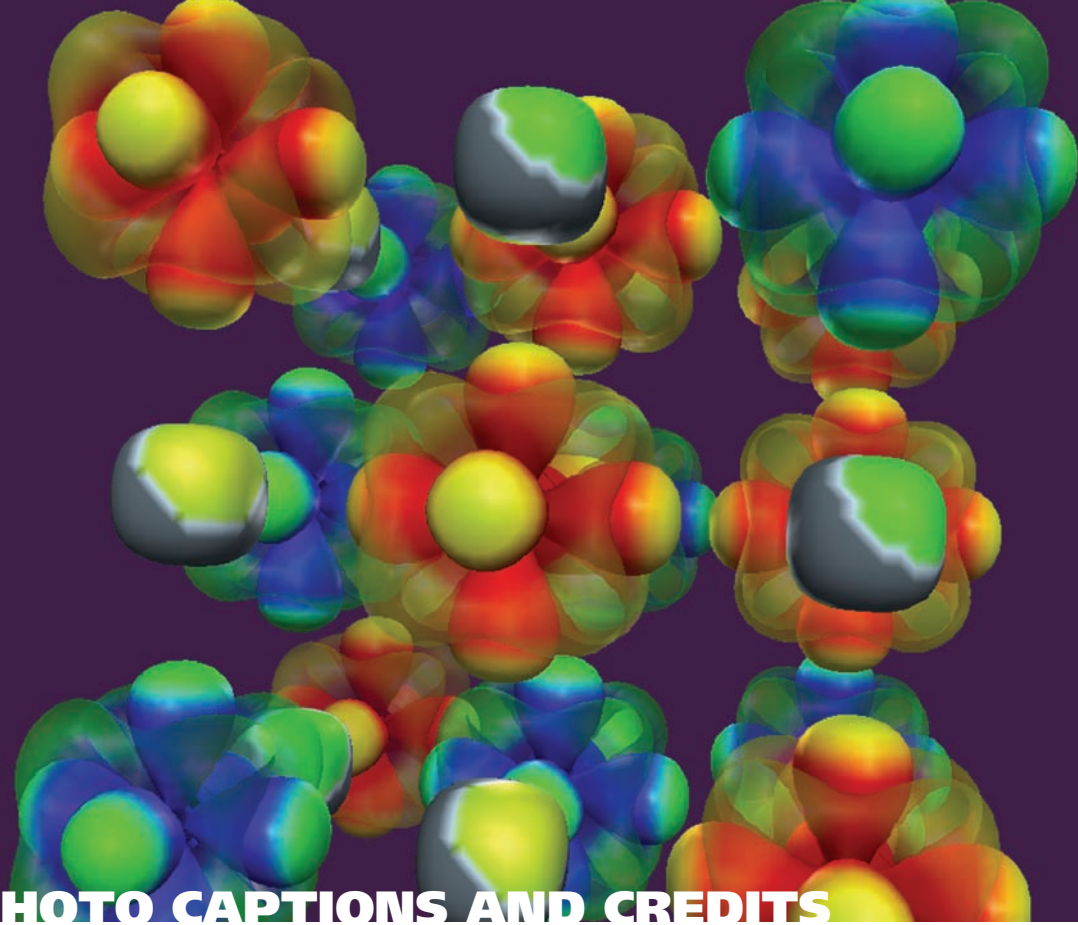
**Michael P. Crosby**

Executive Officer  
National Science Board

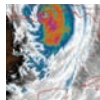
**Right:** This image uses fundamental quantum physics to show where the electrons in iron oxide (FeO) are. Iron is an important component of most minerals in the Earth. Iron's influence on mineral properties at high pressures is crucial to understanding the behavior of the deep Earth. Current electronic structure methods fail to describe FeO correctly. These methods predict, for example, that iron oxide is metallic when it is actually insulating.

In a grant funded by the National Science Foundation program Collaborations in Mathematical Geoscience, researcher Ronald Cohen of the Carnegie Institution of Washington and his collaborators aim to go beyond the current state-of-the-art method and develop and apply more accurate methods known as "Quantum Monte Carlo" to this and other problems in Earth materials. These new methods will increase the accuracy of our understanding of the deep Earth.

*Credit:* Ronald Cohen, Carnegie Institution of Washington



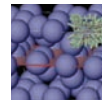
## PHOTO CAPTIONS AND CREDITS



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Real-time radar data and high-tech communications were the keystones to success recently as the Rainband and Intensity Change Experiment (RAINEX) project began its research with Hurricane Katrina. The first hurricane research project to fly planes nearly simultaneously inside and outside a hurricane's principal rainband, RAINEX gathered information that will help scientists to better understand changes in a hurricane's intensity and to validate state-of-the-art numerical models used in forecasting. Once data are collected and analyzed, the researchers will share this information with hurricane operational centers and national environmental prediction centers throughout the country and the world. The National Science Foundation funded the work of atmospheric scientist Robert Houze, University of Washington, and meteorologist and physical oceanographer Shuyi Chen, University of Miami Rosenstiel School of Marine and Atmospheric Sciences, who also worked with scientists from the National Center for Atmospheric Research in Boulder, CO, the National Oceanic and Atmospheric Administration, and the U.S. Navy on the RAINEX project.

*Credit:* National Oceanic and Atmospheric Administration



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*Credit:* Virgil Percec, University of Pennsylvania



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*Credit:* Courtesy of New York-Presbyterian Hospital



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*Credit:* Global Biodiversity Information Facility



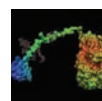
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*Credit:* Adrian Pingstone



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*Credit:* WGBH



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*Credit:* San Diego Supercomputer Center



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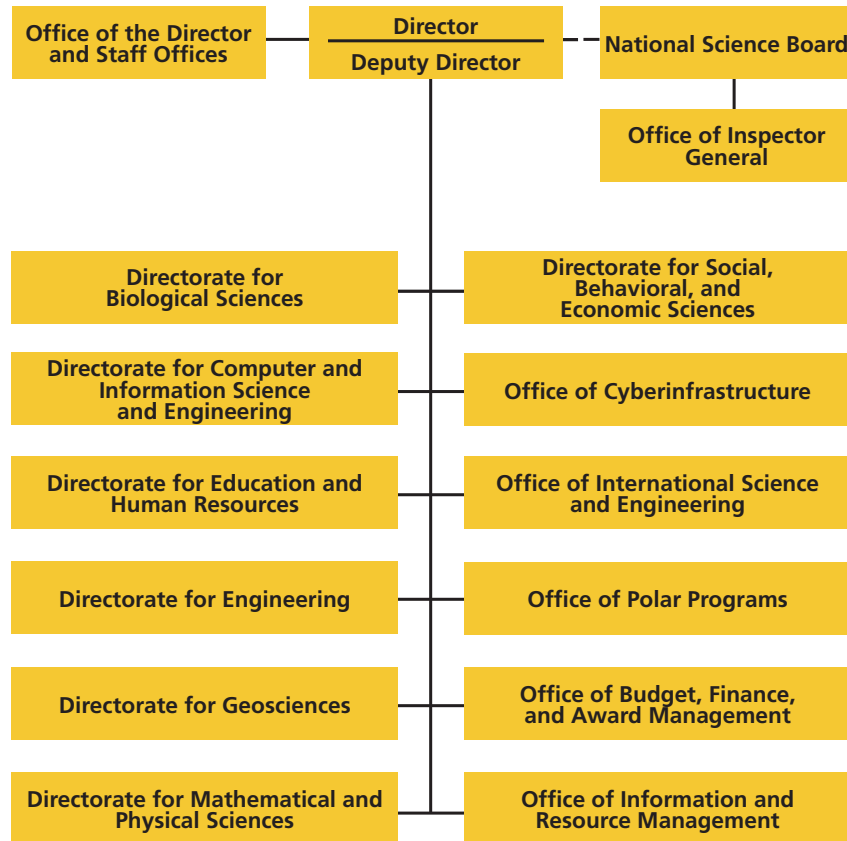
*Credit:* Gary Urton, the Khipu Database Project, Harvard University/Zina Deretsky, National Science Foundation



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*Credit:* Dave Finley, courtesy National Radio Astronomy Observatory and Associated Universities, Inc.

## FY 2005 Organization Chart



NSF is headed by a Director who is appointed by the President and confirmed by the U.S. Senate. A description of each directorate and management office and a listing of NSF's executive staff and officers can be found in appendixes 1 and 2. A 24-member National Science Board (NSB), also appointed by the President with the consent of the Senate, meets six times a year to establish the overall policies of the Foundation. The NSB, made up of prominent contributors to the science, mathematics, engineering, and education communities, also serves the President and the Congress as an independent advisory body on policies related to the U.S. science and engineering enterprise. A list of NSB members can be found in appendix 3.

The NSF workforce includes approximately 1,400 full-time staff. In addition to the permanent staff, NSF regularly recruits visiting scientists, engineers, and educators who are leaders in their fields. Recruiting active researchers and educators to fill rotating assignments infuses new talent and expertise into NSF and is integral to the Foundation's mission of supporting the entire spectrum of science and engineering research and education, particularly research at the frontier. Rotators make up about 15 percent of NSF's workforce. NSF also employs contractors who are engaged in commercial administrative activities.



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