Overview

NATIONAL SCIENCE FOUNDATION
FY 2006 BUDGET REQUEST
OVERVIEW

Innovation and technology are the powerhouses of the American economy – and science and engineering research and education provide the fuel. The new knowledge, people, and capabilities that come out of America's research and educational institutions each year provide the foundation for generating the jobs and wealth that keep the economic engines humming.

Sustained output requires sustained resources. The National Science Foundation requests $5.605 billion in FY 2006 to maintain the science and engineering community's contributions to economic growth and ability to respond to a wide range of national needs.

With the wealth of benefits that investments in science and engineering bring to the nation, perhaps none is more powerful than the capability to respond quickly and effectively to challenges of all kinds. NSF's programs reach over 2,000 institutions across the nation, and they involve almost 200,000 researchers, teachers, and students in all fields of science and engineering and at all levels of education. This breadth of activity in and of itself creates a vital national resource, as it provides a nation with a constantly invigorated base of knowledge, talent, and technology. For example, in areas ranging from terrorism threats to natural disasters, NSF's ongoing support of research in areas such as advanced information technologies, sensors, and earthquake engineering ensures a broad base of expertise and equipment that allows the science and engineering community to respond quickly in times of need.

NSF Funding by Account
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Research and Related Activities	$4,293.34	$4,220.55	$4,333.49	$112.94	2.7%
Education and Human Resources	944.10	841.42	737.00	-104.42	-12.4%
Major Research Equipment and Facilities Construction	183.96	173.65	250.01	76.36	44.0%
Salaries and Expenses	218.92	223.20	269.00	45.80	20.5%
National Science Board	2.22	3.97	4.00	0.03	0.8%
Office of Inspector General	9.47	10.03	11.50	1.47	14.7%
Total, NSF	$5,652.01	$5,472.82	$5,605.00	$132.18	2.4%

The FY 2006 Request focuses on four funding priorities that address current national challenges as well as strengthen the core portfolios of NSF's research and education investments:

- Strengthening core disciplinary research.
- Providing broadly accessible cyberinfrastructure and world-class research facilities.
- Broadening participation in the science and engineering workforce.
- Sustaining organizational excellence in NSF management practices.

This year's investments will strengthen the core disciplines that empower every step of the process from discovery at the frontier to the development of products, processes, and technologies that fuel the economy. At the same time, NSF's investments will enable increasing connections and cross-fertilization among disciplines.

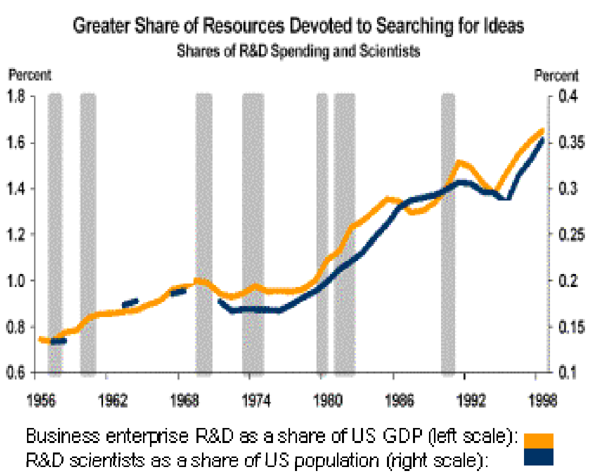
NSF's focus on a clear set of priorities will help the nation meet new challenges and take advantage of promising opportunities, while at the same time spurring the growth and prosperity needed to secure the nation's long-term fiscal balance. The FY 2006 budget will emphasize investments that address established interagency research priorities, meet critical needs identified by the science and engineering community, and advance the fundamental knowledge that strengthens the nation's base of innovation and progress. NSF will respond to these challenges by supporting the best people, ideas, and tools in the science and engineering enterprise, and by employing the best practices in organizational excellence.

A Proven Return

Federal investments in leading-edge research and education have paid extraordinary dividends over the past 50 years. Numerous studies have found that up to half of the U.S. economic growth in the latter half of the 20th Century stemmed from new technologies and the advances in science and engineering that enabled them. Today, the U.S. economy is shaped by ideas and innovation. Since the 1950's, the inputs to the economy from U.S. science, engineering and technology have risen steadily. As the graph below shows, the R&D intensity of U.S. business and industry has more than doubled, as has its share of leading-edge knowledge workers.

"Over the past half century, the increase in the value of raw materials has accounted for only a fraction of the overall growth of U.S. gross domestic product. The rest of that growth reflects the embodiment of ideas in products and services that consumers value."

Alan Greenspan
Chairman
Federal Reserve Board
April 2003



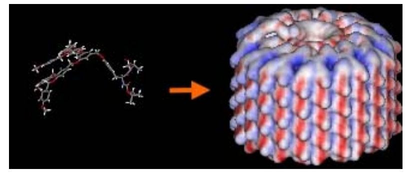
Source: NSF and Federal Reserve Bank of San Francisco

U.S. economic leadership is rooted in a long history of excellence in science, engineering and technology. New knowledge at the frontier and people trained to work at the frontier provide the nation's most critical capital – the engine of innovation and change. As the pace of discovery intensifies worldwide, greater federal investment is needed to keep the nation at the competitive edge and to reap the benefits that publicly funded research and education bring to every sphere of society – greater employment opportunities and wealth, better health and a cleaner environment, strengthened national security, and an enhanced ability to respond to critical needs.

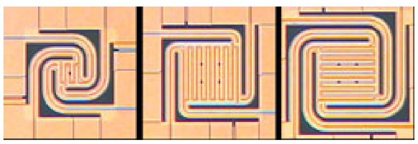
Securing the Future

During the past year, NSF-funded researchers reported numerous breakthroughs and advances that hold great promise for economic and societal benefit – and responded to urgent national and global needs with skill and alacrity. Just a few of the most promising examples are highlighted below.

Virgil Percec and colleagues at the University of Pennsylvania have created the first artificial analogs of nature's molecular "pores" – the tiny, hollow channels that perform a multitude of essential tasks in living cells. Potential applications range from the extraction of fresh water from seawater to an entirely new class of antibiotics.



A variety of small, protein-like molecules (left) will self-assemble into molecular-scale channels, or "pores" (right). *Credit: Virgil Percec laboratory, University of Pennsylvania*



Microhotplates crafted of silicon carbide, each consisting of a central plate surrounded by curved tethers. The largest is less than 100 microns across. *Credit: Boston Microsystems, Inc.*

With support from the Small Business Innovation Research (SBIR) program, engineers at Boston MicroSystems, Inc., have created a miniature hot plate only a few dozen microns across (about the width of a human hair) that can reach temperatures up to 1100ºC (2012ºF). These tiny "labs" on a microchip can serve as substrates, heaters and conductors for thin-film experiments ranging from materials analysis to the development of advanced sensors. Researchers are already developing applications such as oxygen and engine emissions sensors.

A global network of seismic instruments, long supported by NSF, produced a real-time record of the South Asian earthquake and subsequent seismic waves traveling through the earth, providing vital data needed for both earthquake studies and the potential development of tsunami warning systems.

Natural hazards researchers traveled to the field within weeks of the disaster to gather perishable information before it was lost in the cleanup and reconstruction. This yielded vital information on physical damage to structures and the environment and on the social and behavioral response of the population, which in turn advances the efforts of scientists and engineers working to improve the stability of buildings and infrastructure and the response capabilities of communities.

Earthquake engineering researchers from the University of Southern California recorded details of the destruction from the December 2004 South Asian earthquake, including the height of debris left by the subsequent tsunami. The researcher holds a 5-meter-high rod against a house in Panteraja, Sumatra. *Credit: © Jose C. Borrero, University of Southern California Tsunami Research Group, http://www.usc.edu/dept/tsunamis*

FY 2006 PRIORITIES

In FY 2006, NSF will focus significant resources on four priorities that build upon opportunities identified by the science and engineering community and address major national challenges identified by the Administration. Strengthening the capabilities in each of these areas will enhance the productivity and efficiency of the science and engineering enterprise while producing concrete economic and social benefits for the nation.

Strengthening Core Disciplinary Research

For FY 2006, total funding for NSF's Research and Related Activities Account increases by $113 million (nearly 3 percent) to a total of $4.33 billion. This investment encompasses both the established and the emerging areas supported through NSF's research directorates and programs. These fields and disciplines are the wellspring for discoveries that lead to the products, processes, and services that improve health, wealth, living conditions, environmental quality, and national security.

Researchers operate in an increasingly complex environment, in which emerging fields often cross disciplinary boundaries. But it is fundamental discovery and knowledge in core fields that open up avenues for more complex investigations and enable new multidisciplinary directions. NSF is the only federal agency that supports all fields of science and engineering research, and in some fields – such as anthropology, environmental biology, plant biology, psychology, sociology, mathematics, and computer and information sciences and engineering – NSF funds the majority of federally-supported academic basic research. In FY 2006, NSF will also provide leadership in planning U.S. participation in observance of the International Polar Year scheduled to take place in 2007.

A focus for NSF's programming in FY 2006 is the funding rate for research grants, which has declined from 30 percent in the late 1990s to an estimated 20 percent in FY 2005. In FY 2006, NSF will increase the funding rate to the FY 2004 level of 21 percent, while striving to maintain recent gains in award size and duration.

Preparing future scientists and engineers is the key to sustaining the spirit of innovation that underlies the nation's continued growth and prosperity. One of NSF's core values has been, consistently, to integrate education with research – ensuring that the science and engineering workforce gains the skills, knowledge, and insight that come from working at the frontiers of discovery.

Providing Broadly Accessible Cyberinfrastructure and World-Class Research Facilities

Leading-edge tools are essential to researchers working at the frontiers of science and engineering, and to students who will carry skill in their use into the workplace. In FY 2006, NSF is placing a high priority on investments in cyberinfrastructure and in unique, widely shared research facilities. These activities continue the longstanding NSF tradition of providing the most sophisticated tools to the broadest possible population of scientists, engineers, students and educators. In addition, the FY 2006 Request transfers responsibility to NSF from the U.S. Coast Guard for funding the operations and maintenance of polar icebreaking activities.

- **Cyberinfrastructure** is fast becoming one of the essentials of science and engineering productivity. Advances in modeling, simulation, visualization, data storage, communication, and other related elements are transforming the conduct of research and education, while accelerating their contributions to economic growth and responsiveness to national needs. In FY 2006, NSF investments in cyberinfrastructure total $509 million, an increase of $36 million (7.6 percent) over the FY 2005 level

– and an increase of $100 million over the FY 2004 level. With these resources, NSF and the research community aim to make cyberinfrastructure more powerful, stable and accessible to researchers and educators across the nation and around the world.

- Funding for **Major Research Equipment and Facilities Construction** increases by $76 million (44 percent), to fund five major facilities that will serve a broad spectrum of the science and engineering community. They include world-class astronomy, physics, and environmental observatories identified as the highest priorities for advancing the frontiers of science and engineering while seeking breakthroughs that will contribute to the nation's health and well being:
  - ALMA: the Atacama Large Millimeter Array, which will be the world's largest, most sensitive radio telescope operating at millimeter wavelengths.
  - EarthScope, a distributed, multi-purpose geophysical instrument.
  - IceCube, the world's first high-energy neutrino observatory, to be located under the ice at the South Pole.
  - RSVP, the Rare Symmetry Violating Processes project, which enables cutting-edge physics experiments to study the fundamental properties of nature.
  - The Scientific Ocean Drilling Vessel (SODV), a deep-sea drilling vessel for long-term use in a new international scientific ocean drilling program.

- **Polar Icebreaking Activities:** In FY 2006, NSF will assume the responsibility, from the U.S. Coast Guard, for funding the costs of icebreakers that support scientific research in polar regions; $48.0 million was transferred for those purposes.

Broadening Participation in the Science and Engineering Workforce

The City University of New York (CUNY) is increasing the number of Black and Latino students receiving doctoral degrees in science and engineering fields through the NSF Alliances for Graduate Education and the Professoriate (AGEP) program. The share of STEM degrees awarded to minority students has risen from 7 percent to 21 percent over a five-year period.

In our knowledge-intensive society, the nation needs to capitalize on all available talent to sustain a first-rate workforce of skilled technologists, scientists and engineers. NSF devotes considerable resources to strengthening the education and career opportunities available to a broad spectrum of the population.

The FY 2006 Request maintains a total investment of nearly $400 million in programs with a proven track record of tapping the potential of those underrepresented in the science and engineering workforce–especially minorities, women, and persons with disabilities.

Three highly successful programs – the Louis Stokes Alliances for Minority Participation, the Alliances for Graduate Education and the Professoriate, and the Centers of Research Excellence in Science and Technology – form the centerpiece of this investment. They serve as models for integrating resources in the educational community with those in the research community to improve minority enrollment and retention in science and engineering.

Sustaining Organizational Excellence in NSF Management Practices

To realize the agency's mission and vision, NSF expects its business practices and processes to meet the same high standards as its investments in science and engineering. Achieving results-oriented management and stewardship begins with adequate resources. FY 2006 funding for activities that advance NSF's Organizational Excellence goal increases by $46 million over the FY 2005 level for a total of $336 million.

Staffing across the Foundation will increase by 25 full-time equivalent employees to help manage NSF's increasingly complex portfolio and address new requirements for security, accountability, and award oversight. Other priorities include expanding e-government systems and capitalizing on recommendations from the ongoing business analysis.

Already, in its continuing quest for organizational excellence, NSF has earned three "green lights" on the scorecard that tracks the President's Management Agenda (PMA). NSF was previously recognized for its achievements in financial management and for its forward-reaching e-government activities; more recently, its efforts to integrate budget with performance has achieved this level of recognition.

CROSS-CUTTING ACTIVITIES

In implementing its FY 2006 activities, NSF will emphasize four additional themes that cut across the budget priorities and strengthen their impact on science and engineering research and education.

- *Crosscutting areas of emerging opportunity.* NSF has provided sustained funding over several years to interdisciplinary endeavors that hold exceptional promise for advancing knowledge and addressing national interests. The FY 2006 Request continues to support the four NSF Priority Areas: $84 million for Biocomplexity in the Environment, $243 million for Nanoscale Science and Engineering, $89 million for the Mathematical Sciences Priority Area, and $39 million for Human and Social Dynamics.

- *International collaborations.* There has been a vast increase in the globalization of science and engineering in recent years. International research partnerships are critical to the United States in maintaining a competitive edge, capitalizing on global economic opportunities, and participating in addressing global problems. Toward this end, the FY 2006 Request provides $35 million for NSF's Office of International Science and Engineering.

A U.S.-Russian collaborative research project will develop an international microbial observatory to explore the microbial world in remote volcanic and geothermal areas of the Kamchatka Peninsula. U.S. researchers and graduate students gain access to a unique region of the world. The results of their research are likely to lead to the discovery of microorganisms with high potential for industrial applications.

- *Interagency initiatives.* In addition to strengthening the core portfolios of the NSF research directorates, NSF will continue to play a lead role in interagency collaborations that address pressing national needs and opportunities for substantial economic growth.
  - In FY 2006, NSF investments in the National Nanotechnology Initiative total $344 million, up $6 million from FY 2005.
  - Participation in the Networking and Information Technology Research and Development initiative will increase to $803 million, $8 million over the FY 2005 level.
  - Funding for the Climate Change Science Program is funded at $197 million, a decrease of $1 million from FY 2005.

- *Homeland Security Activities.* The FY 2006 Request includes a total of $344 million for activities directly related to government-wide efforts in homeland security R&D. This represents an increase of $2 million over FY 2005. Nearly 80 percent of this investment is devoted to a variety of activities related to Critical Infrastructure Protection, including cybersecurity, risk management, modeling and simulation, distributed systems, and surveillance robotics. A particular focus is advancing research and innovation that will improve security in today's computer and network systems as well as embed the best practices of cybersecurity in the design and development of tomorrow's systems while also preparing a workforce with state-of-the-art security skills. Funding is also maintained for other key Homeland Security-related activities, including the Ecology of Infectious Diseases program, jointly sponsored by NSF and the National Institutes of Health, and the Microbial Genome Sequencing program, jointly sponsored by NSF and the U.S. Department of Agriculture. These will contribute to a better understanding of potential bioterrorism threats and how to combat them.

R&D INVESTMENT CRITERIA

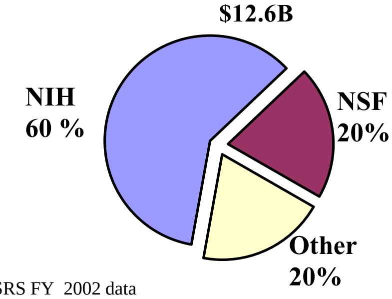
The nation's economic productivity is enhanced when federal agencies work smarter, producing desired outcomes at acceptable costs.

NSF's FY 2006 Request incorporates the Research and Development Investment Criteria outlined in the President's Management Agenda. The three sections below describe NSF's approach to ensuring that its investments address Relevance, Quality, and Performance. More specific information on the criteria is integrated throughout this document in discussions of investments by each of NSF's directorates and major program offices.

Relevance

NSF is the only federal agency with a mandate to strengthen the health and vitality of U.S. science and engineering and support fundamental research and education in all scientific and engineering disciplines. NSF-sponsored activities result in new across-the-board knowledge and technologies and educate a world-class workforce of scientists, engineers, mathematicians, educators, and other technically trained professionals.

Total Federal Support: Basic Research at Academic Institutions $12.6B



NSF/SRS FY 2002 data

Although NSF investments account for only 4 percent of total federal funding for research and development, the agency provides 20 percent of federal support to academic institutions for basic research. NSF investments are especially vital in non-medical fields and disciplines. For over two decades, NSF has been a principal source of federal support for basic research at colleges and universities in such areas as computer science, mathematics, the physical sciences, the social sciences, the environmental sciences, engineering, and non-medical areas of the life sciences. Much of this research, however, also directly benefits medical diagnosis, regenerative medicine, drug delivery and the design and processing of pharmaceuticals.

The NSF Strategic Plan for FY 2003-2008 is set in the context of the evolving long-term issues that are transforming science and education research. Researchers operate in an increasingly complex environment, in which science and engineering cross the boundaries of disciplines, organizations, and nations. The frontier changes quickly, and discovery requires ever-more-sophisticated skills and methods, as well as technology and instrumentation. Global competition for technical workers and science and education professionals has intensified, and so have the skills expected in today's changing workplace. Leadership and excellence in discovery, innovation and learning are the most effective means to meet and surpass these new challenges.

Quality

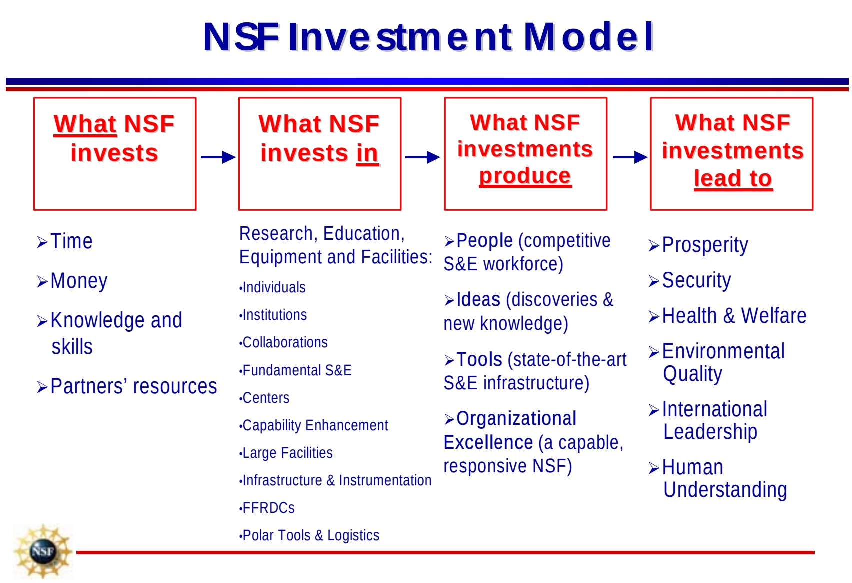
NSF leads federal agencies in funding research and education activities based upon competitive merit review, with nearly 90 percent of its research and education funding going to awards selected through a competitive merit review process. In FY 2004, NSF awarded more than 10,000 new grants from more than 44,000 competitive proposals.

All proposals for research and education projects are evaluated using two criteria: the *intellectual merit* of the proposed activity and its *broader impacts*, ranging from effects on teaching, training and learning to improvements in cybersecurity. Reviewers also consider how well the proposed activity fosters the integration of research and education and broadens opportunities to include a diversity of participants, particularly from underrepresented groups.

Perhaps the most dramatic indicator of the level of competition for NSF funding is the quality of the proposals that go unfunded every year. In FY 2004, for example, proposals totaling $2.1 billion were declined even though they were rated as highly as the proposals that received funding. These declined proposals represent a rich portfolio of highly-regarded yet unfunded opportunities to advance research and education.

Performance

Strategic investments intended to achieve long-term outcomes (illustrated in the Investment Model below) are the target of performance assessments at NSF. Specific measures of organizational effectiveness relate to the internal practices, operations and processes that support the NSF mission. Historically, NSF has relied upon external committees of experts to evaluate the long-term outcomes from research and education. This is appropriate given the broad scope of science and engineering covered by NSF, and the critical and extensive use of merit review for selecting new awards. Today, these external evaluations provide integral information for the assessments conducted using the Program Assessment Rating Tool (PART).



External Evaluations. The NSF Advisory Committee for GPRA Performance Assessment (AC/GPA) leads the annual evaluation of NSF's performance. In FY 2004, the Advisory Committee for Business and Operations (AC/BO) assisted the AC/GPA in the evaluation of the Organizational Excellence goal. The AC/GPA summarized its findings as follows:

"It was the unanimous judgment of the Committee that NSF has demonstrated significant achievement for all indicators in all the three strategic outcome goals of People, Ideas, and Tools and for the merit review indicator for the Organizational Excellence outcome goal. The Advisory Committee for Business and Operations concluded that NSF demonstrated significant achievement for the other indicators in the Organizational Excellence goal."

"The Committee also concluded that the four outcome goals are mutually reinforcing and synergistic. They represent an integrated framework that combines research and education in a positive way and also provides the organizational infrastructure to advance the national scientific, technological, engineering, and mathematics enterprise."

Program Assessment Rating Tool (PART) Results

Investment Category/ Priority Area	Assessment (Budget) Year	Result
People		
Individuals	Fiscal Year 2005	Effective*
Institutions	Fiscal Year 2006	Effective*
Collaborations	Fiscal Year 2006	Effective*
Ideas		
Fundamental Science and Engineering	Fiscal Year 2007	**
Centers	Fiscal Year 2008	**
Capability Enhancement	Fiscal Year 2008	**
Tools		
Large Facilities	Fiscal Year 2005	Effective*
Infrastructure and Instrumentation	Fiscal Year 2008	**
Federally Funded Research and Development Centers	Fiscal Year 2007	**
Polar Tools, Facilities, and Logistics	Fiscal Year 2006	Effective*
Priority Areas		
Information Technology Research	Fiscal Year 2005	Effective*
Nanoscale Science and Engineering	Fiscal Year 2005	Effective*
Biocomplexity in the Environment	Fiscal Year 2006	Effective*
Mathematical Sciences	Fiscal Year 2008	**
Human and Social Dynamics	Fiscal Year 2008	**

* "Effective" is the highest rating issued by the Office of Management and Budget. Other ratings are "Moderately Effective," "Adequate," "Ineffective," and "Results Not Demonstrated."
** PART to be completed in the future.

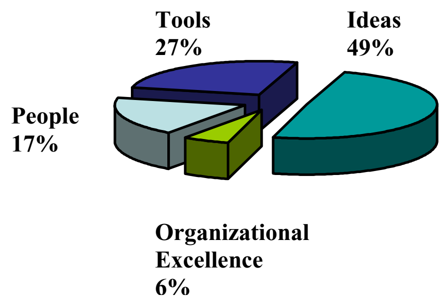
Program Assessment Rating Tool. The PART process has also become a central component of NSF's performance framework. NSF developed the PART evaluation schedule shown on the left consistent with the investment categories and priority areas established in the Strategic Plan.

In recent years, only around 15 percent of the over 600 programs evaluated across federal agencies received the highest rating of "Effective." For the FY 2005 and FY 2006 PART evaluations, all eight NSF programs evaluated received a rating of effective. More detailed information on the PARTs completed for FY 2006 is included in Performance Information Chapter of this Request.

FY 2006 Budget Request by Strategic Goal

NSF invests in a rich mix of programs, platforms and partnerships developed by the research and education community. Funding levels for these programs and activities in the FY 2006 Request directly link with the Strategic Outcome Goals and Investment Categories established in the NSF Strategic Plan for FY 2003-2008.

FY 2006 Budget Request by Strategic Goal



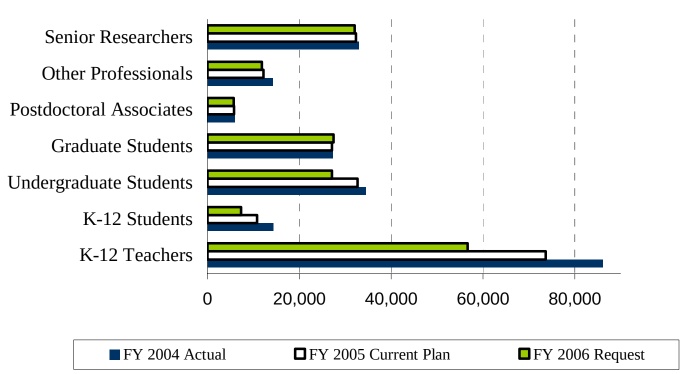
NSF Budget by Strategic Outcome Goal and Investment Category

(Dollars in Millions)

		FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People	Individuals	567.37	547.12	519.15	-27.97	-5.1%
	Institutions	181.13	177.55	159.32	-18.23	-10.3%
	Collaborations	398.38	304.45	300.30	-4.15	-1.4%
		1,146.88	1,029.12	978.77	-50.35	-4.9%
Ideas	Fundamental Science and Engineering	2,200.88	2,151.52	2,144.17	-7.35	-0.3%
	Centers Programs	362.85	350.83	358.49	7.66	2.2%
	Capability Enhancement	258.79	247.49	254.47	6.98	2.8%
		2,822.52	2,749.84	2,757.13	7.29	0.3%
Tools	Facilities	594.95	644.03	714.89	70.86	11.0%
	Infrastructure and Instrumentation	335.84	320.01	334.32	14.31	4.5%
	Polar Tools, Facilities and Logistics	277.07	257.46	300.63	43.17	16.8%
	Federally-Funded R&D Centers	195.61	182.56	183.50	0.94	0.5%
		1,403.48	1,404.06	1,533.34	129.28	9.2%
Organizational Excellence		279.13	289.79	335.75	45.96	15.9%
Total, NSF		$5,652.01	$5,472.82	$5,605.00	$132.18	2.4%

Totals may not add due to rounding.

Number of People Involved in NSF Activities



People

A diverse, competitive, and globally-engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens.

The Robotics Academy, a program at Tufts University and the University of Nevada, Reno, provides opportunities for undergraduates to learn in the context of multidisciplinary problem solving. In order to mirror the diversity seen in many "real-world" teams, the Academy includes teams with engineers, human factors students, computer scientists, and child development majors. Here, undergraduates in child development and engineering teach youngsters in the after school program.

The Foundation's FY 2006 budget provides $978.77 million, a decrease of $50.35 million, or 4.9 percent, below the FY 2005 Current Plan, to prepare a highly skilled and diverse science and engineering workforce. Within this total, funds have been reallocated to target programs that have been successful in broadening participation among groups, communities, regions, and institutions that are underrepresented in science and engineering fields.

Individuals. Investments totaling $519.15 million, a decrease of $27.97 million, or 5.1 percent, support the education and training of world-class scientists, engineers, mathematicians, technologists and educators. Among programs targeted for sustained or increased investment are Noyce Scholarships, up $110,000 to a total of $8.0 million, CAREER, up $2.40 million to $133.79 million, and Research Experiences for Undergraduates (REU), up $2.57 million to $53.69 million. Support for the three flagship graduate programs – Graduate Research Fellowships, Integrative Graduate Education and Research Traineeships, and Graduate Teaching Fellowships in K-12 Education – will be sustained at FY 2005 levels ($215.69 million). Stipends will be maintained at $30,000 and an estimated 4,600 students will be supported in FY 2006. The Teacher Professional Continuum Program is decreased by $27.20 million (45 percent).

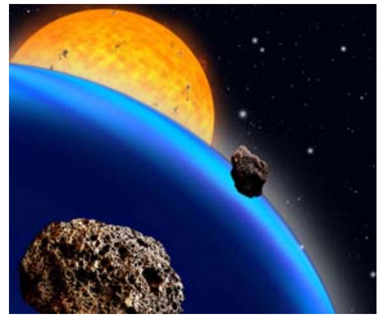
Institutions. Investments totaling $159.32 million in FY 2006, a reduction of $18.23 million, or 10.3 percent, enable colleges, universities and other institutions to strengthen the quality of science and engineering education and increase the numbers of students attracted to science and engineering fields at all levels. Programs that enable these institutions to ensure adequate training for a wider portion of the science and engineering workforce include ADVANCE, maintained at the FY 2005 level of $19.80 million, STEM Talent Expansion Program at $25.0 million, and the Advanced Technological Education program at $45.0 million. In addition, Engineering Education Reform increases by $1.0 million to $15.47 million. In order to fund these priorities, reductions were taken in Course, Curriculum and Laboratory Improvement (-$9.80 million to $37.14 million) and Instructional Materials and Assessment Development (-$9.52 million to $19.0 million).

Informal science education engages millions of youngsters each year in science and engineering activities. Cast members of *ZOOM*, produced by WGBH, put their heads together for the show's sixth season. *Credit: Mark Ostow for WGBH.* © *2004*

Collaborations. Investments totaling $300.30 million, a decrease of $4.15 million, or 1.4 percent, will foster partnerships among colleges, universities, school districts, and other institutions – public, private, state, local, and federal – to strengthen science and engineering education at all levels and broaden participation in science and engineering fields. The FY 2006 budget supports a wide range of partnership programs and collaborations including the Louis Stokes Alliances for Minority Participation ($35.0 million), Alliances for Graduate Education and the Professoriate ($15.0 million), and Historically Black Colleges and Universities-Undergraduate Program (HBCU-UP) ($25.0 million). Funding within Research and Related Activities to enhance integration of programs to broaden participation increases substantially to $44.53 million. Informal Science Education is maintained at $63.0 million. In addition, the FY 2006 Request provides $60.0 million for the President's Math and Science Partnership program.

Ideas

Discovery across the frontier of science and engineering, connected to learning, innovation, and service to society.



Scientists using a network of small telescopes and the transit method of detection have made their first direct discovery of a planet orbiting a bright star. A periodic dimming of light from a bright star 500 light-years away revealed the planet's presence. *Credit: David A. Aguilar, Harvard-Smithsonian Center for Astrophysics*

In FY 2006, NSF is requesting $2.76 billion, an increase of $7.29 million, or 0.3 percent, over the FY 2005 Current Plan, to support the best ideas generated by the science and engineering community. In FY 2006, NSF will place greater emphasis on increasing the funding rate for research grants while striving to maintain recent gains in award size and duration.

Fundamental Science and Engineering. Investments totaling $2.14 billion, a decrease of $7.35 million, will support the best new ideas generated by the science and engineering community. Strengthening disciplinary research in all science and engineering fields is a priority for FY 2006 and will be accomplished through balanced investments across NSF programs. NSF plays a lead role in collaborating with other federal research agencies to fund initiatives of significant national importance. In FY 2006, NSF investments in the National Nanotechnology Initiative (NNI) total $343.77 million, up $5.55 million. NSF will increase its investment in Networking and Information Technology Research and Development (NITRD) by $8.34 million to a total of $803.24 million. NSF funding for the Climate Change Science Program decreases to $196.88 million, down $1.0 million. This includes an investment of $171.88 million for the U.S. Global Change Research Program and $25.0 million for the Climate Change Research Initiative. In addition, $94.24 million is provided for the Plant Genome Research program, which is vital to understanding the genomics of plants of major economic importance.

Centers Programs. By bringing together people, ideas and tools on scales large enough to effect significant progress in disciplinary and cross-disciplinary fields, Centers play a key role in advancing science and engineering in the U.S., particularly through their encouragement of interdisciplinary research and the integration of research and education. Investments in FY 2006 total $358.49 million, an increase of $7.66 million over the FY 2005 Current Plan. In FY 2006, NSF provides an increase of $2.0 million for the Science and Technology Centers to continue support for two Centers initiated in FY 2005. Funding for all ongoing STCs totals $53.89 million. Support for Science of Learning Centers increases by $3.16 million to a total of $23.0 million to provide startup support for up to four new SLCs.

The National Science Foundation and the National Institute of Environmental Health Sciences are funding four joint Centers for Oceans and Human Health launched in FY 2004.

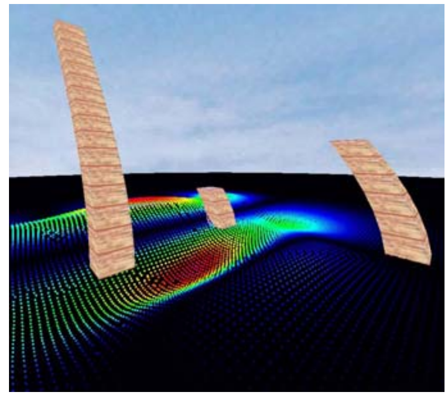
Capability Enhancement. In FY 2006, investments totaling $254.47 million, an increase of $6.98 million, will build the capability of individuals and institutions to perform high quality, competitive research, education, and technological innovation. Investments in Centers of Research Excellence in Science and Technology (CREST), up $2.63 million to $18.50 million, will strengthen research and education in minority-serving institutions. Funding is also increased for EPSCoR, up $320,000 to $94.0 million, and Small Business

Innovation Research (SBIR) and Small Business Technology Transfer (STTR), up $2.57 million to $105.33 million.

Tools

> *Broadly accessible, state-of-the-art S&E facilities, tools and other infrastructure that enable discovery, learning and innovation.*

In FY 2006, NSF proposes to invest $1.53 billion, an increase of $129.28 million, or 9.2 percent, in the development and stewardship of a wide variety of facilities, instrumentation and other infrastructure. Leading-edge tools are essential to researchers working at the frontier of science and engineering, and to students who will bring skill in their use into the workplace. NSF is placing a high priority on investments in the development of cyberinfrastructure and in unique national facilities.



This figure represents a simulation of 3-, 6- and 16- story structures and maximum story drift in response to ground motion (strike-slip fault). Such computation and visualization research is being conducted under a SPUR (Seismic Performance of Urban Regions) alliance involving the Engineering Research Center at Mississippi State University, the Pacific Earthquake Engineering Research (PEER) Center at the University of California, Berkeley, and geotechnical engineers at Carnegie Mellon University. Together they are creating a powerful new system for analyzing the impact of an earthquake on a region, for use by public policy makers and earthquake engineering researchers. The goal is to forecast the amount and distribution of damage to buildings, bridges, and lifelines caused by an earthquake.

The goal of NSF and the research community is to make *cyberinfrastructure* highly powerful, stable, persistent, and widely accessible to researchers and educators across the nation and around the world. NSF will invest in two complementary, coordinated areas. Investments in shared cyberinfrastructure will address the need for interoperability and will provide the base for investment in individual disciplines. Domain-focused investments are driven by the identified research and education needs and opportunities in a particular science or engineering community. Some of the investments fall neatly within traditional disciplines, while others reach across a number of science and engineering fields. In FY 2006, NSF investments in widely-shared and domain-specific cyberinfrastructure total $509.15 million, an increase of $36.01 million. This investment will support a rich mix of projects and encourage broad community participation in developing tools that serve all fields as well as those that meet the needs of specific communities.

A new, deeper diving vehicle will replace *Alvin*, the submersible that has served scientists for 40 years. *Credit: Woods Hole Oceanographic Institution*

Facilities. NSF proposes investments in FY 2006 totaling $714.89 million, an increase of $70.86 million, in the development, construction, and operation of state-of-the-art facilities and platforms that enable researchers and educators to work at the frontier of discovery. The $250.01 million Request for the Major Research Equipment and Facilities Construction Account, a part of NSF's overall Facilities investment, will support projects of national importance. These include the Atacama Large Millimeter Array (ALMA) ($49.24 million), EarthScope ($50.62 million), IceCube ($50.45 million), Scientific Ocean Drilling Vessel ($57.92 million), and the Rare Symmetry Violating Processes (RSVP) ($41.78 million).

NSF also requests $62.82 million to initiate two new projects, Ocean Observatories ($13.50 million), and the Alaska Regional Research Vessel ($49.32 million), in FY 2007; and $28.48 million to initiate Advanced LIGO in FY 2008.

Infrastructure and Instrumentation. FY 2006 investments totaling $334.32 million, an increase of $14.31 million, support state-of-the-art instruments, platforms, information technology, databases, and other tools to advance U.S. leadership in science and education, and increase productivity and innovation among researchers, educators and students working at the frontier. This also includes $89.53 million to support the Major Research Instrumentation program (MRI). Investments in MRI support a wide variety of mid-sized state-of-the-art research equipment, and reach a broad range of institutions, including non-Ph.D-granting colleges, universities and community colleges.

Polar Tools, Facilities and Logistics. Investments totaling $300.63 million, an increase of $43.17 million, will provide state-of-the-art tools, facilities and other infrastructure to advance polar research and education. With a transfer from the U.S. Coast Guard of $48 million, NSF will assume the responsibility for funding the costs of icebreakers that support scientific research in polar regions. The FY 2006 Request will keep high priority projects (e.g., the McMurdo power plant and South Pole Traverse) on schedule. However, reallocations within the program base will be required, and some procurements and field relocation projects will be deferred.

Federally-funded Research and Development Centers. FY 2006 investments in FFRDCs total $183.50 million, up $940,000 over FY 2005. FFRDCs address research, development, and policy issues that create unique, important and long-term capabilities for the federal government, in response to law, mandate or widely recognized need. Funding of $82.27 million, an increase of $1.05 million, for the National Center for Atmospheric Research will support continued activities at the Center and provide $5.0 million to initiate operation of the new HIAPER (High-Performance Instrumented Airborne Platform for Environmental Research) research aircraft. Support for the National Radio Astronomy Observatory (NRAO) will also increase by $370,000 to a total of $47.40 million, and support for the National Optical Astronomy Observatory (NOAO) will decrease by $560,000 to a total of $37.36 million.

Organizational Excellence (OE)

An agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.

NSF is committed to excellent, results-oriented management and stewardship. The FY 2006 Budget Request for Organizational Excellence totals $335.75 million, an increase of $45.96 million, or 15.9 percent, over the FY 2005 Current Plan of $289.79 million. In keeping with the President's Management Agenda, the FY 2006 Request maintains NSF's commitment to providing outstanding customer service and to maintaining leadership in eGovernment and state-of-the-art business practices.

President's Management Agenda Scorecard

	Baseline	Status	Progress
	(Sep. 30, 2001)	(December 31, 2004)	
Strategic Management of Human Capital	R	Y	G
Competitive Sourcing	R	R	R
Improving Financial Performance	G	G	G
Expanded E-Gov't.	Y	G	G
Budget and Performance Integration	R	G	G

Highlights from NSF's FY 2006 investments in OE include:

- Strengthening the NSF workforce, through an increase of 25 employees across the Foundation and increased investments in human capital management, professional development activities, and funding for award monitoring and oversight activities.

- Strengthened information technology investments, including increased spending for IT Security and a four-fold increase for next-generation grants management capabilities and eGov investments.

A major driver in shaping these investments has been the ongoing NSF Business Analysis, which is addressing the fundamental challenges facing NSF as it becomes a fully integrated organization capable of working both within and across traditional disciplinary and organizational boundaries.

Summary Tables and Charts

National Science Foundation FY 2006 Request

Summary of Major Changes by Account

(Dollars in Millions)

NSF FY 2005 TOTAL FUNDING	**$5,473**
Research and Related Activities	
Biological Sciences	*+5*
Increases funding for complex environmental systems with emphasis on aquatic and watershed systems, biological databases and informatics, Broadening Participation activities, microbial biology research, FIBR support on complex, multidimensional biology and grants for early career and mid-career researchers.	
Computer and Information Science and Engineering	*+7*
Increases support for developing software and hardware architectures, redesigning current network systems, developing sensor systems, promoting advances in science and engineering informatics, and increasing core funding rates. In addition, support will continue for the Extensible Terascale Facility and other cyberinfrastructure resources.	
Engineering	*+19*
Funds CLEANER planning activities, transition from construction to operations for NEES, Integrative Systems research, research into how students learn engineering, and targets Security Technology research.	
Geosciences	*+15*
Increases funding for natural hazards and extreme events research. HIAPER and AMISR become fully operational, as operations ramp up for EarthScope. A major effort will be made to facilitate linkages across NSF programs to promote education and diversity.	
Mathematical and Physical Sciences	*+16*
Increases funding for core research and education programs; develops research resources and facilities of the future; prepares the next generation of scientists and researchers; and broadens participation in MPS programs. Themes to be emphasized include: Physics of the Universe, Fundamental Mathematical and Statistical Science, Physical Sciences at the Nanoscale, Cyberinfrastructure and the Cyberscience it Enables, and the Molecular Basis of Life Processes.	
Social, Behavioral and Economic Sciences	*+2*
Augments support for Human and Social Dynamics priority area with particular goal of increasing the number of awards funded; increases support for Broadening Participation activities; SRS survey redesigns; reallocates funds to a range of core research activities from sunsetting programs and Centers funding.	
Office of International Science and Engineering	*+1*
Funding increases enhance support for the Human and Social Dynamics priority area, reflecting a heightened focus on international research. Additional funds are focused on broadening participation, particularly to encourage women and underrepresented groups to enter graduate programs, complete advanced degrees, and incorporate international experiences in their academic careers.	
Office of Polar Programs	*+43*
Funds icebreaking activities previously supported by U.S. Coast Guard.	
Integrative Activities	*+5*
Funds a second cohort of up to four Science of Learning Centers; enables two Science and Technology Centers initiated in FY 2005 to become fully operational; and increases support for the acquisition of research instrumentation.	
Subtotal, R&RA	**+113**
Education and Human Resources	**-104**
Funding for the Experimental Program to Stimulate Competitive Research, graduate fellowships and traineeships, and most Human Resource Development (HRD) programs is maintained at a level similar to FY 2005. Funding for the Math and Science Partnership will support awards made in previous years. No new partnership awards will be made in FY 2006. The Teacher Professional Continuum, Instructional Materials Development, Centers for Learning and Teaching, Scholarships for Service, National STEM Education Digital Library and Course, Curriculum and Laboratory Improvement programs are decreased. No new REC awards are expected in FY 2006.	
Major Research Equipment and Facilities Construction	**+76**
Provides FY 2006 funding for five ongoing projects: ALMA, EarthScope, IceCube, RSVP, Scientific Ocean Drilling Vessel.	
Salaries and Expenses	**+46**
Funds an additional 23 FTE and provides increases for key IT systems and security upgrades.	
National Science Board	**0**
Office of Inspector General	**+1**
Funds the annual audit of NSF's financial statements; in prior years this funding was provided in the NSF budget.	
Total Change, NSF	**+132**
NSF FY 2006 REQUEST	**$5,605**

National Science Foundation
By Strategic Goal and Account
FY 2006 Congressional Request

(Dollars in Millions)

NSF Accounts	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request								
			People	Ideas	Tools	OrgExc	FY 2006 Request	Change over FY 2004 Actual		Change over FY 2005 Current Plan	
								$	%	$	%
FY 2004 Actual	**$5,652.01**		**$1,146.88**	**$2,822.52**	**$1,403.48**	**$279.13**					
FY 2005 Current Plan		**$5,472.82**	**$1,029.12**	**$2,749.84**	**$1,404.06**	**$289.79**					
BIO	$587.05	$576.61	$62.61	$398.10	$116.36	$4.72	$581.79	-5.26	-0.9%	5.18	0.9%
CISE	605.35	613.72	75.42	402.10	135.08	7.96	620.56	15.21	2.5%	6.84	1.1%
ENG *(less SBIR/STTR)*	461.99	458.54	87.08	347.25	33.27	7.75	475.35	13.36	2.9%	16.81	3.7%
SBIR/STTR	103.58	102.76	0.00	105.33	0.00	0.00	105.33	1.75	1.7%	2.57	2.5%
GEO	713.41	694.16	32.55	391.94	279.29	5.32	709.10	-4.31	-0.6%	14.94	2.2%
MPS	1,091.59	1,069.86	116.42	693.38	269.90	6.53	1,086.23	-5.36	-0.5%	16.37	1.5%
SBE	184.30	196.90	11.02	143.74	40.30	3.73	198.79	14.49	7.9%	1.89	1.0%
OISE[1/]	40.83	33.73	8.00	24.16	0.00	2.35	34.51	-6.32	-15.5%	0.78	2.3%
OPP	341.72	344.36	7.33	77.43	300.63	1.53	386.93	45.21	13.2%	42.57	12.4%
IA	163.52	129.91	9.50	31.90	93.50	0.00	134.90	-28.62	-17.5%	4.99	3.8%
Research & Related Activities	**$4,293.34**	**$4,220.55**	**$409.93**	**$2,615.33**	**$1,268.33**	**$39.89**	**$4,333.49**	**$40.15**	**0.9%**	**$112.94**	**2.7%**
Education & Human Resources[2/]	**$944.10**	**$841.42**	**$568.84**	**$141.80**	**$15.00**	**$11.36**	**$737.00**	**-$207.10**	**-21.9%**	**-$104.42**	**-12.4%**
Major Research Equipment & Facilities Construction	**$183.96**	**$173.65**	**$0.00**	**$0.00**	**$250.01**	**$0.00**	**$250.01**	**$66.05**	**35.9%**	**$76.36**	**44.0%**
Salaries & Expenses	**$218.92**	**$223.20**	**$0.00**	**$0.00**	**$0.00**	**$269.00**	**$269.00**	**$50.08**	**22.9%**	**$45.80**	**20.5%**
National Science Board	**$2.22**	**$3.97**	**$0.00**	**$0.00**	**$0.00**	**$4.00**	**$4.00**	**$1.78**	**80.4%**	**$0.03**	**0.8%**
Office of Inspector General	**$9.47**	**$10.03**	**$0.00**	**$0.00**	**$0.00**	**$11.50**	**$11.50**	**$2.03**	**21.4%**	**$1.47**	**14.7%**
Total, National Science Foundation	**$5,652.01**	**$5,472.82**	**$978.77**	**$2,757.13**	**$1,533.34**	**$335.75**	**$5,605.00**	**-$47.01**	**-0.8%**	**$132.18**	**2.4%**
H-1B Visa	*$57.28*	*$100.00*					*$100.00*				
Total NSF, Including H-1B Visa	*$5,709.29*	*$5,572.82*	*$978.77*	*$2,757.13*	*$1,533.34*	*$335.75*	*$5,705.00*	*-$4.29*	*-0.1%*	*$132.18*	*2.4%*
Percent Increase over Prior Year, excluding H-1B Visa			**-4.9%**	**0.3%**	**9.2%**	**15.9%**					

Totals may not add due to rounding.

[1/] OISE FY 2004 Actual includes $10.75M provided to NSF by the U.S. State Department for an award to the U.S. Civilian Research and Development Foundation.

[2/] FY 2005 funding for the Math and Science Partnership (MSP) was included in the Integrative Activities line of the FY 2005 Request as submitted to Congress. MSP funding is reflected in the EHR Account in the table above. If the FY 2005 Request for EHR is changed to match Congressional action, it would include the funds for MSP (for a revised EHR total of $851.36M) and would show that the change to the current plan is -$9.94M, which is an overall reduction for EHR of 1.2 percent.

National Science Foundation
By Strategic Outcome Goal and Investment Category
FY 2006 Congressional Request

(Dollars in Millions)

Strategic Outcome Goals and Investment Categories	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request
Individuals	$567.37	$547.12	$519.15
Institutions	181.13	177.55	159.32
Collaborations	398.38	304.45	300.30
PEOPLE	**$1,146.88**	**$1,029.12**	**$978.77**
Fundamental Science & Engineering	2,200.88	2,151.52	2,144.17
Centers Programs	362.85	350.83	358.49
Capability Enhancement	258.79	247.49	254.47
IDEAS	**$2,822.52**	**$2,749.84**	**$2,757.13**
Facilities	594.95	644.03	714.89
Infrastructure & Instrumentation	335.84	320.01	334.32
Polar Tools, Facilities & Logistics	277.07	257.46	300.63
Federally-Funded R&D Centers	195.61	182.56	183.50
TOOLS	**$1,403.48**	**$1,404.06**	**$1,533.34**
ORGANIZATIONAL EXCELLENCE	**$279.13**	**$289.79**	**$335.75**
TOTAL, NSF	**$5,652.01**	**$5,472.82**	**$5,605.00**

Strategic Outcome Goals as a Percent of NSF Budget

Strategic Outcome Goals	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request
People	20.3%	18.8%	17.5%
Ideas	49.9%	50.2%	49.2%
Tools	24.8%	25.7%	27.4%
Organizational Excellence	4.9%	5.3%	6.0%
Total, NSF	**100%**	**100%**	**100%**

National Science Foundation
Tools by Investment Category
FY 2006 Congressional Request

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Facilities[1,2]	**$594.95**	**$644.03**	**$714.89**	**$70.86**	**11.0%**
Academic Research Fleet	$82.50	83.20	83.20	0.00	0.0%
Advanced Modular Incoherent Scatter Radar	$12.40	12.50	11.00	-1.50	-12.0%
Cornell Electron Storage Ring	$18.00	16.62	14.71	-1.91	-11.5%
Gemini	$13.27	14.81	18.50	3.69	24.9%
Incorporated Research Institutions for Seismology	$13.00	12.16	13.31	1.15	9.5%
Large Hadron Collider	$7.00	10.50	13.50	3.00	28.6%
Laser Interferometer Gravitational Wave Observatory	$33.00	32.00	32.00	0.00	0.0%
Major Research Equipment & Facilities Construction[1]	$179.53	209.93	288.15	78.22	37.3%
Nanofabrication (NNIN)	$13.80	13.90	13.90	0.00	0.0%
National High Magnetic Field Laboratory	$24.50	25.50	25.50	0.00	0.0%
National Superconducting Cyclotron Laboratory	$15.65	17.50	17.50	0.00	0.0%
Ocean Drilling Program/Integrated Ocean Drilling Pgm	$35.10	38.00	32.00	-6.00	-15.8%
Shared Cyberinfrastructure Facilities / Partnerships for Advanced Computational Infrastructure	$110.66	120.76	114.00	-6.76	-5.6%
Other Facilities[2]	$36.54	36.65	37.62	0.97	2.6%
Infrastructure & Instrumentation	**$335.84**	**320.01**	**334.32**	**14.31**	**4.5%**
Major Research Instrumentation	$109.90	89.28	89.53	0.25	0.3%
National STEM Digital Library	$23.91	24.09	20.66	-3.43	-14.2%
Research Resources	$176.21	182.93	200.31	17.38	9.5%
Science Resource Statistics	$25.82	23.71	23.82	0.11	0.5%
Polar Tools, Facilities and Logistics[3]	**$277.07**	**257.46**	**300.63**	**43.17**	**16.8%**
Antarctic Facilities and Operations	$151.11	152.55	196.32	43.77	28.7%
Antarctic Logistics	$67.54	67.52	67.52	0.00	0.0%
Arctic Logistics	$37.39	37.39	36.79	-0.60	-1.6%
South Pole Station[1]	$21.03	0.00	0.00	0.00	N/A
Federally-Funded R&D Centers	**$195.61**	**182.56**	**183.50**	**0.94**	**0.5%**
National Astronomy & Ionosphere Center	$12.34	12.42	12.50	0.08	0.6%
National Center for Atmospheric Research	$82.92	81.22	82.27	1.05	1.3%
National Optical Astronomy Observatories	$41.35	37.92	37.36	-0.56	-1.5%
National Radio Astronomy Observatories	$54.98	47.03	47.40	0.37	0.8%
Science and Technology Policy Institute	$4.02	3.97	3.97	0.00	0.0%
Total, Tools Support	**$1,403.48**	**$1,404.06**	**$1,533.34**	**$129.28**	**9.2%**

Totals may not add due to rounding.

[1]All MREFC projects are included in Facilities, except South Pole Station. Funding levels for MREFC projects in this table include initial support for operations and maintenance funded through R&RA (and EHR) as well as construction, acquisition and commissioning costs funded through MREFC.

[2]Other Facilities includes support for the Network for Computational Nanotechnology, and other physics, materials research, ocean sciences, atmospheric sciences, and earth sciences facilities.

[3]Polar Tools, Facilities and Logistics includes South Pole Station, an MREFC project, with funding as described above.

National Science Foundation
Selected Cross-Cutting Programs
FY 2006 Congressional Request
(Dollars in Millions)

Selected Cross-Cutting Programs		FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	FY 2006 Request: Change over FY 2004 Actual: Amount	Percent	FY 2006 Request: Change over FY 2005 Current Plan: Amount	Percent
ADVANCE	Research & Related Activities	19.11	19.80	19.80	0.69	3.6%	0.00	0.0%
	Education & Human Resources	0.32	0.00	0.00	-0.32	N/A	0.00	N/A
	Total, NSF	**$19.43**	**$19.80**	**$19.80**	**$0.37**	**1.9%**	**$0.00**	**0.0%**
Course, Curriculum & Lab Improvement - CCLI	Research & Related Activities	5.87	5.44	5.14	-0.73	-12.4%	-0.30	-5.5%
	Education & Human Resources	41.71	41.50	32.00	-9.71	-23.3%	-9.50	-22.9%
	Total, NSF	**$47.58**	**$46.94**	**$37.14**	**-$10.44**	**-21.9%**	**-$9.80**	**-20.9%**
Interagency Education Research Initiative - IERI	Research & Related Activities	8.63	1.75	0.75	-7.88	-91.3%	-1.00	-57.1%
	Education & Human Resources	14.92	12.00	5.30	-9.62	-64.5%	-6.70	-55.8%
	Total, NSF	**$23.55**	**$13.75**	**$6.05**	**-$17.50**	**-74.3%**	**-$7.70**	**-56.0%**
Faculty Early Career Development - CAREER	Research & Related Activities	151.83	131.39	133.79	-18.04	-11.9%	2.40	1.8%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$151.83**	**$131.39**	**$133.79**	**-$18.04**	**-11.9%**	**$2.40**	**1.8%**
Graduate Research Fellowships - GRF	Research & Related Activities	8.06	8.06	8.06	0.00	0.0%	0.00	0.0%
	Education & Human Resources	87.92	88.47	88.57	0.65	0.7%	0.10	0.1%
	Total, NSF	**$95.98**	**$96.53**	**$96.63**	**$0.65**	**0.7%**	**$0.10**	**0.1%**
Graduate Teaching Fellowships in K-12 Education - GK-12	Research & Related Activities	7.68	8.16	8.16	0.48	6.3%	0.00	0.0%
	Education & Human Resources	42.14	41.73	41.83	-0.31	-0.7%	0.10	0.2%
	Total, NSF	**$49.82**	**$49.89**	**$49.99**	**$0.17**	**0.3%**	**$0.10**	**0.2%**
Integrative Graduate Education and Research Training - IGERT	Research & Related Activities	42.42	44.47	44.47	2.05	4.8%	0.00	0.0%
	Education & Human Resources	25.29	24.50	24.60	-0.69	-2.7%	0.10	0.4%
	Total, NSF	**$67.71**	**$68.97**	**$69.07**	**$1.36**	**2.0%**	**$0.10**	**0.1%**
Long-Term Research Sites - LTER	Research & Related Activities	21.27	22.78	22.78	1.51	7.1%	0.00	0.0%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$21.27**	**$22.78**	**$22.78**	**$1.51**	**7.1%**	**$0.00**	**0.0%**
Model Institutions for Excellence-MIE	Research & Related Activities	7.27	0.00	0.00	-7.27	-100.0%	0.00	N/A
	Education & Human Resources	2.44	2.49	0.00	-2.44	-100.0%	-2.49	-100.0%
	Total, NSF	**$9.71**	**$2.49**	**$0.00**	**-$9.71**	**-100.0%**	**-$2.49**	**-100.0%**
Postodoctoral Programs	Research & Related Activities	18.53	16.40	15.80	-2.73	-14.7%	-0.60	-3.7%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$18.53**	**$16.40**	**$15.80**	**-$2.73**	**-14.7%**	**-$0.60**	**-3.7%**
Research Experience for Teachers - RET	Research & Related Activities	5.81	6.45	8.45	2.65	45.6%	2.00	31.0%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$5.81**	**$6.45**	**$8.45**	**$2.65**	**45.6%**	**$2.00**	**31.0%**
Research Experience for Undergraduates - REU	Research & Related Activities	51.73	51.12	53.69	1.96	3.8%	2.57	5.0%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$51.73**	**$51.12**	**$53.69**	**$1.96**	**3.8%**	**$2.57**	**5.0%**
Research Experience for Undergraduates - REU Sites Only	Research & Related Activities	30.37	30.86	32.43	2.06	6.8%	1.57	5.1%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$30.37**	**$30.86**	**$32.43**	**$2.06**	**6.8%**	**$1.57**	**5.1%**
Research Experience for Undergraduates - REU Supplements Only	Research & Related Activities	21.36	20.26	21.26	-0.10	-0.5%	1.00	4.9%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$21.36**	**$20.26**	**$21.26**	**-$0.10**	**-0.5%**	**$1.00**	**4.9%**
Research Opportunity Awards - ROA	Research & Related Activities	1.78	1.09	1.09	-0.69	-38.7%	0.00	0.0%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$1.78**	**$1.09**	**$1.09**	**-$0.69**	**-38.7%**	**$0.00**	**0.0%**
Research in Undergraduate Institutions - RUI	Research & Related Activities	33.05	27.59	27.55	-5.50	-16.6%	-0.04	-0.1%
	Education & Human Resources	0.00	0.00	0.00	0.00	N/A	0.00	N/A
	Total, NSF	**$33.05**	**$27.59**	**$27.55**	**-$5.50**	**-16.6%**	**-$0.04**	**-0.1%**

Totals may not add due to rounding.

NSF Funding Profile

Approximately half of the awards that are supported in a particular fiscal year are competitively reviewed in that year through NSF's merit review process. The other awards are continuations of projects that were competitively reviewed in a prior year. As shown in the Number of Competitive Awards, the Funding Rate is the number of competitive awards made during a year as a percentage of total proposals competitively reviewed. It indicates the probability of receiving an award when submitting proposals to NSF.

Research Grants are those limited to research projects and excludes other categories of awards that fund infrastructure-type activities such as equipment and conference awards, which do not require multi-year support.

The Annualized Award Size displays the average annual level of research grants provided to awardees. It is calculated by dividing the total dollars of each award by the number of years over which it extends. Both the average and the median annualized award size for competitively-reviewed awards are shown.

Average Duration is the average length of time covered by the award, in years.

The Quantitative Data Tables, provided under a separate tab, are based on all proposals and awards, including competitive awards, contracts, cooperative agreements, supplements and amendments to existing grants and contracts.

NSF FUNDING PROFILE

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards			
Number	10,360	10,110	10,010
Funding Rate	24%	26%	27%
Statistics for Research Grants			
Number of Research Grants	6,430	6,170	6,310
Funding Rate	21%	20%	21%
Median Annualized Award Size	$101,800	$105,000	$105,200
Average Annualized Award Size	$139,640	$137,100	$136,800
Average Duration (yrs.)	3.0	3.0	3.0

NSF NSTC CROSSCUTS
FY 2006 Budget Request to Congress

	Climate Change Science Programs Includes U.S. Global Change Research Programs Climate Change Research Initiative			Networking and Information Technology Research and Development			National Nanotechnology Initiative		
	FY 2004 Actual	FY 2005 Plan	FY 2006 Request	FY 2004 Actual	FY 2005 Plan	FY 2006 Request	FY 2004 Actual	FY 2005 Plan	FY 2006 Request
BIO	15.10	15.10	15.10	70.00	77.00	77.00	5.31	47.00	49.00
CISE	0.00	0.00	0.00	598.05	613.72	620.56	17.56	18.48	12.00
ENG	1.00	1.00	1.00	11.20	11.20	11.20	108.88	127.77	127.77
GEO	157.49	150.35	149.35	14.56	14.56	14.56	7.94	7.94	9.00
MPS	5.47	5.45	5.45	48.81	60.50	62.20	111.48	132.14	141.54
SBE	24.50	15.48	15.48	15.58	12.47	12.47	2.59	1.56	1.56
OISE	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.26	0.00
OPP	11.10	10.50	10.50	1.33	1.50	1.50	0.00	0.00	0.00
IA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R&RA	214.66	197.88	196.88	759.76	790.95	799.49	253.76	335.15	340.87
EHR	0.00	0.00	0.00	3.05	3.95	3.75	2.29	3.07	2.90
MREFC	0.00	0.00	0.00	10.05	0.00	0.00	0.00	0.00	0.00
NSF TOTAL	**$214.66**	**$197.88**	**$196.88**	**$772.86**	**$794.90**	**$803.24**	**$256.05**	**$338.22**	**$343.77**

Note: The Climate Change Science Programs incorporate the U.S. Global Change Research Program and the Climate Change Research Initiative per Section 84-Character Classification (Schedule C) in OMB Circular No. A-11 (2003)

National Science Foundation
Homeland Security Activities
FY 2006 Congressional Request

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Critical Infrastructure Protection[1]	$258.72	$271.55	$273.78	$2.23	0.8%
Research to Combat Bioterrorism	27.00	27.00	27.00	0.00	0.0%
Microbial Genome Sequencing	*17.00*	*17.00*	*17.00*	*0.00*	*0.0%*
Ecology of Infectious Diseases	*10.00*	*10.00*	*10.00*	*0.00*	*0.0%*
Cybercorps / Scholarships for Service	15.84	14.12	10.00	-4.12	-29.2%
Counterterrorism	32.30	25.00	27.00	2.00	8.0%
Physical / Information Technology Security	6.09	4.57	6.37	1.80	39.4%
TOTAL, NSF	**$339.95**	**$342.24**	**$344.15**	**$1.91**	**0.6%**

[1] Excludes Cybercorps.

National Science Foundation
Major Investments in Broadening Participation
FY 2006 Congressional Request

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Louis Stokes Alliances for Minority Participation - LSAMP	$33.32	$35.02	$35.00	-$0.02	-0.1%
Alliances for Graduate Education and the Professoriate - AGEP	15.26	14.79	15.00	0.21	1.4%
Centers of Research Excellence in Science and Technology - CREST	19.84	15.87	18.50	2.63	16.6%
R&RA Integrative Collaborations	0.00	0.00	8.00	8.00	N/A
Advanced Technology Education - ATE	45.85	45.14	45.00	-0.14	-0.3%
Experimental Program to Stimulate Competitive Research - EPSCoR	94.24	93.68	94.00	0.32	0.3%
Historically-Black Colleges and Universities Undergraduate Program - HBCU-UP	23.83	25.22	25.00	-0.22	-0.9%
Informal Science Education - ISE	62.13	63.06	63.00	-0.06	-0.1%
Math and Science Partnership - MSP	138.71	79.36	60.00	-19.36	-24.4%
Noyce Scholarships	8.00	7.89	8.00	0.11	1.4%
Tech Talent / Science, Technology, Engineering and Math Talent Expansion Program - STEP	25.00	25.28	25.00	-0.28	-1.1%
TOTAL, NSF	**$466.18**	**$405.31**	**$396.50**	**-$8.81**	**-2.2%**

National Science Foundation
People Funding by Level of Education
FY 2006 Congressional Request

(Dollars in Millions)

Level of Education	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
K-12 Programs	$298.21	$204.21	$145.11	-$59.09	-28.9%
Undergraduate Programs	300.52	290.51	276.79	-13.72	-4.7%
Graduate & Professional Programs	445.50	425.52	437.74	12.22	2.9%
Other People Programs	102.65	108.89	119.13	10.24	9.4%
TOTAL, NSF	**$1,146.88**	**$1,029.12**	**$978.77**	**-$50.35**	**-4.9%**

Number of People Involved in NSF Activities

Many people are directly involved in NSF programs and activities, receiving salaries, stipends, or participant support. In addition, NSF programs indirectly impact many millions of people. These programs reach preK-12 students, preK-12 teachers, the general public and researchers through activities including workshops; informal science activities such as museums, television, videos, and journals; outreach efforts; and dissemination of improved curriculum and teaching methods. The FY 2006 decrease in the number of people involved in NSF activities largely reflects the phasing out and narrowing scope of a number of EHR programs and corresponding reductions in the EHR budget -- particularly efforts in Teacher Development, Instructional and Assessment Materials Development, and Course, Curriculum and Laboratory Improvement. These will result in fewer K-12 students and teachers supported, and an overall decrease in the estimated number of awards, which will result in fewer senior researchers, other professionals, postdoctoral associates, and undergraduate students supported by NSF.

Number of People Involved in NSF Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	32,960	32,360	32,060
Other Professionals	14,190	12,190	11,850
Postdoctoral Associates	6,000	5,790	5,750
Graduate Students	27,230	27,130	27,470
Undergraduate Students	34,530	32,670	27,150
K-12 Students	14,320	10,820	7,320
K-12 Teachers	86,120	73,680	56,680
Total Number of People	215,350	194,640	168,280

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

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

Postdoctoral Associates are individuals who have received Ph.D., M.D., D.Sc., or equivalent degrees and who are not members of the faculty of the performing institution. Most of these postdoctoral associates are supported through funds included in research projects, centers or facilities awards. The balances are recipients of postdoctoral fellowships.

Graduate Students include students compensated from NSF grant funds. Some of these students receive support through programs such as the NSF Graduate Research Fellowships, Integrative Graduate Education and Research Traineeship Program (IGERT), and NSF Graduate Teaching Fellowships in K-12 Education. The balance assists senior researchers or postdoctoral associates in performing research, and are supported through funds included in research projects, centers, or facilities awards. NSF provides support for approximately five percent of the science and engineering graduate students in the U.S.

Undergraduate Students include students enrolled in technical colleges or baccalaureate programs compensated from NSF grant funds. They may either be assisting senior researchers or postdoctoral associates in performing research, or participating in NSF programs specifically aimed at undergraduate students, such as Research Experiences for Undergraduates and the Louis Stokes Alliances for Minority Participation.

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

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

NSF Funding By Account

(Actual Dollars in Millions - Current Dollars)

Fiscal Year	Research & Related Activities	Education & Human Resources	Academic Research Infrastructure	Major Research Equipment & Facilities Construction	Salaries & Expenses	Office of Inspector General	National Science Board	NSF
51	0.0	0.0	0.0		0.1	0.0		0.2
52	1.4	1.5	0.0		0.5	0.0		3.5
53	2.1	1.4	0.0		0.9	0.0		4.4
54	4.5	1.9	0.0		1.5	0.0		8.0
55	8.9	2.1	0.0		1.5	0.0		12.5
56	10.8	3.5	0.0		1.7	0.0		16.0
57	22.0	14.3	0.0		2.4	0.0		38.6
58	27.4	19.2	0.0		2.9	0.0		49.5
59	66.3	61.3	0.0		5.3	0.0		132.9
60	88.4	63.7	0.0		6.5	0.0		158.6
61	104.0	63.4	0.0		7.6	0.0		175.0
62	173.3	78.6	0.0		9.0	0.0		260.8
63	218.9	91.0	0.0		10.9	0.0		320.8
64	239.9	102.6	0.0		12.1	0.0		354.6
65	282.4	120.4	0.0		13.1	0.0		416.0
66	328.6	124.3	0.0		13.1	0.0		466.0
67	327.7	123.4	0.0		14.0	0.0		465.1
68	350.2	134.7	0.0		15.4	0.0		500.3
69	292.9	123.1	0.0		16.5	0.0		432.5
70	316.4	126.4	0.0		19.7	0.0		462.5
71	369.4	105.0	0.0		21.8	0.0		496.1
72	482.4	93.7	0.0		24.6	0.0		600.7
73	519.4	62.2	0.0		28.6	0.0		610.3
74	533.3	80.7	0.0		31.7	0.0		645.7
75	581.2	74.0	0.0		37.9	0.0		693.1
76	619.7	62.5	0.0		42.2	0.0		724.4
77	672.0	74.3	0.0		45.5	0.0		791.8
78	734.7	73.9	0.0		48.7	0.0		857.3
79	791.8	80.4	0.0		54.8	0.0		926.9
80	836.8	80.1	0.0		58.2	0.0		975.1
81	900.4	75.7	0.0		59.2	0.0		1,035.3
82	909.8	26.2	0.0		63.2	0.0		999.1
83	1,013.0	23.0	0.0		65.7	0.0		1,101.7
84	1,177.7	63.0	0.0		66.3	0.0		1,306.9
85	1,344.6	90.6	0.0		72.0	0.0		1,507.1
86	1,329.6	91.7	0.0		71.8	0.0		1,493.2
87	1,440.0	109.9	0.0		77.8	0.0		1,627.6
88	1,481.3	156.8	0.0		84.5	0.0		1,722.6
89	1,600.5	194.1	0.0		91.3	0.0		1,885.9
90	1,696.6	230.4	0.4		96.4	2.3		2,026.1
91	1,868.5	331.9	39.0		101.2	2.9		2,343.5
92	1,940.5	459.4	33.4		110.0	3.9		2,547.1
93	2,046.3	505.1	49.8	34.1	110.8	3.7		2,749.7
94	2,168.4	569.0	105.4	17.0	123.5	3.9		2,987.2
95	2,281.5	611.9	117.5	126.0	129.0	4.5		3,270.3
96	2,327.8	601.2	70.9	70.0	132.5	4.0		3,206.3
97	2,433.9	619.1	30.0	76.1	134.3	5.3		3,298.8
98	2,572.6	633.2	0.0	78.2	136.9	4.8		3,425.7
99	2,821.6	662.5	0.0	56.7	144.1	5.4		3,690.3
00	2,979.9	683.6	0.0	105.0	149.3	5.6		3,923.4
01	3,372.3	795.4	0.0	119.2	166.3	6.6		4,459.9
02	3,616.0	866.1	0.0	115.4	169.9	6.7		4,774.1
03	4,054.4	934.9	0.0	179.0	189.4	8.7	2.9	5,369.3
04	4,293.3	944.1	0.0	184.0	218.9	9.5	2.2	5,652.0
2005 Plan	4,220.6	841.4	0.0	173.7	223.2	10.0	4.0	5,472.8
2006 Request	4,333.5	737.0	0.0	250.0	269.0	11.5	4.0	5,605.0

NSF Funding By Account

(Actual Dollars in Millions - FY 2004 Constant Dollars)

Fiscal Year	Research & Related Activities	Education & Human Resources	Academic Research Infrastructure	Major Research Equipment & Facilities Construction	Salaries & Expenses	Office of Inspector General	National Science Board	NSF
51	0.2	0.0	0.0	0.0	0.8	0.0	0.0	0.9
52	8.5	9.3	0.0	0.0	3.2	0.0	0.0	21.0
53	12.7	8.4	0.0	0.0	5.2	0.0	0.0	26.3
54	26.5	11.1	0.0	0.0	9.1	0.0	0.0	46.7
55	51.5	12.1	0.0	0.0	9.0	0.0	0.0	72.6
56	61.1	19.9	0.0	0.0	9.5	0.0	0.0	90.6
57	120.0	78.1	0.0	0.0	12.8	0.0	0.0	210.9
58	145.0	101.8	0.0	0.0	15.5	0.0	0.0	262.3
59	346.0	319.7	0.0	0.0	27.4	0.0	0.0	693.2
60	455.4	328.6	0.0	0.0	33.5	0.0	0.0	817.5
61	528.4	322.4	0.0	0.0	38.5	0.0	0.0	889.3
62	870.7	394.9	0.0	0.0	45.1	0.0	0.0	1,310.8
63	1,086.5	451.6	0.0	0.0	53.9	0.0	0.0	1,592.0
64	1,176.9	503.1	0.0	0.0	59.1	0.0	0.0	1,739.2
65	1,361.9	580.6	0.0	0.0	63.3	0.0	0.0	2,005.7
66	1,551.4	586.9	0.0	0.0	61.8	0.0	0.0	2,200.0
67	1,498.7	564.2	0.0	0.0	64.2	0.0	0.0	2,127.1
68	1,546.7	595.0	0.0	0.0	67.9	0.0	0.0	2,209.6
69	1,237.1	520.0	0.0	0.0	69.6	0.0	0.0	1,826.7
70	1,267.2	506.2	0.0	0.0	78.8	0.0	0.0	1,852.2
71	1,408.9	400.5	0.0	0.0	83.0	0.0	0.0	1,892.4
72	1,757.2	341.4	0.0	0.0	89.5	0.0	0.0	2,188.0
73	1,812.0	217.1	0.0	0.0	99.8	0.0	0.0	2,128.9
74	1,735.1	262.6	0.0	0.0	103.0	0.0	0.0	2,100.8
75	1,713.0	218.2	0.0	0.0	111.6	0.0	0.0	2,042.8
76	1,703.5	171.7	0.0	0.0	116.1	0.0	0.0	1,991.3
77	1,718.4	189.9	0.0	0.0	116.4	0.0	0.0	2,024.8
78	1,760.3	177.0	0.0	0.0	116.7	0.0	0.0	2,053.9
79	1,755.6	178.3	0.0	0.0	121.4	0.0	0.0	2,055.3
80	1,706.0	163.2	0.0	0.0	118.7	0.0	0.0	1,987.9
81	1,671.8	140.6	0.0	0.0	109.9	0.0	0.0	1,922.3
82	1,581.0	45.5	0.0	0.0	109.8	0.0	0.0	1,736.3
83	1,686.0	38.2	0.0	0.0	109.3	0.0	0.0	1,833.6
84	1,890.4	101.1	0.0	0.0	106.4	0.0	0.0	2,097.8
85	2,090.3	140.8	0.0	0.0	111.9	0.0	0.0	2,343.0
86	2,020.1	139.3	0.0	0.0	109.1	0.0	0.0	2,268.6
87	2,132.1	162.7	0.0	0.0	115.1	0.0	0.0	2,409.9
88	2,126.4	225.1	0.0	0.0	121.2	0.0	0.0	2,472.7
89	2,211.6	268.2	0.0	0.0	126.1	0.0	0.0	2,605.9
90	2,260.3	307.0	0.5	0.0	128.4	3.1	0.0	2,699.3
91	2,399.3	426.2	50.1	0.0	130.0	3.7	0.0	3,009.3
92	2,430.7	575.5	41.8	0.0	137.8	4.8	0.0	3,190.5
93	2,506.4	618.6	60.9	41.7	135.8	4.5	0.0	3,367.9
94	2,600.0	682.3	126.4	20.4	148.1	4.7	0.0	3,581.8
95	2,679.2	718.6	137.9	148.0	151.5	5.2	0.0	3,840.4
96	2,682.1	692.7	81.7	80.7	152.7	4.6	0.0	3,694.4
97	2,756.3	701.1	34.0	86.2	152.1	6.0	0.0	3,735.7
98	2,878.4	708.4	0.0	87.5	153.2	5.4	0.0	3,832.9
99	3,116.1	731.6	0.0	62.6	159.1	6.0	0.0	4,075.4
00	3,225.7	740.0	0.0	113.7	161.6	6.1	0.0	4,247.0
01	3,566.3	841.2	0.0	126.1	175.9	7.0	0.0	4,716.5
02	3,754.4	899.3	0.0	119.8	176.4	7.0	0.0	4,956.8
03	4,135.0	953.5	0.0	182.6	193.2	8.9	2.9	5,476.1
04	4,293.3	944.1	0.0	184.0	218.9	9.5	2.2	5,652.0
2005 Plan	4,136.5	824.7	0.0	170.2	218.8	9.8	3.9	5,363.8
2006 Request	4,165.7	708.5	0.0	240.3	258.6	11.1	3.8	5,388.0

NSF Authorizations

Current Authorizations -- National Science Foundation

LEGISLATION	FY 2004 Actual	Authorization Levels FY 2004	FY 2005	FY 2006	FY 2005 Enacted Levels[2]
		(Dollars in Millions)			
National Science Foundation Act of 1950 (P.L. 81-507)[1]					
Scholarships and Graduate Fellowships		within limits of funds made available for this purpose			
General Authority		within the limits of available appropriations			
Administering Provisions		to make such expenditures as may be necessary			
International Cooperation and Coordination with Foreign Policy		within the limit of appropriated funds			
Contract Arrangements		utilize appropriations available			
NSF Authorization Act of 2002 (P.L.107-368)					
NSF, Total	$5,652.01	$6,390.83	$7,378.34	$8,519.78	$5,472.82
Account Specific					
Research and Related Activities	$4,293.34	$4,799.82	$5,543.79	**	$4,220.55
Education and Human Resources	$944.10	$1,157.19	$1,330.77	**	$841.42
Major Research Equipment and Facilities Construction	$183.96	$211.18	$258.88	**	$173.65
Salaries and Expenses	$218.92	$210.32	$231.34	**	$223.20
National Science Board	$2.22	$3.85	$4.25	**	$3.97
Office of Inspector General	$9.47	$8.47	$9.32	**	$10.03
Directorate Specific					
Biological Sciences (BIO)	$587.05	*	*	**	***
Computer and Information Science and Engineering (CISE)	$605.35	*	*	**	***
Engineering (ENG)	$565.57	*	*	**	***
Geosciences (GEO)	$713.41	*	*	**	***
Mathematical and Physical Sciences (MPS)	$1,091.59	*	*	**	***
Social, Behavioral, and Economic Sciences (SBE)	$184.30	*	*	**	***
Office of International Science and Engineering (OISE)	$40.83	*	*	**	***
Office of Polar Programs (OPP)	$341.72	*	*	**	$344.36
Polar Research	$274.18	*	*	**	***
Antarctic Support	$67.54	*	*	**	***
Integrative Activities (IA)	$134.90	*	*	**	***
Program Specific					
Math and Science Partnership (MSP) - *strengthens math and science education through partnerships between state and local school districts and institutions of higher education*	$138.71	$300.00	$400.00	N/A	$79.36
Robert Noyce Scholarship Program - *encourages science, technology, engineering and mathematics (STEM) majors and professionals to become math and science teachers*	$8.00	$20.00	$20.00	N/A	$7.89
STEM Talent Expansion Program (STEP) or "tech talent" expansion - *increases U.S. citizens or permanent residents receiving STEM associate or bachelor's degrees*	$25.00	$30.00	$35.00	N/A	$25.28

Current Authorizations -- National Science Foundation

LEGISLATION	FY 2004 Actual	Authorization Levels FY 2004	FY 2005	FY 2006	FY 2005 Enacted Levels[2]
		(Dollars in Millions)			
Cyber Security Research and Development Act (P.L.107-305)					
Program Specific					
Computer and Network Security Capacity Building Grants	$18.00	$20.00	$20.00	$20.00	***
Computer and Network Security Research Centers	$10.00[3]	$24.00	$36.00	$36.00	***
Computer and Network Security Research Grants	$37.00[3]	$40.00	$46.00	$52.00	***
Graduate Traineeships in Computer and Network Security	$9.5[*]	$20.00	$20.00	$20.00	***
21st Century Nanotechnology Research and Development Act (P.L.108-153) and P.L.107-368					
Nanoscale Science and Engineering	$256.05	$350.00	$385.00	$424.00	***
National Earthquake Hazards Reduction Program Reauthorization Act of 2003 (P.L.108-360)	$45.04	N/A	$38.00	$39.10	***
National Windstorm Impact Reduction Act of 2004 (P.L.108-360)	45.04	N/A	N/A	$8.70	***
Small Business Research and Development Enhancement Act of 1992 (P.L.102-564); Small Business Reauthorization Act of 2000 (P.L.106-554); Small Business Technology Transfer Program Reauthorization Act of 2001 (P.L.107-50) Small Business Innovation Research Program (authorized until 2008) Small Business Technology Transfer Program (authorized until 2009)	$103.58 combined for SBIR & STTR programs	2.5% of research funds (SBIR); 0.3% of research funds (STTR)			***

[1]Organic language establishing NSF, authorization/appropriation language does not correspond to current accounts and programs;
[2]H.Rep.108-792, Conference Report accompanying H.R.4818, Consolidated Appropriations Act, 2005; includes rescission of 0.8%;
[3]Excludes estimate of graduate student support for US citizens and permanent residents;
[4]Estimates support provided to US citizens and permanent residents through research grants and center awards, excluding tuition and benefits;
[5]Estimate extrapolated from FY 2003 spending estimate.

*Authorization levels determineds at account level;
**As specified in Section 5 (f)(1) of P.L. 107-368, the FY 2006 authorization level is contingent upon a determination by Congress that the Foundation has made successful progress toward meeting certain management goals;
***To be determined via FY 2005 operating plan.

Research and Related Activities

RESEARCH AND RELATED ACTIVITIES $4,333,490,000

The FY 2006 Budget Request for the Research and Related Activities (R&RA) Appropriation is $4,333.49 million, an increase of $112.94 million, or 2.7 percent, above the FY 2005 Current Plan of $4,220.55 million. Support from the R&RA Appropriation enables U.S. leadership and accelerated progress across the expanding frontiers of scientific and engineering research and education. In turn, these activities support areas of inquiry critical to long-term U.S. economic strength, security, and quality of life.

Research activities spur the knowledge, ideas, tools and approaches that increase understanding, solve problems, and stimulate opportunities for economic growth. The productive exchange of knowledge, information and technology can accelerate innovation, often yielding new insights into the underlying research. Researchers from different disciplines increasingly transcend traditional boundaries to solve complex problems. Students work with senior scientists performing research, fostering the natural integration of research and education, and obtaining the skills needed for the next generation's workforce of scientists and engineers.

Research and Related Activities

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biological Sciences	$587.05	$576.61	$581.79	$5.18	0.9%
Computer and Information Science and Engineering	605.35	613.72	620.56	6.84	1.1%
Engineering	565.57	561.30	580.68	19.38	3.5%
Geosciences	713.41	694.16	709.10	14.94	2.2%
Mathematical and Physical Sciences	1,091.59	1,069.86	1,086.23	16.37	1.5%
Social, Behavioral and Economic Sciences	184.30	196.90	198.79	1.89	1.0%
Office of International Science and Engineering[1]	40.83	33.73	34.51	0.78	2.3%
U.S. Polar Research Programs	274.18	276.84	319.41	42.57	15.4%
U.S. Antarctic Logistical Support Activities	67.54	67.52	67.52	0.00	0.0%
Integrative Activities	163.52	129.91	134.90	4.99	3.8%
Total, Research and Related Activities	$4,293.34	$4,220.55	$4,333.49	$112.94	2.7%

Totals may not add due to rounding.

[1] OISE FY 2004 Actual includes $10.99 million provided to NSF by the U.S. Department of State for an award to the U.S. Civilian Research and Development Foundation.

FY 2006 Appropriations Language

For necessary expenses in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), and the Act to establish a National Medal of Science (42 U.S.C. 1880-1881); services as authorized by 5 U.S.C. 3109; maintenance and operation of aircraft and purchase of flight services for research support; acquisition of aircraft; ~~$4,254,593,000~~ *$4,333,500,000 to remain available until September 30, 2007,* of which not to exceed ~~$350,000,000~~*$425,000,000* shall remain available until expended for Polar research and operations support, and for reimbursement to other Federal agencies for operational and science support and logistical and other related activities for the United States Antarctic program; ~~the balance to remain available until September 30, 2006~~: *Provided, That from amounts specified for Polar research and operations support, the National Science Foundation shall reimburse the Coast Guard for such sums as mutually determined to be necessary for Coast Guard operations and maintenance of the U.S. polar icebreaking fleet: Provided further,* That receipts for scientific support services and materials furnished by the National Research Centers and other National Science Foundation supported research facilities may be credited to this appropriation: ~~Provided further, That to the extent that the amount appropriated is less than the total amount authorized to be appropriated for included program activities, all amounts, including floors and ceilings, specified in the authorizing Act for those program activities or their subactivities shall be reduced proportionally: Provided further, That $95,000,000 of the funds available under this heading shall be made available for a comprehensive research initiative on plant genomes for economically significant crops: Provided further, That not to exceed $25,954,000 of these funds shall be for all costs, direct and indirect, associated with personnel assignments under the Intergovernmental Personnel Act~~. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2005.)*

Explanation of proposed changes to appropriation language:

- Adds language to clarify NSF's increased responsibility for funding polar icebreaking activities.

- Deletes language related to allocating funds proportionately across programs, Plant Genome research, and ceilings on funding for Intergovernmental Personnel Act appointments. Each of these issues is more appropriately addressed through administrative measures.

Research and Related Activities
FY 2006 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Rescission	Carryover/ Recoveries	Transfers[1]	Total Resources	Obligations Incurred/ Est.
FY 2004 Appropriation	4,276.60	-25.23	37.78	10.75	4,299.90	4,293.34
FY 2005 Current Plan	4,254.59	-34.04	6.56	-	4,227.11	4,227.11
FY 2006 Request	4,333.49	-	-	-	4,333.49	4,333.49
Change from FY 2005	78.90				106.38	

Totals may not add due to rounding.

[1]The U.S. Department of State transferred $10.99 million for an award to the U.S. Civilian Research and Development Foundation ($10.75 million in FY 2004 funds is shown under transfers, and the $240,000 balance of FY 2003 funds is included as carryover into FY 2004).

Explanation of Carryover:

Within the Research and Related Activities (R&RA) appropriation $6.56 million was carried forward into FY 2005. The Office of Polar Programs (OPP) portion totals $5.60 million and includes $2.74 million for Antarctic Logistics Support, $270,000 for the Operations Support Program and $2.20 million in unobligated recoveries. The Office of Integrative Activities (OIA) carried forward $425,955 for the Science and Technology Centers (STC) site visits. The Office of International Science and Engineering (OISE) carried forward $287,000 for the start-up costs for the NSF/China Office. The remaining amounts are from several awards in various programs that were not ready for obligation in FY 2004.

RESEARCH AND RELATED ACTIVITIES
FY 2006 Performance Highlights

The table below shows the strategic planning and evaluation framework for activities funded through the Research and Related Activities (R&RA) appropriation. This framework was established in the NSF Strategic Plan for FY 2003-2008. NSF's strategic outcome goals are assessed annually by the Advisory Committee for GPRA Performance Assessment. The investment categories are assessed using the Program Assessment Rating Tool (PART). Additional information on these activities is available in the Performance Information section of this document.

Research and Related Activities
by Strategic Outcome Goal and Investment Category
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request
Individuals	324.68	309.55	312.92
Institutions	41.05	40.17	40.98
Collaborations	34.83	29.41	56.53
PEOPLE, total	$400.56	$379.13	$410.43
Fundamental Science & Engineering	2,147.36	2,102.13	2,116.27
Centers Programs	362.85	350.83	357.89
Capability Enhancement	144.71	137.94	141.97
IDEAS, total	$2,654.92	$2,590.90	$2,616.13
Facilities	431.22	469.58	464.08
Infrastructure & Instrumentation	317.84	301.58	319.79
Polar Tools, Facilities & Logistics	256.04	257.46	300.63
Federally-Funded R&D Centers	195.61	182.56	182.53
TOOLS, total	$1,200.71	$1,211.18	$1,267.03
ORGANIZATIONAL EXCELLENCE	$37.14	$39.33	$39.89
Total, R&RA	$4,293.34	$4,220.55	$4,333.49

In developing the FY 2006 Budget Request, NSF completed the PART for three investment categories and one priority area that receive R&RA funding. All were rated "effective," the highest rating.

- Institutions. Major activities in R&RA include ADVANCE; Course, Curriculum and Laboratory Improvement; and Engineering Education Reform. Overall, the PART found Institutions to be an "effective" program and that additional attention should continue to be focused on achieving performance and efficiency targets.

- Collaborations. Major activities in R&RA include Partnerships for Innovation, Model Institutions of Excellence, and undergraduate research centers and related activities in the mathematical and physical sciences and the geosciences. Overall, the PART found

Collaborations to be an “effective” program and that additional attention should continue to be focused on achieving performance and efficiency targets.

- Polar Tools, Facilities and Logistics. Major activities in R&RA include Antarctic Facilities and Operations, Antarctic Logistics, and Arctic Logistics. Overall, the PART assessments found Polar Tools, Logistics and Facilities to be an “effective” program with recommendations to perform a targeted review through a Committee of Visitors (completed), continue to improve performance targets and monitoring, and further promote the use of Earned Value Management in facilities construction. NSF has developed goals for this investment category using the Facilities Construction goal, incorporating Earned Value Management, and Facilities Operations. Therefore, since FY 2004, Polar Tools, Logistics and Facilities construction and operations have been tracked separately from these other facilities.

- Biocomplexity in the Environment (BE). R&RA funding for the BE priority area is roughly $84 million in the FY 2006 Request and is provided by all research directorates and Offices. Overall, the PART assessments found this program to be “effective” and that additional attention should continue to be focused on achieving performance and efficiency targets.

Biological Sciences

BIOLOGICAL SCIENCES $581,790,000

The FY 2006 Budget Request for the Directorate for Biological Sciences (BIO) is $581.79 million, an increase of $5.18 million, or 0.9 percent, over the FY 2005 Current Plan of $576.61 million.

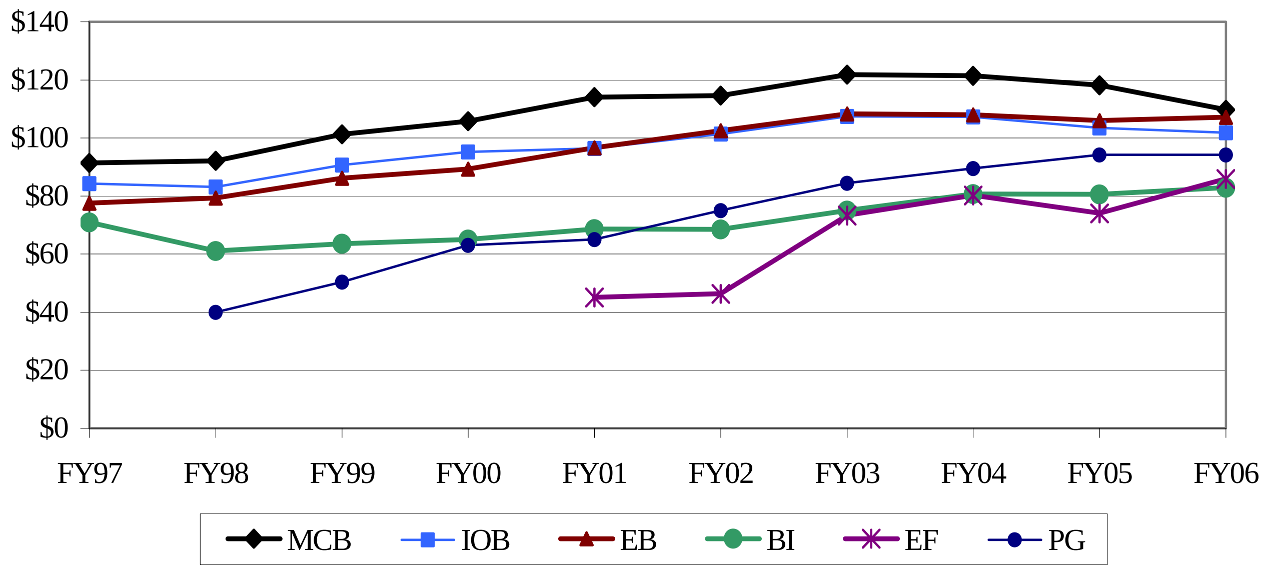
Biological Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Molecular and Cellular Biosciences (MCB)	121.42	118.16	109.75	-8.41	-7.1%
Integrative Organismal Biology (IOB)	107.29	103.50	101.76	-1.74	-1.7%
Environmental Biology (EB)	107.94	106.04	107.18	1.14	1.1%
Biological Infrastructure (BI)	80.68	80.62	82.93	2.31	2.9%
Emerging Frontiers (EF)	80.24	74.05	85.93	11.88	16.0%
Plant Genome (PG)	89.47	94.24	94.24	0.00	0.0%
Total, BIO	$587.05	$576.61	$581.79	$5.18	0.9%

Totals may not add due to rounding.

The Directorate for Biological Sciences (BIO) supports the vitality of the biological sciences at U.S. colleges and universities, especially in those areas where NSF has a major responsibility. BIO supports research, infrastructure, and education.

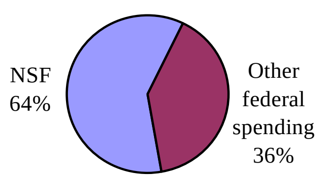
BIO Subactivity Funding
(Dollars in Millions)



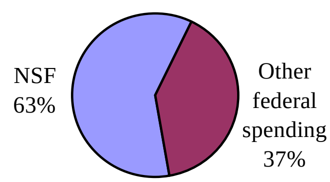
RELEVANCE

BIO is the dominant federal supporter of basic research in non-medical aspects of the biological sciences at academic institutions – providing over 63 percent of the support for these activities. Because most federal support for the life sciences goes to health-related research funded by the National Institutes of Health, NSF's contribution to the broader array of the biological sciences is significant and strategically focused – particularly in such areas as environmental biology and plant sciences.

Federal Support for Basic Research in Environmental Biology at Academic Institutions



Federal Support for Basic Research in Non-Medical Biological Sciences at Academic Institutions



Fundamental research on understanding all aspects of "life" – from the cell to whole ecosystems – is supported within NSF, where the ability to integrate the range of biological sub-disciplines is unique. BIO support represents 64 percent of all federal funding for basic research in environmental biology and an estimated 59 percent of support in plant biology at academic institutions. Additionally, NSF plays a catalytic role in supporting interdisciplinary biological research through investments that develop a deeper understanding of complex biological systems through collaborations among physical, computational, behavioral, social, and biological researchers and engineers. Issues of national importance related to the environment, economy, and human welfare require an understanding of how living organisms function and interact with non-living systems. BIO-supported research enhances this understanding.

Summary of Major Changes by Division *(Dollars in Millions)*

BIO FY 2005 Current Plan…………………………………………………………….…….. $576.61

Molecular and Cellular Biosciences -$8.41

Decreased support in part reflects the transfer of Microbial Observatories and microbial interactions and processes research to the Emerging Frontiers Subactivity to form the core of a new emphasis on Microbial Biology. Additional real decreases in the core will result in fewer awards being made. In addition to Microbial Biology, FY 2006 priorities include areas of emerging importance: analysis of living networks and complex interacting processes; cyberinfrastructure; plant biology and the Arabidopsis 2010 project.

Integrative Organismal Biology -$1.74

Decreased support reflects the initiation of the Microbial Biology emphasis in Emerging Frontiers. Funds will be directed from other areas of core support to focus on research areas of emerging importance such as: integrative studies on organisms; integration of developmental biology and evolutionary physiology; and the genetic/cellular basis of behavior.

Environmental Biology +$1.14

Increased support will be allocated to areas of research on complex ecological and evolutionary systems, with an emphasis on aquatic and watershed systems. Some funds will be redirected from other areas of core support to focus on this important area of pioneering research. A small budgeted increase for the National Center for Ecological Analysis and Synthesis is planned as well.

Biological Infrastructure +$2.31

Research Resources:

Support for instrumentation programs, in particular the multi-user instrumentation program, will be decreased. (-$5.05 million)

Funds redirected from instrumentation support will focus on biological databases and informatics activities. (+$7.00 million)

NEON: Planning and development of the National Ecological Observatories Network (NEON) project execution plan is well underway, and already has identified the critical need to develop cybernetwork and sensor tools as NEON moves to the construction stage. A priority will be placed on support to develop these critical tools in a manner consistent with the NEON project execution plan. (+$50,000)

Human Resources:

Stipends for REU (Research Experiences for Undergraduates) sites and Postdoctoral Fellowships will increase. Support for activities designed to broaden participation of under-represented and under-served communities will increase, including Research Opportunities for Community College Faculty supplements. (+$310,000)

Emerging Frontiers +$11.88

Microbial Biology

A new emphasis on microbial biology will be established. While microbial research has long been supported across the biological sciences, and will continue to be supported within core programs, some activities are being transferred from Molecular and Cellular Biosciences to Emerging Frontiers to form components of the new emphasis area for enhancement across disciplinary boundaries at the leading edge. Included in the emphasis area will be microbial genome sequencing, microbial observatories, microbial interaction and processes, and other microbial research and training activities. (+$12.21 million)

Frontiers in Integrative Biological Research (FIBR)

FIBR support will increase by $1.27 million in FY 2006 to augment research projects on complex, often multidimensional, major biological questions that are addressed using the creative application of a broad range of scientific concepts, strategies, and research tools from within and outside the biological sciences. (+$1.27 million)

Broadening Participation

Support will increase for research planning grants for early career researchers and career advancement awards to mid-career researchers to promote the professional development and retention of underrepresented scientists and engineers in the Biological Sciences. (+$1.0 million)

Center for Synthesis in Biological Evolution

The decrease of $600,000 to $3.0 million reflects a shift from start up costs to the day-to-day research and educational activities of the Center. (-$600,000)

Nanoscale Science and Engineering

Funding will decrease by $2.0 million to $3.85 million in FY 2006 in a planned phase of this priority area. BIO will emphasize research on nanoscale sensors and information processors that could provide new tools for understanding detection of environmentally important signals. (-$2.0 million)

Plant Genome No Change

Support for Plant Genome Research projects, which include Functional Genomics, Large-scale Sequencing for Genomes of Economically Important Plants, Informatics Tools Development, and Interagency Activity on Research Collaboration with Scientists in Developing Countries will continue at the FY 2005 level.

Subtotal, Changes +$5.18

FY 2006 Request, BIO………………………………………………………………...… $581.79

Summary of Directorate-wide Investments *(Dollars in Millions)*

BIO FY 2005 Current Plan………………………………………………………………….. $576.61

Core Research +$2.38

Disciplinary and interdisciplinary research in the BIO core will increase by $1.11 million for a total of $293.87 million.

Molecular & Cellular Biosciences	-$8.41 million
Integrative Organismal Biology	-$1.74 million
Environmental Biology	+$0.79 million
Biological Infrastructure	+$0.26 million
Emerging Frontiers	+$11.48 million

Funding will support awards central to 21st Century Biology. As research breakthroughs are realized from recent advances in genomics, proteomics, informatics, computer science, mathematics, physics, chemistry, engineering, and the earth and social sciences, a new biology has emerged that is multidimensional, multidisciplinary, information-driven, education-oriented, and internationally engaged. In FY 2006, a new emphasis on microbial biology will be fostered in the Emerging Frontiers Subactivity.

Centers -$0.25

Centers for Analysis and Synthesis

A decrease of $250,000 to a total of $6.82 million for two BIO-supported Centers: the Center for Ecological Analysis & Synthesis [+$350,000] and the Center for Evolutionary Synthesis [-$600,000].

Plant Genome Virtual Centers

Plant Genome Virtual Centers (centers without walls) are collaboratories where coordinated, multi-investigator teams pursue comprehensive plant genome research programs relevant to economically important plants or plant processes. Funding for FY 2006 will be maintained at $36.0 million, equal to FY 2005.

Research Resources +$2.00

An increase of $2.0 million for a total of $109.16 million. Research Resources provides essential support for the core infrastructure needs of the community supported by the BIO Directorate. This support includes multi-user instrumentation, development of instrumentation and new techniques, living stock centers, marine laboratories and terrestrial field stations, databases, and support for development of informatics tools and techniques. In FY 2006, a shift in resources from multi-user instrumentation is necessary to support the long-term needs of databases and the increasing dependence of the biological sciences' community on the cyberinfrastructure necessary for 21st century research and analysis.

National Ecological Observatory Network +$0.05

NEON will increase by $50,000 for a total of $6.0 million. The ongoing planning process for NEON will continue. Robust cyberinfrastructure has emerged as a key. Funds will continue development of necessary tools and infrastructure that would add critical components in preparation for construction of the NEON platform.

Broadening Participation +$1.00

An increase of $1.0 million will focus on fostering linkages between programs in BIO and LSAMP, AGEP, and CREST, and to continue support for the Career Advancement Awards and Research Planning Grants.

Subtotal, Changes +$5.18

FY 2006 Request, BIO………………………………………………………………………… $581.79

PRIORITY AREAS

In FY 2006, BIO will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment (BE), Nanoscale Science and Engineering (NSE), Mathematical Sciences (MS), and Human and Social Dynamics (HSD). Support for BE and NSE will decrease as programs transition into core activities across the Directorate for Biological Sciences.

Biological Sciences Investments in NSF Priority Areas
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Percent
Biocomplexity in the Environment	39.86	39.86	30.43	-9.43	-23.7%
Nanoscale Science and Engineering	5.31	5.85	3.85	-2.00	-34.2%
Mathematical Sciences	2.18	2.21	2.21	0.00	0.0%
Human and Social Dynamics	0.50	0.50	0.50	0.00	0.0%

Biocomplexity in the Environment: A total of $30.43 million will continue support for the Ecology of Infectious Disease and Microbial Genome Sequencing. A new program emphasis on environmental genomics will be initiated in FY 2006 in partnership with GEO and OPP. Assembling the Tree of Life program will continue with support from Emerging Frontiers.

Nanoscale Science and Engineering: A decrease of $2.0 million, for a total of $3.85 million, will begin the transitioning of the NSF-wide priority area into base programs. Base support for research on nanoscale science totals approximately $50 million across BIO research programs focusing on nanoscale studies of the structure, function, and assembly of cellular elements.

Mathematical Sciences: A total of $2.21 million will continue support for interdisciplinary science and engineering through research on mathematical and statistical challenges posed by large data sets, managing and modeling uncertainty, and modeling complex nonlinear systems.

Human and Social Dynamics: A total of $500,000 will be provided to support a focus on modeling human and social dynamics that are related to biological systems.

QUALITY

BIO maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The percent of research funds that were allocated to projects that undergo external merit review was 97 percent in FY 2004, the last year for which complete data exist.

To ensure the highest quality in processing and recommending proposals for awards, BIO convenes Committees of Visitors, which are comprised of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate for Biological Sciences also receives advice from the Advisory Committee for Biological Sciences (BIOAC) on such issues as: the mission, programs, and goals that can best serve the scientific community; how BIO can promote quality graduate and undergraduate education in the biological sciences; and priority investment areas in biological research. The BIOAC meets twice a year. Members represent a cross section of biology and include members from academic institutions and industry. The Committee includes a balanced representation of women, under-represented minorities, and geographic regions.

PERFORMANCE

NSF's FY 2006 Budget Request is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Biological Sciences

By Strategic Outcome Goal and Investment Category

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	55.66	58.90	58.90	-	-
Institutions	2.71	2.71	2.71	-	-
Collaborations	1.07	0.00	1.00	1.00	-
	59.44	61.61	62.61	1.00	1.6%
Ideas					
Fundamental Science and Engineering	330.08	313.55	315.93	2.38	0.8%
Centers Programs	58.77	64.60	64.35	-0.25	-0.4%
Capability Enhancement	23.75	17.82	17.82	-	-
	412.60	395.97	398.10	2.13	0.5%
Tools					
Facilities	4.70	7.15	7.20	0.05	0.7%
Infrastructure and Instrumentation	105.25	107.16	109.16	2.00	1.9%
Polar Tools, Facilities and Logistics	-	-	-	-	-
Federally-Funded R&D Centers	-	-	-	-	-
	109.95	114.31	116.36	2.05	1.8%
Organizational Excellence	5.05	4.72	4.72	-	-
Total, BIO	$587.05	$576.61	$581.79	$5.18	0.9%

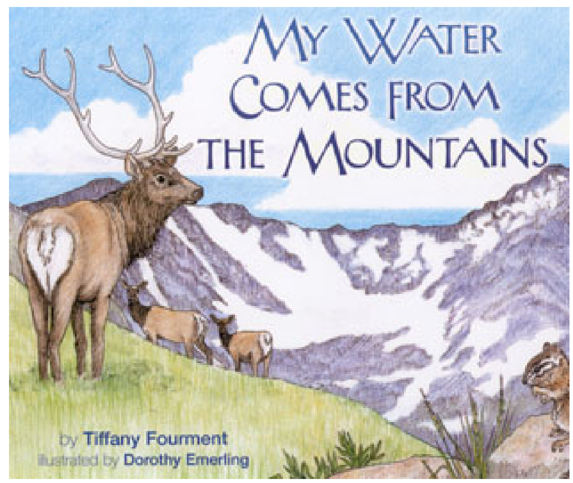
Totals may not add due to rounding.

BIO will continue its commitment to education, training, and increasing diversity while emphasizing 21st Century Biology within all of its divisions and subactivities. The FY 2006 budget will maintain award size and continue to focus on multidisciplinary research activities, inter-agency partnerships, and international activities with special attention given to broadening participation at all levels.

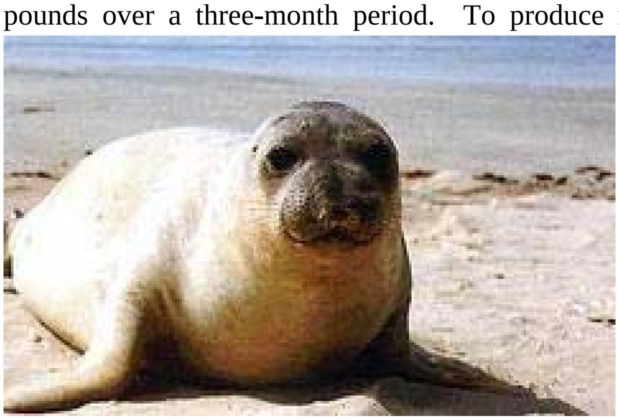
Recent Research Highlights

DNA fingerprinting detects a deadly pathogen in North American forests. Pathogenic *Ceratocystis* is an opportunistic fungus. It invades a plant's root system and eventually destroys the tissue within the trunk. North American forests containing aspen, hickory, maple, oak, poplar, and sycamore are highly susceptible to this plant pathogen, which has arrived from tropical regions on shipments of commercial wood products. Researchers are using nuclear and mitochondrial DNA fingerprinting to distinguish between native and introduced populations of this fungus. NSF-supported researchers, which include graduate students, have developed new procedures regulating the import of tropical wood-based materials into North America and assists with efforts to identify new exotic pests in forest ecosystems.

A new children's book is enhancing the high-altitude ecological literacy of valley dwellers. Models developed at a Colorado BIO Long Term Ecological Research (LTER) site – the only long-term study site for high-elevation areas on the North American continent, have revealed explicit links between aquatic and terrestrial ecosystems. Research results inspired a children's book about the water cycle, *My Water Comes from the Mountains*, a product of the Schoolyard LTER program targeting K-12 students. The book explores the ecology of the region and explains the hydrological cycle supplying water from the Colorado Mountains to the City of Boulder and ecosystems of the Continental Divide. The author, a former student at the LTER, invited students from her third grade class to draw their impressions of the LTER field site to illustrate the book, which is now available in bookstores. Copies have been distributed as class sets to the elementary schools in local school districts and beyond. A second children's book based on the Antarctic LTER site is already in the works.



Energy allocation during fasting in Northern Elephant seals: Starving for love. Northern Elephant seals, which weigh over 6,000 pounds, spend 60-80 percent of the time underwater, but come ashore twice a year, to molt, breed and give birth. Onshore, elephant seals fast and can lose as much as 1,500 pounds over a three-month period. To produce milk for their newborn calves, they metabolize fat (blubber) reserves for energy. NSF-supported researchers have discovered that glucose production in fasting elephant seals is comparable to that of humans and dogs, two non-fasting adapted species, suggesting that seals can alter the rate of glucose production in response to food limitation in order to share and conserve energy. Determining how animals undergoing long-term fasting allocate their limited energy resources is furthering understanding of energy conservation and its affects on parental investment, growth and

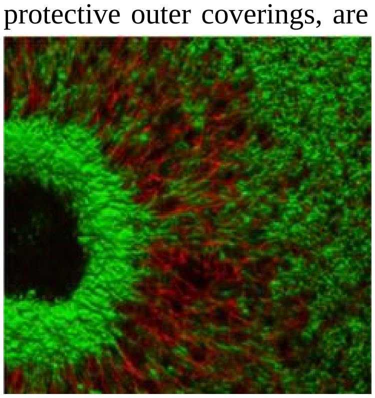


development, among fasting and non-fasting adapted species. Research on glucose management has direct implications to the study of diabetes, as elephant seals maintain glucose levels that are considered to be diabetic-like in human systems.

Broadening participation in plant genomics. The cultivated potato is thought to have come to the U.S. from the Andes *via* Europe. NSF-supported esearchers working on disease resistance genes in cultivated and wild varieties of potato are partnering with the Makah Nation in Washington State to help them discover the origin of their indigenous potato variety, the Ozette potato. High school and college students are testing the idea that the Ozette potato came directly from the Inca in the Andean regions of Peru and Bolivia, rather than from Scottish and Irish immigrants in the 17th century. Participating students from the Makah and Yakima Nations conduct research in the laboratory using genetic markers that characterize potatoes from different areas and learn how to use computational tools to analyze their data.

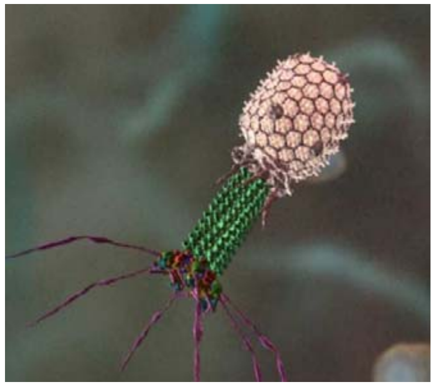
DiGIR: Driving the Federation of Biological Databases. Federated databases are rapidly becoming a major force in advancing biology. They supply an alternative to large expensive centralized databases and drive the development and acceptance of community standards and intellectual property norms that benefit all of biology by allowing universal access to data and broad collaboration. Using DiGIR (Distributed Generic Information Retrieval), a protocol developed for single point access to distributed data sources, NSF-supported researchers have created HerpNET, a federated, biodiversity database and MOBY, a federated genomics/proteomics database, making enormous amounts of distributed data available to researchers.

Healing in Cell Membranes. The cell membranes of individual cells, particularly animal cells that lack protective outer coverings, are fragile and vulnerable to mechanical injury. Cells cannot survive if their membranes have been breached. Therefore, the ability of a cell to rapidly repair injured membranes is critical to its survival. A BIO-supported study of wound healing at the cellular level used lasers to create holes in the membrane of frog cells. The cells were injected with fluorescent probes and imaged with high-resolution confocal microscopy to observe the healing process. After wounding, protein contraction in the cells pulled filaments to the wound border forming a contractile ring (green center ring in photo). Contraction of the filaments closes the wound resulting in healing. The results of this research help us better understand cells as complex systems and the mechanisms they use to repair their membranes and ensure their survival after an injury.



Using Genetics to Conserve Plant Species. *Vanilla planifolia*, a plant species in the Orchid family, is one of a few sources of the world's most popular extract, vanilla, and is the only orchid species out of approximately 25,000 that has significant agricultural value. In fact, U.S. manufacturers imported 2.5 million pounds of vanilla beans in 2002. Despite the plant's economic importance, little is known about the Orchid's natural history, including it's physical structure and pollination processes, and even less so about the plant's genetic makeup. Most vanilloid species respond poorly to cultivation, and many are under severe threat of extinction because of habitat destruction. By increasing our understanding of this plant's life history and evolution, BIO-supported researchers are working to ensure that this important plant will always be available.

From Nature to Nanotechnology. Researchers supported by BIO have learned how the bacterial virus, bacteriophage T4, attacks its host, the *E. coli* bacterium. The research describes for the first time how the virus uses a needle-like biochemical puncturing device to invade its host. By understanding how this tiny drilling mechanism works, scientists may be able to use nanotechnology to mimic the mechanism to create nanomachinery that could be used in manufacturing processes or for injecting nucleic acids into cells for a variety of biotechnology applications.



Other Performance Indicators

The tables below show the change in the number of people benefiting from BIO funding, and trends in the award size, duration and number of awards.

Number of People Involved in BIO Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	3,270	3,230	3,230
Other Professionals	1,740	1,720	1,730
Postdoctorates	1,460	1,470	1,470
Graduate Students	2,710	2,790	2,790
Undergraduate Students	2,440	2,450	2,450
K-12 Teachers	20	20	20
Total Number of People	11,640	11,680	11,690

BIO Funding Profile

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	1,432	1,406	1,419
Funding Rate	24%	24%	24%
Statistics for Research Grants:			
Number of Research Grants	925	909	917
Funding Rate	19%	19%	19%
Median Annualized Award Size	$133,191	$133,191	$133,191
Average Annualized Award Size	$171,016	$171,016	$171,016
Average Award Duration, in years	3.3	3.3	3.3

MOLECULAR AND CELLULAR BIOSCIENCES $109,750,000

The FY 2006 Request for the Division of Molecular and Cellular Biosciences (MCB) is $109.75 million, a decrease of $8.41 million, or 7.12 percent, over the FY 2005 Current Plan Level of $118.16 million.

Molecular and Cellular Biosciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Percent
Molecular and Cellular Biology	**$121.42**	**$118.16**	**$109.75**	**-$8.41**	**-7.1%**
Major Components:					
Research & Education Projects	$121.42	$118.16	$109.75	-$8.41	-7.1%

About MCB:

The Division of Molecular and Cellular Biosciences is organized into three clusters: Biomolecular Systems, Cellular Systems, and Genes and Genome Systems. In all these areas, analyses of complex processes requires multi-disciplinary research, involving not only biologists, but also physicists, chemists, mathematicians, computer scientists, and engineers. MCB actively pursues collaborations in all these areas. Research supported by MCB also contributes to the knowledge base and develops leading edge tools for research addressing questions at higher levels of biological organization, such as applications of genomics to studies of phylogeny and ecology.

The Biomolecular Systems cluster supports research at the interface of life science and physical sciences and includes the scientific themes of molecular biochemistry, biophysics, and metabolic pathways and networks. Development of cutting-edge technologies integrating theoretical, computational, and experimental approaches to the study of individual biological molecules and their functional complexes is a priority.

The Cellular Systems cluster supports research that addresses questions about how living cells are organized, how they communicate, and how they respond to internal and external signals. Areas supported include nanoscale studies of the structure, function, and assembly of cellular elements, such as the cytoskeleton, membranes, intracellular compartments, and eukaryotic and prokaryotic cell walls and envelopes. Cellular mechanisms underlying immune-like function in plants and diverse animals, particularly lower vertebrates and invertebrates, are also a priority.

The Genes and Genome Systems cluster supports studies of genomes and genetic mechanisms in all types of organisms. Areas of interest include genome organization, replication, recombination, repair, and vertical and lateral transmission of heritable information, as well as study of the processes that carry out and regulate gene expression such as transcription and translation of the information encoded in the genome. Although enhanced understanding in all these areas is of intrinsic value, it also has application in bio-based sectors of the economy, such as nanotechnology, and contributes to national security, particularly biosecurity.

In general, 42 percent of the MCB portfolio is available for new awards. The remaining 58 percent funds awards made in previous years.

MCB priorities for FY 2006:

Core Research: MCB funds pioneering research, especially studies of complex molecular and cellular systems and processes. Some of the activities represented in these areas of research include:

Research and Education at the Interface of Biology and the Physical Sciences: MCB core activities support research on the structure, dynamics, mechanisms of action, and control of the molecules that comprise the machinery of the living cell. In partnership with the divisions in the Directorate for Mathematics and Physical Sciences, MCB will continue to emphasize support for beginning investigators whose pioneering projects integrate research and education and so develop not only new knowledge, but a new generation of scientist-educators who bridge this interface.

Living Networks and Complex Processes: There is growing appreciation that the functions of living cells cannot be understood as a collection of individual, linear processes, but only when viewed as interacting and interdependent networks. MCB will give priority to theoretical, computational, mathematical modeling and simulation approaches in all areas of the molecular and cellular biosciences. Formulating and testing physical and mathematical models of the structure and function of living networks of complex molecules, metabolic pathways, and other exquisitely regulated cellular processes addresses one of the greatest computational challenges facing biology in the 21st century, creating multi-scale models that integrate our understanding of biological structure, function, and interactions at all levels into a predictive whole. From capturing and analyzing genome data to mathematically simulating complex networks of cellular signaling events, **Cyberinfrastructure** will play a key role.

Microbial Biology: Microbes make up most of the earth's biomass and are essential for the earth's functioning; yet except for the few that cause human disease we still know remarkably little about the vast majority of them. MCB will continue to give priority to research on microbes through its core activities. The establishment of a Microbial Biology emphasis in the Emerging Frontiers Subactivity recognizes the importance of this area of research, uniquely supported by NSF. Funds to support microbial observatories have been transferred to EF for this activity. Genome-enabled and biochemical approaches are being used to identify and characterize the metabolic machinery that enables the vast variety of microbes to populate every imaginable habitat on Earth.

Plant biology and the Arabidopsis 2010 Project: Unsolicited research supported by MCB led to the discovery of the value of *Arabidopsis thaliana* as a model flowering plant. The MCB Division will continue to make support for plant biology research, particularly research enabled by the availability of the complete genome sequence of *Arabidopsis* and directed toward a complete understanding of the functions of all *Arabidopsis* genes by the year 2010, a high priority.

Changes from FY 2005:

- Disciplinary and interdisciplinary research in the MCB core will decrease by $8.41 million. In part, this reflects the transfer of Microbial Observatories and Microbial Interactions and Processes research to the Emerging Frontiers Subactivity, but also reflects a real decrease in base funding.

INTEGRATIVE ORGANISMAL BIOLOGY $101,760,000

The FY 2006 Budget Request for the Division of Integrative Organismal Biology (IOB) is $101.76 million, a decrease of $1.74 million, or 1.68 percent, over the FY 2005 Current Plan Level of $103.50 million.

Integrative Organismal Biology Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Integrative Organismal Biology	**$107.29**	**$103.50**	**$101.76**	**-$1.74**	**-1.7%**
Major Components:					
Research & Education Projects	$103.34	$99.55	$97.81	-$1.74	-1.7%
Centers					
STC for Behavioral Neuroscience	$3.95	$3.95	$3.95	$0.00	0.0%

About IOB:

The Division of Integrative Organismal Biology is organized into four clusters: Behavioral Systems, Developmental Systems, Environmental and Structural Systems, and Functional and Regulatory Systems. Research supported by the IOB Division focuses on understanding the structure and function of organisms, with particular emphasis on the mechanisms by which organisms develop, behave, and respond to their environment. Understanding organisms requires integration of information across levels of analysis and stages of development and across phyla, environments, and evolutionary time. It can also require advanced computational techniques and interdisciplinary perspectives from other areas of biology, the physical sciences, mathematics, engineering, social sciences and computer science. An underlying theme is the development and use of a wide diversity of organisms to identify unifying principles common to all organisms and to understand the variety of adaptive mechanisms that have evolved in specific organisms.

The Behavioral Systems cluster focuses on the development, function, mechanisms, and evolution of behavior, biological rhythms, and interactions between organisms. This cluster supports research on social and reproductive behavior; behavioral ecology and physiology; neural and hormonal mechanisms of behavior; interaction between behavior and the immune system; and the biological bases of learning, cognition, and communication

The Developmental Systems cluster focuses on the nature, control, and evolution of those processes that comprise the life cycle of organisms. Research on the mechanisms of gametogenesis, fertilization, embryogenesis, differentiation, pattern formation, and morphogenesis, including research on the development, regeneration, and aging of the nervous system is supported. Genomic approaches, gene networks, integration of developmental gene pathways, and computational approaches are included.

The Environmental and Structural Systems cluster focuses on the function and evolution of organisms in their physiochemical and biotic environments. Included are studies of physiological ecology, functional morphology, animal sensation and movement, molecular bases of tissue biomechanical properties, and environmental genomics.

The Functional and Regulatory Systems cluster focuses on fundamental physiological mechanisms and how they have evolved, with emphasis on organisms as integrated systems. This area includes comparative physiology, neurophysiology, mechanisms of solute transport, and comparative or evolutionary immunology.

In general, 52 percent of the IOB portfolio is available for new awards. The remaining 48 percent funds awards made in previous years.

IOB Priorities for FY 2006:

Core Research: Funds will be redirected from lower priority research areas, by reducing the number of awards across IOB to enhance funding in areas of pioneering research and complex processes. Highest priority will be placed on the following areas:

Integrative Studies on Organisms: IOB will place highest priority on integrative studies that lead to a deeper understanding of the underlying principles, mechanisms, and processes in the behavior, development, physiology, and evolutionary fitness of organisms. Studies that combine the use of genomics, proteomics, cellular, biochemical, computational, and/or physiological approaches will be highlighted.

Integration of Developmental Biology and Evolutionary Physiology: Developmental biologists have, for many years, focused their efforts in understanding ontogeny by focusing on a relatively small number of “model” organisms, while physiologists have employed a broad array of study systems, each selected for its suitability to address a specific physiological mechanism. Research employing genomics, analytics, and phenomics to produce a conceptual, analytical and methodological synthesis of these two disciplines will also be a priority because it will lead to understanding how developmental and physiological systems are integrated and how complex phenotypes are built.

Genetic/Cellular Basis for Behavior: The integration of the ability to identify the activity of individual genes active in specific neurons, with the ability to identify and examine neural networks in a variety of organisms will allow the focusing of research on the genetic/cellular basis for behavior. Research in this area will examine how the activation of specific genes in individual neurons results in specific behaviors.

Changes from FY 2005:

- Disciplinary and interdisciplinary research in the IOB core will decrease by $1.74 million. Fewer awards will be made in all core areas.

ENVIRONMENTAL BIOLOGY $107,180,000

The FY 2006 Request for the Division of Environmental Biology (DEB) is $107.18 million, an increase of $1.14 million, or 1.08 percent, over the FY 2005 Current Plan Level of $106.04 million.

Environmental Biology Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Environmental Biology	**$107.94**	**$106.04**	**$107.18**	**$1.14**	**1.1%**
Major Components:					
Research & Education Projects	$89.17	$85.04	$85.83	$0.79	0.9%
Centers Program					
Long Term Ecological Research	$15.62	$17.53	$17.53	$0.00	0.0%
National Center for Ecological Analysis and Synthesis	$3.15	$3.47	$3.82	$0.35	10.0%

About DEB:

The Division of Environmental Biology is organized into four clusters: Ecological Biology, Ecosystem Science, Population and Evolutionary Processes, and Systematic Biology and Biodiversity Inventories. DEB supports fundamental research to inventory life on earth, to discover life's origins and evolutionary history, and to understand the dynamics of biological populations, communities and ecosystems, including their complex interactions, which result in goods and services that humans require (e.g., breathable air, potable water, food and fiber, crop pollination). Studies supported by DEB clusters accelerate the rate at which we discover new species; address the genealogical relationships of plants, animals, fungi, and microbes; elucidate the spatial and temporal dynamics of species interactions (e.g., competition, predation); discover the principles or rules by which species are assembled into functional communities and change through time; and determine the flux of energy and materials through ecosystems.

The Ecological Biology Cluster supports research on natural and managed ecological systems, primarily in terrestrial, wetland, and freshwater habitats. Research areas include experimental, observational, theoretical, and modeling studies on the structure and function of complex associations that focus on biotic components, and the coupling of small-scale systems to each other and to large-scale systems.

The Ecosystem Science Cluster supports research on natural, managed, and disturbed ecosystems, including those in terrestrial, freshwater, and wetland (including salt marsh) environments. Descriptive and manipulative approaches in field, mesocosm, and laboratory settings are supported, with the expectation that the bulk of the research is question- or hypothesis-driven.

The Population and Evolutionary Processes Cluster focuses on population properties that lead to variation within and among populations. Approaches include empirical and theoretical studies of microevolution, organismal adaptation, geographical differentiation, natural hybridization and speciation, as well as processes that lead to macroevolutionary trait patterns.

The Systematic Biology and Biodiversity Inventories Cluster supports the general science of systematics, whose three main missions are: to discover, describe, and inventory global species diversity; to analyze and synthesize the information derived from this global discovery effort into predictive classification systems that reflect the history of life; and to organize the information derived from this global program in efficiently retrievable forms that best meet the needs of science and society.

In addition, the LTER Program in the Ecosystem Science Cluster, which was founded in 1980 and is jointly funded by BIO, GEO and OPP, is a network of 26 comprehensive research sites ranging from Alaska, throughout the continental US and Puerto Rico, to Antarctica, in ecosystems broadly representative of the global range. Although most LTER sites focus on near pristine terrestrial ecosystems, the network also includes urban and agricultural sites, coastal estuaries, and near-coastal oceans (including a coral reef site in the South Pacific). A Network Office coordinates network information systems and cross-site communication, as well as education, outreach, and international activities, while promoting an open access data policy that facilitates synthesis. All LTER projects share five common research themes that facilitate multi-site comparisons and encourage interdisciplinarity. Over 1200 scientists and students participate in the LTER program.

In general, 56 percent of the DEB portfolio is available for new awards. The remaining 44 percent funds awards made in previous years.

DEB priorities for FY 2006:

Core Activities: DEB supports research that addresses a continuum of questions ranging from evolutionary processes to ecosystem services, consistent with present community strengths; anticipated needs to catalyze future research; and developments in cyberinfrastructure. In essence, DEB supports studies of "What is there … how did it originate … how does it function … and how do the parts interact to form an integrated whole?" So that the information generated by these investigations is transformed to knowledge – within the scientific community and throughout the citizenry – DEB places a high priority on integrating research and education through activities that engage individuals at all levels from "K to gray."

Education and Outreach: DEB will continue to place a premium on outstanding education and outreach efforts that are coupled to research projects. DEB support will emphasize broad career horizons, experiential learning, and biosphere literacy, which prepare people to understand and apply information about the biosphere in daily life, at home, at work, and in the community. The historic levels of support for CAREER grants, Doctoral Dissertation Improvement Grants, and Research Experiences for Undergraduates will be maintained. DEB will maintain funding for the LTER Schoolyard Science activity to enhance engagement of students in the primary and secondary schools.

Complex Systems: DEB-supported activities will continue to focus on what NSF supports uniquely, or uniquely well. In this context, DEB will emphasize support for research on complex ecological and evolutionary systems, in particular research on aquatic or watershed systems that highlights emergent properties and forecasting capabilities. In supporting studies in such areas as biogeography, systematic biology, microbial ecology, and invasive species, particular emphasis will be given to quantitative understanding of the complex interrelationships between biological diversity, evolutionary processes, and ecosystem functioning. These efforts will depend on biological infrastructure such as advanced instrumentation and research collections.

Cyberinfrastructure: Special emphasis will be given to leveraging new cyberinfrastructure capabilities, developing partnerships with the informatics and computer sciences community, and bringing innovative tools into the arsenal of environmental biologists. These investments arise from the initial support from the ITR program, and are particularly evident in DEB centers: the LTER site network and NCEAS.

Disturbance Ecology: DEB will maintain support for disturbance ecology, emphasizing how such human activities as deforestation, habitat fragmentation, and species introductions affect the dynamics of biological systems, and subsequently alter the biological services that arise from those systems.

Long Term Ecological Research (LTER): This Program will continue to support site-based integrated research and educational activities that focus on five core areas: pattern and control of primary production; spatial and temporal distribution of populations selected to represent trophic structure; pattern and control of organic matter accumulation in surface layers and sediments; patterns of inorganic input and movement of nutrients through soils, ground water, and surface waters; and patterns and frequency of disturbance. The program includes emphases on cross-site collaborations, as well as the development of cyberinfrastructure capabilities for data management, visualization, and analysis.

Changes from FY 2005:

- Disciplinary and interdisciplinary research in the DEB core will increase by $790,000. This additional support and additional funds redirected from other activities will be allocated to the areas of complex ecological and evolutionary systems, with special emphasis on research that focuses on aquatic and watershed systems. This will include species discovery and phylogenetic relationships of organisms; the dynamics of freshwater and estuarine populations, communities and ecosystems; and theoretical and modeling studies that integrate the drivers, indicators and responses of water-based biological systems.
- National Center for Ecological Analysis and Synthesis: Synthetic and transformative research supported by this Center will be augmented by $350,000. The Center primarily supports research at the frontiers of population biology, ecology, and ecosystem science. The strong emphasis on quantitative, analytical, and broad scale research will continue to explore the intricacies of complex environmental systems, as well as strengthen multidisciplinary studies of relevance to natural resource management and conservation.

BIOLOGICAL INFRASTRUCTURE $82,930,000

The FY 2006 Budget Request for the Division of Biological Infrastructure (DBI) is $82.93 million, an increase of $2.31 million, or 2.86 percent, over the FY 2005 Current Plan Level of $80.62 million.

Biological Infrastructure Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Research Resources	$49.10	$49.32	$51.32	$2.00	4.1%
Human Resources	$31.58	$31.30	$31.61	$0.31	1.0%
Biological Infrastructure	**$80.68**	**$80.62**	**$82.93**	**$2.31**	**2.9%**
Major Components:					
Research & Education Projects	$75.98	$73.47	$75.73	$2.26	3.1%
Facilities					
National Nanotechnology Infrastructure Network	$0.30	$0.40	$0.40	$0.00	0.0%
National Ecological Observatories Network	$3.60	$5.95	$6.00	$0.05	0.8%
Cornell High Energy Synchrotron Source	$0.80	$0.80	$0.80	$0.00	0.0%

About DBI:

The Division of Biological Infrastructure is organized into two clusters: Research Resources and Human Resources. DBI's goal is to ensure that all biologists have access to the infrastructure required for both disciplinary and interdisciplinary research. Resources supported range from physical infrastructure, such as multi-user instrumentation, to research training for students at all levels. In addition, teams of biologists, mathematicians, physicists, chemists, computer scientists, and engineers are supported to develop new biological research tools such as software, new algorithms, and novel instrumentation.

The Research Resources cluster supports planning for the proposed National Ecological Observatories Network (NEON); instrument procurement and development; maintenance and improvement of living stock collections of microbes, plants and animals; development of biological databases and informatics tools; and enhancements to biological research collections. Research resource development for the Arabidopsis 2010 project is supported as well. These research resources are essential for cutting-edge biological research.

The Human Resources cluster supports a range of activities with the goal of nurturing the next generation of biologists. Projects supported are designed to meet NSF's goals of integrating research and education and broadening participation. This cluster also manages BIO's participation in the NSF-wide human resource development programs, i.e. REU sites, IGERT, ADVANCE, and GK-12.

In general, 68 percent of the DBI portfolio is available for new awards. The remaining 32 percent funds awards made in previous years.

DBI Priorities for FY 2006:

Research Resources

Instrumentation Resources: DBI supports three instrumentation programs: (1) Instrument Development for Biological Research (IDBR); (2) Multi-User Equipment (MUE) for biological research; and (3) improvement of Field Station and Marine Laboratories (FSML). In FY 2006 funding for IDBR and FSML will be maintained at FY 2005 levels. Additional resources will be redirected from instrumentation activities to biological databases and informatics to support cyberinfrastructure needs in biology.

Biological Databases and Informatics (BD&I): Biological research collection improvement and computerization, research on curatorial and collection management techniques, and community-based development activities are supported. In FY 2006 DBI will place a high priority on networking collection databases.

Biological research collections (BRC): BRC supports natural history collections archived at museums, botanical gardens, field stations, and academic institutions that are widely used for biological research and education. DBI will place a highest priority on networking of the collection databases.

Living stock collections (LSC): LSC supports repositories of research organisms, genetic stocks, seeds, cell lines and DNA clones that are associated with whole organisms in a collection. Funds are also provided for curatorial databases and for linking the information associated with a collection to other information resources or scientific databases. DBI gives highest priority to those resources most frequently used by the NSF-BIO community.

Arabidopsis 2010 Project: The Arabidopsis 2010 Project is a BIO-wide activity whose goal is to determine the function of all *Arabidopsis* genes by 2010. DBI supports 2010 projects that build community research resources such as collections of full-length cDNA clones and a large collection of *Arabidopsis* mutants.

National Ecological Observatories Network (NEON): NEON will be a continental scale research instrument consisting of geographically distributed infrastructure, networked via state-of-the-art communications. NEON will transform the conduct of ecological research and our ability to predict environmental change by enabling real-time ecological studies, spanning all levels of biological organization, on major environmental challenges at regional to continental scales. In FY 2006, planning for NEON implementation will continue.

Human Resources

Postdoctoral Research Fellowships: In FY 2006, BIO will focus on two fellowship programs: (1) Minority Postdoctoral Research Fellowships, and (2) Biological Informatics Postdoctoral Research Fellowships.

Undergraduate Mentoring in Environmental Biology (UMEB): UMEB supports 5-year projects designed to engage undergraduates, especially from under-represented groups, in year-round research and sustained mentoring activities. This program, which is run every other year, will be offered in FY 2006.

Cross-disciplinary Research at Undergraduate Institutions (C-RUI): This program for predominantly undergraduate institutions supports cross-disciplinary research that involves biologists and researchers from at least one other discipline. CRUI is offered in alternate years with UMEB.

Research Experience for Undergraduates (REU) sites: Support for REU sites continues to be a high priority, particularly since the program has provided opportunities for participation of students from underrepresented groups in innovative and novel ways, e.g. through collaborations between community colleges and research institutions.

Changes from FY 2005:

- Research Resources will increase by $2.0 million. Funds will be redirected from other activities in research resources to increase the informatics and database activities by $7.0 million.

- NEON will increase by $50,000 for a total of $6.0 million. The ongoing planning process for NEON will continue. As part of that process, specific technical needs are being identified for building NEON. Robust cyberinfrastructure has emerged as a key.

- Human Resources will increase by $310,000. Stipends for REU students and Postdoctoral fellows will increase to $400 per week and $45,000 per year, respectively. The participation of under-represented groups and under-served communities on BIO-supported research projects will be enhanced by making Research Opportunities for Community College Faculty supplements to BIO awardees.

EMERGING FRONTIERS $85,930,000

The FY 2006 Budget Request for the Emerging Frontiers (EF) Subactivity is $85.93 million, an increase of $11.88 million, or 16.0 percent, over the FY 2005 Current Plan Level of $74.05 million.

Emerging Frontiers Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Emerging Frontiers	**$80.25**	**$74.05**	**$85.93**	**$11.88**	**16.0%**
Major Components:					
Research & Education Projects	$80.25	$70.45	$82.93	$12.48	17.7%
Centers Program					
Center for Synthesis in Biological Evolution	$0.00	$3.60	$3.00	-$0.60	-16.7%

About EF:

The Emerging Frontiers Subactivity is an incubator for 21st Century Biology. EF supports pioneering research and networking activities that arise from advances in disciplinary research. By encouraging synergy among disciplines using project, network and centers models, Emerging Frontiers fosters new initiatives and catalyzes research at the boundaries of disciplines, which are subsequently integrated into core programs. In FY 2005 for example, the Research Coordination Networks program, after a three-year growth and development period within EF, was mainstreamed into BIO disciplinary programs. EF includes BIO-initiated multidisciplinary programs, programs that contribute to Homeland Security goals, as well as the NSF priority areas (Nanoscale Science and Engineering, Mathematical Sciences, Human and Social Dynamics, and Biocomplexity in the Environment). EF supports activities that broaden the participation of underrepresented groups in EF research and networking programs, thereby ensuring that the widest array of individuals and institutions participate in EF pioneering activities.

In general, 75 percent of the EF portfolio is available for new awards. The remaining 25 percent funds awards made in previous years.

EF priorities for FY 2006:

Microbial Biology: In FY 2006, a new emphasis on microbial biology at all levels from the molecular to the ecological will be established within EF. While microbial research has long been supported across the biological sciences, and will continue to be supported within core programs, some activities are being transferred from MCB to EF to form components of the new emphasis area. Included in the emphasis area will be microbial genome sequencing, microbial observatories, microbial interactions and processes, and other microbial research and training activities.

> **Microbial Genome Sequencing Program:** Microbial genome sequence data provide basic information about named microbial species and clues to the identity and function of microbes, newly isolated from nature or introduced by human agents. In FY 2006 the Microbial Genome

Sequencing Program, conducted jointly with the USDA CSREES competitive grants program, will continue support for microbial genome sequencing and will support experimental approaches and the development of tools to examine novel microbial sequences.

Microbial Observatories and Microbial Interactions and Processes Program: Microbial Observatories and Microbial Interactions and Processes funds researchers to enhance our understanding of the microbial world by using leading edge tools such as microbial genome sequence data.

Assembling the Tree of Life: Theoretically, all life from microbes to humans can be connected through phylogenetic relatedness to form a single, vast evolutionary *Tree of Life*. With support from EF, multidisciplinary teams of informaticians, mathematicians, and biologists, using advanced cyber tools as well as museum, molecular, and digital databases, will continue to tackle the enormous computational and scientific hurdles that must be overcome in Assembling the Tree of Life (AToL). If successful, the results of these efforts will be useful in agriculture, biomedicine, environmental management and other areas that rely on the comparative approach or model organisms.

Environmental Genomics: Understanding the complex biological processes that drive environmental systems requires multidisciplinary teams using the latest approaches and tools. In FY 2006, a partnership between BIO, GEO and OPP will bring the power of genomics to bear on important environmental topics such as relationships between nutrient cycling and ecological dynamics, population genetics, ecosystem structure and productivity; the evolution of species and changes in biodiversity; and ecosystem vulnerability and resilience to extreme events.

Ecology of Infectious Diseases Program: This program, jointly conducted with the NIH, continues to support efforts to understand the ecological and biological mechanisms that govern relationships between human-induced environmental changes and the emergence and transmission of infectious diseases. The potential benefits of findings from this program include: development of disease transmission theory, increased capacity to forecast disease outbreaks, and improved understanding of how diseases emerge and re-emerge.

Frontiers in Integrative Biological Research: FIBR continues support for research on major biological questions that are addressed using the creative application of a broad range of strategies and research tools from within and outside the biological sciences. FIBR projects encompass multiple levels of organization of complexity, time and space, or range of organisms or processes, use combined experimental and theoretical analyses; and apply a broad range of interdisciplinary approaches in a single, coherent effort.

Center for Synthesis in Biological Evolution: This center was first established in FY 2005 with funding through FY 2009. In FY 2006, it will continue to develop new tools and cross-disciplinary standards for management of biological information, support data analysis capabilities, host workshops, and begin to host and curate databases that are important for evolutionary synthesis.

Broadening Participation: BIO will strive to engage and broaden the participation of individuals from groups traditionally underrepresented in the biological sciences by providing planning grants for early career researchers, and funding career advancement awards to mid-career researchers to promote their professional development and retention in the biological sciences. Linkages between programs in BIO and programs in EHR such as CREST, AGEP, and LSAMP will be enhanced.

Changes from FY 2005:

- Center for Synthesis in Biological Evolution: The decrease in funding level to $3.0 million, or $600,000 less than FY 2005 reflects a shift from covering start-up costs to the day-to-day research and educational activities of the Center.
- Nanoscale Science and Engineering: Funding will decrease by $2.0 million to $3.85 million in FY 2006. BIO will emphasize research on nanoscale sensors and information processors that could provide new tools for understanding detection of environmentally important signals.
- Microbial Observatories and Microbial Interactions and Processes: Funding in FY 2006 will be $12.21 million to support projects that employ the latest genomic and leading edge tools to study microbes in their natural habitats.
- Broadening Participation: Support for research planning grants and career advancement awards will increase by $1.0 million to a total of $4.0 million. Further connections between BIO and EHR will be forged.
- Frontiers in Integrative Biological Research: The additional $1.27 million will allow BIO to make more of these complex, multi-disciplinary research grants and planning grants. FIBR grants have a longer duration and are funded at a higher average annual award size than many core research grants in order to facilitate these new approaches to major biological questions. Total funding is $20.0 million.

PLANT GENOME RESEARCH $94,240,000

The FY 2006 Budget Request for the Plant Genome Research (PGR) Subactivity is $94.24 million, equal to the FY 2005 Current Plan Level.

Plant Genome Research Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Plant Genome Research	**$89.47**	**$94.24**	**$94.24**	**$0.00**	**0.0%**
Major Components:					
Research & Education Projects	$53.47	$58.24	$58.24	$0.00	0.0%
Virtual Centers	$36.00	$36.00	$36.00	$0.00	0.0%

About PGR:

The Plant Genome Research Subactivity was initiated in FY 1998, building upon an existing base of genome research supported throughout the BIO Directorate. PGR supports projects that make significant contributions to our understanding of plant genome structure and function. Emphasis is placed on plants of economic importance, as well as plant processes of potential economic value. Long-term benefits of this research include fundamental breakthroughs in our understanding of plant biology and practical applications to crop improvement, and the development of novel, plant-based products.

The program was established as part of the National Plant Genome Initiative (NPGI). NSF plays a major role in the NPGI. Other participating agencies include USDA, DOE, NASA, USAID, and NIH. The NSF program follows the guidelines and objectives of the NPGI. PGR works closely with the other agencies in coordinating funding activities through the Interagency Working Group on Plant Genomes under the auspices of the National Science and Technology Council within OSTP, and by jointly sponsoring activities ranging from genome sequencing projects to workshops.

PGR has supported two general kinds of projects, one to develop research infrastructure that would enable a broad community of scientists to participate in plant genome research and the other to understand the structure, organization and function of plant genomes using an integrative approach. Informatics and education/training are integral to both of these projects. Accomplishments and progress by plant genome funded researches on both fronts include:

- Sequenced the whole genome of a reference grass species (rice) and a reference dicotyledonous species (Arabidopsis);
- Determined the most efficient strategy to sequence the maize genome and began projects to sequence the entire maize genome;
- Deposited over 3 million Expressed Sequence Tags (ESTs) to genes from economically important plants in GenBank, the majority from Plant Genome Research Program projects;
- Established efficient maize transformation methods;

- Developed a novel tool (TILLING) to identify collections of mutations in any gene in any plant, applied to 16 plant species, and utilized in 6 countries including the TILLING facility at IRRI (the International Rice Research Institute) in the Philippines;
- Developed a high-throughput screen for finding mutations that affect the structure of plant cell walls and a collection of monoclonal antibodies to identify every chemical component of those walls;
- Sequenced the genomes of two important plant pathogens (a causal agent of potato blight and rice blast) and applying the information to understanding how the pathogen establishes the initial infection process and how the plant fights against it;
- Continued discovery of new genes involved in plant processes of economic importance, including disease resistance, stress tolerance, and floral development;
- Established a new kind of genome database for plants, called PlantGDB, which will point the way to the future, where plant genome data will be presented in an integrated and cross-referenced form;
- Established two centers to develop microarrays, data analysis tools, and a community database for rice and maize gene expression analysis; and
- Increased understanding of the domestication processes of major crop species from their wild relatives.

Plant species being studied cover about 20 economically important plants ranging from apple to wheat, including all major food, forage, fiber and wood crops.

In general, 32 percent of the PGR portfolio is available for new awards. The remaining 68 percent funds awards made in previous years.

PGR priorities for FY 2006:

PGR will place priorities on projects that build on research resources, tools and information accumulated over the last six years.

Continue Support for Maize Genome Sequencing: PGR will continue to support the interagency maize genome-sequencing project that began in FY 2005. Maize is the most economically important crop in the U.S. From a scientific standpoint, the maize genome when completed will become the most complex eukaryotic genome to be sequenced to date, including the human genome. This sequencing project was made possible because of earlier investments by PGR to understand the structure and organization of the maize genome as well as to develop the best sequencing strategies.

Understanding Complex Plant Processes of Economic Importance: The research community has become increasingly able to answer long-standing major questions in plant biology because of the new tools and information resulting from PGR activities. A new focus of the program will be on increased understanding of the fundamental mechanisms underlying complex plant processes of economic importance beyond merely identifying genes involved in the process. Such projects of high economic importance would include: (1) formation of specialized plant structure such as tubers and bulbs; (2) assembly of softwood and hardwood; (3) efficiency in water utilization by plants; (3) uptake of nutrients from the soil; (4) biosynthesis of organelles such as chloroplasts, mitochondria, and peroxisomes; (5) complex interactions between plants and other organisms; and (6) determination of photosynthetic rate.

Plant Genomics Data Management: Enormous amounts of data on many different aspects of plant genomics are flooding cyberspace. It is critical that seamless ways for biologists to access and make use of the data by biologists be developed. Two major focus areas will be databases and informatic tools. Specific issues associated with databases are the long-term curation and maintenance, interoperability among databases, and accessibility. Informatics tools are needed for the community to make maximum use of data in the databases. 21st Century Biology requires that scientists be able to interrogate existing data in order to make conceptual advances based on the analysis and synthesis of that data.

Research Collaboration with Scientists in Developing Countries: PGR will continue to support research collaboration between US scientists and scientists in developing countries with a focus on plant genomics and plant biotechnology. The activity began in FY 2004, and is coordinated with OISE at NSF as well as USAID. The intent of this activity is to support collaborative research linking US researchers with partners from developing countries to solve problems of mutual interest in agriculture, energy and the environment. It will place US and international researchers at the center of a global network of scientific excellence. Thus far, PGR has supported research collaboration with scientists from Mexico, Peru, Indonesia, Philippines, Nepal, India, and several African nations.

Virtual Centers: Virtual centers are PGR awards that involve multiple investigators from multiple institutions. They can be research projects or infrastructure building projects. Coordination of management of the outcomes of research, broadening participation of under-represented and under-served groups, training of the next generation of scientists, and outreach to K-12 teachers and students are emphasized.

Changes from FY 2005:

The FY 2006 Request is equal to the FY 2005 Current Plan. Budget allocation among various research projects will be made based on merit review of competing proposals. The only administrative change expected in FY 2006 is that PGR will limit the number of proposals a single investigator can submit to PGR per competition, in an effort to broaden participation of scientists and institutions from all segments of the US scientific community.

Computer and Information Science and Engineering

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING $620,560,000

The FY 2006 Budget Request for the Computer and Information Science and Engineering (CISE) Directorate is $620.56 million, an increase of $6.84 million, or 1.1 percent, over the FY 2005 Current Plan of $613.72 million.

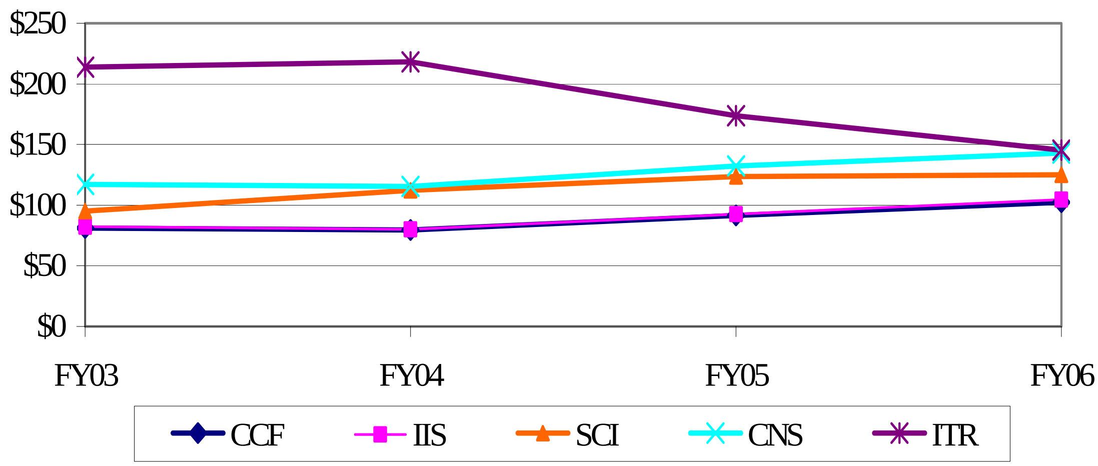
Computer and Information Science and Engineering Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Computing and Communication Foundations (CCF)	79.59	91.41	102.53	11.12	12.2%
Computer and Network Systems (CNS)	115.40	132.39	142.96	10.57	8.0%
Information and Intelligent Systems (IIS)	80.02	92.54	104.67	12.13	13.1%
Shared Cyberinfrastructure (SCI)	112.29	123.60	124.96	1.36	1.1%
Information Technology Research (ITR)	218.07	173.78	145.44	-28.34	-16.3%
Total, CISE	$605.35	$613.72	$620.56	$6.84	1.1%

Totals may not add due to rounding.

The Computer and Information Science and Engineering Directorate (CISE) supports investigator-initiated research in all areas of computer and information science and engineering; guides the development, deployment, and management of cutting-edge national computing and information infrastructure for all science and engineering research and education; and contributes to the education and training of future generations of computer scientists and engineers.

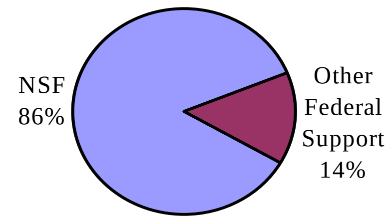
CISE Subactivity Funding
(Dollars in Millions)



Note: CISE subactivities have been reorganized; crosswalk data prior to FY 2003 are not available. The chart indicates that, with the completion of the ITR priority area, CISE ITR investments are being redirected to prominent IT research challenges and opportunities in core CISE activities in CCF, CNS and IIS.

RELEVANCE

Federal Support for Basic Research in Computer & Information Science & Engineering at Academic Institutions



CISE is the principal source of federal funding for university-based basic research in computing disciplines, providing the vast majority - 86 percent - of total federal support in this area. The CISE Directorate also plays a leadership role in the multi-agency Networking and Information Technology Research and Development (NITRD) program, chairing many of the working groups that promote interagency coordination.

Consistent with the Administration's NITRD priority, in FY 2006 CISE will continue to support innovative IT research and education activities, promoting advances in new software, hardware, systems, and algorithms. Informed by the recommendations of the High End Computing Revitalization Task Force (HEC-RTF), these investments include funds targeted to the development of new HEC Hardware and software architectures. CISE will also focus on building research capacity in areas foundational to homeland security, such as cyber security, machine translation, artificial intelligence, computer vision, and technologies for collaboration and information retrieval. This is consistent with the interagency Homeland Security R&D priority. CISE will continue to contribute to the National Nanotechnology Initiative, supporting exploratory and interdisciplinary work on novel nano-based devices and architectures that promise to form the basis of future computing and communication systems.

In FY 2006, CISE will continue to capitalize on the positive outcomes of the agency's former Information Technology Research (ITR) priority area. ITR, an NSF-wide priority area from FY 2000 to FY 2004, spurred innovative research, permitted work on realistic-scale problems, and built strong bridges between computing and other fields. ITR outcomes have led to the emergence of a new CISE "core", with a greater focus on inter- and cross-disciplinary research and education activities. In FY 2006, support will continue for projects of varying size and scope, including single investigators, research teams, and center-scale activities.

As a result of the essential and growing role of computing in society, the number of new scientific opportunities and challenges presented by the field far exceeds CISE's ability to fund them. While CISE has always received many more quality proposals than can be funded, as a consequence of growth in the field proposal funding rates have declined dramatically in recent years. In FY 2004, proposal funding rates in some CISE programs dropped precipitously to levels significantly below the NSF average.

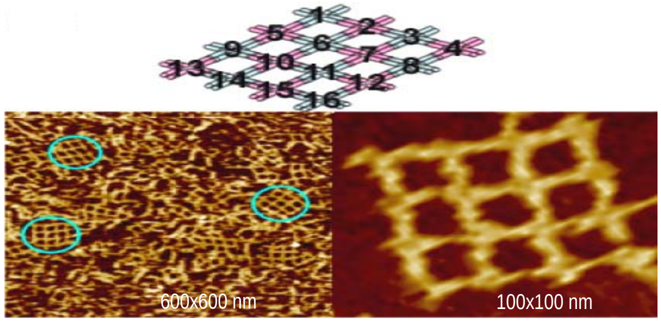
Increased CISE funding in FY 2006 will focus on addressing the most prominent challenges and opportunities of information technology, while at the same time addressing the need to increase proposal funding rates.

Summary of Major Changes by Division *(Dollars in Millions)*

CISE FY 2005 Current Plan………………………………………………………………. **$613.72**

Computing and Communication Foundations +$11.12

Increased support will lead to the development of revolutionary software and hardware architectures that improve the raw performance of computing systems, potentially by orders of magnitude and contribute to the improved security, reliability, and manageability of computing systems. In addition, increased support will lead to new understanding of both the limits and optimal methods of computation and communication in our increasingly mobile and interconnected world. The accompanying graphic, demonstrates the self-assembly of DNA-based structures, which have promise to form the basis of future generations of computing architectures.



Computer and Network Systems +$10.57

Increased funding will support projects that promote the systematic redesign of current network systems, a pressing challenge since the Internet as we currently know it is fast reaching the limits of its capacity and capability. Available funds in CNS will also support the development of sensor systems that can greatly improve our ability to predict, detect and respond to natural disasters. CNS will also increase support for projects aimed at making significant breakthroughs in the design and implementation of systems software. Improving the security of computing and communications systems is of vital importance and is an essential component in the Division's programs.

Information and Intelligent Systems +$12.13

Increased support will promote advances in Science and Engineering Informatics, informing the development of information tools and technology that permit the effective collection, representation and analysis of very large collections of scientific data that further promotes discovery. It will also enable increased funding rates and build research capacity in areas foundational to homeland security such as machine translation, artificial intelligence, computer vision and robotics.

Shared Cyberinfrastructure +$1.36

Support will continue to be provided for the Extensible Terascale Facility and other cyberinfrastructure resources, tools and services to meet the needs of the national science and engineering community. Efforts to build a base for the future expansion of cyberinfrastructure will also continue to be supported.

Information Technology Research -$28.34

In FY 2006, funds are moved from the ITR subactivity to the CCF, CNS, and IIS Divisions to support emerging scientific opportunities in the CISE core and to increase core funding rates.

Subtotal, Changes +$6.84

FY 2006 Request, CISE…………………………………………………………………...….. $620.56

Summary of Major Changes in Directorate-wide Investments *(Dollars in Millions)*

CISE FY 2005 Current Plan………………………………………………………………. $613.72

Trustworthy Computing: +$5.0

Computers, especially those that are networked, reside at the heart of systems on which people now rely, both in critical national infrastructures and in their homes, cars, and offices. Today, many of these systems are far too vulnerable to cyber attacks that can inhibit their function, corrupt important data, or expose private information.

To respond to these challenges, CISE established a new program in FY 2004 called Cyber Trust to complement ongoing cyber security research and education investments made in the core CISE programs. In FY 2006, focused investments in Cyber Trust and the core CISE programs will: target basic research aimed at making computing systems more secure; develop improved understanding of the human, organizational, legal, and economic contexts in which trusted computing systems are developed and operated; and strengthen education for those who will create such systems and for those who will configure, operate, investigate, and use the systems produced.

Cyberinfrastructure-Computational Science, High End Computing, and Information Integration: +$12.96

The practice of science and engineering at the research frontier is being transformed by increasingly powerful and pervasive information technology, as described in the 2003 Report of the NSF Advisory Committee on Cyberinfrastructure (*Revolutionizing Science and Engineering through Cyberinfrastructure*). The 2004 Report of the High-End Computing Revitalization Task Force further noted that most currently available hardware, software, systems, and algorithms are focused mainly on business applications only suitable for smaller-scale scientific and engineering problems. These systems do not meet the high-end supercomputing needs of the science and engineering community.

In FY 2006, CISE will promote advances in cyberinfrastructure through focused research investments that include: building complex software and tools for high-end computing architectures; developing multi-scale analysis methods in computational science; and developing more sophisticated tools and technologies to support the analysis and management of scientific data and information.

Continued CISE leadership and investments in the development and deployment of a pervasive and persistent cyberinfrastructure, including HEC systems essential to the work of the national science and engineering community, are also planned for FY 2006. These investments draw upon strong interdisciplinary partnerships of computer scientists and scientists in other domains and will leverage the outcomes generated by CISE cyberinfrastructure research investments.

Finally, CISE funds will explore promising new approaches to prepare current and future generations of scientists and engineers to exploit cyberinfrastructure to advance their research and education agendas.

Broadening Participation in Computing: +$10.00

The growing influence of computing in society coupled with declining enrollments in computing fields demands a significant national effort aimed at increasing the number of young people entering and remaining in the computing field. This increase must occur across all segments of the population, but it is particularly important among those groups that historically have not participated at high rates: women, persons with disabilities, and minorities. The under participation of these groups causes a loss of opportunity for individuals, a loss of talent to the workforce, and a loss of diverse perspectives and creativity in shaping the future of technology. This CISE-wide emphasis aims to develop and implement innovative models for recruiting, mentoring, and retaining students from underrepresented communities in post secondary programs in computing disciplines.

Reductions in other CISE programs -$21.12

Funds previously available for IT research and education broadly, are targeted in FY 2006 to the IT priorities described above.

Subtotal, Changes +$6.84

FY 2006 Request, CISE……………………………………………………………………...….. $620.56

PRIORITY AREAS

In FY 2006, CISE will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

CISE Investments in NSF Priority Areas
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biocomplexity in the Environment	8.01	8.00	3.00	-5.00	-62.5%
Nanoscale Science and Engineering	17.56	18.48	5.00	-13.48	-72.9%
Mathematical Sciences	2.18	2.29	2.29	0.00	0.0%
Human and Social Dynamics	3.00	3.00	3.00	0.00	0.0%

Biocomplexity in the Environment: A total of $3.0 million will focus on environmental system synthesis, integration of observing systems, and computational challenges in biodiversity and ecosystem informatics. Prior CISE investments in Biocomplexity in the Environment have stimulated new research activities in the CISE core. Consequently, in FY 2006 CISE is redirecting funds previously invested in Biocomplexity in the Environment to related core activities such as Science and Engineering Informatics in IIS.

Nanoscale Science and Engineering: A total of $5.0 million will continue support for projects that advance the adoption of nano-devices and systems in computing applications. Prior CISE investments in Nanoscale Science and Engineering have stimulated new research activities in the CISE core. Consequently, in FY 2006 CISE is redirecting funds previously invested in Nanoscale Science and Engineering to related core activities such as Emerging Models and Technologies for Computation in CCF.

Mathematical Sciences: A total of $2.29 million will emphasize interdisciplinary research and education bridging IT and mathematical disciplines, with focus on algebraic and geometric algorithms, algorithms for scalable scientific computations and algorithms for visualization.

Human and Social Dynamics: A total of $3.0 million will expand research in areas such as augmented cognition and the exploration of new interfaces and tools that allow people to make informed and rational decisions in spite of human limitations and biases.

QUALITY

CISE maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The percent of research funds that were allocated to projects that undergo external merit review was 96 percent in FY 2004, the last year for which complete data exist.

To ensure the highest quality in processing and recommending proposals for awards, CISE convenes Committees of Visitors (COVs), composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments. In FY 2005, CISE will oversee the COV for ITR and for the SCI Division. COVs planned for FY 2006 include those for the CCF, CNS, and IIS Divisions.

CISE also receives advice from the Advisory Committee for Computer and Information Science and Engineering (CISEAC) on such issues as: the mission, programs, and goals that can best serve the scientific community; how CISE can promote quality graduate and undergraduate education in the computer and information science and engineering sciences; and priority investment areas in computer and information science and engineering research. The CISEAC meets twice a year with members volunteering their time to serve on subcommittees for three additional days per year. Members from both academe and industry represent a cross section of the computer and information science and engineering field, with representatives from many different sub-disciplines within the field. The CISEAC includes a balanced representation of women, underrepresented minorities, and individuals from a range of geographic regions.

PERFORMANCE

NSF's FY 2006 budget is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Computer and Information Science and Engineering
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

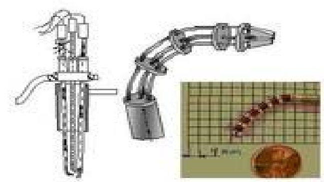
	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	48.89	44.55	46.55	2.00	4.5%
Institutions	7.67	7.95	7.95	-	-
Collaborations	0.92	2.50	20.92	18.42	736.8%
	57.48	55.00	75.42	20.42	37.1%
Ideas					
Fundamental Science and Engineering	409.42	409.39	396.40	-12.99	-3.2%
Science and Technology Centers	4.00	4.00	4.00	-	-
Capability Enhancement	0.95	1.45	1.70	0.25	17.2%
	414.37	414.84	402.10	-12.74	-3.1%
Tools					
Facilities	111.16	121.26	114.50	-6.76	-5.6%
Infrastructure and Instrumentation	14.66	14.66	20.58	5.92	40.4%
Polar Tools, Facilities and Logistics	-	-	-	-	-
Federally-Funded R&D Centers	-	-	-	-	-
	125.82	135.92	135.08	-0.84	-0.6%
Organizational Excellence	7.68	7.96	7.96	-	-
Total, CISE	$605.35	$613.72	$620.56	$6.84	1.1%

Totals may not add due to rounding.

CISE will continue its commitment to education, training, and increasing diversity within the computing field; an increase of almost $18 million in PEOPLE collaborations reflect this commitment and represents growing CISE investments in the Broadening Participation in Computing (BPC) and Cyberinfrastructure CI-TEAM programs. Prominent IT research challenges and opportunities in the core CISE Divisions of CCF, CNS and IIS are also targeted in FY 2006. At the same time, the FY 2006 Request seeks to increase funding rates and to emphasize crosscutting research and education opportunities in computing.

Recent Research Highlights

Cooperative Steady-Hand Augmentation of Human Skill in Micromanipulation Tasks. The primary focus of this research is on development of a cooperatively controlled 'steady hand' robot for microsurgery and other fine manipulation tasks, research exploring and extending the steady hand paradigm, and application of the system for prototypical microsurgical tasks in areas such as ophthalmology and otology. Researchers at John Hopkins University have conceived of and begun prototyping a new class of highly dexterous robotic devices suitable for minimally-invasive microsurgical procedures in the throat and airways, as well as for other precise, multi-handed tasks in confined spaces.



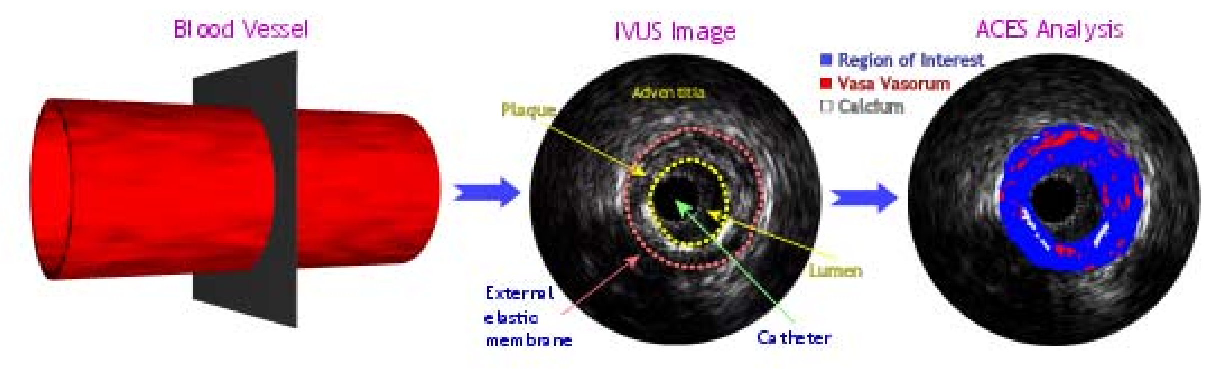
(Left) Conceptual design for a 3-armed robot for microsurgery of the throat and airways. (Middle) Detail of novel 4mm diameter micro-parallel arm with flexible elements; (Right) Photo of prototype snake-like arm constructed after completion of NSF grant.

The mechanical architecture of these robots consists of a snake-like unit and a modular detachable parallel unit that attaches at the tip of the snake-like unit. The snake-like unit uses a novel design utilizing multiple continuous backbones for its actuation. The parallel manipulation unit uses flexible links to accurately manipulate the payload in a small workspace and eliminates the need for small mechanical joints. All these features support the down-size scalability of these designs to diameters smaller than 5 mm – a critical dimension beyond which standard designs of snake-like units and parallel robots for payload manipulation becomes extremely expensive and mechanically complicated. These smaller diameters are needed for many surgical applications.

ITR: Learning-Centered Design Methodology: Meeting the Nation's Need for Computational Tools for K-12 Science Education (Engineering Scaffolded Work Environments). The University of Michigan’s Center for Highly-Interactive Computing in Education (HI-CE) has designed, classroom-tested, and freely-distributed a suite of educational applications for handheld computers through ITR funding. They have recorded over 100,000 downloads of this software over the past two years. Of the 12 educational applications ranked by eSchool News, nine were produced under ITR funding at HI-CE. In effect, HI-CE software enables educators to take handheld computers designed for business and repurpose them for use in K-12.

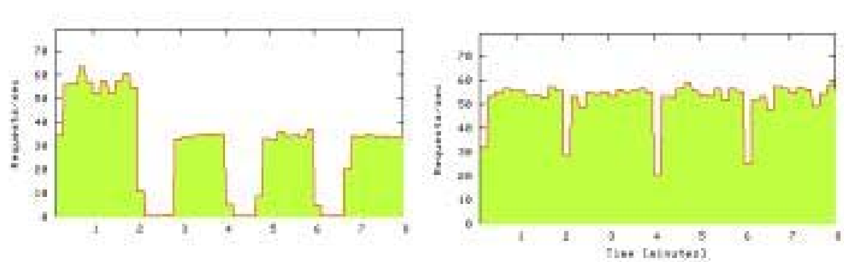
Under supplemental Research Experiences for Teachers (RET) funding, HI-CE investigators have worked with over a dozen K-12 teachers across the country to develop curricular materials that provide science and math teachers with concrete ways in which to use HI-CE’s software on handheld computers. Moreover, HI-CE software is used in the curricular examples in many books published for K-12 about handheld computers. From basic research to commercialization, with nationwide, free distribution in between, this effort has demonstrated how a University-based project can “fill the pipeline” with cutting-edge, provocative technology.

Cardiovascular Informatics. Sudden heart attacks remain the leading cause of death in the U.S. Since the majority of sudden cardiac deaths occur in people with no prior symptoms, there is an urgent need for computational tools to assist in screening for the conditions that underlie these cardiac events. Researchers at the University of Houston are developing advanced computer vision technology for a variety of applications, including assisting with the diagnosis of coronary heart disease. Patients who already present risk factors undergo an intravascular ultrasound procedure that is capable of analyzing in detail any plaques present in coronary blood vessels. In particular, those plaques that are considered vulnerable (i.e., likely to rupture and cause a heart attack) have been found to encourage the growth of new microvessels in their vicinity. These microvessels are small vessels and are generally difficult to detect. However, using the contrast-enhanced intravascular ultrasound acquisition technique developed by researchers at the University of Houston, evidence of their presence can be detected.



Recovery Oriented Computing. The time required to restart a system after failure continues to be a major concern for systems that must be continuously available. Safety-critical systems are particularly affected by a lengthy interval for recovery and restart.

In an innovative NSF CAREER research project, Armando Fox, Assistant Professor, Stanford University, earned recognition as one of *Scientific American* magazine's 50 outstanding young scientists for 2003. Dr. Fox has generalized the concept of "recovery through rebooting" to "micro-reboot" individual components of existing applications, significantly improving their availability with no application changes and no a priori knowledge of application structure. Dr. Fox successfully demonstrated that a technique called "statistical-anomaly based failure detection" finds and localizes faults in these applications. While traditional techniques typically leave systems in unpredictable states, this research pursues a new design philosophy called Crash-Only Software. A crash-only system or component can be safely and predictably crashed at any time using mechanisms orthogonal to the component itself, allowing rebooting to be safely used as a recovery mechanism from many fault types. The ultimate goal is self-managing systems technology for future reliable distributed systems.



The graph on the left shows recovery via traditional reboot. The graph on the right shows recovery via micro-reboot. Note that the troughs are much smaller.

Data Mining for Detecting Network Intrusions. Novel data mining based anomaly detection techniques developed under NSF support have been incorporated in the Minnesota Intrusion Detection System (MINDS) that help cyber security analysts detect intrusions and other undesirable activity in real life networks.

MINDS is being used at the Army Research Laboratory (ARL) Center for Intrusion Monitoring and Protection (CIMP) and at the University of Minnesota to successfully detect novel intrusions, policy violations, and insider abuse that cannot be identified by widely used signature-based tools such as Snort. MINDS allows cyber security experts to quickly analyze massive amounts of network traffic, as they only need to evaluate the most anomalous connections identified by the system. Further summarization of these anomalous connections using association pattern analysis helps in understanding the nature of cyber attacks, as well as in creating new signatures for use in intrusion detection systems. The underlying techniques have applicability in many areas beyond cyber security, such as financial and health care fraud detection.

Prototype Leadership-Class Supercomputer Up and Running. Nearly half of the new XT3 "Red Storm" system at the Pittsburgh Supercomputing Center (PSC), more than 1,000 processors providing roughly five teraflops of capability, were installed and running in PSC's machine room by the end of December, 2004. The XT3 architecture is based on the "Red Storm" system developed at the Sandia National Laboratories. The PSC system will soon provide 10 teraflops of capability for NSF science and engineering research and education.

Applications already running on the new system include storm forecasting, earthquake modeling, quantum chromodynamics, cosmology and numerical relativity. A quantum materials science application, LSMS, shows per-processor performance on the XT3 more than twice that of LeMieux, PSC's existing terascale computer system. Other application areas expected to benefit significantly from the PSC XT3 system include molecular dynamics modeling of complex biological systems, modeling of cellular microphysiology, fluid dynamics and turbulence, blood flow, climate modeling, and network simulation and modeling.

Ten racks of XT3 containing nearly 1,000 AMD Opteron processors stand side-by-side in PSC's machine room at the Westinghouse Energy Center, Monroeville, PA.

Other Performance Indicators

The tables below show the change in the number of people benefiting from CISE funding, and trends in the award size, duration and number of awards.

Number of People Involved in CISE Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	4,200	4,400	4,420
Other Professionals	1,400	1,200	1,210
Postdoctorates	500	500	600
Graduate Students	4,700	4,800	4,870
Undergraduate Students	810	1,000	1,150
Total Number of People	11,610	11,900	12,250

CISE Funding Profile

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	1,064	1,050	1,050
Funding Rate	16%	17%	19%
Statistics for Research Grants:			
Number of Research Grants	823	900	905
Funding Rate	14%	15%	16%
Median Annualized Award Size	$119,734	$116,000	$116,000
Average Annualized Award Size	$175,474	$165,000	$165,000
Average Award Duration, in years	3.2	3.0	3.0

COMPUTING AND COMMUNICATION FOUNDATIONS $102,530,000

The FY 2006 Request for the Division of Computing and Communication Foundations (CCF) is $102.53 million, an increase of $11.12 million, or 12.2 percent, over the FY 2005 Current Plan of $91.41 million.

Computing and Communication Foundations Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Computing and Communication Foundations	**$79.59**	**$91.41**	**$102.53**	**$11.12**	**12.2%**
Major Components:					
Research & Education Grants	75.59	87.41	98.53	11.12	12.7%
Science and Technology Centers	4.00	4.00	4.00	0.00	0.0%

About CCF:

CCF is organized into three clusters: Theoretical Foundations, Foundations of Computing Processes and Artifacts, and Emerging Models and Technologies for Computation. Within and across these clusters, CCF supports research and education activities that explore the foundations of computing and communication devices and their usage. Research and education projects supported promote advances in computing and communication theory, algorithms for computer and computational sciences, architecture and design of computers and software, and investigations of revolutionary computing paradigms such as bio-inspired computing. CCF projects also integrate education with research to prepare future generations of computer science and engineering professionals.

In FY 2004, the CCF Division at NSF received over 1,800 proposals, including considerably more high quality proposals than could be funded. In fact, the CCF funding rate was only 18 percent, six percent below the NSF average. Within the FY 2005 Current Plan, approximately 50 percent of CCF funding is already committed to grants made in previous years. A portfolio that includes a “mortgage” of approximately 50 percent for ongoing grants allows CCF to maintain a funding rate of 15 to 20 percent, and ensures about half of CCF funds are available each fiscal year for new awards. This flexibility is particularly crucial in the computing field where the pace of technological innovation is rapid.

CCF supports the Science and Technology Center for Embedded Networked Sensing (CENS). CENS is exploring embedded networked sensing systems, large-scale, distributed, systems, composed of smart sensors and actuators embedded in the physical world. These systems promise to form a critical infrastructure resource for society – they will monitor and collect information on such diverse subjects as plankton colonies, endangered species, soil and air contaminants, medical patients, and buildings, bridges and other man-made structures. Across this wide range of applications, embedded networked sensing systems promise to reveal previously unobservable phenomena.

CCF Priorities for FY 2006:

Ensuring Architectural Robustness for Hardware and Software:
Innovative computing architectures are needed that improve not just the raw performance of computing systems, but their reliability, predictability, and transformability. As an example, researchers at the

University of Maryland and at Mississippi State University are mining data on defects and changes in industrial software projects. This will lead to software architectures that can cope with change during software development. Introduction into the classroom will help train individuals who can produce robust, high-quality software. A new CCF focus on Architectural Robustness will seek to improve the quality of all aspects of computing and information systems. Architectural Robustness will guide the CISE-wide emphasis on High-End Computing research in FY 2006, which will focus on easing the integration of applications onto high-end architectures.

Fabricating Emerging Technologies:
New technologies for computation demand new fabrication methods. For example, lithographic techniques used in today's silicon chips may not extend to the nanometer scale, or may require additional constraints for such technologies as quantum logic. Research on fabricating emerging technologies will explore the algorithmic and computational implications of these new methods and constraints. Currently researchers at the California Institute of Technology are developing tiling techniques for building DNA nanostructures that assemble themselves automatically and correct for errors in self-assembly. This may result in a new understanding of biological processes, as well as miniaturizing devices that compute or communicate.

Strengthening the Foundations of Connectivity:
High-speed wireless and optical communications continue to change the ways we interconnect sensors, processors, and other devices. Massive numbers of devices may change positions and connections, leading to new protocols and algorithms as well as new inherent limits. For example, researchers at Brigham Young University and the University of Colorado are developing techniques for controlling multiple unmanned air vehicles that can sense and communicate. The Theoretical Foundations cluster will support research on Foundations of Connectivity to explore the control and use of these mobile changing networks, which will accelerate their use in applications such as environmental monitoring, precision agriculture, and homeland security.

Enabling Geometric Computation:
CCF will also focus on the scientific opportunities associated with Geometric Computation, to transform the use of information technology to improve modeling and understanding of the physical world. Researchers at Carnegie–Mellon University are developing new techniques for geometric modeling of soft tissue. Researchers at Johns Hopkins University are exploring haptic interfaces that provide tactile understanding of complex shapes or soft tissue. New techniques for rendering graphics images will improve our visual understanding of complex structures. These will come together to produce ideas such as biophysical models of tissues of individual patients that physicians can use for disease diagnosis and treatment.

Changes from FY 2005:

The FY 2006 Request for CCF includes an increase of $11.12 million, which will be directed toward the following activities:

Core Research and Education: +$11.12

Disciplinary and interdisciplinary research in the CCF core will increase by $10.77 million. This additional support will be allocated to activities like those described herein, and will help address the low proposal funding rate in CCF.

Support for Research Experiences for Undergraduate supplements will increase by $350,000.

COMPUTER AND NETWORK SYSTEMS $142,960,000

The FY 2006 Request for the Division of Computer and Network Systems (CNS) is $142.96 million, an increase of $10.57 million, or 8.0 percent, over the FY 2005 Current Plan of $132.39 million.

Computer and Network Systems Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Computer and Network Systems	**$115.39**	**$132.39**	**$142.96**	**$10.57**	**8.0%**
Major Components:					
Research & Education Grants	100.73	111.81	122.38	10.57	9.5%
Computing Research Resources	14.66	14.66	20.58	5.92	40.4%
Other Infrastructure Support	0.00	5.92	0.00	-5.92	-100.0%

About CNS:

The CNS Division is organized into four clusters: Computer Systems, Network Systems, Computing Research Infrastructure, and Education and Workforce. Organization into clusters minimizes stove-piping within the subdisciplines that CNS supports and allows changes in support patterns dependent on the scientific opportunities and needs of the subdisciplines represented in this Division. Within and across these clusters, CNS supports research and education activities that invent new computing and networking technologies and that explore new ways to make use of existing technologies. The Division seeks to develop a better understanding of the fundamental properties of computer and network systems through analysis, prototyping, and experimentation, and to create better abstractions and tools for designing, building, analyzing, and measuring future systems. The Division also supports the computing infrastructure that is required to enable state-of-the-art computer science research and education, and it coordinates cross-divisional activities that foster the integration of research, education, and workforce development to develop future generations of computer science and engineering professionals.

In FY 2004, the CNS Division received over 2,000 proposals, including many more quality proposals than could be funded. In fact, the CNS funding rate was only 18 percent, six percent below the NSF average. Within the FY 2005 Current Plan, approximately 50 percent of CNS funding is already committed toward previous awards. A portfolio that includes a “mortgage” of approximately 50 percent for ongoing grants allows CNS to maintain a funding rate of 15 to 20 percent and ensures about half of CNS funds are available each fiscal year for new awards. This flexibility is particularly crucial in the computing field where the pace of technological innovation is rapid.

CNS Priorities for FY 2006:

Strengthening Systems Software:
Computer systems are ubiquitous in today’s world; hence society’s increasing dependence on them. However, computer systems often tend to perform poorly, become compromised, or fail. Moreover, as they become increasingly large and complex, these problems are compounded, threatening the infrastructure on which society depends. CNS will increase support for projects aimed at making significant breakthroughs in the design and implementation of systems software. This software must be

smarter in order to adaptively support applications working in dynamic environments, and simpler not only for reliability improvement but for cost reduction of application development.

Building Cyber Trust:
The Cyber Trust program promotes a vision of a society in which networked computer systems are: more predictable, more accountable, and less vulnerable to attack and abuse; developed, configured, operated and evaluated by a well-trained and diverse workforce; and used by a public educated in their secure and ethical operation. As such, the program covers a wide range of research areas. The FY 2006 foci will be both in foundation establishment and security-measure development. The former is important since we will only be able to develop predictably trustworthy computer systems if we can model and analyze cyber-trust-related phenomena. Given security threats faced today, we also need to accelerate developing technologies that can immediately address these threats.

Examining Networked Systems:
Computer and communication networks are among society's most important infrastructures. However, today's network systems are based on models developed in the 1970s and 1980s. To develop an architecture that takes into account current and future technology advances and the requirements of modern applications, CNS will support projects that study the systematic redesign of current network systems. This will lead to a new understanding of digital (wired, wireless, sensor) networks and lay a solid foundation for their long-term development.

Changes from FY 2005:

The FY 2006 Request for CNS includes an increase of $10.57 million that will be directed toward the following areas:

Core Research and Education: +$10.57

Disciplinary and interdisciplinary research in the CNS core will increase by $10.20 million. This additional support will be allocated to research and education priorities as described above and will help address the low funding rate in CNS.

Support for Research Experiences for Undergraduates increases by $370,000.

Computing Research Resources:

Funding for Computing Research Infrastructure is $20.58 million in FY 2006. This reflects a recategorization of computing infrastructure funds previously reported as other support.

INFORMATION AND INTELLIGENT SYSTEMS $104,670,000

The FY 2006 Request for the Division of Information and Intelligent Systems (IIS) is $104.67 million, an increase of $12.13 million, or 13.1 percent, over the FY 2005 Current Plan of $92.54 million.

Information and Intelligent Systems Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Information and Intelligent Systems	**$80.02**	**$92.54**	**$104.67**	**$12.13**	**13.1%**
Major Component:					
Research & Education Grants	80.02	92.54	104.67	12.13	13.1%

About IIS:

The IIS Division at NSF is organized into three clusters: Data, Inference, and Understanding; Systems in Context; and Science and Engineering Informatics. Organization into clusters minimizes stove-piping within the subdisciplines that IIS supports and allows changes in support patterns dependent on emerging scientific opportunities and needs. Within and across these clusters, IIS supports research and education that increases the capabilities of human beings and machines to create, discover, and reason by advancing the ability to represent, collect, store, organize, locate, visualize, and communicate information. The IIS Division contributes to interdisciplinary research on how observational data leads to discovery in the sciences and engineering. IIS activities also integrate research and education activities to prepare future generations of computer science and engineering professionals.

In FY 2004, the IIS Division received over 2,300 proposals, including many more high quality proposals than could be funded. In fact, the IIS funding rate was only 13 percent, more than ten percent below the NSF average. Within the FY 2005 Current Plan, approximately 50 percent of funding is already committed toward previous awards. A portfolio that includes approximately 50 percent of continuing grants made in prior years allows IIS to maintain a funding rate of 10 to 15 percent and ensures almost half of IIS resources are available each fiscal year for new awards. This flexibility is particularly crucial in the computing field where the pace of technological innovation is rapid.

IIS Priorities for FY 2006:

Enabling Science and Engineering Informatics:
A recent article in The Washington Post notes that "There are so many genes for drug companies and researchers to target due to the slew of information netted by the Human Genome Project, that better technology is needed to help search and sort the genes…" (The Washington Post, TechNews, June 9, 2004). The technology underlying search engines that enable information on the World Wide Web to be indexed and searched has been supported by IIS grants. Analogous technology is needed to organize scientific data and knowledge.

In FY 2006, IIS will develop an emphasis on ecosystem informatics, modeling, and visualization. This work will build on workshops co-sponsored by NSF, the U.S. Environmental Protection Agency, the National Aeronautics and Space Administration and the U.S. Geological Survey that have identified information technology needs in this area. As an example of the challenges in this area, researchers at the University of Southern California have been working on automating the integration of databases across state government agencies. They are addressing the challenging problem of merging different fields with the same information from different databases. The goal of this integration is to provide a complete picture of air quality and emissions, a phenomenon that does not conform to the regional, state, and country organizations charged with collecting this information.

Enhancing Information Security and Privacy:
The storing of digital records provides efficiencies through the sharing of information, but may also result in the compromise of individual privacy. The inability to transfer paper medical records, x-rays, and other test results across organizations increases the possibility of adverse medical outcomes and may result in unnecessarily repeating medical tests. Storing this information in databases permits rapid access to the information but unfortunately may permit unauthorized disclosure.

In FY 2006, IIS will support research to develop new technologies to ensure that privacy is not sacrificed while realizing the compelling advantages of sharing and aggregating data. For example, researchers at Purdue University have recently demonstrated an approach to analysis of medical data to find correlations between symptoms and diseases without revealing information about the individuals.

Creating Usable Information Technology:
IIS will also focus resource increases on research that makes information technology more usable. Advances will lead to computers that conform to people's needs rather than making people conform to the constraints of computers. Research on how people make decisions, collaborate, and organize information informs the design of interfaces and tools that present or summarize information at the appropriate time for a given task. For example, researchers at Oregon State University have developed an approach to organizing information (such as documents, e-mail, and World Wide Web activity) around tasks, such as preparing a budget, making travel arrangements, or teaching a class. Such an organization allows tasks to be suspended and resumed, freeing the user from remembering where documents were previously saved when returning to a task.

Changes from FY 2005:

The FY 2006 Request for IIS includes an increase of $12.13 million, which will be directed toward the following:

Core Research and Education: +$12.13

Disciplinary and interdisciplinary research in the IIS core will increase by $11.83 million focused in areas such as those highlighted herein. This funding increase will also help address the extremely low proposal funding rate in IIS.

Support for Research Experiences for Undergraduate supplements will increase by $300,000.

SHARED CYBERINFRASTRUCTURE $124,960,000

The FY 2006 Request for the Division of Shared Cyberinfrastructure (SCI) is $124.96 million, an increase of $1.36 million, or 1.1 percent, over the FY 2005 Current Plan of $123.60 million.

Shared-Cyberinfrastructure Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Shared Cyberinfrastructure	**$112.29**	**$123.60**	**$124.96**	**$1.36**	**1.1%**
Major Components:					
Cyberinfrastructure Tools	110.66	120.76	114.00	-6.76	-5.6%
Workforce Development	1.63	2.84	10.96	8.12	285.9%

About SCI:

The SCI Division supports acquisition, operation, and upgrade of national cyberinfrastructure in support of the nation's science and engineering research and education community. Cyberinfrastructure includes resources such as supercomputers; high-capacity mass-storage systems; system software suites and programming environments; productivity software libraries and tools; large-scale data repositories; and the experts and support staff that create and maintain these IT-based resources. Cyberinfrastructure also includes networks of various reach and granularity from dedicated, high-speed backbone networks that connect high-performance computational resources and high-end instrumentation sites, to wireless networks that connect embedded sensor nodes in remote scientific field sites. SCI also meets the community's needs with an array of software tools and services that hide cyberinfrastructure complexities and heterogeneity while offering clean logical interfaces to users. The tools and services supported by SCI include information management systems and data services, scalable interactive visualization tools, and middleware service building blocks for high-end computational resources.

The SCI Division staff collaborate closely with staff in all the NSF Directorates and Offices to ensure the advances in cyberinfrastructure supported by SCI will meet the demands of tomorrow's science and engineering communities.

In FY 2004, SCI received 220 proposals for funding consideration. In fact, the majority of SCI funds support ongoing longer-term projects such as the management and operations of the Extensible Terascale Facility, and the provision of network bandwidth for international research network connections. Within the FY 2005 Current Plan, approximately 65 percent of SCI funds are already committed to support for these longer-term cyberinfrastructure projects. An additional 10 percent of SCI funds are committed to other ongoing cyberinfrastructure projects such as those funded through the NSF Middleware Initiative.

SCI Priorities for FY 2006:

Providing Shared Cyberinfrastructure Tools:
SCI supports the management and operations of cyberinfrastructure resources to meet the computational needs of the national science and engineering community. This includes support for the management and operations of high-end computing assets resident in a number of organizations, including the National

Center for Supercomputing Applications, the Pittsburgh Supercomputing Center, the San Diego Supercomputer Center (SDSC), the Texas Advanced Computing Center and others. In FY 2006, SCI will continue to provide support for the vast majority of computing cycles made available to the open science community. Systems supported provide users with access to a broad range of supercomputer architectures and enable advances in all science and engineering disciplines. Consider, for example, the work done by researchers at the University of Oklahoma's Center for Analysis and Prediction of Storms (CAPS) using the SCI-funded LeMieux system at the Pittsburgh Supercomputing Center. Using 2048 processors on LeMieux, CAPS researchers successfully reproduced a 1977 storm and the high intensity tornado that it spawned. This simulation represents a watershed event in the drive towards more accurate warning systems for tornados and their precursor cyclones.

The addition of the Extensible Terascale Facility (also known as the Teragrid) to the SCI portfolio provides further value to the national community. Through the ETF Science Gateway effort, many new users from a range of scientific communities will be able to use sophisticated computational tools and applications developed specifically to meet the needs of their particular communities.

As an example of other essential contributions enabled by SCI funding, SDSC's Storage Resource Broker was recently endorsed and adopted as a cornerstone technology in the national strategy for the long-term (centuries in duration) preservation/archiving of digital data.

In FY 2006, approximately $19 million will provide for selective cyberinfrastructure enhancements identified through an ongoing process being developed within NSF to identify cyberinfrastructure priorities (see the Facilities chapter for more information).

Strengthening Network Infrastructure:
In FY 2006, SCI will also continue support for the development, deployment and sustained use of a set of reusable and expandable middleware functions that benefit many science and engineering applications in a networked environment. Robust middleware services are especially important for enhancing scientific productivity and for facilitating research and education collaborations through the sharing of data, instruments, and computing resources. SCI programs encourage open source software development and distribution approaches, as well as development of necessary middleware standards. As an example of the impact of middleware investments on scientific advances, SCI-supported investigators at the University of Wisconsin-Madison and their Condor software for grid computing have enabled a 100-fold increase in the performance of an important computational tool (Pedtool) used by geneticists worldwide to locate genes associated with complex diseases.

Preparing the Cyberinfrastructure Workforce:
Cyberinfrastructure is having a profound impact on the practice of science and engineering research and education. It is enabling individuals, groups, and organizations to advance science and engineering in ways that revolutionize *what they can do*, *how they do it*, and *who can participate*. To harness the full power of cyberinfrastructure and the promise it portends for discovery, learning, and innovation across and within all areas of science and engineering, SCI will make focused investments in the CI-TEAM program. CI-TEAM will contribute to the preparation of a science and engineering workforce with the knowledge and requisite skills needed to create, advance, and exploit cyberinfrastructure over the long-term. It builds on the outcomes created by prior investments in the Education, Outreach and Training (EOT) activities of the Partnerships for Advanced Computational Infrastructure (PACI).

Changes from FY 2005:

The FY 2006 Request for SCI includes an increase of $1.36 million, which will be directed toward the following:

Workforce Development

Funds allocated to the CI-TEAM program will increase to $10.0 million. Funds are reallocated from Cyberinfrastructure Tools[1]

[1] NSF's investments in the development and provision of shared cyberinfrastructure services and tools are made in partnership with a number of organizations around the nation, reflecting the pervasive impact of information technology and the growing capabilities and expertise now resident in a larger number of organizations. As such, the agency's investments in shared cyberinfrastructure tools are no longer best characterized as "facilities" investments. Consequently, in FY 2007 and beyond, NSF will report its investments in shared cyberinfrastructure tools as Infrastructure and Instrumentation. In the FY 2006 Request, further discussion of shared cyberinfrastructure tools can be found in the Facilities chapter.

INFORMATION TECHNOLOGY RESEARCH $145,440,000

The FY 2006 Request for the Information Technology Research (ITR) Subactivity is $145.44 million, a decrease of $28.34 million, or 16.3 percent, below the FY 2005 Current Plan of $173.78 million.

Information Technology Research Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Information Technology Research	**$218.06**	**$173.78**	**$145.44**	**-$28.34**	**-16.3%**
Major Component:					
Research & Education Grants	218.06	173.78	145.44	-28.34	-16.3%

About ITR:

During FYs 2000 through 2004, the ITR Subactivity provided for CISE investments in the agency-wide ITR priority area. It provided support for state-of-the-art IT research and related education activities; enhanced support for more focused research in areas of national importance such as cyber security, homeland security, and cyberinfrastructure; and permitted the funding of a larger number of complex, often interdisciplinary, projects.

In FY 2005, approximately 68 percent of ITR funds are committed to projects established in prior fiscal years. The remaining 32 percent of funds are available to make new awards.

The table above indicates that, with the completion of the ITR priority area, CISE is redirecting approximately $28 million to important IT research challenges and opportunities in core CCF, CNS and IIS activities. Funds available in the ITR Subactivity will be used to target prominent CISE-wide IT research and education priorities as described below.

ITR Priorities for FY 2006:

High-End Computing and Computational Science:
As a result of the ever-growing complexity of scientific and engineering problems, the computational needs of the national research community continue to grow. Some classes of scientific challenges and the optimal design of large and complex artifacts impose enormous demands on computing resources. Unfortunately, most of the currently available hardware, software, systems, and algorithms are primarily focused on business applications and are only suitable for smaller scale scientific and engineering problems; these hardware and software systems do not meet the high-end computing (HEC) needs of the science and engineering community.

Consequently, in FY 2006 ITR will emphasize fundamental research on high-end software and hardware systems that are designed specifically to address important computation- and data-intensive science and engineering opportunities and challenges. Research activities will focus on building complex software and tools for high-end computing architectures; developing multi-scale analysis methods in computational science; and developing more sophisticated information management and data analysis tools and technologies to support the analysis of scientific data and information.

Science of Design:
Complex interdependencies strain our ability to create, maintain, comprehend, and control software-intensive IT systems. The Science of Design emphasis seeks to build a body of knowledge that will provide a stronger scientific basis for the design of IT systems, leading to more effective development, evolution and understanding of IT systems of large scale, scope, and complexity. Research outcomes will include new theoretical and empirical knowledge on design, computational methods and tools for design, and new curricula for the next generation of IT designers.

Trustworthy Computing:
Targeted CISE investments in cyber security research and education will lead to the development of trustworthy IT systems. Research will be supported in a wide range of areas, addressing trustworthiness at all levels of IT system design, implementation, and use. Better abstractions are needed for reasoning about system behavior and attributing responsibility for system actions. Better means are needed for benchmarking, measurement, and data collection to build the empirical underpinnings of the field. Innovative approaches are also needed in cyber security education, so that capable students participate in relevant research and research results are quickly integrated into the educational process. System trustworthiness considerations must be included throughout the computer and information science and engineering curriculum, not just in courses for specialists. The concepts of proper system operation and ethical use of technology must have even broader reach, to touch individuals throughout the academic enterprise and beyond.

Broadening Participation in Computing:
The Broadening Participation in Computing (BPC) emphasis area aims to significantly increase the number of domestic students receiving post secondary degrees in the computing disciplines. Three types of BPC projects will be supported:

- Broad alliance projects will design and carry out comprehensive programs addressing under-representation in the computing disciplines;
- Demonstration projects will focus on a specific underrepresented community, a specific point in the academic pipeline, or a specific impediment to full participation in computing; and
- Supplemental grants to existing NSF projects will be made in order to engage more members of the computing research community in significant BPC efforts.

Changes from FY 2005:

In FY 2006, CISE will redirect $28.34 million from the broad category of IT Research to IT priorities in the core CISE Subactivities of CCF, CNS, and IIS. With funds available in the ITR Subactivity, CISE will fund the research and education and workforce preparation priorities described above.

Engineering

ENGINEERING $580,680,000

The FY 2006 Budget Request for the Directorate for Engineering (ENG) is $580.68 million, an increase of $19.38 million, or 3.5 percent, over the FY 2005 Current Plan of $561.30 million.

Engineering Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Bioengineering and Environmental Systems (BES)	51.00	48.22	50.68	2.46	5.1%
Chemical and Transport Systems (CTS)	69.21	65.79	68.99	3.20	4.9%
Civil and Mechanical Systems (CMS)	67.22	81.98	84.21	2.23	2.7%
Design and Manufacturing Innovation (DMI)	65.92	63.85	67.41	3.56	5.6%
Electrical and Communications Systems (ECS)	74.61	71.64	74.35	2.71	3.8%
Engineering Education and Centers (EEC)	134.03	127.06	129.71	2.65	2.1%
Office of Industrial Innovation (OII)	103.58	102.76	105.33	2.57	2.5%
Total, ENG	$565.57	$561.30	$580.68	$19.38	3.5%

Totals may not add due to rounding.

The Directorate for Engineering supports the leading edge of fundamental engineering research. The fruits of this activity yield critical new technologies; innovative systems that enhance the way we live, work and play; and the foundation to build the world's most capable engineering workforce. Together, these engineering investments ensure that our nation will be more secure and more prosperous, and its citizens will be healthier and more productive.

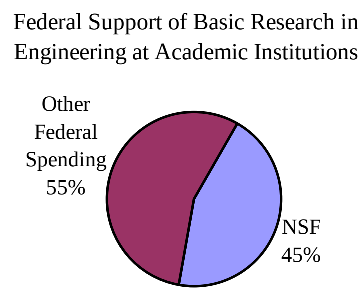
The engineering research and innovation supported by the Directorate for Engineering spans all areas of science (See "Comparable Division of Science and Engineering" table below). ENG also supports the entire spectrum of fundamental engineering research – from new discoveries to research advancing underpinning methodologies. It does not include incremental product change or late term product development.

COMPARABLE DIVISION OF SCIENCE AND ENGINEERING	
SCIENCE Research and Discovery	**ENGINEERING** Research and Engineering Innovation
Physics	Mechanical Engineering; Electrical Engineering; Nuclear Engineering
Chemistry	Chemical Engineering
Astronomy	Aerospace Engineering
Biosciences	Bioengineering; Biomedical Engineering
Geosciences	Civil Engineering
Social and Behavioral Sciences	Industrial and Systems Engineering; All Engineering Fields
Computer Sciences	All Engineering Fields
Mathematics	All Engineering Fields

Engineering Innovation involves using scientific knowledge and design methodologies to create new structures, new devices, and new systems and processes that lead to significant social and economic value. Some of the research that ENG currently supports will develop new nano materials and processes that will lead to whole new industries, develop new means of building and protecting our infrastructure to be more resistant to natural disasters and those of human origin, and create new smart drug delivery systems that are tailored to individuals.

RELEVANCE

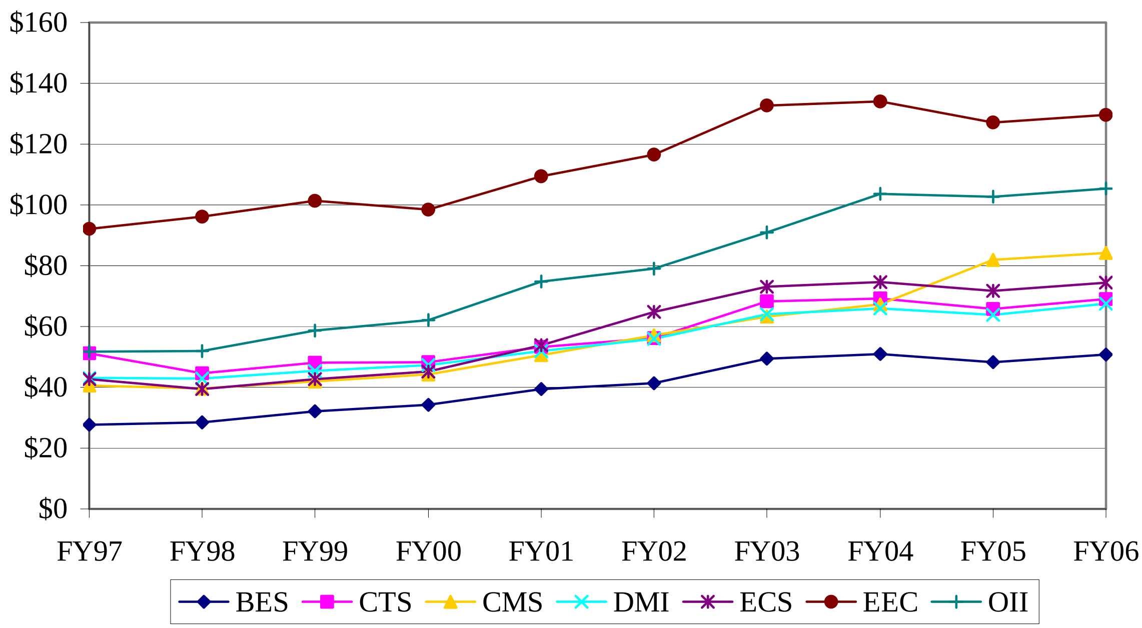
The Engineering Activity is a major source of federal funding for university-based, fundamental engineering research, providing 45 percent of the total federal support in this area.



ENG investments in engineering research and education build and strengthen a national capacity for innovation that leads to the creation of new, shared wealth and a better quality of life. ENG investments align closely with Administration Research and Development priorities, with a commitment to emerging technologies—nanotechnology, cyberinfrastructure, network systems, molecular electronics, photonics, metabolic engineering, bioengineering, and manufacturing innovation. Support for research in these areas contributes to major advances in health care, manufacturing, and homeland security. It also enables the technological advancement of our society. A recent Lemelson-MIT project highlighted what it considered to be the top 25 innovations of the past 25 years. Among these advances were fiber optics, cell phones, air bags, HDTV, and the number one innovation – the Internet. This list demonstrates the impact of engineering innovation on our daily lives.

ENG leads the Foundation's efforts in the area of nanotechnology, plays a significant leadership role in the National Nanotechnology Initiative (NNI), and works closely with the other NSF Activities and other federal agencies in advancing this exciting field. Nanotechnology has the potential to enable revolutionary technologies that can advance a broad spectrum of science and engineering disciplines. Nanotechnology is reaching into all areas of society and the economy. In 2003, over 5,300 U.S. patents in nanotechnology were issued, all "Fortune 500" manufacturing companies have entered the field, and over 1,000 new business startups have been documented. Current estimates point to revenues of $1 trillion and the creation of 2 million new jobs by 2015.

ENG Subactivity Funding
(Dollars in Millions)



Summary of Major Changes by Division *(Dollars in Millions)*

ENG FY 2005 Current Plan....…………………………………………………………….....$561.30

Bioengineering and Environmental Systems (BES) +$2.46

The funding increase will be used to (1) support a solicitation on the vibrant new field of Quantitative Systems Biotechnology (QSB), and (2) fund Collaborative Large-scale Engineering Analysis Network for Environmental Research (CLEANER) planning activities. QSB is the transformative result of the impact of the genomic revolution from the biological sciences powerfully interfacing with engineering, computer science, and mathematics. Work on QSB so far has focused primarily on very simple organisms, such as bacteria and yeast. The new solicitation will advance toward more complex organisms, eventually to include humans. Profound impact on human health, wealth, and environment is anticipated. For CLEANER, the strategic intent is to fundamentally transform and radically advance the scientific and engineering knowledge base required to address the challenges of large-scale, human-dominated, complex environmental systems, in particular, the quality and quantity of the nation's water supply, an issue of increasing concern.

Chemical and Transport Systems (CTS) +$3.20

CTS research and education investments contribute significantly to the knowledge base and to the development of the workforce for major components of the U.S. economy. The division is experiencing increased proposal pressure in the core areas of chemical and transport systems. Growth in nanoscale engineering, the frontiers of manufacturing, and environmentally relevant energy technologies will occur. Particular emphasis will be placed on critical infrastructure systems related to safety and security. The increase in funding in FY 2006 will be focused on support of investigator-initiated ideas and pioneering research within this area of safety and security. Significant potential exists for fundamental lasting impact on both physical and cyberinfrastrucuture systems.

Civil and Mechanical Systems (CMS) +$2.23

The CMS division will utilize the increase to accommodate the important transition from the construction phase to the operations and research phase for the Network for Earthquake Engineering Simulation (NEES). NEES represents an $82 million MREFC investment made between FY 2000 and FY 2004, and is entering a ten-year operations and research phase. It will not only increase our understanding of how the constructed environment responds to earthquakes and tsunamis, but will also be a prototype for future cyberinfrastructure applications across all scientific and engineering disciplines. CMS will also respond to increasing proposal pressures in emerging areas in civil and mechanical systems, such as simulation-based engineering science, nanomechanics, complex systems, biomechanics, smart structures, and mechatronics.

Design and Manufacturing Innovation (DMI) +$3.56

Innovation remains an intellectual focus of DMI core programs. This increment in core programs will create tools for the 3D nano- and micro-factories of the future, and provide the knowledge to design globally competitive and sustainable manufacturing enterprises. With a reallocation of base funds and the requested increase, FY 2006 will focus on rebuilding core programs as well as the Grant Opportunities for Academic Liaison with Industry (GOALI) program. This is a priority for DMI, because investigator-initiated research lays the groundwork for future investments in education, research, and innovation.

Electrical and Communications Systems (ECS) +$2.71

The increase supports "Integrative Systems" principles in the design, development and implementation of new nano/micro/macro/complex and hybrid systems with engineering solutions for a variety of application domains. Integrated systems are increasingly viewed as critical in meeting a broad range of societal challenges in the 21st Century, including those associated with sensing, imaging, telecommunications, wireless networks, power systems, environment, health care, transportation, biomedicine, manufacturing, natural disasters, homeland security, and other systems-related areas.

Engineering Education and Centers (EEC) +$2.65

EEC is reformulating its current support for engineering education into a new program aimed at defining and elevating fundamental research into how students learn engineering. To date, engineering education reform has been based more on qualitative ideas of how to engage students in their learning and not on fundamental research that integrates an understanding of how students learn, and how the curriculum can be improved to attract more talented and diverse students. The new initiative combines the Department Level Reform program and the unsolicited Engineering Education program into a new Transforming Engineering Education program.

Office of Industrial Innovation (OII) +$2.57

OII is in a unique position to pull together novel research ideas that intersect the frontiers of research in nano-bio-info technology. With the increase in funding, OII will target "Security Technology" in its Small Business Innovation Research (SBIR) solicitation, to help address the national priority of homeland security.

In FY 2005 the Foundation reorganized the ENG Division structure to further enhance Organizational Excellence. Under the proposed reorganization, ENG separated the SBIR/STTR component of the Design, Manufacture and Industrial Innovation (DMII) Division and created a new Subactivity called the Office of Industrial Innovation (OII). The new name for the DMII Division was changed to Design and Manufacturing Innovation (DMI). This easy-to-identify structure will further strengthen NSF and ENG's management of this legislatively authorized federal program.

Subtotal, Changes +$19.38

FY 2006 Request, ENG…………………………………………………………………...…..$580.68

Summary of Changes by Directorate-wide Investments *(Dollars in Millions)*

ENG FY 2005 Current Plan………………………………………………………..………..$561.30

Core Research +$8.32

Disciplinary and interdisciplinary research in the ENG core will increase by $8.32 million for a total of $242.19 million.

Bioengineering and Environmental Systems	+2.14 million
Chemical and Transport Systems	+2.82 million
Civil and Mechanical Systems	+0.85 million
Design and Manufacturing Innovation	+3.21 million
Electrical and Communications Systems	+2.31 million
Engineering Education and Centers	-3.01 million

Core research increases specifically support the ENG Subactivities. These increases, and management decisions aimed at constraining the numbers of proposals received, will result in an important, but small (3 percent) increase in the ENG funding rate. Funding increases serve to boost pioneering research in fields such as biomedical engineering, reaction engineering, nano/bio mechanics, hazard mitigation and disaster response, security and critical infrastructure, nanoelectronics, and environmentally benign design and manufacturing.

Faculty Early Career Development Program (CAREER) +$1.00

Support for the CAREER program increases to a total of $32.0 million, enhancing opportunities for junior-level engineering researchers to receive support for developing activities.

Research Experience for Teachers (RET) +$1.50

The RET program totals $4.0 million to support the active involvement of K-12 teachers and community college faculty in engineering research in order to bring knowledge of engineering and technological innovation into their classrooms.

Research Experiences for Undergraduates (REU) +$1.50

Support for the REU program increases to a total of $12.80 million, allowing support for 100 additional students.

Industry/University Cooperative Research Centers (I/UCRC) +$1.25

Funding for the I/UCRC program will increase from $6.0 million to $7.25 million with the funds being used to provide research supplements to advance the underlying fundamental science and technology of the centers.

Small Business Innovation Research (SBIR) +$2.32

Small Business Technology Transfer (STTR) +$0.25

Network for Earthquake Engineering Simulation (NEES) +$0.98

Operations and Maintenance costs for the non-profit NEES Consortium, Inc. increase to a total of $20.52 million, to manage, operate and maintain the geographically distributed national NEES facility.

Net, all other program changes ……………………………..………………….……………… $2.26
Subtotal, Changes +$19.38

FY 2006 Request, ENG……………………………………………………………………$580.68

PRIORITY AREAS

In FY 2006, ENG will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics. Additional support for these areas comes through awards to unsolicited proposals.

Engineering Investments in NSF Priority Areas
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biocomplexity in the Environment	6.00	6.00	6.00	0.00	0.0%
Nanoscale Science and Engineering	108.88	127.77	127.77	0.00	0.0%
Mathematical Sciences	2.91	2.91	2.91	0.00	0.0%
Human and Social Dynamics	2.00	2.00	2.00	0.00	0.0%

Biocomplexity in the Environment: A total of $6.0 million will support activities in the Materials Use: Science, Engineering, and Society (MUSES) program.

Nanoscale Science and Engineering: A total of $127.77 million will foster an accelerated transition from scientific discoveries to engineering innovation, due to the increased rate of discoveries in the last several years. Funding priority will be given to: (1) research enabling the nanoscale as the most efficient manufacturing domain, including fabrication of nanostructured materials, nanosystems, and nanoscale catalysis; (2) nanobiotechnology and nanobiology for improving human performance; (3) innovative nanotechnology solutions to biological-chemical-radiological-explosive detection and protection; (4) discovery, understanding, and potential application of phenomena specific to the nanoscale; (5) nanoelectronics and nanophotonics; (6) development of new instrumentation and standards for imaging, characterization, and manipulation of materials and systems in three dimensions at the nanoscale; (7) education and training of a new generation for future industries, including high school, undergraduate, graduate, and informal education; and (8) understanding and addressing the societal implications of nanotechnology.

Mathematical Sciences: A total of $2.91 million will continue to support synergistic collaborations between mathematicians and engineers to strengthen engineering modeling and experimental work and enhance undergraduate and graduate engineering education.

Human and Social Dynamics: A total of $2.0 million will be invested in Decision Making and Risk activities to support studies on the security and reliability of critical infrastructure networks, and in Dynamics of Human Behavior to focus on the integration of nanotechnology, biotechnology, information technology, and cognitive science for improving human physical and mental abilities, as well as a new generation of tools and processes to achieve this goal.

QUALITY

ENG maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The percent of research funds that were allocated to projects that undergo external merit review was 96 percent in FY 2004, the last year for which complete data exist.

To ensure the highest quality in processing and recommending proposals for awards, ENG convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Engineering (AC/ENG) on such issues as: the mission, programs, and goals that can best serve the engineering community; how ENG can promote quality graduate and undergraduate education in the engineering sciences; and priority investment areas in engineering research. The AC/ENG meets twice a year and members represent a cross section of engineering with representatives from many different sub-disciplines within the field, a cross section of institutions including industry, broad geographic representation, and balanced representation of women and under-represented minorities.

PERFORMANCE

NSF's FY 2006 budget is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Engineering
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	68.27	62.22	66.22	4.00	6.4%
Institutions	19.39	17.87	18.73	0.86	4.8%
Collaborations	2.13	1.00	2.13	1.13	113.0%
	89.79	81.09	87.08	5.99	7.4%
Ideas					
Fundamental Science and Engineering	248.42	233.87	242.19	8.32	3.6%
Centers Programs	98.46	97.54	97.81	0.27	0.3%
Capability Enhancement	109.88	108.76	112.58	3.82	3.5%
	456.76	440.17	452.58	12.41	2.8%
Tools					
Facilities	11.75	32.29	33.27	0.98	3.0%
Infrastructure and Instrumentation					
Polar Tools, Facilities and Logistics					
Federally-Funded R&D Centers					
	11.75	32.29	33.27	0.98	3.0%
Organizational Excellence	7.27	7.75	7.75		
Total, ENG	$565.57	$561.30	$580.68	$19.38	3.5%

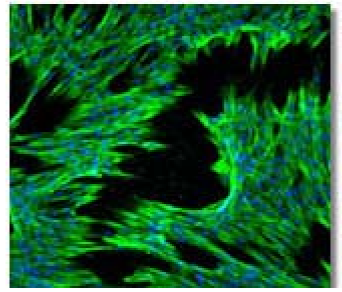
Totals may not add due to rounding.

ENG will continue its commitment to education, training, and increasing diversity within all of its Subactivities. The FY 2006 budget will maintain award size and continue to focus on multidisciplinary research activities, interagency partnerships, and international activities with special attention given to broadening participation at all levels.

Recent Research Highlights

Research On Bio-Material Scaffolding Could Lead to Replaceable Body Parts

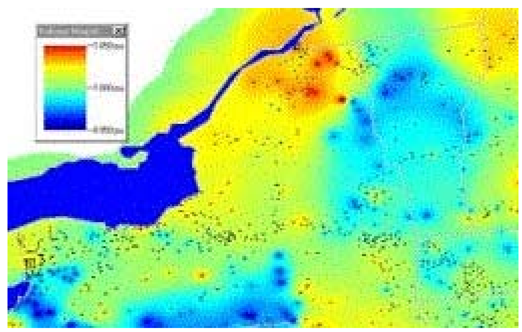
Kristi Anseth is a chemical engineer at the University of Colorado at Boulder. She is leading a team of researchers in building the scaffolds of new materials that promise to elevate many aspects of medical care for injuries and disease. Already a nationwide leader in the study of biomaterials, Anseth's creative work at the intersection of chemistry, biology, and engineering may one day lead to wide use of easily replaceable body parts for people suffering from injuries or chronic conditions. NSF has named Anseth to receive the Alan T. Waterman Award, the Foundation's most prestigious honor for young researchers.



Picture depicts how cells within the heart valve can be regulated through a delivery of biologically active molecules.

Real-Time Monitoring of National Electric Power Grid

Basic research conducted by the NSF-supported Industry/University Cooperative Research Center on Power Systems Engineering (PSerc) has been used to create innovative new software tools for real-time monitoring of the health of the nation's electric power grid. These tools directly address the root causes of cascading power failures, such as the one that affected the eastern United States in August 2003. Now being tested in California, the new monitoring tools are designed to alert power system operators to potentially dangerous grid conditions in a more timely and effective way, thus increasing their ability to take corrective action to prevent widespread power failures. The tools were developed by the Consortium for Electric Reliability Technology Solutions (CERTS), of which PSerc is a founding member.



New visualization technologies made possible by PSerc basic research are designed to enhance the capacity of electric power system operators to monitor grid conditions, maintain system reliability, and prevent cascading blackouts.

Biodegradable Machining Compound Used for Hard Drive Manufacturing is More Effective Than Toxic Ones

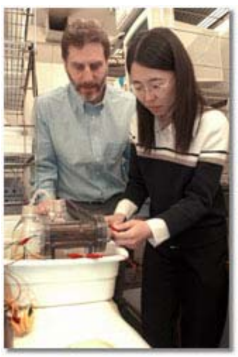
Machine used by Ventana Research for evaluating fluids during the Phase I SBIR program.

Derived in part from green tea, a new biodegradable machining compound for computer hard drive manufacturing is three to four times more effective than its toxic counterparts. In an industry where more than 161 million hard drives leave assembly lines each year, the new compound could significantly improve manufacturing efficiency and minimize environmental risks. Engineered by John Lombardi of Ventana Research Corporation in Tucson, Arizona, as part of a Small Business Innovation Research (SBIR) grant, the chemical is part of a slurry that polishes the ceramics—made from aluminum oxide and titanium carbide—used in computer hard drive read-write heads.

Wearable Device Gives New Freedom to the Visually-Impaired

The head-mounted components of the Wearable Low Vision Aid. Shown are the camera with a ring of infra-red LEDs (left) and the head mounted display (right).

Using a common laptop computer and a sophisticated head-mounted projection device, students at the University of Washington have created a system to help people with poor vision navigate around stationary objects. The Wearable Low Vision Aid is the first portable device to draw attention to obstacles using an illuminated, vibrating crystal that projects a warning icon—a raster image much like a television's—onto the user's retina. The system was built entirely by graduate and undergraduate students over the past four years under the direction of Eric Seibel, research assistant professor for mechanical engineering at the Human Interface Technology Laboratory at the University of Washington.



Biological Fuel Cell

Biological Fuel Cell Makes Electricity While Cleaning Water

Something big may be brewing on the sewage-treatment circuit thanks to a new design that puts bacteria on double duty—treating wastewater and generating electricity at the same time. The key to making it work is an innovative, single-chambered microbial fuel cell. A fuel cell resembles a battery, generating electricity from a chemical reaction. But instead of running down unless it's recharged, the cell receives a constant supply of fuel and then releases electricity. Typical fuel cells run on hydrogen. In a microbial fuel cell, bacteria metabolize their food—in this case, organic matter in wastewater—to release electrons that yield a steady electrical current. The single-chambered prototype, developed by researchers at Pennsylvania State University, allows the process to work efficiently in wastewater.

Robot First: Giant "Printer" Builds Wall

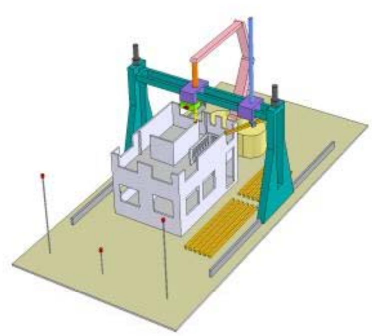
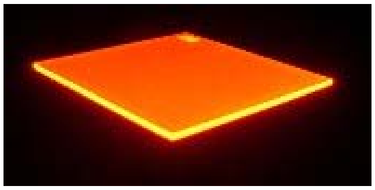


Diagram of the construction of a conventional building using Contour Crafting.

A robot developed with NSF support has built the first wall ever constructed entirely by machine, with no use of human hands. Measuring about 5 feet long, 3 feet high, and 6 inches thick, the wall was constructed in January 2004 in the University of Southern California lab of Behrokh Khoshnevis, who calls his creation "the most historic wall since the Great Wall of China." Khoshnevis believes that by the end of 2005, his robots will be able to construct a one-story, 2,000-square foot home on site in a single day. His pioneering efforts to automate the building process are based on a technology known as Contour Crafting, a layered fabrication process controlled by computer. After 7 years of research and development, Khoshnevis has created a robot that can build large structures by extruding semi-liquid material from a pump in inch-thick layers to form the outside edges of an object, such as the wall of a building. The robot moves back and forth along a gantry installed at the construction site to deposit each layer of the wall. After the exterior layers have been laid down, the robot returns to pour concrete or other filler material into the hollow wall. In effect, this technology will enable homes and other structures to be "printed out" from computer design software, much as ink jet printers produce documents from word processing software.

Awards to ENG researchers

Innovative Solar Cell Boosts Energy Output

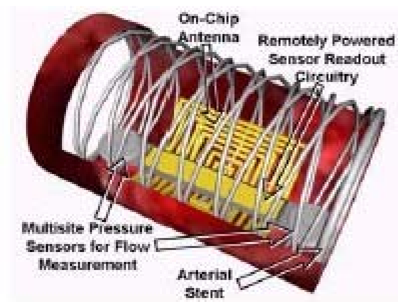


High performance luminescent solar concentrator (LSC)

A grantee at Penn State Erie, The Behrend College, has developed a multiple-dye high performance luminescent solar concentrator (LSC) that converts solar energy into electricity at 36 percent greater efficiency than that of the best single-dye LSC. An LSC is a thin, flat plate of highly fluorescent material that uses total internal reflection to concentrate light at its edges, where it is absorbed and converted to electricity by semiconductor solar cells.

Wireless Micro-Sensor Monitors Blood Flow from the Inside

Researchers at the Wireless Integrated MicroSystems (WIMS) ERC at the University of Michigan have developed an "active stent." This device has a wireless differential-pressure measurement system embedded in a micro-fabricated stent that can be used to diagnose reductions in intra-arterial blood flow caused by the onset of restenosis. The device is only 200µm thick, with a volume of 2mm^3. It can detect a 13 percent reduction of blood flow in the carotid artery.

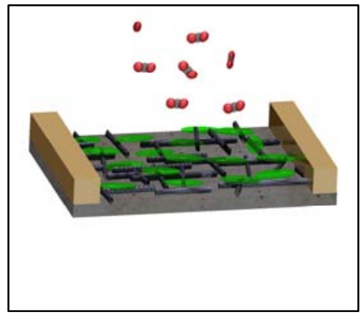


Wireless micro-fabricated "Active Stent"

Simple Chemistry Predicts Pinhole Leaks in Copper Pipes

NSF-supported investigator Marc Edwards, Professor of Civil and Environmental Engineering at the Virginia Polytechnic Institute and State University, has completed the first laboratory experiments demonstrating that changes in water chemistry alone are sufficient to cause pinhole leaks in copper tubing in drinking water distribution systems. An outbreak of such leaks began in home plumbing systems in the suburbs of Washington, D.C., and elsewhere in the late 1990s, costing consumers billions of dollars per year for repair and replacement. While investigating the causes of these leaks, Edwards discovered very high levels of lead contamination in D.C.-area drinking water and designed new sampling procedures for testing drinking water to measure more accurately the degree of lead contamination. Environmental exposure to high levels of lead can seriously impair virtually all aspects of mental and physical functioning, especially the rapidly developing neurological systems of young children. The goal of Edwards' ongoing research is to enable scientists and engineers to rationally predict and prevent problems with pinhole corrosion. With current support from NSF's program on Materials Use: Science, Engineering and Society (MUSES), Edwards works with a multidisciplinary team investigating the broader economic, social, and health aspects of materials failure in drinking water infrastructure. Edwards testified in March 2004 before the U.S. House of Representatives Committee on Government Reform on lead in Washington, D.C. drinking water. In April 2004, *Time* magazine named Edwards an Innovator and one of the most influential people in the nation on the future of water resources issues. He was a 1995 recipient of an NSF Presidential Faculty Fellowship.

Nanotech Sensor Monitors Breathing: New Tool For Emergency Response



Conceptual illustration of the carbon nanotube network device coated with poly (ethylene imine) and starch polymer layer for detection of CO_2 gas
Credit: Alexander Star, Nanomix

Researchers have created a tiny device that can monitor a victim's breathing in emergency situations by effectively shrinking an operating room machine into a small, disposable tool that can be carried to a disaster site. NSF-supported researchers at Nanomix, Inc., in Emeryville, Calif., have created a transistor that fuses carbon nanotubes, polymers and silicon into a capnography sensor – a human breathing monitor. Alexander Star and his colleagues at Nanomix and the University of California, Los Angeles, describe the new sensor in the cover article of the November 15 issue of the journal *Advanced Materials*. Their study shows that carbon nanotube transistors fused with carbon dioxide-detecting polymers can determine carbon dioxide (CO_2) concentrations in both ambient and exhaled air.

Robot Helps Children Develop Language Skills

Children interact with child-friendly therapeutic robot

Researchers at AnthroTronix Inc., a rehabilitation engineering company, have developed an interactive robotic system to facilitate receptive and expressive language development in children with disabilities. This child-friendly robot is controlled by gestures and voice activation; it is adaptable to individual needs regardless of physical limitations, and also allows the child to interact with its environment. This device provides therapists with an effective tool to support the integration of speech/language development with children's educational and social development.

Other Performance Indicators

The tables below show the change in the number of people benefiting from ENG funding, and trends in the award size, duration, number of awards, and funding rates.

Number of People Involved in ENG Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	5,246	5,194	5,350
Other Professionals	1,478	1,463	1,507
Postdoctorates	392	388	400
Graduate Students	4,858	4,809	4,963
Undergraduate Students	2,285	2,262	2,420
Total Number of People	14,259	14,116	14,640

ENG Funding Profile

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	1,753	1,740	1,775
Funding Rate	20%	19%	22%
Statistics for Research Grants:			
Number of Research Grants	955	948	1,032
Funding Rate	15%	15%	18%
Median Annualized Award Size	$96,677	$96,677	$96,677
Average Annualized Award Size	$119,817	$119,900	$119,900
Average Award Duration, in years	2.9	2.9	2.9

BIOENGINEERING AND ENVIRONMENTAL SYSTEMS $50,680,000

The FY 2006 Budget Request for the Bioengineering & Environmental Systems Division is $50.68 million, an increase of $2.46 million, or 5.1 percent, above the FY 2005 Current Plan of $48.22 million.

Bioengineering and Environmental Systems Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Bioengineering and Environmental Systems	**$51.00**	**$48.22**	**$50.68**	**$2.46**	**5.10%**
Major Components:					
Research and Education Grants	47.35	43.57	46.03	2.46	5.6%
National Nanoscale Infrastructure Network	1.65	1.65	1.65	0.00	0.0%
Nanoscale Science & Engineering Centers	2.00	3.00	3.00	0.00	0.0%

About BES:

The Bioengineering and Environmental Systems (BES) Division supports research, innovation, and education in the rapidly evolving fields of bioengineering and environmental engineering. BES has two principal objectives. The first objective is to enable and facilitate the deployment of new technologies in these fields in service to society for use in the medical, biotechnology, and environmental arenas. The second objective is to advance bioengineering and environmental engineering education, particularly through the development of innovative programs by new faculty.

In general, 53 percent of the BES portfolio is available for new awards. The remaining 47 percent funds awards made in previous years.

BES achieves these objectives across its three program clusters:

- Biochemical Engineering/Biotechnology (BEB);
- Biomedical Engineering and Research to Aid Persons with Disabilities (BME/RAPD); and
- Environmental Engineering and Technology (EET).

BES Priorities for FY 2006:

Current BES high-emphasis research and education areas include post-genomic engineering, tissue engineering, biophotonics, nano-biosystems, and engineering environmental analysis and problem-solving options development. These high-emphasis research areas are built on a continuing base that includes biosensors, biomaterials, biomechanics, controlled release, bioimaging, medical devices and instrumentation, artificial organs, therapeutic agent bioprocessing, industrial bioproducts bioprocessing, bioremediation, ecological engineering, water and waste treatment, biomining, and food engineering.

Within the U.S. and international research communities, BES support has played a key role in catalyzing and developing highly promising new cutting edge bioengineering and environmental engineering research fields, such as tissue engineering and metabolic engineering. BES has also led the formation of interagency coordination and collaboration in these fields, including the Multi-Agency Tissue

Engineering Science (MATES) working group and the Metabolic Engineering Working Group. The NSF/DARPA/NIH Biophotonics Partnership is another joint effort initiated by BES.

Post-Genomic Engineering: As a consequence of the genomics revolution that is underway in the biological sciences, engineers now have an entirely new, and explosively growing database on which to build new engineering developments and innovations that will provide important advances in the medical, biotechnology, and environmental arenas.

Tissue Engineering (TE): TE for ENG includes gene and drug delivery. A common thread throughout TE areas is the unique biocompatible (and often biologically based) polymers that act as the matrix for cells to develop into three-dimensional tissues, and shield drugs and genes until they are delivered to the proper organs or specific target cells without causing side effects on healthy cells. The search for these key materials, and understanding how and why they function as they do, are key BES goals. A renewed research thrust in tissue culture engineering will be an important contributing factor in the rapid development of practical ex vivo cell culture techniques and stem cell culture technology for medical applications.

Biophotonics: Biophotonics seeks to exploit the power of photonics to advance bioengineering. Low cost diagnostics will require novel integration of photonics, molecular biology, and material science. Complex biophotonic sensors capable of detecting and discriminating among large classes of biomolecules are important not only to biology and medicine but also to environmental sensing.

Nano-Biosystems: Many nanoscale systems and phenomena are based on biological systems. BES plays a key role in funding exploratory research on biosystems at nanoscale. Chips and sensors, combined with microfluidics, are intimately integrated with the nanobiotechnology area, since many of these systems are used on chips for medical, environmental, and other sensing applications.

Engineering Environmental Analysis and Problem-Solving Options Development: Rapidly expanding cyberinfrastructure capabilities are enabling the potential for developing radically new approaches to engineering analysis of environmental problems. Building on such new analysis approaches, it will be possible to generate problem-solving options for implementation alternatives that are based on strong participation not only by engineers, but the full complement of stakeholders, including biological and physical scientists, social scientists, community members, and government officials at the local, state, federal, and in some cases, international levels. On the technical side, development of new sensors, databanks, communication networks, analytical models, and even conceptual frameworks is required.

BES will continue to provide support for specialized resources and infrastructure that facilitate research and educational activities, including the National Nanotechnology Infrastructure Network (NNIN) and Nanoscale Science and Engineering Centers (NSECs).

Changes from FY 2005:

- The Sensor and Sensors Network solicitation run in FY 2005 will not be repeated in FY 2006. Funds in the amount of $3.0 million will be reallocated coupled with the BES overall increase of $2.46 million to:
  - The solicitation on Quantitative Systems Biotechnology (QSB), which was not run in FY 2005,
  - Collaborative Large-scale Engineering Analysis Network for Environmental Research (CLEANER) planning activities, and
  - BME/RAPD unsolicited awards.

CHEMICAL AND TRANSPORT SYSTEMS $68,990,000

The FY 2006 Budget Request for the Chemical and Transport Systems Division is $68.99 million, an increase of $3.20 million, or 4.9 percent, above the FY 2005 Current Plan of 65.79 million.

Chemical and Transport Systems Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Chemical and Transport Systems	**$69.21**	**$65.79**	**$68.99**	**$3.20**	**4.9%**
Major Components:					
Research and Education Grants	61.48	57.11	60.29	3.18	5.6%
Nanoscale Science & Engineering Centers	2.20	3.15	3.15	0.00	0.0%
National Nanoscale Infrastructure Network	1.55	1.55	1.55	0.00	0.0%
Science & Technology Center	3.98	3.98	4.00	0.02	0.5%

About CTS:

The Chemical and Transport Systems (CTS) Division supports research and education in areas that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. CTS research and education investments contribute significantly to the knowledge base and to the development of the workforce for major components of the U.S. economy. These include the process industries (chemicals, pharmaceuticals, forest products, materials, petroleum, food, and textiles), utilities, microelectronic component manufacturers, and producers of consumer products of all kinds.

CTS supports research in the core disciplines of chemical reaction engineering, interfacial phenomena and separations, fluid dynamics and particle processes, and combustion and thermal transport. These areas are essential to ensure continued growth of the fundamental engineering knowledge base, which is the foundation for advances in a wide range of technologies.

In general, 70 percent of the CTS portfolio is available for new awards. The remaining 30 percent funds awards made in previous years.

CTS Priorities for FY 2006:

CTS will continue to support research in the core disciplines such as catalysis, chemical process design, advanced materials, fuel cells, fluid flow, combustion, heat transfer, and particle processes for many applications including sensors and membranes. These investments contribute to advances that are important for the environment, energy, transportation, information technologies, health-related products, and other areas that impact our daily lives.

While sustaining the vitality of these core research areas, CTS actively supports the following key areas of particular NSF emphasis:

Nanoscale Science and Engineering: This is an important area for CTS, especially for its role in enabling novel systems innovation including product development, manufacturing techniques, nano-biotechnology, and environmental sustainability. CTS support in this area is maintained at the FY 2005 level of $27.30 million. This funding allows continued development of research in the synthesis and processing of matter at the nanometer-length scale, producing materials with novel physical, optical, chemical, and biological properties. Much of the materials processing at the nano-scale occurs at the surface or interface between various phases. Understanding structural morphologies and properties at the molecular and nano-scale and developing methods to integrate these new functional materials to bulk scale via new experimental tools and simulation capabilities will permit major advances and applications in many areas central to CTS and other engineering fields.

The specific fields of catalysis, micro-fluidics, interfacial, plasma, and bulk materials processing, and adsorption media for selective chemical and biochemical separations find applications through use of selective membranes, fuel cells, sensors, and environmental technologies. The syntheses of particles, films, and 3D structures with functional nanoscale features by methods involving nucleation, molecular and particle self-assembly, controlled thermal and molecular transport, as well as chemical reactions, is a priority for CTS nano-scale research. In order to accelerate the benefits from increased investments in fundamental research on these topics, CTS will allocate funds to address issues that deal with scale-up of the synthesis processes, development of new instrumentation, chemical and bio-sensors, and electronic materials, as well as refined methods for materials characterization at the nanoscale. The results of this pioneering research will also find uses in other fields of science and engineering.

Smart Manufacturing and Processing: Manufacturing of specialty products, such as pharmaceuticals, health-related diagnostics, and high-value additives, involve the integration of materials design, synthesis, characterization and processing steps. Both theoretical and experimental strategies, such as combinatorial methods and lab-on-the-chip techniques, contribute to this integration. Molecular design and synthesis, self-assembly and directed assembly of gaseous, liquid, and solid materials at the nano-scale, micro-fluidics, and nano-fluidics constitute some of the frontier research activities that CTS will pursue. Molecular design and process control based on the range of scale from molecular to enterprise-wide considerations is an important activity.

Other CTS processing areas that are of growing importance are powder processing based on a fundamental understanding of particles interactions, laser surface interactions, crystal growth processing, combustion synthesis of materials, manufacturing with jets of materials, and the development of nano materials for tailoring the thermal, mechanical, and electrical properties of composite systems. A promising new approach explored in CTS is high throughput manufacturing of nano-porous films via flow-induced micelle alignment and other liquid-liquid micro-fluidics systems.

Environmentally and Energy Focused Processes and Products: CTS will continue support of environmentally relevant technologies and fundamental aspects of energy production. Research leading to products and processes that avoid negative environmental impact will be a CTS priority. Examples of CTS interest areas are environmentally benign production processes that minimize undesirable side products, new biocatalysis methods that permit the use of renewable feedstocks, and separation and purification processes that use less energy, as well as environmentally sound solvents, cleaner combustion processes, and reliable process-design methods that reduce or eliminate environmental impact.

Energy-focused research is an active CTS area, and it includes catalysts for fuel cells, new structures and compositions for hydrogen storage, and materials used in energy production from alternative resources. The hydrogen economy will need an array of new materials for the range of energy production, fuel storage, and conversion that is envisioned. CTS is interested in fundamental aspects of development of fuel cells including the further development of micro fuel cells as well as large ones for transportation.

Other related environmental and energy-focused CTS interests include fluid-sediment interactions over complex coastal topography and river flow and the analysis and design methodology that may revolutionize the shape and energy efficiency of aircraft of the future**.**

Safety and Security: Research in this area is directed at assisting development of improved, long-range homeland security technologies. One CTS effort includes sensors-related research that provides for fast and selective responses and development of robust sensors that are very compact. Safety involves a system approach integrating detection, analysis, validation, and decision making into a proactive prevention process. CTS research focuses on fast, accurate, non-intrusive detection and sensing methods for chemical, thermal, and biological events and process control and prevention strategies**.** Flow and mixing of cohesive powders is a CTS research topic of great interest to the pharmaceutical, chemical, and petrochemical industry, but also has application in natural phenomena such as landslides and avalanches. A fundamental understanding of the underlying mechanisms will enable process design and optimization of industrial processes and prediction and mitigation of related natural hazards.

CTS will continue to provide support for specialized resources and infrastructure that facilitate research and educational activities, including the National Nanotechnology Infrastructure Network (NNIN) and Nanoscale Science and Engineering Centers (NSECs), and a Science and Technology Center (STC) on New Materials for Water Purification.

Changes from FY 2005:

- The requested increase of $3.20 million in funding in FY 2006 will be distributed among the four core areas to support high-potential ideas and pioneering research as well as two additional awards in the Faculty Early Career Development (CAREER) Program. This distribution will ultimately be based on actual proposals received in FY 2006.

CIVIL AND MECHANICAL SYSTEMS $84,210,000

The FY 2006 Budget Request for the Civil and Mechanical Systems Division is $84.21 million, an increase of $2.23 million, or 2.7 percent, above the FY 2005 Current Plan of $81.98 million.

Civil and Mechanical Systems Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Civil and Mechanical Systems	**$67.22**	**$81.98**	**$84.21**	**$2.23**	**2.7%**
Major Components:					
Research and Education Grants	65.42	60.04	61.29	1.25	2.1%
Nanoscale Science & Engineering Centers	1.60	2.20	2.20	0.00	0.0%
National Nanoscale Infrastructure Network	0.20	0.20	0.20	0.00	0.0%
Network for Earthquake Engineering Simulation	-	19.54	20.52	0.98	5.0%

About CMS:

The Civil and Mechanical Systems (CMS) Division has two major goals: to invest in research and workforce development that will provide the fundamental and quantitative foundation for the engineering profession in application to civil and mechanical systems and the built environment, and to support the rapid development and deployment of new knowledge and technology in service to the public to decrease vulnerability to natural and technological hazards.

In general, 61 percent of the CMS portfolio is available for new awards. The remaining 39 percent funds awards made in previous years.

CMS Priorities for FY 2006:

CMS research contributes to the knowledge base and intellectual growth in the areas of mechanics and materials, infrastructure construction and management, dynamics and control, sensing for civil and mechanical systems, geotechnology, structures, as well as the reduction of risks and casualties induced by earthquakes and other natural and technological hazards. The division encourages cross-disciplinary partnerships for frontier research at the intersections with traditional civil and mechanical engineering disciplines, to promote discoveries using technologies such as sensors, adaptive systems, nanotechnology, and simulation to enable revolutionary advances in our nation's civil and mechanical systems.

The $2.23 million increase coupled with a reallocation of funds in the CMS budget will be utilized in strengthening research in the core programs. These investments are clustered into the following three higher–level themes:

1. *Engineered Materials and Mechanics*
2. *Intelligent Civil and Mechanical Systems*
3. *Infrastructure Systems and Hazard Mitigation*

In addition, recent events have brought focus on the nation's increasingly interdependent, complex and vulnerable human, social, natural and physical systems. CMS pursues cross-directorate and interagency partnerships such as the Partnership for Advancing Technology in Housing (PATH) program with the Department of Housing and Urban Development (HUD) that provides such knowledge enhancement and advanced tools for the evaluation of vulnerability. In support of this and of NSF's mission in the National Earthquake Hazards Reduction Program (NEHRP), CMS invests in research on the impact of natural and technological hazards on constructed, natural, and human environments. CMS funds rapid-response reconnaissance investigations following extreme events in the United States or abroad. CMS continues to invest in a variety of crosscutting activities, such as Nanoscale Science and Engineering, Biocomplexity in the Environment, Human and Social Dynamics, Mathematical Sciences priority areas, and others.

NEES Operations and Grand Challenge Research: The main priority of the CMS division continues to be the operations and research for the Network for Earthquake Engineering Simulation (NEES). The construction of NEES, funded during FY 2000-2004 within the Major Research Equipment and Facilities Construction (MREFC) account, was successfully completed October 2004. NEES is a project to construct, upgrade, and network an innovative system of geographically distributed test facilities in earthquake engineering. The integration of the system is accomplished via NEESgrid, which utilizes innovative grid computing technologies. This project will also promote international collaborations for earthquake and tsunami engineering research, as well as education and outreach opportunities. For additional information on this project, see the Facilities Chapter. The non-profit NEES Consortium, Inc. has been established, with funding of approximately $20 million per year from CMS, to manage, operate, and maintain the geographically distributed national NEES facility. With over 500 members, both institutional and individual, and an elected board of representatives, it includes all elements of the research community in earthquake engineering. All research, as well as educational and outreach activities, utilizing NEES will be scheduled through the NEES consortium. This consortium will be responsible for maintaining the NEES infrastructure, both at the equipment sites, as well as its integration via NEESgrid. The NEES Consortium will also link the U.S. earthquake engineering research community to earthquake engineering research activities/facilities in Japan, Europe, and other nations. In FY 2006 at least $9 million will be used to support basic research in multi-hazard engineering involving experimental and theoretical simulations at the NEES facilities. NEES research will address important challenges in earthquake and tsunami engineering research. These are described in the recent National Research Council study entitled *Preventing Earthquake Disasters; The Grand Challenge in Earthquake Engineering*, National Academies Press, 2003.

CMS will continue to provide support for specialized resources and infrastructure that facilitate research and educational activities, including the National Nanotechnology Infrastructure Network (NNIN) and Nanoscale Science and Engineering Centers (NSECs).

Changes from FY 2005:

- The CMS division will utilize the increase of $1.25 million in Research and Education Grants to respond to increasing proposal pressures in emerging areas in civil and mechanical systems, such as simulation based engineering science, complex systems, nanomechanics, biomechanics, smart structures, and mechatronics.

- An increase of $980,000 to a total of $20.52 million will continue to accommodate the important transition from the construction phase to the operations and research phase for the Network for Earthquake Engineering Simulation (NEES).

DESIGN AND MANUFACTURING INNOVATION $ 67,410,000

The FY 2006 Budget Request for the Design and Manufacturing Innovation Division is $67.41 million, an increase of $3.56 million, or 5.6 percent above the FY 2005 Current Plan of $63.85 million.

Design and Manufacturing Innovation Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Design and Manufacturing Innovation	**$65.92**	**$63.85**	**$67.41**	**$3.56**	**5.6%**
Major Components:					
Research and Education Grants	62.17	59.00	62.56	3.56	6.0%
Nanoscale Science & Engineering Centers	2.30	3.40	3.40	0.00	0.0%
National Nanoscale Infrastructure Network	1.45	1.45	1.45	0.00	0.0%

About DMI:

The Design and Manufacturing Innovation (DMI) Division supports academic research and education for discovery and innovation in new enterprises, and the enhancement of productivity and global competitiveness in existing U.S. industries. This Division also supports the development of a diverse human resource base comprised of an educated, adaptable and knowledge-enabled workforce, which is vital to U.S. global competitiveness. The core DMI programs – Engineering Design, Operations Research, Manufacturing Enterprise Systems, Service Enterprise Engineering, Nanomanufacturing, Materials Processing and Manufacture, and Manufacturing Machines and Equipment – support discoveries and innovations that will help to create the nation's 21st Century manufacturing enterprises.

The Grant Opportunities for Academic Liaison with Industry (GOALI) program, managed by DMI for the Engineering Directorate, enables partnerships between industry and academe with a common intellectual and educational agenda.

A major change in the Design and Manufacturing Innovation (DMI) Division during FY 2005 was the establishment of a separate Office of Industrial Innovation in the Engineering Directorate, which moved the Small Business Innovation Research and Small Business Technology Transfer programs out of DMI.

In general, 87 percent of the DMI portfolio is available for new awards. The remaining 13 percent funds awards made in previous years.

DMI Priorities for FY 2006:

DMI's core programs support investigator-initiated, fundamental research on topics related to design, manufacture, and service systems that provide products and systems of value to society. In FY 2006, DMI plans to continue to invest in research leading to environmentally benign design and manufacture systems, engineered service systems for health care delivery, and additive hybrid net shape processes to produce the meso- and micro-scale machines that will be needed for micro and nanoscale products.

Retrospective assessments conclude that DMI grants have resulted in fundamental contributions leading to the creation of new research fields and knowledge in design, manufacturing, and service. A recent example of the critical role of basic manufacturing research, which is featured on the cover of the NNI strategic plan, shows that the road to commercialization began at NSF with research funded by DMI, subsequent support by other federal agencies, and commercialization enabled by NSF SBIR/STTR investments. Looking toward the future, DMI is engaged with its research community through benchmarking studies in the fields of hybrid additive/subtractive manufacturing processes and micro machines, that will transform material on the nano to meso scales – with precision and performance only dreamed of today.

DMI also supports the development of people, through foundation-wide programs and supplements such as CAREER, ADVANCE, REU, and RET, as well as foundation-wide interdisciplinary research priorities critical to the nation's future.

Nanomanufacturing, converting the discoveries of nanoscience into new products for the benefit of society, is a key component of the Nanoscale Science and Engineering (NSE) priority area, and is a grand challenge for the National Nanotechnology Initiative. A range of manufacturing discoveries and innovations are needed to design the systems and processes to deliver products, devices, and components that take advantage of the unique properties of the nano scale. Simultaneously, an entirely new manufacturing workforce needs to be educated and trained in nanotechnology to bring to fruition the many exciting opportunities that nanotechnology has opened up. While the nanomanufacturing program is the focal point of NSE in DMI, the need for new knowledge from different fields makes NSE an important component of all the academic research programs in DMI.

The Materials Use: Science, Engineering, and Society (MUSES) Program is an emphasis of the Biocomplexity in the Environment (BE) priority area, supporting the design and synthesis of new materials with environmentally benign impact on biocomplex systems.

The Mathematical Sciences priority area offers multidisciplinary opportunities for advances in distributed sensors systems, scalable manufacturing enterprise systems, modeling uncertainty and managing risk, and new modeling techniques that predict processing behavior and product performance on scales ranging from the molecular to the macro.

DMI will continue to provide support for specialized resources and infrastructure that facilitate research and educational activities, including the National Nanotechnology Infrastructure Network (NNIN) and Nanoscale Science and Engineering Centers (NSECs).

Changes from FY 2005:

- In FY 2005, DMI began phasing down its support of the Innovation and Organizational Change Program. In FY 2006, DMI will discontinue supporting this program, reallocating the remaining $500,000 to other core programs.

- With this reallocation of base funds and a requested increase of $3.56 million, FY 2006 will focus on rebuilding core programs as well as the GOALI program. This is a priority for DMI, because investigator-initiated research lays the groundwork for future investments in education, research, and innovation. DMI's investments in Nanomanufacturing will strengthen improvement of human physical and mental abilities through the integration of nanotechnology, biotechnology, information technology, and cognitive science, as well as building a new generation of tools and processes to achieve this goal.

ELECTRICAL AND COMMUNICATIONS SYSTEMS $74,350,000

The FY 2006 Budget Request for the Electrical and Communications Systems Division is $74.35 million, an increase of $2.71 million, or 3.8 percent, over the FY 2005 Current Plan of $71.64 million.

Electrical and Communications Systems Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Electrical and Communications Systems	**$74.61**	**$71.64**	**$74.35**	**$2.71**	**3.8%**
Major Components:					
Research and Education Grants	63.68	59.66	62.35	2.69	4.5%
Nanoscale Science & Engineering Centers	2.40	3.45	3.45	0.00	0.0%
National Nanoscale Infrastructure Network	4.55	4.55	4.55	0.00	0.0%
Science and Technology Center	3.98	3.98	4.00	0.02	0.5%

About ECS:

The Division of Electrical and Communications Systems (ECS) addresses fundamental research issues underlying component and device technologies, computation, networking, control, and systems principles at the nano, micro and macro scales, and supports the integration and networking of intelligent systems for a variety of application domains in sensing, imaging, telecommunications, wireless networks, natural disasters, homeland security, power systems, environment, transportation, biomedicine, nanomanufacturing, and other device and systems-related areas. ECS envisions a research community that will address major technological challenges in devices and systems due to the convergence of micro/nano/info/bio-electronics, controls, communications, networks, and computation.

ECS has a continuing goal to integrate education into its programs to ensure the education of a diverse workforce in the 21st Century who will continue innovative advances for the rapid development of emerging technologies as drivers of the global economy. This vision is encouraged and strengthened by the “Engineer of 2020” report of the National Academy of Engineering (NAE) that foresees a “bewildering array of new technologies” confronting an engineering profession that must be educated in research, development and design, as well as possessing the attributes of strong analytical skills, creativity, ingenuity, professionalism, and leadership.

The strategic development of ECS programs in research and education supports NSF themes in nanotechnology, biocomplexity in the environment, cyberinfrastructure, human and social dynamics, sensors and sensor networks, information technology, mathematical sciences, and the workforce for the 21st Century. ECS strengthens its programs through linkages to other areas of engineering, science, industry, and government.

In general, 76 percent of the ECS portfolio is available for new awards. The remaining 24 percent funds awards made in previous years.

The ECS Division is organized around three programs that focus on research and educational issues of device and component technologies, computational technologies, and integrative systems: (1) Electronics, Photonics, and Device Technologies (EPDT), (2) Control, Networks, and Computational Intelligence (CNCI) and (3) Integrative Systems (IS).

ECS Priorities for FY 2006:

The EPDT program seeks to improve the fundamental understanding of devices and components based on the principles of electronics, photonics, magnetics, electro-optics, electromagnetics, electromechanics, and related physical phenomena. The program will continue to invest in advancing the frontiers of spin electronics, molecular electronics, bioelectronics, nonsilicon electronics, organic electronics, photonics, optoelectronics, MEMS/NEMS, power electronics, and microwave and mixed signals. EPDT further support related topics in quantum engineering, communications, and computing. EPDT will continue to support revolutionary electromagnetic materials and device solutions, RF integrated circuits, and reconfigurable antennas needed for telecommunications, telemedicine, and other wireless applications. ECS will enable discovery and innovation through new approaches to electronics, beyond the scaling limits of complementary metal oxide semiconductor (CMOS) technology. Led by ECS, NSF has embarked on cooperative efforts with the semiconductor industry and Semiconductor Research Corporation on the theme of Silicon Nanoelectronics and Beyond (SNB). Research in SNB will explore the ultimate limits to scaling of features and alternative physical principles for devices at the nanoscale.

The CNCI program will continue to invest in the analysis and design of intelligent engineering networks and complex dynamical systems, for control, communications, computation, and energy applications in telecommunications, Internet, energy, transportation, and manufacturing. CNCI will further invest in adaptive dynamic programming, reinforced learning, pattern recognition, and intelligent agents to develop brain-like networked architectures performing real-time learning, computational video and imaging, and embedded control of robotics. ECS is committed to support the development of innovative hardware/software architectures for emerging areas of cyberinfrastructure and cybersecurity. ECS also continues a strong emphasis on critical infrastructure aspects of electric power systems and grids, including integration of renewable and distributed energy systems into large power networks, and understanding of associated regulatory and economic structures.

The IS program supports innovative research in areas that integrate device concepts and systems principles in the design, development, and implementation of new nano/micro/macro/complex and hybrid systems with engineering solutions for diverse applications. The program is intended to spur visionary systems-oriented activities in collaborative research and education environments. Emphasis in the IS program is on system-on-a-chip, system-in-a-package, cyberengineering systems, wireless and optical communications systems, quantum information systems, robotics and machine intelligent systems, power and energy systems, and organic/silicon-based hybrid systems, among others. Integrative systems continually offer new challenges in basic research and promise for future applications.

ECS will continue to provide management support for specialized resources and infrastructure that facilitate research and educational activities, including the National Nanotechnology Infrastructure Network (NNIN), Science and Technology Center on Nanobiotechnology at Cornell University, and Nanoscale Science and Engineering Centers at Cornell University and the University of California at Berkeley. ECS actively participates in the development and management of cross-disciplinary programs and has coordinated the multi-directorate research focus on Sensors and Sensor Networks. ECS has also funded a special research focus on Technological Challenges in Organic Electronics, Photonics, and Magnetics, with co-support from DARPA and the Office of Naval Research.

ECS is initiating a pilot program on Graduate Research Supplements (GRS) to current research grants funded by ECS for women and minority Ph.D. students majoring in electrical engineering disciplines, in order to increase the number of women and minority students in advanced academic and professional careers.

ECS will hold grantees workshops to assess the results of research and education grants and to encourage interaction among principal investigators, as well as focused workshops to assess research and technology areas of current and future importance. ECS has organized a workshop jointly with the semiconductor industry on Silicon Nanoelectronics and Beyond; a U.S.-Japan Workshop on Nanophotonics; and a U.S.-India Workshop on Nanotechnology: Issues in Interdisciplinary Research and Education. ECS also convened a workshop at NSF on 21st Century Women in Science and Engineering involving 100 women undergraduate and graduate students, and a workshop on Bringing Control Engineering to Middle and High School Students and Teachers involving 250 students and their teachers from the Maui School District in Hawaii.

Changes from FY 2005:

The increase in the FY 2006 request will accommodate reallocations of funds in emerging areas within the core programs:

- An increase of $2.51 million will support "Integrative Systems" principles in the design, development and implementation of new nano/micro/macro/complex and hybrid systems with engineering solutions for a variety of application domains. Integrated systems, are increasingly viewed as critical in meeting a broad range of societal challenges in the 21st Century, including those associated with sensing, imaging, telecommunications, wireless networks, power systems, environment, health care, transportation, biomedicine, manufacturing, natural disasters, homeland security, and other systems-related areas.

- Reallocation of additional core funds in the amount of $3.0 million will support unsolicited proposals in the following emerging areas: quantum engineering, diagnostic and implantable devices, flexible electronics, ultra-fast communications, neuro-dynamic control and learning for complexity, and adaptive dynamic programming.

- An increase of $200,000 will also support two additional CAREER awards.

ENGINEERING EDUCATION AND CENTERS $129,710,000

The FY 2006 Budget Request for the Engineering Education and Centers Division is $129.71 million, an increase of $2.65 million, or 2.1 percent, from the FY 2005 Current Plan of $127.06 million.

Engineering Education and Centers Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Engineering Education and Centers	**$134.03**	**$127.06**	**$129.71**	**$2.65**	**2.1%**
Major Components:					
Research and Education Grants	45.68	40.43	41.60	1.17	2.9%
Engineering Research Centers	65.60	61.57	61.80	0.23	0.4%
Earthquake Engineering Research Centers	5.99	6.00	6.00	0.00	0.0%
Nanoscale Science & Engineering Centers	8.41	9.71	9.71	0.00	0.0%
Industry/University Cooperative Research Centers	6.00	6.00	7.25	1.25	20.8%
Network for Computational Nanotechnology	2.35	3.35	3.35	0.00	0.0%

About EEC:

The Engineering Education and Centers (EEC) Division promotes and facilitates university research and curricula by supporting innovative programs that integrate research and education, improve the quality of the engineering workforce, cut across disciplines, and whose breadth of investigation spans from idea inception to proof-of-concept. The EEC's programs are divided into three major categories: development of interdisciplinary research centers that foster partnerships between academe, government and industry; advancing graduate and undergraduate engineering education; and development of a diverse and capable technical workforce. EEC's programs provide opportunities for teams of faculty and students to explore and test emerging technologies and curricular reforms with the potential to transform the engineering education enterprise, start-up new industries, or radically impact current industrial processes and products. Through involvement with EEC's awards, engineering students have the unique opportunity to integrate knowledge across disciplines to advance technology in partnership with industry, to understand how to link discoveries with design and manufacturing issues, and to benefit from new modes of engineering education informed by new learning theories, teaching methods, and new engineering and scientific discoveries. EEC programs address issues that are critical to all fields of engineering, and benefit from a centralized management focus, and complement the research and education portfolios of the other divisions of ENG. Its programs benefit from a scope encompassing all of engineering and a scale that both facilitates the incorporation of new scientific knowledge into engineering and requires rigorous monitoring and evaluation systems.

In general, 61 percent of the EEC portfolio is available for new awards. The remaining 39 percent funds awards made in previous years.

EEC Priorities for FY 2006:

In FY 2006, EEC will provide support for Engineering Research Centers (ERC), Nanoscale Science and Engineering Centers (NSEC), Earthquake Engineering Research Centers (EERC), and Industry/University Cooperative Research Centers (I/UCRC). Industry and universities develop long-term, interdisciplinary partnerships in NSF-supported centers, which spin off a broad range of fundamental knowledge and new inventions. The stream of advanced technologies emanating from the centers is carried into industry by partnerships with practicing engineers and scientists and by new generations of graduating engineers who have learned the skills needed to be effective leaders in technology innovation.

In FY 2005, 18 Engineering Research Centers (ERC) focused on the definition, fundamental understanding, development and validation of technologies needed to realize a well-defined class of engineered systems with the potential to spawn whole new industries or radically transform the product lines, processing, technologies, or service delivery methodologies of ongoing firms. ERC faculty, students, and their industrial partners integrate discovery and learning in an interdisciplinary environment that reflects the complexities and realities of real-world technology. ERC innovations impact the curriculum at all levels from precollege education to life-long learning. ERCs focus on diversity of the engineering workforce at all levels through recruitment and retention of women and underrepresented minorities in their core teams and through outreach partnerships with NSF diversity awardees such as the Louis Stokes Alliances for Minority Participation. ERCs conduct research and developed educational materials on key technologies related to the engineering of living tissues, sensory prostheses that interface to the human nervous system, extreme ultraviolet/soft X-ray light sources for advance microscopy at the nanoscale, systems for detection of and warning of severe storms, computer-integrated surgical systems, biomaterials for implants, environmentally benign manufacturing technologies for chemical and semiconductor manufacturing, advanced fibers and films processing, ultra fine particles, reconfigurable manufacturing systems, advanced semiconductor packaging, wireless integrated microsystems, subsurface sensing and imaging, integrated media systems, and power electronics. In FY 2006, four new ERCs will be added to the portfolio, enabled by funds released into the ERC Program through the graduation to self-sufficiency of five ERCs in FY 2005, and phasing down support to seven ERCs during FY 2005 and 2006 to prepare them for self-sufficiency. All ERCs operate with funds from NSF, academe, industry, and other federal agencies.

The eight Nanoscale Science and Engineering Centers fully or partially supported by EEC perform research to advance the development of the ultra-small technology that will transform electronics, materials, medicine and many other fields. EEC's support is provided to give them the opportunity to explore engineered systems technologies. The centers address challenges and opportunities that are too complex and multi-faceted for individual researchers or small teams to tackle. They involve key partnerships with industry, national laboratories and other sectors and support education programs from the graduate to the pre-college level designed to develop a highly skilled workforce and advance pre-college training and the public understanding of science and engineering. Funds are also provided to smaller interdisciplinary teams and to the Network for Computational Nanotechnology, a web-accessible repository of simulations of nanoscale phenomena for research and education.

In FY 2005, the 50 I/UCRCs worked closely with industry to develop enabling technologies needed to manage the electrical power system, improve manufacturing and biological processes, develop new materials, information and telecommunications technologies, and innovate new products and services. EEC provides modest seed funds and management expertise to these highly leveraged centers, with states joining in many partnerships to expand the centers' activities to have an impact on local economic development. In FY 2006, funds will be added to the I/UCRC program to allow the current centers to compete for supplements for fundamental research that will advance their center's capability.

The three Earthquake Engineering Research Centers bring together multi-institutional teams of investigators to provide the knowledge and technology base for industry and public agencies to build and retrofit structures and other infrastructure to prevent damage from earthquakes. These centers take a systems approach, integrating engineering, seismological, and societal response knowledge to develop technologies and decision support systems. The centers integrate research and education and develop partnerships with industry and the public agencies responsible for earthquake hazard mitigation at the regional, state, and local levels. These centers are producing structural design models and earthquake hazard mitigation technology for buildings and transportation and lifeline systems and engaging designers and policymakers in the development of hazard mitigation strategies for communities with earthquake risks.

EEC programs in engineering education and human resource development are aimed at transforming engineering education to produce an engineering workforce that is diverse and creative, understands the impacts of its solutions on both technical and social systems, and possesses the ability to adapt to the rapidly evolving technical environment in industry, academe, and society. In FY 2006, EEC will expand the focus of our engineering education and human resource programs to 1) support research on how people learn engineering, especially design, creativity and innovation, and 2) to catalyze the restructuring of engineering education culture and pedagogy so it better fosters multidisciplinary systems level thinking among faculty and students, makes social impact more central to the study of engineering, and attracts more diverse students. These two foci flow from the recent National Academy of Engineering reports "Assessing the Capacity of the U. S. Engineering Research Enterprise: Preliminary Report for Public Review" and "The Engineer of 2020: Visions of Engineering in the New Century." Existing successful programs in Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET) which have been shown to be successful programs for development of an engineering workforce will see increases in FY 2006.

Changes from FY 2005:

The FY 2006 Budget Request for EEC is $129.71 million, an increase of $2.65 million from FY 2005. This increase combined with reallocation of funds will be accommodated, as follows:

- Support for ERCs will see an increase of $230,000 to provide additional resources for their diversity and outreach programs;

- Funding for the I/UCRC program will increase from $6.0 million to $7.25 million with the funds being used to provide research supplements to advance the underlying fundamental science and technology of the centers;

- EEC is reformulating its current support for engineering education into a new program aimed at defining and elevating fundamental research into how students learn engineering. To date, engineering education reform has been based more on qualitative ideas of how to engage students in their learning and not on fundamental research that integrates an understanding of how students learn, and how the curriculum can be improved to attract more talented and diverse students. The new initiative combines the Department Level Reform program and the unsolicited Engineering Education program into a new Transforming Engineering Education program at $11.82 million.

- Increased investments to implement the recommendations of the Directorate for Engineering Workforce Report, most notably an increase in the Research Experiences for Undergraduates program by $1.50 million to $8.50 million total and the Research Experiences for Teachers program from $2.50 million to $4.0 million.

OFFICE OF INDUSTRIAL INNOVATION $105,330,000

The FY 2006 Budget Request for the Office of Industrial Innovation (OII) Subactivity is $105.33 million, an increase of $2.57 million, or 2.5 percent over the FY 2005 Current Plan of $102.76 million.

Office of Industrial Innovation Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Office of Industrial Innovation	**$103.58**	**$102.76**	**$105.33**	**$2.57**	**2.5%**
Major Components:					
Small Business Innovation Research	92.70	91.97	94.29	2.32	2.5%
Small Business Technology Transfer	10.88	10.79	11.04	0.25	2.3%

About OII:

The Office of Industrial Innovation (OII) is a newly created office, which was housed under the previous Division of Design, Manufacture, and Industrial Innovation (DMII). OII manages two congressionally mandated small business programs, Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, for the entire Foundation. OII is especially well positioned to meet the innovation component of NSF's vision through its broad science and engineering research topics. Solicitation topics are released twice a year for Phase I proposals, which address feasibility research from small businesses that can be carried out within six months for SBIR and within one year for STTR. All SBIR/STTR Phase I grantees have an opportunity to submit Phase II proposals, which describe research plans covering a two-year period leading up to prototypes of products/process/systems. In addition, Phase II proposals contain commercialization plans that propose the transformation of the scientific and engineering research to commercial and/or societal benefits. From the business community perspective, NSF SBIR/STTR investments are considered pre-seed investment, too risky for even early stage investment. The research topics generated in the SBIR/STTR solicitations are grouped into three areas of business opportunities with potential Phase III investments beyond NSF SBIR/STTR funding. These topics are designed to be attractive to and/or meet the needs of capital/investment markets, strategic partners, and national and societal priorities.

Within the SBIR/STTR research topics, Biotechnology, Information Technology, and Electronics Technology are positioned as potentially attractive to the venture capital and angel network communities. Advanced Materials and Manufacturing and Chemical Technology research topics are of interest to the large corporations with potential for strategic partnerships with the small business community. In response to national priorities, Manufacturing Innovation and Security Technology research topics are solicited.

In general, 100 percent of the OII portfolio is available for new awards.

OII Priorities for FY 2006:

In response to the Executive Order 13329 requiring all federal agencies with SBIR programs to emphasize manufacturing research, NSF SBIR/STTR created a special research topic, Manufacturing Innovation in FY 2005. The topic covers the full spectrum of the manufacturing sector from aerospace to pharmaceutical, seeking research proposals in manufacturing processes, machines, systems and their societal implications. Based on the successful response in FY 2005, the topic will be solicited again in FY 2006. In FY 2004, NSF SBIR/STTR defined a new Security Technology topic to seek future innovations from the small business community to meet the needs of national security. The topic is uniquely defined at the intersection of leading discoveries in nanotechnology, biotechnology, and information technology. Based on the successful response, this topic has been refined to be released in FY 2005 for funding in FY 2006. In addition, a focused Chemical Technology topic will be released and funded in FY 2006 for the first time. Additional topics to be released include Biotechnology, Information Technology, and Advanced Materials Technology.

SBIR/STTR grantees have made a mark in their contribution to the innovation capital of the nation appearing in numerous media releases. One noteworthy example is the recognition gained by several grantees by receiving R&D Magazine's prestigious R&D 100 awards. The Office of Industrial Innovation has embarked on an in-depth survey of SBIR/STTR grantees to document economic and social outcomes of NSF investments in these important programs. Simultaneously, the OII is working with the National Academies by providing complete historical data on all SBIR proposals and awards along with complete details on contact information so that the National Research Council can conduct an independent study of the federal SBIR program amongst the top five agencies.

Following the 1990's economic growth and the burst of the technology bubble in the early 21st Century, the small business community found the SBIR and STTR programs as one of the few sources of capital to support and nurture early stage research ideas. Consequently, the volume of proposals grew a dramatic 80 percent with the consequence of low funding rates leaving many excellent research ideas un-funded.

Changes from FY 2005:

- Starting in FY 2005 and continuing in FY 2006, OII has focused on a few select technologies, has aligned the topics to meet national needs, and is focusing on rebuilding eroding funding rates.

- Homeland security is a national priority addressed by several agencies. OII is in a unique position to pull together novel research ideas that intersect the frontiers of research in nano-bio-info technology. With the increase in funding, OII will also target "Security Technology" in its SBIR solicitation.

- The SBIR program increases $2.32 million to a total of $94.29 million.

- The STTR program increases $250,000 to a total of $11.04 million.

Geosciences

GEOSCIENCES $709,100,000

The FY 2006 Budget Request for the Directorate for Geosciences (GEO) is $709.10 million, an increase of $14.94 million, or 2.2 percent, over the FY 2005 Current Plan of $694.16 million.

Geosciences Funding

(Dollars in Millions)

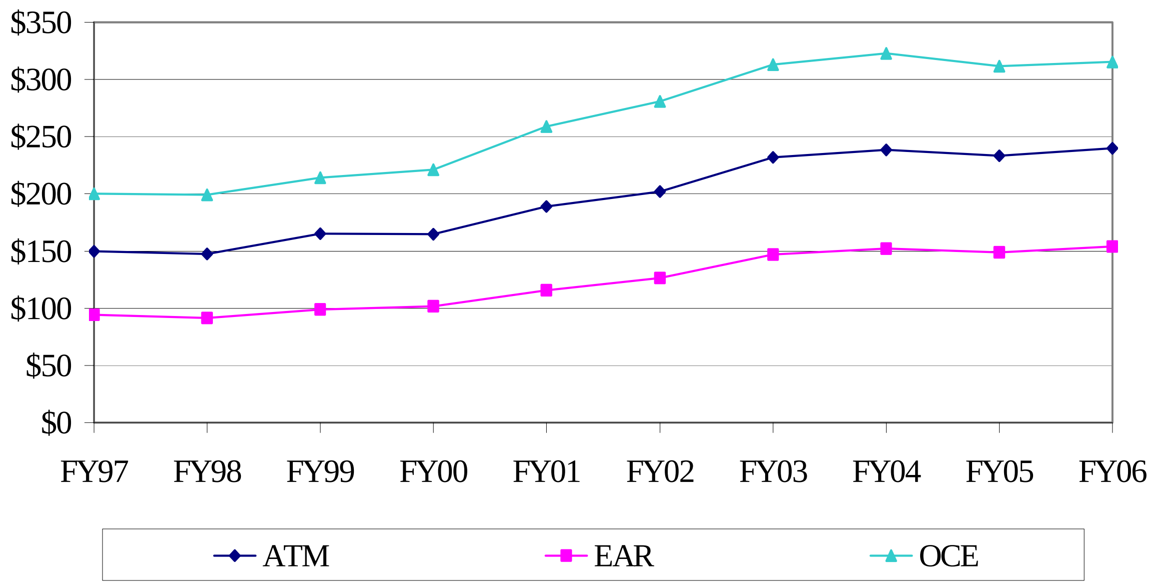
	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Atmospheric Sciences (ATM)	238.40	233.43	239.79	6.36	2.7%
Earth Sciences (EAR)	152.03	148.96	154.07	5.11	3.4%
Ocean Sciences (OCE)	322.98	311.77	315.24	3.47	1.1%
Total, GEO	$713.41	$694.16	$709.10	$14.94	2.2%

Totals may not add due to rounding.

The Directorate for Geosciences (GEO) supports the research, infrastructure, and education in the atmospheric, earth, and ocean sciences needed to advance our understanding of the integrated Earth system.

GEO Subactivity Funding

(Dollars in Millions)

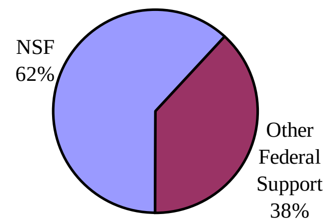


RELEVANCE

GEO supports basic research that contributes to a better understanding of the many processes that affect the global environment such as the role of the atmosphere and oceans in climate, the planetary water cycle, and the effects of increased concentrations of greenhouse gases in the atmosphere. Support is provided for interdisciplinary studies in climate and hydrologic systems, biogeochemical dynamics, ecological systems and dynamics, solid earth processes, and solar influences on the Earth system. Basic research supported by the Directorate for Geosciences enables preparation for and subsequent mitigation of the effects of these and other inevitable natural events. Lives are saved and property is preserved through better prediction and understanding of natural environmental hazards such as earthquakes, tornados, hurricanes and tsunamis. Associated with these studies is the need for databases and cyberinfrastructure to provide the scientific community with the resources to assemble and utilize data and information efficiently and effectively.

GEO is the principal source of federal funding for university-based basic research in the geosciences, providing about 62 percent of the total federal support in these areas. Not only does GEO play a critical role in addressing the nation's need to understand, predict and respond to environmental events and changes, but also helps to determine the best use of Earth's resources. Fundamental research in the geosciences advances scientific knowledge of Earth's environment, including resources such as fresh water, energy, minerals, and biological diversity. GEO-supported activities contribute to national and global observational capabilities and infrastructure for land, ocean, and atmospheric processes.

Federal Support for Basic Research in Geosciences at Academic Institutions



Summary of Major Changes by Division *(Dollars in Millions)*

GEO FY 2005 Current Plan……………………………………………………………………….$694.16

Atmospheric Sciences (ATM)

Increased support will target the following areas: the operation of the High-performance Instrumented Platform for Environmental Research (HIAPER), which begins full operation in FY 2006; the operation of the Advanced Modular Incoherent Scatter Radar (AMISR); and improved cyberinfrastructure and numerical models which will allow new discoveries, greater access to atmospheric data, and improved understanding of the atmospheric environment. +6.36

Earth Sciences (EAR)

Increased support focuses on operational and scientific support of the EarthScope facility, which is being constructed through the MREFC Account, and improving the cyberinfrastructure available to earth scientists. +$5.11

Ocean Sciences (OCE)

Areas receiving increased funding support include developmental activities related to the Ocean Observatories Initiative (OOI), operation of the academic research fleet, and development of advanced ocean research cyberinfrastructure. +$3.47

Subtotal, Changes +$14.94

FY 2006 Request, GEO……………………………………………………………...…….$709.10

Summary of Major Changes by Directorate-Wide Investments *(Dollars in Millions)*

GEO FY 2005 Current Plan……………………………………………………….…..……..$694.16

Research no change

Disciplinary and interdisciplinary research supported by GEO will remain approximately level in FY 2006.

Funding supports awards central to 21st Century geoscience. As research breakthroughs are realized from recent advances in computation, modeling, and observation techniques, a research enterprise has developed that is multidimensional, multidisciplinary, information-driven, education-oriented, and internationally engaged.

Natural Hazards +$7.00

Building on years of research on understanding and predicting impacts resulting from environmental phenomena, research activities on preparation and response to extreme environmental events such as hurricanes, earthquakes and tsunamis, tornados, space weather events will be augmented in FY 2006 as part of GEO's "all hazards" approach to natural hazards research.

New Facility Operations +$7.13

Several new facilities are becoming increasingly operational in FY 2006. As the EarthScope facility, being constructed through the MREFC Account, continues to grow in capability, operational support is ramping up to enable its full utilization. The High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER) aircraft constructed through the MREFC Account will be fully operational in FY 2006, as will the Advanced Modular Incoherent Scatter Radar.

GEO Facilities Funding

(Dollars in Millions)

Facilities	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Academic Research Fleet	$82.50	$83.20	$83.20	$0.00	0.0%
Advanced Modular Incoherent Scatter Radar	12.40	12.50	11.00	-1.50	-12.0%
Alaska Regional Research Vessel	0.30	0.30	0.30	0.00	0.0%
EarthScope	1.70	4.69	7.32	2.63	56.1%
Integrated Ocean Drilling Program	35.10	32.10	30.00	-2.10	-6.5%
Incorporated Research Institutions for Seismology	13.00	12.16	13.31	1.15	9.5%
Ocean Observatories Initiative	2.90	3.00	4.00	1.00	33.3%
Ocean Drilling Program		5.90	2.00	-3.90	-66.1%
Scientific Ocean Drilling Vessel	2.10	0.50		-0.50	-100.0%
Other GEO Facilities	20.50	20.30	22.27	1.97	9.7%
Total, GEO	$170.50	$174.65	$173.40	-$1.25	-0.7%

Linking Educational Programs +$2.51

A major effort to facilitate linkages across NSF's programs to promote education and diversity will be initiated in FY 2006.

NSF-wide Educational Programs no change

Participation in NSF-wide programs to support education, diversity, and new faculty across all areas of science and education will be maintained at the FY 2005 level.

Net, all other program changes ……………………………..…………………….……….………….…-$1.70

Subtotal, Changes $14.94

FY 2006 Request, GEO……………………………………………………………..……………$709.10

PRIORITY AREAS

In FY 2006, GEO will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

GEO Investments in NSF Priority Areas

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biocomplexity in the Environment	37.22	37.22	37.22	0.00	0.0%
Nanoscale Science and Engineering	7.94	7.94	6.14	-1.80	-22.7%
Mathematical Sciences	7.07	7.07	7.07	0.00	0.0%
Human and Social Dynamics	1.35	1.35	1.35	0.00	0.0%

Biocomplexity in the Environment: In FY 2006, GEO provides $37.22 million, level with the FY 2005 Current Plan, to support a set of coordinated activities in environmental science, engineering and education that advance scientific knowledge about the connection between the living and non-living Earth system. In FY 2006, a special focus on integrated natural cycles will be initiated, including an emphasis on environmental genomics in partnership with the Directorate for Biological Sciences and the Office of Polar Programs. Also included is $4.0 million related to homeland security, used to study the Ecology of Infectious Diseases.

Nanoscale Science and Engineering: In accord with the planned rampdown of the Priority Area, GEO's FY 2006 support for Nanoscale Science and Engineering drops $1.80 million, to a level of $6.14 million. Activities will focus on:

- Development and application of chemical and biological sensor technology for making rapid, high-precision observations at submicroscopic spatial and volumetric scales;
- Support for crosscutting studies aimed at understanding the distributions and behavior of nanoscale structures throughout the Earth, atmosphere, and oceans; and

- Development of heavily instrumented interdisciplinary Earth System Observatories that facilitate our understanding of nanoscale geoscience processes, including platforms to detect and characterize nanoscale particles and their interactions throughout the atmosphere and oceans.

Mathematical Sciences: In FY 2006, GEO supports multidisciplinary research involving the partnering of mathematicians and geoscientists to investigate topics spanning the earth, atmospheric, and ocean sciences at a level of $7.07 million, unchanged from the FY 2005 level.

Human and Social Dynamics: In FY 2006, GEO provides $1.35 million to engage the social science community in understanding and predicting behavior in response to extreme events (earthquakes, tsunamis, hurricanes, tornados, solar disruptions, etc.) and other natural processes affecting society.

QUALITY

GEO maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The share of basic and applied research funds that were allocated to projects that undergo merit review was 75 percent in FY 2004, the last year for which complete data exist. OMB's definition of competitive, merit-based review does not include Federally Funded Research and Development Centers. Therefore, support for the National Center for Atmospheric Research, although regularly merit-reviewed, is not considered as funding that undergoes competitive, merit-based review for this calculation. If included, the merit-reviewed share of GEO funding would rise to 87 percent.

To ensure the highest quality in processing and recommending proposals for awards, GEO convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Geosciences (AC/GEO) on such issues as: the mission, programs, and goals that can best serve the scientific community; how GEO can promote quality graduate and undergraduate education in the geosciences; and priority investment areas in geoscience research. The AC/GEO meets twice a year and members represent a cross section of the geosciences, with representatives from many different sub-disciplines within the field; a broad range of academic institutions and industry; broad geographic representation; and balanced representation of women and under-represented minorities.

PERFORMANCE

NSF's FY 2006 budget is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Geosciences
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	23.55	23.95	23.95	0.00	0.0%
Institutions	3.14	3.50	3.50	0.00	0.0%
Collaborations	4.09	2.60	5.10	2.50	96.2%
	30.78	30.05	32.55	2.50	8.3%
Ideas					
Fundamental Science and Engineering	392.41	371.58	377.82	6.24	1.7%
Centers Programs	14.51	14.07	14.12	0.05	0.4%
	406.92	385.65	391.94	6.29	1.6%
Tools					
Facilities	170.50	174.65	173.40	-1.25	-0.7%
Infrastructure and Instrumentation	17.14	16.89	22.89	6.00	35.5%
Federally-Funded R&D Centers	83.55	81.95	83.00	1.05	1.3%
	271.19	273.49	279.29	5.80	2.1%
Organizational Excellence	4.52	4.97	5.32	0.35	7.0%
Total, GEO	$713.41	$694.16	$709.10	$14.94	2.2%

Totals may not add due to rounding.

GEO will continue its commitment to education, training, and increasing diversity in FY 2006. The FY 2006 budget will maintain award size and continue to focus on multidisciplinary research activities, inter-agency partnerships, and international activities with special attention given to broadening participation at all levels. In addition, development of new infrastructure remains a priority, with ongoing support for the acquisition of new regional research vessels and increased support for the operation of the EarthScope facility being constructed through the MREFC Account.

Recent Research Highlights

Global Seismic Network

The Global Seismic Network, developed by IRIS and supported by the National Science Foundation in partnership with the U.S. Geological Survey, was the primary data source for rapid location and warning -- within eight minutes -- of the Great Sumatra Earthquake of December 26, 2004. However, the seismic warning was not linked to the necessary communications and civil infrastructure in the resultant tsunami region in order to disseminate a warning in time to save lives.

JOIDES Resolution Completes 20 Years of Ocean Drilling

After 20 years, the equivalent of more than 16 circumnavigations, and the recovery of greater than 220 km of sediment and rock cores from nearly 1,800 holes drilled in the ocean floor, the JOIDES Resolution research vessel returned to its home port of Galveston, Texas in October 2003. The homecoming marked the end of the final voyage of the Ocean Drilling Program (ODP) and the beginning of the newly inaugurated Integrated Ocean Drilling Program to be jointly led by the United States and Japan. In keeping with the tradition established by Captain Cook's exploration vessel of the same name, the JOIDES Resolution spent a generation addressing fundamental questions about the Earth. The seafloor samples acquired by the Resolution have provided new insights into Earth's climate history, the deep biosphere, seismically-active ocean margins, oceanic crustal structure, the flux of fluid and energy through the ocean floor, the formation of the present-day ocean basins, and the consequences of meteorite impacts.

Over the history of the program, 1,800 scientists from 30 nations participated in ODP cruises. Fifteen hundred U.S. scientists from more than 160 universities and research centers in 46 states sailed as shipboard scientists or used the program's sample and data archives. Many of the program participants were graduate students who have gone on to become leaders of the U.S. marine science community. With the participation of these U.S. scientists, the Resolution became the first vessel to sample microbes from hundreds of meters beneath the seafloor, to retrieve fluids that originate deep in seismogenic subduction zones, to recover pieces of the oceanic lower crust and upper mantle, to acquire cores that contain evidence of periods of catastrophic global warming, and to deploy seismometers in boreholes as part of an effort to expand the global seismic monitoring network. These and other scientific results of ODP are documented in over 18,000 scientific publications and reports.

Space Weather Summer School

The Center for Integrated Space Weather Modeling conducted its third annual summer school at Boston University in August 2003. The summer school is targeted for college students and young scientists wishing to learn more about space weather and how it is simulated using complex computer models. The school instructs students on the basic physics behind space weather as well as the impacts of space weather on technical systems. The hands-on approach allows students to run models independently and explore the varying response of Earth's geospace environment to different conditions in the sun and solar wind.

Reaching Out to Communities and Kids with Science

The Reaching Out to Communities and Kids with Science in San Francisco (SF-ROCKS) supported by the Opportunities to Enhance Diversity in the Geosciences program operates at four ethnically diverse high schools in the San Francisco Unified School District (Burton, Balboa, Washington, and Marshall high schools). Since the beginning of our funded project in the fall of 2001, the SF-ROCKS program has exposed more than 500 freshmen at the high schools to the SF-ROCKS lesson plans that are part of the integrated science course curriculum at the schools. The lesson plans incorporate aspects of the geology and meteorology of the area adjacent to the high schools are designed to increase the students' awareness of the unique geologic setting of the communities in which they live. At the end of their freshman year, a select group of high school students are invited to the SFSU campus for a 2-week summer institute where they take part in geoscience research projects with SFSU faculty and students. As a result of their participation in the institute, many of the students are exposed to university life for the first time and have an opportunity to learn more about careers in geology, meteorology, and oceanography.

Other Performance Indicators

The tables below show the number of people benefiting from GEO funding, and trends in award size, duration, number of awards and funding rates.

Number of People Involved in GEO Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	4,471	4,200	4,400
Other Professionals	2,633	2,500	2,600
Postdoctorates	666	600	600
Graduate Students	2,347	2,200	2,300
Undergraduate Students	1,410	1,300	1,400
Total Number of People	11,527	10,800	11,300

GEO Funding Profile

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	1,419	1,330	1,400
Funding Rate	33%	31%	31%
Statistics for Research Grants:			
Number of Research Grants	804	760	790
Funding Rate	30%	28%	28%
Median Annualized Award Size	$114,730	$114,730	$114,730
Average Annualized Award Size	$149,050	$149,050	$149,050
Average Award Duration, in years	2.9	3.0	3.0

ATMOSPHERIC SCIENCES $239,790,000

The FY 2006 Request for the Division of Atmospheric Sciences (ATM) is $239.79 million, an increase of $6.36 million, or 2.7 percent, over the FY 2005 Current Plan of $233.43 million.

Atmospheric Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Atmospheric Sciences Research Support	156.65	153.38	158.69	5.31	3.5%
National Center for Atmospheric Research	81.75	80.05	81.10	1.05	1.3%
Atmospheric Sciences	**$238.40**	**$233.43**	**$239.79**	**$6.36**	**2.7%**
Major Components					
Research and Education Grants	125.05	121.60	126.51	4.91	4.0%
Science and Technology Centers	4.00	3.88	3.88	0.00	0.0%
Facilities					
National Center for Atmospheric Research (NCAR)	*81.75*	*80.05*	*81.10*	*1.05*	*1.3%*
Upper Atmospheric Radar Facilities	*19.50*	*19.91*	*18.40*	*-1.51*	*-7.6%*
Other Facilities and infrastructure	*8.10*	*7.99*	*9.90*	*1.91*	*23.9%*

About ATM:

The extreme weather events of 2004 remind us that weather and climate affect every aspect of our daily lives. Tropical storms over the Atlantic Ocean, Caribbean Sea or Gulf of Mexico can develop into fierce hurricanes that pound the East Coast, spawning tornadoes and producing torrential rains and floods, and resulting in large numbers of fatalities and billions of dollars of damage to property. In the upper reaches of the Earth's atmosphere, huge solar storms can damage satellites, disrupt communication and navigation systems, and cause widespread failures in the electrical power grid. The human impacts of urban pollution, and extreme weather can be severe and costly. In order to improve our ability to predict and mitigate these events, we need to further our understanding of the physics, chemistry and dynamics of the Earth's atmosphere, from the Earth's surface to the sun, on timescales ranging from minutes to millennia. We need to understand better the underlying trends, the impact of man-made changes, the complex interactions between systems, and the coupling among the atmosphere, the biosphere and the oceans. The Division of Atmospheric Sciences supports such research through the provision of large, complex facilities, community modeling projects, cyber infrastructure and individual research grants, providing about 60 percent of the total federal support for academic atmospheric research.

ATM provides support for: 1) basic science projects and 2) the acquisition, maintenance and operation of observational and cyber infrastructure facilities (and services) that enable modern day atmospheric science research activities.

For the science activities supported by the Division, a variety of modes of support are used. Although the majority of this support is through the traditional "individual investigator" merit-reviewed, multi-year grants, ATM also supports: small scale, limited-duration exploratory research projects; collaborative or multi-investigator group projects focusing on a particular project subject or activity; large center or center-like projects; and the funding for the research conducted by NSF's National Center for Atmospheric Research (NCAR) that extends and enhances research at universities.

Facility funding is provided through cooperative agreements to NCAR and several other institutions to acquire, maintain and operate specific observational and cyberinfrastructure facilities that support the research and educational activities of NSF sponsored projects, scientists, and students.

Facilities are approximately 46 percent of the ATM portfolio. Of the remaining 54 percent, approximately 49 percent of funds support new awards and 51 percent are committed to funding awards made in previous years.

ATM priorities for FY 2006:

- **Natural Hazards:** Building on years of research on understanding and predicting impacts resulting from environmental phenomena, including two recent NCAR-sponsored workshops on Early Warning Systems, scientists from academia and NCAR's Institute for the Study of Society and Environment will augment research activities on understanding, preparing and responding to extreme environmental events;
- **Support for Biogeochemical Cycles:** including emphasis on understanding the sources, sinks and processes which control the atmospheric abundance and distribution of carbon, water and other nutrient elements;
- Support for new **Environmental Modeling** that employs data assimilation and innovative mathematical and statistical techniques to improve predictions of fundamental space, atmospheric and Earth system processes;
- Improved **Cyberinfrastructure and Numerical Models** which will allow new discoveries, greater access to atmospheric data, and improved understanding of the atmospheric environment;
- Continued support of **Interagency and International Programs**, including the U.S. Weather Research Program, the National Space Weather Program and cooperative international science programs;
- Continued **Construction and Deployment** of new infrastructure, including the next-generation upper atmospheric radar system, AMISR (the Advanced Modular Incoherent Scatter Radar); and the new high-altitude NCAR aircraft, HIAPER (High Performance Instrumented Airborne Platform for Environmental Research).

Changes from FY 2005:

- Research and education grants and centers: increase by $4.91 million to a total of $126.51 million, and includes:
  - an increase of $3.35 million in research activities aimed at understanding the Earth's hydrologic cycle;
  - an increase of $3.35 million in research on natural hazards (i.e. severe weather and space weather);
  - an increase of $2.0 million for cyber infrastructure investments; and
  - a decrease of $3.85 million in other disciplinary programs.

- Facilities increase by $1.45 million to a total of $109.40 million, and includes:
  - an increase of $3.0 million for deployment, operations and maintenance of the new HIAPER research aircraft;
  - an increase of $1.50 million for deployment, operations and maintenance of AMISR (the Advanced Modular Incoherent Scatter Radar); as well as a planned decrease of $3.0 million for the final construction costs of AMISR; and
  - a decrease of $1.50 million across several NCAR programs.

  Additional information on major ATM-supported facilities is available in the Facilities Chapter.

EARTH SCIENCES $154,070,000

The FY 2006 Request for the Division of Earth Sciences (EAR) is $154.07 million, an increase of $5.11 million, or 3.4 percent, over the FY 2005 Current Plan of $148.96 million.

Earth Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Earth Science Project Support	119.75	115.19	119.73	4.54	3.9%
Instrumentation and Facilities	32.28	33.77	34.34	0.57	1.7%
Earth Sciences	**$152.03**	**$148.96**	**$154.07**	**$5.11**	**3.4%**
Major Components:					
Research and Education Grants	124.95	120.05	121.31	1.26	1.0%
Science and Technology Centers	6.88	6.76	6.76	0.00	0.0%
Facilities					
Incorporated Research Institutions for Seismology (IRIS)	*13.00*	*12.16*	*13.31*	*1.15*	*9.5%*
EarthScope Operations	*1.70*	*4.69*	*7.32*	*2.63*	*56.1%*
Other Earth Sciences Facilities	*5.50*	*5.30*	*5.37*	*0.07*	*1.3%*

About EAR:

Earthquakes are perhaps the most destructive yet unpredictable natural phenomena known; the toll from December's earthquake and tsunami in Asia, with more than 160,000 lives lost and billions of dollars in property damage, is but the most recent example of this incredible force. Research supported by the Division of Earth Sciences seeks to improve our understanding of how earthquakes and tsunamis are triggered and to forecast where major earthquakes are likely to occur. EAR supports research and education activities that improve our understanding of processes that govern the behavior and characteristics of the Earth's surface environment and determine its internal structure, composition and dynamics. EAR funding supports theoretical, computational, laboratory and field studies, and state-of-the-art scientific infrastructure needs. New understanding gained from such studies provides the scientific basis for 1) predicting natural hazards such as earthquakes, tsunamis, volcanic eruptions, floods and droughts, and the mitigation of their impacts; 2) discovery and management of mineral, energy, and water resources; and 3) environmentally sound decision-making. EAR projects are often partnered with and complementary to focused efforts by other federal and state agencies.

The EAR portfolio has three major modes of support: research and education grants, centers, and facilities.

- EAR research and education grants range in scope from individual-investigator awards for research based at the investigator's home institution, to awards to major user groups with responsibility for experiments at national or international user facilities.

- EAR centers include two Science and Technology Centers (STCs).
  - SAHRA (Sustainability of semi-Arid Hydrology and Riparian Areas) crosses disciplinary boundaries to link multi-scale processes through models that can readily be used to guide decision-making in water resources management in arid climates. The modeling integrates ecological, socio-economic, and hydrologic principles at the river basin scale, and uses site-

specific data from the San Pedro (Arizona) and Rio Grande Basins from GIS, remote sensing, and field-based censuses.

- NCED (National Center for Earth-Surface Dynamics) integrates erosion and sedimentation physics in holistic applications to interactive systems reshaping the Earth's surface. These processes need to be better understood because they are critical in achieving environmental sustainability and public safety.

- EAR also supports major world-class facilities that are needed by certain subfields to answer the highest priority science questions. This category includes support for shared research facilities such as:
  - Incorporated Research Institutions for Seismology (IRIS) for seismological research and global hazard monitoring,
  - UNAVCO, Inc. for precision geodetic measurements using Global Positioning Systems (GPS),
  - Other shared research facilities are accelerator-based mass spectrometers, ion-beam microprobes, and synchrotron beam lines.

  The program also funds the research and educational needs for instrumentation and computational infrastructure at universities and colleges throughout the nation. Additional information on major EAR-supported facilities is available in the Facilities Chapter of this document.

Facilities are approximately 15 percent of the EAR portfolio. Of the remaining 85 percent, approximately 44 percent of funds support new awards and 56 percent are committed to funding awards made in previous years.

EAR priorities for FY 2006:

- **EarthScope Operation and Science Support**: The new EarthScope facility, being constructed through the MREFC Account, is continuing to ramp up operations and to increasingly enable new science at the intersection of several subfields within the earth sciences. Supporting the operation of the facility and the science it enables continues to be a high priority for EAR. Additional information can be found in the MREFC Chapter.

- **Maintaining a strong, flexible program of research and education grants to create new ideas and technologies and attract and train students** is the primary focus in stewardship of the portfolio. Emphasis will be given to increasing the support for theoretical research across the portfolio, followed by biological geoscience and cyberscience.

Changes from FY 2005:

- Research, education grants and centers increase $1.26 million to a total of $121.31 million. EAR will continue to support forefront areas of geology, with continued emphasis on EarthScope science, hydrology, cyberscience, and geobiology. Education and outreach activities receiving continued emphasis include enhancing K-12 science teacher training, expanding diversity within the research community, integrating research and education, and include the training of young physicists.

- Facilities increase by $3.85 million to a total of $26.0 million. The increase is primarily for EarthScope operations as new stations are installed and come online and support for the shared research facilities noted above.

OCEAN SCIENCES $315,240,000

The FY 2006 Request for the Division of Ocean Sciences (OCE) is $315.24 million, an increase of $3.47 million, or 1.1 percent over the FY 2005 Current Plan of $311.77 million.

Ocean Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Ocean Section	120.35	115.98	117.28	1.30	1.1%
Integrative Programs Section	118.40	113.70	114.97	1.27	1.1%
Marine Geosciences Section	84.23	82.09	82.99	0.90	1.1%
Ocean Sciences	**$322.98**	**$311.77**	**$315.24**	**$3.47**	**1.1%**
Major Components:					
Research and Education Grants	194.85	181.64	190.61	8.97	4.9%
Long-term Ecological Research Centers	3.63	3.63	3.63	0.00	0.0%
Facilities					
Academic Research Fleet	*82.50*	*83.20*	*83.20*	*0.00*	*0.0%*
Integrated Ocean Drilling Program (IODP)	*35.10*	*32.10*	*30.00*	*-2.10*	*-6.5%*
Other Ocean Sciences Facilities	*6.90*	*11.20*	*7.80*	*-3.40*	*-30.4%*

About OCE:

The oceans play a pivotal role in climate, contain the largest and most unexplored habitat for life on Earth and provide routes for commerce and sites for recreation. The oceans are also the source of important food and energy resources in great demand by society. Movement of the oceanic plates build spectacular undersea mountain ranges, but also causes earthquakes and tsunamis that wrench and reshape the margins of the ocean basins with disastrous impacts on coastal communities. Research supported by the Division of Ocean Sciences enable ocean scientists to make major breakthroughs in the understanding of ocean biology, chemistry, geology and physics. Scientific advances have, in part, been created by an extraordinary period of invention and discovery from which new capabilities have emerged in the areas of computation, molecular biology, deep drilling and ocean-observing technologies. Research and education supported by OCE improve understanding of the physical, chemical and biological processes that characterize both coastal seas and deep ocean basins, and the geological and geophysical processes that shape the continental shelves and deep sea floor. Support is also provided for the facilities and infrastructure required to gain access to the ocean, including research vessels, manned deep diving submersibles and a wide range of technologically advanced observational instrumentation. Ocean science is a highly interdisciplinary research endeavor that is fundamental to the understanding of the Earth's climate, to resource and hazard assessment, and to the health of the ocean's complex and diverse ecological systems.

The OCE portfolio has three highly integrative programmatic areas of support: research grants, education grants, and facilities to serve the research and education activities.

- OCE research grants range in scope from individual-investigator awards for research based at the investigator's home institution, to awards to major user groups with responsibility for experiments at national or international user facilities.
- OCE education grants support graduate students and undergraduate research experiences, K-12 educational activities, and informal education for the general public. The Centers for Ocean

Science Education Excellence (COSEE) form a major education and outreach network that facilitates the dissemination of ocean-centered educational material and information.

- OCE also supports acquisition, operation, and maintenance of major world-class facilities that are required to provide access to the oceans in order to address the highest priority science questions.

Additional information on OCE-supported facilities is available in the Facilities Chapter of this document.

Facilities are approximately 41 percent of the OCE portfolio. Of the remaining 59 percent, approximately 55 percent of funds support new awards and 45 percent are committed to funding awards made in previous years.

OCE Priorities for FY 2006:

Maintaining a strong, flexible program of research and education grants and the requisite facilities support to create new ideas and technology and attract and train students, is the highest priority in stewardship of the portfolio. Specifically:

- Ocean observations for research and operations are increasingly important for the advancement of ocean science, with many of today's most important discoveries coming from measurements made at the same locations over sustained time periods. The availability of long time-series data extending over several decades – allowing us to "explore-in-time" – is a key element for managing living resources, understanding ocean ecosystems and for resolving uncertainties about the role of the oceans in climate change.
- The Integrated Ocean Drilling Program (IODP) represents an international partnership of scientists, research institutions, and funding agencies organized to explore the evolution and structure of Earth as recorded in the ocean basins. Ocean drilling is an essential capability used to examine processes ranging from changes in the Earth's climate to the rifting and drifting of continents.
- Natural Hazards: Hurricanes, earthquakes and tsunamis can be better predicted with greater understanding of the mechanisms causing such events. Solid Earth Cycles and Geodynamics is a research focus of the NSF-led Integrated Ocean Drilling Program. Improved seismic monitoring capabilities will also be provided through seafloor observatories.
- Non-Equilibrium Ecosystem Dynamics: Many oceanic processes are inherently nonlinear, so that small perturbations at one frequency can cause large-scale changes at another. Today we also have human influences of enormous scale on fisheries and on climate, and these add to an already complex system. The introduction of exotic species, the proliferation of harmful algal blooms and the effectiveness of marine reserves, are all examples where sophisticated ecosystem knowledge is required.
- The network of Centers for Ocean Science Excellence (COSEE) and other ocean education programs are engaging communities in ocean exploration and discovery; increasing awareness, understanding, and appreciation of the oceans; strengthening science and technology education; motivating people from all backgrounds to pursue science and technology careers generally and ocean sciences careers specifically.
- A diverse range of facilities and technical support activities are provided to enable scientific advancement in all areas of ocean science. This includes operation of the academic research fleet to ensure that appropriate ship time and capabilities are provided to meet project requirements for NSF-sponsored studies. Provision of new facilities and infrastructure is coordinated with the Federal Oceanographic Facilities Committee's (FOFC) plan for renewal of the academic fleet.

Changes from FY 2005:

- Research and education grants increase by $8.92 million to a total of $190.56 million. OCE will continue to support forefront areas of ocean science, with expanded emphasis on complex systems, biogeochemical cycles and pathways, and the temporal exploration of the oceans. Education and outreach activities will receive continued emphasis: enhancing COSEE, expanding diversity within the research community, integrating research and education, including the training of young ocean scientists.

- Support for facilities decreases $5.50 million to a total of $121.0 million. This includes:
  - A decrease of $1.0 million for planning activities for the Ocean Observatories Initiative (OOI) project, since the start of this MREFC investment has been deferred to FY 2007.
  - A decrease of $5.30 million in ship operations funding owing to a reduced requirement for research vessel usage. Decreased usage is the result of flat research budgets and decreased cost sharing for ship-time from other ocean agencies.
  - A planned $2.10 million decrease for maintenance and operation of the drillship *Joides Resolution* as its operation phases out prior to the phase-in of a more capable drillship for the IODP.
  - An increase of $3.0 million as installment payment towards construction of a new, replacement regional class research vessel for the academic fleet.

Mathematical and Physical Sciences

MATHEMATICAL AND PHYSICAL SCIENCES $1,086,230,000

The FY 2006 Budget Request for the Mathematical and Physical Sciences (MPS) Directorate is $1.09 billion, an increase of $16.37 million, or 1.5 percent, over the FY 2005 Current Plan of $1.07 billion.

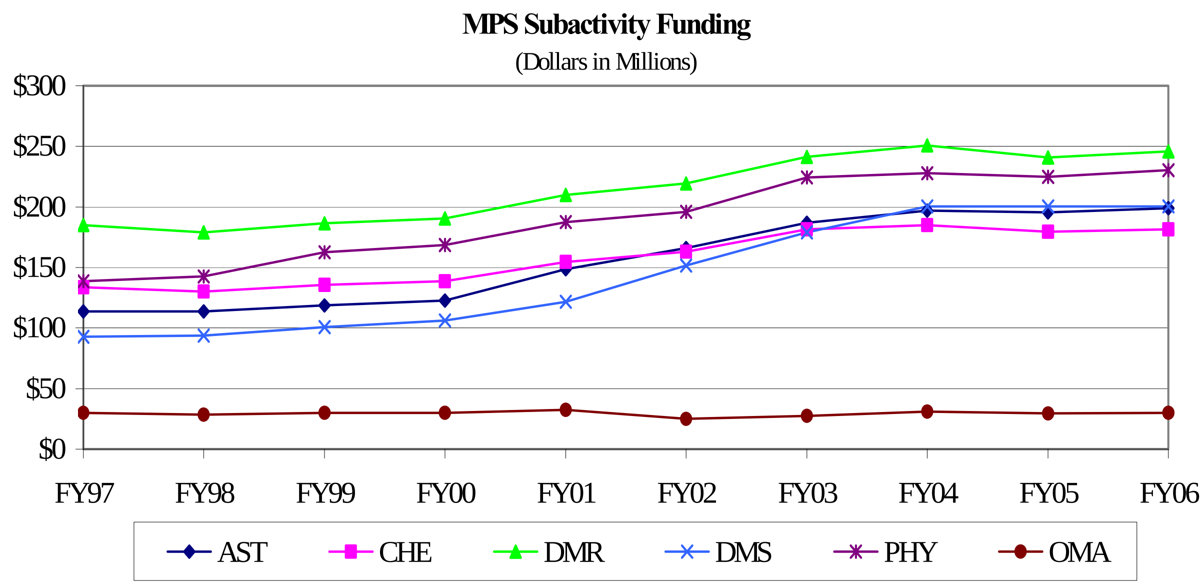
Mathematical and Physical Sciences Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Astronomical Sciences (AST)	196.63	195.10	198.64	3.54	1.8%
Chemistry (CHE)	185.12	179.45	181.37	1.92	1.1%
Materials Research (DMR)	250.65	240.50	245.70	5.20	2.2%
Mathematical Sciences (DMS)	200.35	200.38	200.38	0.00	0.0%
Physics (PHY)	227.77	224.94	230.14	5.20	2.3%
Multidisciplinary Activities (OMA)	31.07	29.49	30.00	0.51	1.7%
Total, MPS	$1,091.59	$1,069.86	$1,086.23	$16.37	1.5%

Totals may not add due to rounding.

The Mathematical and Physical Sciences Directorate provides funds for research, supporting infrastructure, and development of human resources in the mathematical and physical sciences. The portfolio of investments contains a mixture of research and education grants, group and center awards, facilities and instrumentation, including the national astronomy centers, and awards that enhance opportunities for undergraduate and graduate students and postdoctoral researchers and broaden participation in MPS fields. It includes MPS participation in NSF-wide and interagency research and education, and emphasizes discovery, innovation and learning.

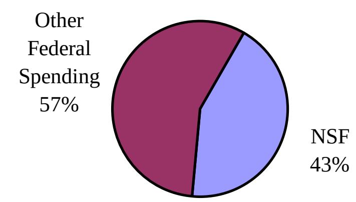


RELEVANCE

From the structure and evolution of the universe to the fundamental particles and processes of matter, from the behavior and control of molecules at the nanoscale to the complexity of their chemical interactions in materials and life processes, from developing new mathematical structures and theories to transforming them into models of natural systems that connect to computation, experimentation, and observation, the questions of MPS-supported research both stir the imagination and drive technological advances. Most of the research is of an exploratory nature. It requires sustained investment as well as access to the tools of advanced discovery. MPS-supported research provides the backbone for advances in other technical, engineering, and health-related disciplines, and provides a broad basis for industrial and technological development. It has played a fundamental role in the technological leadership of the United States and in maintaining its health, economy, defense, and homeland security. By linking research with education and training, MPS also promotes development of the future U.S. science, engineering, and technological workforce, with particular emphasis on broadening participation to engage the nation's entire talent pool.

NSF's role as lead agency in MPS research is appropriate, given its basic research mission. MPS provides about 43 percent of the federal funding for basic research at academic institutions in the mathematical and physical sciences. Within the astronomical sciences, MPS provides about 40 percent of the federal support; in chemistry, about 38 percent; in physics, approximately 32 percent; in materials research approximately 55 percent; and in mathematics more than 75 percent. MPS collaborates with other disciplines within NSF and partners with other agencies, the private sector, and other nations in exploring areas such as the physics of the universe, nanoscale science and engineering, molecular processes in the life and environmental sciences, mathematical modeling across scales of time and space, and the evolving scientific capabilities provided by emerging cyberinfrastructure. Such cooperation enhances the synergistic impact of MPS investments.

Federal Support of Basic Research in Math and Physical Sciences at Academic Institutions



The MPS investment portfolio is designed to enable strong, flexible disciplines that generate discoveries across the MPS frontiers, reach out to other disciplines, accept high risk undertakings that promise significant advances on fundamental questions, and connect with national interests. The portfolio provides broad support across all MPS fields and catalytic support that promotes advances in areas of opportunity, including investments in the infrastructure supporting the conduct of MPS research and education and enabling broad access to it. Such investments range from tabletop instruments to international facilities with hundreds of users as well as the development of next-generation instrumentation. Remote access to facilities made possible by increasingly sophisticated cyber-infrastructure complements on-site capabilities. MPS continually explores the needs and opportunities for investments in infrastructure, enabling new capabilities and assuring sound operation, maintenance and upgrades of existing state-of-the-art facilities needed to perform world-class research. MPS integrates these investments in research and infrastructure with investments aiming to improve the quality and diversity of the U.S. science and engineering workforce and to enhance the public's knowledge of MPS fields by linking both formal and informal education and training programs to forefront research activities in the U.S. and other countries. This approach invigorates education through the excitement of discovery and significantly contributes to the increasing globalization of the MPS enterprise.

Major changes were made in MPS plans in adjusting to the level of the FY 2005 Current Plan. MPS-wide investment strategies for making that adjustment – highlighting core research and education programs; decreasing the number of centers when competitions provide the opportunity to do so; investing in development of the research resources and facilities of the future; and broadening participation in MPS programs – provided the framework for changes in FY 2006.

Summary of Major Changes by Division *(Dollars in Millions)*

MPS FY 2005 Current Plan…………………………………………………………………... **$1,069.86**

Astronomical Sciences +$3.54

Increased support for research and instrumentation development related to the physics of the universe and cyberinfrastructure, as well as Gemini operations and instrumentation development. Decreases for other areas of research and instrumentation programs.

Chemistry +$1.92

Increased support for research and education and center activities related to the molecular basis of life processes and sustainability. Support for facilities and infrastructure will be partially redirected toward promoting cyber-enabled chemistry.

Materials Research +$5.20

Increased support for research and education and center activities related to nanoscale science and engineering balanced by decreasing support for older facilities and small-scale instrumentation.

Mathematical Sciences No change

Continued strong support for the Mathematical Sciences priority area, particularly fundamental mathematical sciences. Enhanced efforts to broaden participation across the portfolio balanced by decreases in the Enhancing the Mathematical Sciences Workforce for the 21st Century (EMSW21) program.

Physics +$5.20

Increased support for core research and education programs with emphasis on physics of the universe and theoretical physics, including additional support for new applicants to the program. Increased funding for operations of the Large Hadron Collider balanced by a decrease for the Cornell Electron Storage Ring and a decrease reflecting completion of concept and design funding for the Rare Symmetry Violating Processes (RSVP) project.

Multidisciplinary Activities +$0.51

Increased support for collaborative activities aimed at broadening participation in and informing the public about MPS disciplines balanced by decreased support in other areas.

Subtotal, Changes *$16.37*
FY 2006 Request, MPS……………………………………………………………………… **$1,086.23**

Summary of Changes by MPS-wide Investments *(Dollars in Millions)*

MPS FY 2005 Current Plan……………………………………………………………………..$1,069.86

Fundamental Science and Engineering +$9.81

In approaching its investments in core research in support of the NSF strategic goals, MPS looks for opportunities that excite the imagination, connect with areas of national priority, and create synergy. In FY 2006, MPS is emphasizing the following scientific themes:

- *Physics of the universe*, a set of activities that build on the National Science and Technology Council report of the same name and partner with the Department of Energy and NASA in exploring the mysteries of dark matter and dark energy, the earliest phases in development of the universe, the fundamental nature of time, matter and space, and the role of gravitation.
- *Fundamental mathematical and statistical science*, activities that strengthen the core of the Mathematical Sciences priority area and enable effective partnering with other disciplines.
- *Physical sciences at the nanoscale*, activities that provide the foundation for efforts to develop nanoscale technologies in partnership with other NSF activities and the government-wide National Nanotechnology Initiative.
- *Cyberinfrastructure and the cyberscience it enables*, connecting with NSF's high priority activities in this area and related activities government-wide in Networking and Information Technology R&D.
- *Molecular basis of life processes*, a set of activities linked to the biology of complex systems that will enable explorations in areas such as how disordered collections of molecules assemble themselves into the elements of living systems, how proteins fold and membranes work, and how physiological processes such as breathing and thinking emerge out of complex, coupled arrays of individual reactions.

Research Resources for the Future +$3.46

MPS researchers and educators require access to research resources (ranging from desktop instrumentation to detectors at beamlines to computational capacity) that enable them to carry out their work. In FY 2006, MPS emphasizes concept development and design leading to new capabilities for the future, including extremely large telescopes, the next generation of light sources, and cyberinfrastructure.

Preparing the Next Generation and Broadening Participation -$2.10

MPS emphasizes integration of research and education and embedding broader participation in all programs. Participation in all NSF-wide programs in support of undergraduate research experiences, graduate fellowships and traineeships, and advancing the role of women in academia will remain constant. Support for the targeted EMSW21 program and targeted postdoctoral research programs will decrease, enabling integration of their purposes in the wider MPS program. MPS plans increased funding for partnerships aimed at broadening participation and public outreach.

Facilities +$1.37

Facilities stewardship in MPS emphasizes funding facilities at a level that supports scientific needs, enhancing facilities deemed likely to be most productive in the future and decreasing support for those where equal or greater capabilities are otherwise available.

MPS Facilities Funding
(Dollars in Millions)

Facilities	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Cornell Electron Storage Ring (CESR)	18.00	16.62	14.71	-1.91	-11.49%
GEMINI Observatory	13.27	14.81	18.50	3.69	24.92%
Large Hadron Collider (LHC)	7.00	10.50	13.50	3.00	28.57%
Laser Interferometer Gravitational Wave Observatory (LIGO)	33.00	32.00	32.00	0.00	0.00%
MSU Cyclotron	15.65	17.50	17.50	0.00	0.00%
Nanofabrication (NNUN/NNIN)	2.80	2.80	2.80	0.00	0.00%
National High Magnetic Field Laboratory (NHMFL)	24.50	25.50	25.50	0.00	0.00%
Rare Symmetry Violating Processes (RSVP)	6.00	2.30	0.00	-2.30	-100.00%
National Astronomy and Ionosphere Center (NAIC)	10.54	10.52	10.60	0.08	0.76%
National Center for Atmospheric Research (NCAR)	1.17	1.17	1.17	0.00	0.00%
National Optical Astronomy Observatories (NOAO)	41.35	37.92	37.36	-0.56	-1.48%
National Radio Astronomy Observatory (NRAO)	54.98	47.03	47.40	0.37	0.79%
Other MPS Facilities	13.39	12.70	11.70	-1.00	-7.87%
Total, MPS	**$241.65**	**$231.37**	**$232.74**	**$1.37**	**0.59%**

In addition, there are three MPS-related projects in construction phases with funding requested in FY 2006 from the MREFC Account: Atacama Large Millimeter Array (ALMA), IceCube, and the Rare Symmetry Violating Processes (RSVP) project. For more information, see the MREFC Chapter.

Centers Programs +$3.83

MPS supports a number of activities that aggregate resources in support of disciplinary and interdisciplinary research that requires a greater level of effort in its conduct. These include centers, institutes, and, in some instances, group-level activity. MPS expects to decrease the number of centers in its portfolio over time as planned competitions permit, while ensuring that active centers are funded at levels that enable them to carry out their work. The FY 2006 increase will enable MPS to meet responsibilities from competitions conducted in earlier years.

MPS Centers Funding
(Dollars in Millions)

Centers	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Chemistry Centers	17.44	13.01	14.81	1.80	13.84%
Materials Centers	57.20	57.00	58.00	1.00	1.75%
Mathematical Sciences Research Institutes	15.05	17.15	17.15	0.00	0.00%
Nanoscale Science and Engineering Centers	12.28	12.28	12.51	0.23	1.87%
Physics Centers	14.27	18.72	19.52	0.80	4.27%
Science and Technology Centers	14.77	15.60	15.60	0.00	0.00%
Total, MPS	**$131.01**	**$133.76**	**$137.59**	**$3.83**	**2.86%**

Subtotal, Changes *+$16.37*

FY 2006 Request, MPS……………………………………………………………………… $1,086.23

PRIORITY AREAS

In FY 2006, MPS will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

MPS Investments in NSF Priority Areas
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biocomplexity in the Environment	4.70	4.03	3.36	-0.67	-16.6%
Nanoscale Science and Engineering	111.48	131.62	95.82	-35.80	-27.2%
Mathematical Sciences	70.23	70.23	70.23	0.00	0.0%
Human and Social Dynamics	0.53	0.50	0.50	0.00	0.0%

Funding for the **Biocomplexity in the Environment** priority area will decrease in FY 2006 as part of the planned phasing down of the priority area. Funds will support activities related to green chemistry, materials use, and theoretical and statistical modeling of complex environmental systems.

Support for **Nanoscale Science and Engineering** will decrease in FY 2006 as part of the planned phasing down of the priority area, with the reduction coming mainly in fundamental research as these activities begin to become part of core programs. Funds will support research on structures, phenomena, and quantum control.

Support for the **Mathematical Sciences** priority area will remain constant, targeting fundamental mathematical sciences, interdisciplinary mathematical sciences, and mathematical sciences education, with the balance among these areas reflecting the evolving nature of the interdisciplinary partnerships.

Funding for **Human and Social Dynamics** includes support for areas such as interdisciplinary research modeling the development and evolution of social and organizational behavior in complex systems.

QUALITY

MPS maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The percent of research funds that were allocated to projects that undergo external merit review was 87 percent in FY 2004, the last year for which complete data exist.

To ensure the highest quality in processing and recommending proposals for awards, MPS convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Mathematical and Physical Sciences (MPSAC) on such issues as: the mission, programs, and goals that can best serve the scientific community; how MPS can promote quality graduate and undergraduate education in the mathematical and physical sciences; and priority investment areas in MPS-supported research. The MPSAC meets twice a year. Members represent a cross section of the mathematical and physical sciences with representatives from many different sub-disciplines within the field; and include members from institutions and industry. The Committee includes a balanced representation of women, members of underrepresented minorities and geographic regions. MPS also participates in three advisory committees that advise multiple agencies: the High Energy Physics Advisory Board (with DOE); the Nuclear Science Advisory Board (with DOE); and the Astronomy and Astrophysics Advisory Committee (with DOE and NASA).

PERFORMANCE

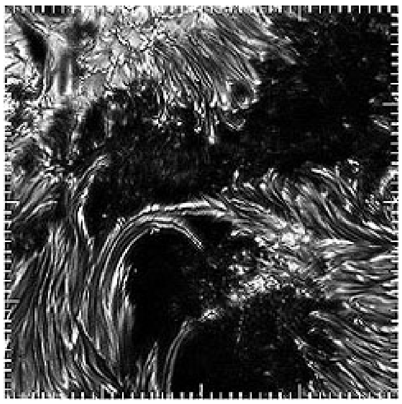
NSF's FY 2006 budget is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Mathematical and Physical Sciences
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	107.46	99.19	96.56	-2.63	-2.7%
Institutions	5.53	5.64	5.48	-0.16	-2.8%
Collaborations	16.26	13.29	14.38	1.09	8.2%
	129.25	118.12	116.42	-1.70	-1.4%
Ideas					
Fundamental Science and Engineering	541.68	537.17	546.62	9.45	1.8%
Centers Programs	131.31	133.76	137.59	3.83	2.9%
Capability Enhancement	9.33	9.21	9.17	-0.04	-0.4%
	682.32	680.14	693.38	13.24	1.9%
Tools					
Facilities	133.61	134.73	136.21	1.48	1.1%
Infrastructure and Instrumentation	31.84	33.70	37.16	3.46	10.3%
Polar Tools, Facilities and Logistics	-	-	-	-	-
Federally-Funded R&D Centers	108.04	96.64	96.53	-0.11	-0.1%
	273.49	265.07	269.90	4.83	1.8%
Organizational Excellence	6.53	6.53	6.53	-	-
Total, MPS	$1,091.59	$1,069.86	$1,086.23	$16.37	1.5%

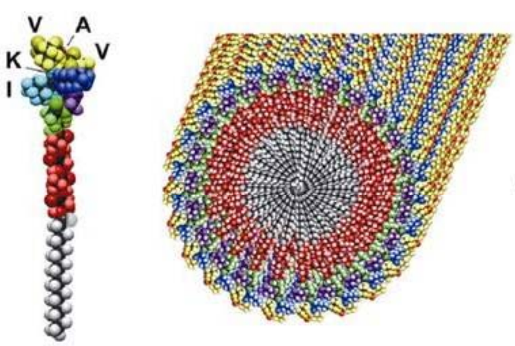
Totals may not add due to rounding.

Recent Research Highlights



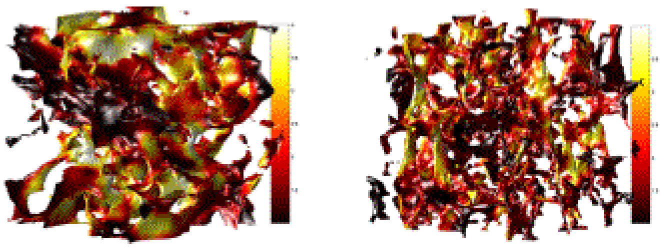
Images at the Heart of Solar Storms – Scientists at the National Solar Observatory used a new set of instruments to record the sharpest-ever images of the heart of the solar flares. They were able to record images and magnetic field strengths on scales of two-tenths of an arcsecond (the angular size of a quarter as viewed from a distance of sixteen miles) using the techniques of adaptive optics to correct for the distorting effects of the Earth's atmosphere. The new instruments will allow scientists to study the fine structure magnetic activity on the Sun, an area that is key to understanding the genesis of solar flares – giant explosions that can disrupt terrestrial communications systems and satellites. (Photo Credit – National Solar Observatory)

The Manufacture of Ammonia – Synthesis of ammonia, a vital component of fertilizers, under mild laboratory conditions has been a challenge for chemists for the past century. Traditional methods for the synthesis of ammonia require very high temperatures and pressures. Paul Chirik and his group at Cornell University have discovered a zirconium compound that assembles nitrogen-hydrogen bonds from molecular nitrogen. Remarkably, breakage of the nitrogen-nitrogen bond (one of the strongest chemical bonds in nature) can be observed at a temperature of only 45º C. Continued heating under hydrogen or exposure to acid results in the synthesis of ammonia. This project is making progress on the synthesis of agriculturally important ammonia under milder conditions than are currently viable for industrial scale production, with potentially strong impact on energy use and the environment.

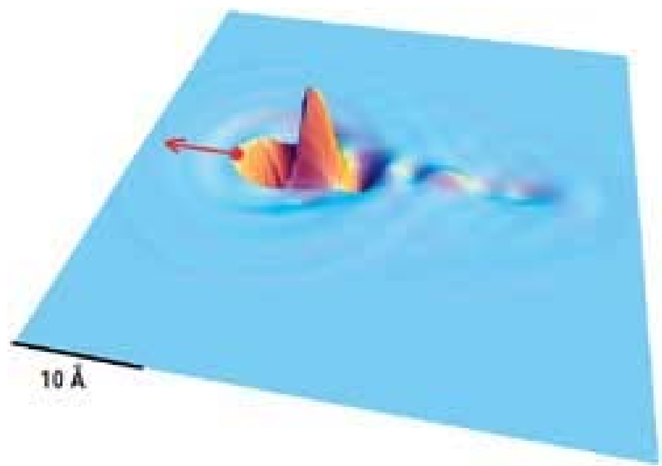


Polymer Nanofibers for Nerve Repair – The repair of injuries to the spinal cord or other parts of the nervous system is a "holy grail" in medicine. The ability to bridge broken nerves, grow new neural pathways, and help the spinal cord regenerate would bring new hope to victims of paralysis, disabling accidents, and neurological diseases. Sam Stupp and his colleagues at Northwestern University have designed very imaginative molecules that self-assemble into nanofibers. The researchers successfully incorporated throughout the surface of these polymer nanofibers a sequence of biologically active groups (peptides) that are known to promote sprouting of nerve cells and to direct growth of neurons. The nanofibers are able not only to grow nerve cells (neurons), but also to block the formation of nerve-tissue scars (astrocytes). Dr. Stupp is collaborating with John Kessler, a neurologist at Northwestern, to bring this technique into clinical testing. (Photo Credit – Dr. Sam Stupp, Northwestern University)

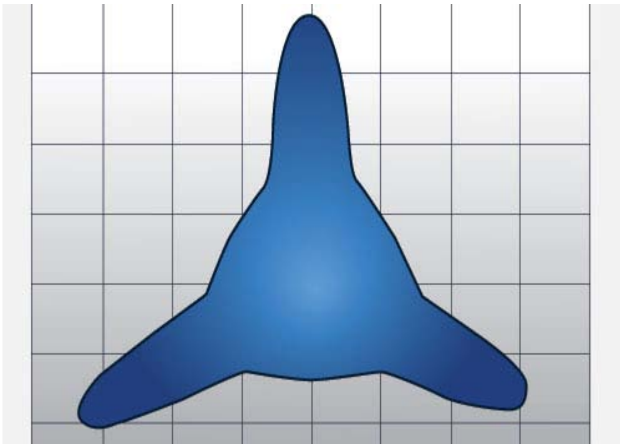
Computer Modeling of Osteoporosis – Osteoporosis is a major socio-economic problem in western societies. It is estimated that osteoporosis-related fractures in the U.S. number in the millions annually, and cost tens of billions of dollars in therapy and rehabilitation. Although therapeutic agents are available to slow its progress, physicians need to be confident that such therapy is essential prior to prescribing medication. Bone density tests are currently used for the purpose. One approach to understanding the relationship between bone density and bone strength involves the use of modeling. Dr. Gemunu Gunaratne of the University of Houston conducted computations on three-dimensional digitized images of bone obtained from micro-computed tomography. The relationship between bone density and bone strength derived from the model provides good agreement with published data on the strength of bones from 101 human subjects ranging in age from 18-90 years. Thus, bone density measurements can be used to predict the strength of weak bones and to suggest the amount of medication required in specific cases. (Photo Credit – University of Houston)



Electron Movies in Attoseconds: X-ray scattering, data analysis method lead to ultrafast imaging of electrons – Cornell University researchers demonstrated that x-rays, when coupled with a new data analysis procedure, can be used to determine the motion of electrons on attosecond (a billionth of a billionth of a second) time scales. The experimental procedures were developed at the NSF-supported synchrotron source at Cornell and then the final measurements were taken using the DOE-supported synchrotron x-ray source at Argonne National Laboratory. The procedure may offer a new way to monitor chemical reactions on unprecedented attosecond time scales. See Abbamonte et al., Phys. Rev. Lett. 92 (2004) 237401



RNA and the Origin of Life – An important hypothesis concerning the origin of life on Earth is that life began in an "RNA World" in which RNA was an early self-replicating molecule. However, a weakness in this hypothesis has been the fact that the sugar ribose, a major component of RNA, is too unstable to persist under prebiotic conditions. In an experiment that has major implications in origin-of-life research, Steven Benner and his colleagues at the University of Florida have shown that borate minerals on the early Earth could have helped to concentrate and stabilize compounds such as ribose. The experiments by Benner and his coworkers demonstrate the idea that simple inorganic material may have played a role in the origin of life on Earth by facilitating the development of an "RNA World."



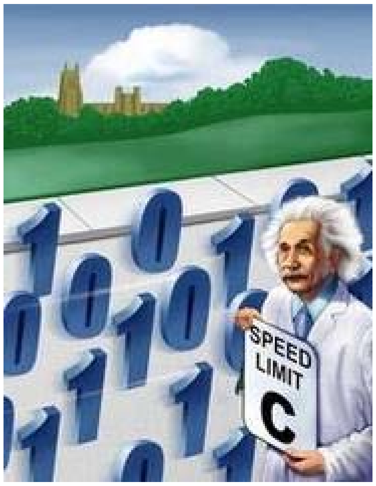
Starting from a slightly tweaked circle, calculations by Harvard's Henry Chen and Michael Brenner showed that more triangular shapes made better faucets and that a sort-of "sucked-in triangle" was the optimal faucet. Credit: *H.H. Chen and M.P. Brenner, Harvard University*

Triangular Nozzles Make the Smallest Droplets – One of the primary technologies for creating small fluid droplets pressurizes a nozzle until a critical volume is reached, when the droplet detaches. The amount of fluid that is released by this process is set by the size of the nozzle. Creating small droplets requires using smaller nozzles; however, smaller nozzles require dramatically larger pressures to release the fluid. Current implementations of this method all use circular nozzles. Drops of about 10 picoliters (10 billionths of a milliliter) are the smallest anyone has managed. Using a mathematical optimization procedure, Harvard University mathematicians Henry Chen and Michael Brenner discovered that specially shaped nozzles decrease the fluid released by 21 percent. The optimum shape is a sort of sucked-in triangle. The triangular taps have potential uses ranging from boosting the resolution of ink-jet printers, to cutting the size of patterns on electronic components that are created by droplet deposition. The mathematical methods developed for solving this problem are of general use for engineering design.

The Biggest and the Brightest Star – A University of Florida-led team of astronomers using the NSF-supported Blanco Telescope at the Cerro Tololo Interamerican Observatory may have discovered the brightest star yet observed in the universe, a fiery behemoth that could be as much as seven times brighter than the current record holder. The bright star, denoted LBV 1806-20, is estimated to be about 45,000 light years away, on the other side of our Milky Way galaxy.

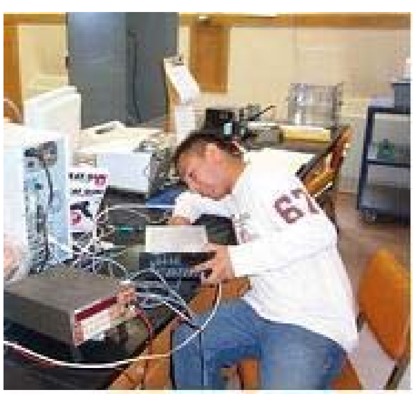
Greening the Cleaning Industry – A multidisciplinary team of scientists and engineers led by Joseph DeSimone of the University of North Carolina, Chapel Hill is working at the Science and Technology Center for Environmentally Responsible Solvents and Processes to 'green' the cleaning industry. They have demonstrated the efficacy of using carbon dioxide and specially designed surfactants, or detergents, to clean clothes in the dry cleaning industry and electronic devices in the microelectronics industry. The carbon dioxide-based garment dry cleaning process was commercialized through Hangers Cleaners and was voted "Best Choice" by *Consumer Reports* in 2003. The Science and Technology Center is also pioneering "dry" carbon dioxide-based processes for use in the microelectronics industry as well as part of a broader vision of a "dry fabrication facility of the future." Researchers have shown that carbon dioxide–based formulations can be effective at etching copper silicon oxide from wafers. Dry lithographic processes are also being developed using specially designed surfactants.

Colliding Electrons in Atoms – Recent experiments conducted by Robert Jones of the University of Virginia with fast laser sources have made it possible to excite two electrons in an atom in a controlled fashion, first one then the other. The electrons are observed to move in orbits around the nucleus like planets and asteroids around the sun. As asteroids sometimes do, at some point the electrons violently collide with each other, resulting in one electron being knocked completely out of the atom and the other left behind. This ability to monitor in real time the details of electron motion within the atom has important consequences for the possible storage of information within the atom.



Can Information be Transmitted Faster than the Speed of Light? – In our modern computer world, light is one of the main forms of transmission of information. In the special theory of relativity, Einstein said that nothing can travel faster than the speed of light in vacuum. But recent experiments have shown that a pulse of light can travel through a medium faster than the speed of light in vacuum. Can information be transmitted faster than the speed of light? Recent experiments by Daniel Gauthier of Duke University have shown that this is not possible. By transmitting two information signals, 0 and 1, in separate pulses, this research has shown that, no matter how fast the pulse might travel, the information stored in the pulse can only travel at the speed of light in vacuum.

Novel Microfabricated Mounts for Macromolecular Crystallography – Working at the NSF-supported Cornell High Energy Synchrotron Source (CHESS), physicist Rob Thorne has developed a novel variation of a method for freezing and mounting crystals of small macromolecular samples, such as proteins. The crystals can then be studied by "X-ray crystallography," a method in which a beam of X-rays scattered by the atoms in a material is used to determine the positions of those atoms within the molecular crystal. The new type of sample mount allows the use of much smaller crystals than had heretofore been possible. It also promises to make possible faster collection of macromolecular crystallographic data, enabling even more complicated biomolecules to be studied. The image illustrates a beam of X-rays emerging from capillary optics and focused on a protein crystal sample held in one of the novel sample holders. The drainage channel leads away from the hole in which the sample is mounted. (Photo Credit – Cornell University)



Native American Undergraduate Research – Northern Arizona University has one of the Nation's largest Native American student populations, drawing from approximately 30 different tribes in the Four-Corners region. Timothy Porter leads a group that has recruited some of these undergraduate students to be involved in research in chemistry and physics. Students work one-on-one with faculty supported by the NSF on a project to evaluate novel materials for new chemical sensors used to monitor and identify the presence and concentration of gases. The chemistry and physics graduation rate for students involved with this project approaches 100 percent. In the image, undergraduate student Lambert Benally connects a precision flow-meter in the laboratory to test the response of a sensor under development to a variety of gases to be detected. (Photo Credit – University of Northern Arizona)

The structure and physical properties of liquid water continue to fascinate and perplex us – a major unsolved problem in science. Anomalies such as the density maximum at 4 degrees C, the minimum in the compressibility, or the unusually high proton transport rate in water are only a few of the unique properties of water. The nature of the excess proton in some water molecules still defies exact characterization. Questions about water networks around ions, proteins, geomedia, aerosols and surfaces cannot be answered without fundamental experimental and theoretical studies on water structure. Are the unusual features of water due to hydrogen bonding? Its tendency to form tetrahedral bonds? Or are these old models wrong? Chemists have recently applied new methods to the study of water, obtaining provocative and controversial results that are stimulating researchers to focus on water. *Science* picked these new results as one of the top 10 "Breakthroughs of the Year" in 2004, citing results from CHE-supported individual investigator awards, collaboratives, and Environmental Molecular Science Institutes.

Other Performance Indicators

The tables below show the number of people benefiting from MPS funding, and trends in award size, duration, and number of awards.

Number of People Involved in MPS Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	6,571	6,400	6,400
Other Professionals	2,052	2,000	2,000
Postdoctorates	2,189	2,150	2,140
Graduate Students	7,418	7,200	7,200
Undergraduate Students	5,683	5,700	5,750
K-12 Students	320	320	320
K-12 Teachers	600	650	650
Total Number of People	24,833	24,420	24,460

MPS Funding Profile

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	2,175	2,110	2,110
Funding Rate	30%	30%	30%
Statistics for Research Grants:			
Number of Research Grants	1,606	1,600	1,600
Funding Rate	28%	28%	28%
Median Annualized Award Size	$100,000	$100,000	$100,000
Average Annualized Award Size	$130,114	$130,114	$130,114
Average Award Duration, in years	3.1	3.1	3.1

ASTRONOMICAL SCIENCES $198,640,000

The FY 2006 Request for the Astronomical Sciences Division (AST) is $198.64 million, an increase of $3.54 million, or 1.8 percent, over the FY 2005 Current Plan of $195.10 million.

Astronomical Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Astronomical Sciences	**$196.63**	**$195.10**	**$198.64**	**$3.54**	**1.8%**
Major Components:					
Research and Education Grants	72.56	80.82	80.78	-0.04	0.0%
Centers Programs	3.93	4.00	4.00	0.00	0.0%
Facilities					
Gemini Observatory	13.27	14.81	18.50	3.69	24.9%
National Astronomy and Ionosphere Center	10.54	10.52	10.60	0.08	0.8%
National Optical Astronomy Observatory/ National Solar Observatory (NOAO/NSO)	41.35	37.92	37.36	-0.56	-1.5%
National Radio Astronomy Observatory	54.98	47.03	47.40	0.37	0.8%

About AST:

The Astronomical Sciences Division is the primary source of support for ground-based astronomy in the U.S. Division support ranges in scope from awards to individual-investigators to large collaborations engaged in a broad array of observational, theoretical, and laboratory research aimed at understanding the origins and characteristics of planets, the Sun, other stars, our galaxy, extragalactic objects, and the structure and origin of the Universe. Special grants and fellowship programs for young faculty, postdoctoral researchers, and undergraduate students encourage the activities of researchers engaged in education and outreach, and increase the participation of underrepresented minorities in science. AST supports the operation of four National Astronomy facilities: the National Optical Astronomy Observatory (NOAO), the National Solar Observatory (NSO), the National Radio Astronomy Observatory (NRAO), and the National Astronomy and Ionosphere Center (NAIC) and provides the U.S. share of funding for the operation of the international Gemini Observatory. Division programs support the development of advanced technologies and instrumentation, the planning and design for future observational facilities and major collaborative projects in astronomy, and the management of the electromagnetic spectrum for scientific use.

The AST portfolio has two major modes of support: research and education grants and facilities.

- AST research and education grants range in scope from awards to individual-investigators to large collaborations carrying out extensive surveys or developing instrumentation.
- AST also supports major world-class facilities that provide access to a wide range of observational resources on a competitive basis. (Additional information about AST facilities is provided in the Facilities Chapter of this document.)

Facilities are approximately 61 percent of the AST portfolio. Of the remaining 39 percent, approximately 55 percent of funds are committed to funding awards made in previous years.

AST Priorities for FY 2006:

Physics of the Universe (POU), the highest scientific priority, which addresses the compelling questions that have arisen at the interface of physics and astronomy. Questions include: What is dark energy? What is dark matter? Can we detect gravity waves as ripples in space-time? These and seven other profound questions were posed by the National Research Council (NRC) report, "Connecting Quarks with the Cosmos." A subsequent National Science and Technology Council report, "The Physics of the Universe: A 21st Century Frontier for Discovery," outlines a national investment plan involving NSF, the Department of Energy (DOE) and NASA. Within NSF, POU is coordinated and supported by the AST and PHY Divisions.

Research Grants Programs, AST's highest priority in stewardship of the portfolio. Emphasis will be given to addressing scientific priorities articulated in the National Research Council's "Astronomy and Astrophysics for the New Millennium," supporting activities in the area of cyberinfrastructure/ cyberscience, and ensuring a healthy and balanced program of research and education grants to the community.

Gemini Observatory operations and instrumentation, AST's highest priority in facility stewardship. Ensuring the optimum performance and productivity of our premier optical/IR (infrared) facility enables forefront research by the scientific community and their students in this international partnership.

Changes from FY 2005:

Research and education grants decrease by $40,000 to a total of $80.78 million. AST will continue to support a wide range of astrophysical investigations, with expanded emphasis on the scientific questions outlined in the Physics of the Universe interagency activity in partnership with PHY, NASA and DOE, and continued emphasis on the development and implementation of the National Virtual Observatory, in partnership with NASA, as part of AST's activities in cyberinfrastructure/cyberscience. Education and outreach activities will receive continued emphasis through postdoctoral fellowship programs, expanding diversity within the research community, and integrating research and education, including the training of young scientists. Support for technology development for the **Large-Aperture Synoptic Survey Telescope** (LSST) and the **Giant Segmented Mirror Telescope** (GSMT) will increase.

Funding for the **Science and Technology Center for Adaptive Optics** remains unchanged at $4.0 million.

Facilities increase by $3.58 million to a total of $113.86 million including:

- Support for the **Gemini Observatory** at a level of $18.50 million, an increase of $3.69 million. As AST's highest priority among our optical and infrared facilities, this level of support will enable enhanced operational and visitor support and begin the funding of a new generation of advanced instrumentation. Included in this amount is $1.0 million for partial return of the Chilean construction capital, with which the U.S. assumes a portion of the Chilean share of the Observatory, along with increased observing access for U.S. astronomers.

- **NAIC** will be supported at the level of $10.60 million. This level of support will enable continued operation and maintenance of the renovated Arecibo telescope and the development of instrumentation to take advantage of its greater sensitivity.

- Support for **NOAO/NSO** base operations at the level of $35.0 million. NOAO is leading the community effort to establish a detailed scientific justification and conceptual design for the GSMT and the LSST, both of which were highly recommended future facilities in recent community reports. Activities at NSO in FY 2006 include design and development for the **Advanced Technology Solar Telescope** (ATST), an instrument that will use new techniques such as adaptive optics to provide a unique capability for investigating a wide range of important questions in solar physics. ATST will be of significant value to studies in atmospheric sciences and space weather in addition to astronomical research. Included within facilities support of NOAO is $2.0 million for the **Telescope System Instrumentation Program** (TSIP), and $360,000 for the **Adaptive Optics Development Program** (AODP), which are administered for the community through NOAO. TSIP, which began in FY 2002 and is being held at its FY 2005 funding level, is a program to unify the privately held and the national optical and IR observatory facilities through a program of support for instrument development and facility improvement in exchange for competitive public access to private facilities. The AODP program is reduced by $840,000 from FY 2005 and is sufficient to cover existing commitments, but allows no new activity.

° **NRAO** is supported at the level of $47.40 million. This level of support will provide for operations, maintenance, and instrumentation for the unique telescopes of NRAO, such as the Robert C. Byrd Green Bank Telescope, the Very Large Array, the Very Long Baseline Array and the early operations of the Atacama Large Millimeter Array (ALMA). Activities in FY 2006 include making continued improvements and enhancements to the Expanded VLA and optimization of science operations of the Byrd Telescope.

CHEMISTRY $181,370,000

The FY 2006 Request for the Chemistry Division (CHE) is $181.37 million, an increase of $1.92 million, or 1.1 percent, over the FY 2005 Current Plan of $179.45 million.

Chemistry Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Chemistry	**$185.12**	**$179.45**	**$181.37**	**$1.92**	**1.1%**
Major Components:					
Research and Education Grants	152.70	150.07	149.50	-0.57	-0.4%
Centers Programs	23.05	19.38	21.41	2.03	10.5%
Instrumentation/Facilities	9.37	10.00	10.46	0.46	4.6%

Totals may not add due to rounding.

About CHE:

The Chemistry Division advances the intellectual frontiers of chemistry. The chemical bond, the bond that links atoms together into myriad forms of matter that define our existence, is the unifying intellectual theme in chemistry. CHE supports research that enables matter to be manipulated, measured, and modeled through management of both strong and weak chemical bonds; the result is exquisite control in designing and synthesizing new molecules and molecular assemblies. Understanding matter from this perspective is essential to advances in many allied fields, including the life, environmental, and materials sciences. Research supported by CHE covers a broad range of subfields, including organic and macromolecular chemistry; experimental physical chemistry; theoretical and computational chemistry; inorganic, bioinorganic and organometallic chemistry; and analytical and surface chemistry. Chemistry directly impacts our daily lives through its contributions to production of food, shelter, clothing, energy, medicine, and countless products that enhance our quality of life. Basic research, education, instrumentation, and facilities supported by CHE contribute to environmental quality and to industrial strength through advancements in fundamental knowledge and the professional development of our technical workforce. A large majority of the CHE investment supports individual investigators and collaborative research centers, with the balance in instrumentation and human resource development.

The CHE portfolio has three major modes of support: research and education grants, centers, and instrumentation and facilities.

- CHE research and education grants range in scope from individual investigator awards to multi-investigator awards that allow groups of researchers to collaborate on disciplinary and multidisciplinary projects.
- CHE centers include seven Environmental Molecular Science Institutes (EMSIs), fifteen Collaborative Research in Chemistry (CRCs) centers, five Chemical Bonding Centers (CBCs), the Science and Technology Center (STC) for Environmentally Responsible Solvents and Processes, and three Nanoscale Science and Engineering Centers. Centers are funded on a competitive basis to support focused efforts on the most important science questions requiring this level of concentration in order to make major advances.
- Through its Chemistry Research Instrumentation and Facilities (CRIF) program, CHE provides modern multi-user instrumentation, such as X-ray diffractometers and nuclear magnetic resonance spectrometers; support for the development of instrumentation that permits new kinds of chemical

measurements and broadens access; and support for cyberinfrastructure and facilities, such as the National High Magnetic Field Laboratory.

In general, 58 percent of the CHE portfolio is available for new awards and activities. The remaining 42 percent funds awards made in previous years.

CHE Priorities for FY 2006:

Maintaining a strong, flexible program of research and education grants that will lead to new opportunities in the chemical sciences. The broad range of forefront research and education projects reflected in individual investigator and multi-investigator awards defines future scientific and technological opportunities in the chemical sciences. The Division's portfolio management encourages beginning investigators through CAREER awards and seeks to identify pioneering research that is high risk and potentially high impact. Along with the various subdisciplines of chemistry, these awards support the MPS emphasis area of the molecular basis of life processes. Examples of science drivers in this area include the tracking of molecules in cells across multiple length, time and organizational scales and understanding the networks of chemical reactions that characterize life. CHE awards also underpin efforts to acquire the fundamental knowledge that will provide a basis for the sustainability of the Earth. For example, chemistry will play a leading role in supporting fundamental molecular research needed for a sustainable hydrogen economy and for environmentally benign manufacturing. CHE will continue to provide substantial support for interdisciplinary work in nanoscale science, which depends heavily on chemists' abilities to manipulate strong and weak chemical bonds.

Developing cyber-enabled chemistry. Investments in cyber-enabled chemistry – the development of databases, data mining tools, molecular visualization and computational capabilities, and remote and networked use of instrumentation and facilities, for example – promise to be transformative in the chemical sciences. They will allow research challenges of unprecedented complexity to be addressed by individual researchers and teams of researchers working in entirely new ways. Moreover, the educational platform provided by cyber-enabled chemistry will provide new paradigms for teaching and learning in the chemical sciences.

Broadening participation. Investments in the Research Experiences for Undergraduates (REU) and Undergraduate Research Centers (URC) programs will provide opportunities for far larger numbers of students, including first- and second-year college students, to create and communicate new knowledge in the chemical sciences. Furthermore, the aforementioned investments in cyber-infrastructure will create national and international platforms that will allow chemical scientists to collaborate with other researchers, anywhere, at any time, permitting greatly enhanced access to resources.

Changes from FY 2005:

Research and education grants and centers increase by $1.46 million to a total of $170.91 million. CHE will continue to support forefront areas of chemistry, with emphasis on molecular basis of life processes and on sustainability. Education and outreach activities will receive continued emphasis, including undergraduate research, integration of research and education, and efforts to broaden participation.

Instrumentation/Facilities increase by $460,000 to a total of $10.46 million. This includes enhanced investments in cyberinfrastructure to develop tools for cyber-enabled chemistry and contributions to the NHMFL and other facilities. Many of the investments in cyber-enabled chemistry will be made through the CRIF program that provides funds for multi-user instrumentation and instrumentation development.

MATERIALS RESEARCH $245,700,000

The FY 2006 Request for the Materials Research Division (DMR) is $245.70 million, an increase of $5.20 million, or 2.2 percent, over the FY 2005 Current Plan of $240.50 million.

Materials Research Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Materials Research	**$250.65**	**$240.50**	**$245.70**	**$5.20**	**2.2%**
Major Components:					
Research and Education Grants	143.85	133.10	138.30	5.20	3.9%
Centers Programs	68.35	68.15	69.15	1.00	1.5%
Facilities					
National High Magnetic Field Laboratory (NHMFL)	24.00	24.00	24.00	0.00	0.0%
National Nanofabrication Infrastructure Network (NNIN)	2.55	2.55	2.55	0.00	0.0%
Other MPS Facilities	11.90	12.70	11.70	-1.00	-7.9%

Totals may not add due to rounding.

About DMR:

The Materials Research Division advances the intellectual frontiers of materials research. It enables the materials community to make new discoveries about the fundamental behavior of matter and materials; to create new materials and new knowledge about materials phenomena; to address questions about materials that often transcend traditional scientific and engineering disciplines and may lead to new technologies; to prepare the next generation of materials researchers; to develop and support the instruments and facilities that are crucial to advance the field; and to share the excitement and significance of materials and condensed-matter science with the public at large. DMR supports research over a broad range of subfields, including condensed matter and materials physics; solid state chemistry; polymers; ceramics; metals; electronic, magnetic and photonic materials; and materials theory. The division maintains a balanced portfolio of research topics through individual investigator grants, focused research groups, centers, and awards for instrumentation and user facilities. DMR programs support a variety of interagency and international partnerships to advance materials research and education.

The DMR portfolio has three major components: research and education awards, centers, and user facilities. Support for international collaboration and for broadening participation in materials research and education is integrated throughout the portfolio.

- DMR research and education awards comprise grants to individual investigators and small groups, and to teams of several investigators addressing complex problems in materials and condensed-matter research. DMR also supports the acquisition and development of instrumentation for materials research.
- DMR Centers include 27 Materials Research Science and Engineering Centers (MRSECs) established through open competitions to address major interdisciplinary problems in materials and condensed-matter science. In addition, the division supports the Science and Technology Center (STC) on Materials and Devices for Information Technology Research and three Nanoscale Science and Engineering Centers (NSECs), and provides partial support for a further seven NSECs. DMR also supports six International Materials Institutes based at U.S. universities to enhance international cooperation in materials.

- DMR supports world-class user facilities for high magnetic fields, synchrotron radiation, and neutron scattering, and provides partial support for the National Nanofabrication Infrastructure Network. Researchers use these facilities to address challenging problems across a very broad spectrum of science and engineering.

Facilities are approximately 15 percent of the DMR portfolio. Of the remaining 85 percent, approximately 55 percent of funds are committed to awards made in previous years.

DMR Priorities for FY 2006:
Maintaining strong support for materials research programs that generate new ideas and novel materials and undergird new technologies. These core programs include awards to individual investigators, groups, and centers. Emphasis will be given to research on materials and condensed-matter phenomena at the nanoscale, biomolecular and bio-inspired materials, computational and theoretical materials research, and materials for future cyberinfrastructure.

Broadening participation in materials research by maintaining vigorous programs for the participation of undergraduates, pre-college students and pre-college teachers in research, and by fostering new partnerships that strengthen the links between institutions serving under-represented groups and DMR-supported research teams, centers, and facilities.

Maintaining support for world-class user facilities while enabling the development of future user facilities and major instrumentation for synchrotron radiation, neutron scattering, and high magnetic fields. (For more detailed information about the National High Magnetic Field Laboratory, please see the Facilities Chapter.)

Changes from FY 2005:
DMR will increase support for **research and education** awards by $5.20 million to a total of $138.30 million, enhancing support for research on novel phenomena and new materials, nanoscale materials, biomolecular and bio-inspired materials, and materials for cyberinfrastructure. DMR will establish up to three new **Partnerships for Research and Education in Materials** (PREMs) at institutions serving under-represented groups, bringing the total number of PREMs to seven.

DMR will increase support for Centers by $1.0 million to a total of $69.15 million, phasing in full support for new **Materials Research Science and Engineering Centers** established in FY 2005.

DMR will reduce overall support for **user facilities** by $1.0 million to a total of $38.25 million, while maintaining critical support for state-of-the-art user facilities for synchrotron radiation, neutron scattering, high magnetic fields, and nanofabrication. Support for instrumentation will be refocused to enhance support for the design and development of mid-scale instruments.

MATHEMATICAL SCIENCES $200,380,000

The FY 2006 Request for the Mathematical Sciences Division (DMS) is $200.38 million, level with the FY 2005 Current Plan of $200.38 million.

Mathematical Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Mathematical Sciences	**$200.35**	**$200.38**	**$200.38**	**$0.00**	**0.0%**
Major Components:					
Research and Education Grants	185.30	183.23	183.23	$0.00	0.0%
Mathematical Sciences Research Institutes	15.05	17.15	17.15	$0.00	0.0%

Totals may not add due to rounding.

About DMS:

The Mathematical Sciences Division advances the intellectual frontiers of the mathematical sciences and contributes to advancing knowledge in other scientific and engineering fields. It plays a key role in the training of the nation's science and engineering workforce. Advances in science and engineering, driven in part by increasingly sophisticated and readily available computing environments, have lifted the mathematical sciences to the forefront of science and engineering, reshaping modern discovery through quantitative predictions, instrumentation development, modeling, visualization, computational algorithms, and optimization methods. Science and engineering are requiring more sophisticated mathematical and statistical tools. This is true not only in the physical, engineering and informational sciences, but also in the biological, geophysical, environmental, social, behavioral, and economic sciences.

NSF has a crucial role in the support of basic academic research in the mathematical sciences, providing more than 75 percent of all federal university-based support. NSF support involves a broader range of infrastructure and fundamental and multidisciplinary research topics than that sponsored by other federal agencies that support academic mathematical sciences research. Especially important is the critical function of the mathematical sciences in the training of the nation’s scientific and engineering workforce.

DMS includes areas such as analysis, geometry, topology, foundations, algebra, number theory, combinatorics, applied mathematics, statistics, probability, mathematical biology, and computational mathematics. Awards in these areas support a variety of research projects, multidisciplinary projects, Focused Research Groups, and Research Training Groups with some grants including funding for graduate and postdoctoral students as well as for workshops, computing equipment and other research and education needs. In addition, DMS supports infrastructure efforts across the mathematical sciences, including national research institutes, postdoctoral, graduate, and undergraduate training opportunities, broadened career experiences for researchers, increased participation in the nation’s research personnel base, research conferences and workshops, and scientific computing research equipment.

The DMS portfolio has two major modes of support: research and education grants, and institutes.

- DMS research grants range in scope from individual-investigator awards to awards for multidisciplinary groups of researchers to attack problems of major scientific importance. DMS provides major support for education and training, particularly through Enhancing the Mathematical Sciences Workforce for the 21st Century (EMSW21), which focuses on research training activities in the mathematical sciences and mentoring activities aimed at increasing the number of U.S. students choosing careers in the mathematical sciences. EMSW21 includes Grants for the Vertical Integration of Research and Education (VIGRE), Research Training Grants in the Mathematical Sciences (RTG), and Mentoring through Critical Transition Points in the Mathematical Sciences (MCTP).

- DMS provides core support for five mathematical sciences research institutes as well as major support for two other institutes. These institutes are funded on a competitive basis and address the growing interface with other disciplines and the mathematical and statistical problems whose solutions will contribute to both fundamental knowledge and national needs. In addition, they often serve as an incubator for new ideas and directions in the mathematical sciences.

In general, 72 percent of the DMS portfolio is available for new awards and activities. The remaining 28 percent funds awards made in previous years.

DMS Priorities for FY 2006:

Maintaining a strong program of research grants. At a minimum, the intention is to maintain the investments in single investigator as well as small group grants. This is the core of the mathematical sciences portfolio.

Investing in algorithm development and computational tools for large-scale problems of scientific importance. Emphasis will be given to stochastic or probabilistic models and modeling of large data sets and, in general, to modeling scientific phenomena that occur over a large range of spatial and temporal scales.

Broadening participation in the mathematical sciences. Emphasis will be given to the support of interactions and networks among a diverse population that will include graduate students and researchers at a wide array of institutions.

Maintaining research training activities in the mathematical sciences. These include training and mentoring activities aimed at increasing the number of U.S. students choosing careers in the mathematical sciences.

Continuing support for the Mathematical Sciences Priority Area. This reflects the importance of mathematical and statistical sciences in the kinds of crosscutting science and engineering research areas described above. It will include maintaining the investment in focused mathematical sciences research teams, interdisciplinary training groups, and other collaborative mechanisms related to advancing science and engineering. The priority area will continue to have three major foci for DMS: (1) fundamental mathematical and statistical sciences, (2) interdisciplinary research that connects the mathematical sciences with other sciences and engineering, and (3) targeted investments in mathematical sciences training activities through research. Interdisciplinary investments will focus on the mathematical and statistical challenges posed by large data sets, managing and modeling uncertainty, and modeling complex nonlinear systems.

Changes from FY 2005:

- **Broadening participation** increases by $3.0 million. This will support interactions among a broader set of researchers with the objective of reaching a more diverse population. These investments are at a scale between individual investigator awards and institutes and focus on the creation of networks of researchers at a diverse set of institutions. Examples include summer schools focused on a given research area; regional, multi-year conferences and workshops; and special years of emphasis. The activities would emphasize involvement of students and postdoctoral researchers.
- **Enhancing the Mathematical Sciences Workforce** in the 21st Century decreases by $3.0 million. These funds are re-targeted to divisional efforts in broadening participation described above and include modes of training that complement EMSW21.

PHYSICS $230,140,000

The FY 2006 Request for the Physics Division (PHY) is $230.14 million, an increase of $5.20 million, or 2.3 percent, over the FY 2005 Current Plan of $224.94 million.

Physics Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Physics	**$227.77**	**$224.94**	**$230.14**	**$5.20**	**2.3%**
Major Components:					
Research and Education Grants	127.69	121.14	126.55	5.41	4.5%
Centers Programs	20.43	24.88	25.88	1.00	4.0%
Facilities					
Laser Interferometer Gravitational Wave Observatory (LIGO)	33.00	32.00	32.00	0.00	0.0%
Large Hadron Collider (LHC)	7.00	10.50	13.50	3.00	28.6%
Rare Symmetry Violating Processes (RSVP)	6.00	2.30	0.00	-2.30	-100.0%
Nationl Superconducting Cyclotron Laboratory (NSCL)	15.65	17.50	17.50	0.00	0.0%
Cornell Electron Storage Ring (CESR)	18.00	16.62	14.71	-1.91	-11.5%

Totals may not add due to rounding.

About PHY:

The Physics Division advances the intellectual frontiers of physics; contributes to advances in other scientific and engineering fields and to the ultimate benefit of the economy, health, and defense of the country; works toward early inspiration of the young, training the next generation of scientists and the high-tech workforce, and sharing the stimulation and understanding provided by science to the general public through the integration of research and education; and stewards the physics community to ensure it remains world-class as it evolves in the future. PHY supports research over a broad range of physics subfields, including atomic, molecular, optical, and plasma physics; elementary particle physics; gravitational physics; nuclear physics; astrophysics; theoretical physics; biological physics; high-performance computing; accelerator physics; complex systems, turbulence; etc. The division maintains a balanced portfolio of research topics using appropriate modes of support and partnering across agency and national boundaries. The PHY portfolio has three major modes of support: research and education grants, centers, and facilities.

- PHY research and education grants range in scope from individual investigator awards for research based at the investigator's home institution, to awards to major user groups with responsibility for experiments at national or international user facilities.
- PHY centers include ten Physics Frontiers Centers (PFCs), the Science and Technology Center (STC) for Biophotonics Science and Technology, and two Nanoscale Science and Engineering Centers. Centers are funded on a competitive basis to support focused efforts on the most important science questions requiring this level of concentration in order to make major advances.
- PHY also supports major world-class facilities that are needed by certain subfields to answer the highest priority science questions. (Additional information about PHY facilities is provided in the Facilities Chapter of this document.)

Facilities are approximately 31 percent of the PHY portfolio. Of the remaining 69 percent, approximately 67 percent of funds are committed to awards made in previous years.

PHY Priorities for FY 2006:

Physics of the Universe (POU), the highest scientific priority, addresses the compelling questions that have arisen at the interface of physics and astronomy. Questions include: What is dark energy? What is dark matter? Can we detect gravity waves as ripples in space-time? These and seven other profound questions were posed by the National Research Council (NRC) report, "Connecting Quarks with the Cosmos." A subsequent National Science and Technology Council report, "The Physics of the Universe: A 21st Century Frontier for Discovery," outlines a national strategy involving NSF, the Department of Energy (DOE) and NASA. The Physics and Astronomical Sciences Divisions will work together and with other federal programs to maximize their impact on this research.

Ramping up the maintenance, operations, and data analysis support for the U.S. Large Hadron Collider (LHC) activity is the highest facility stewardship priority. This is being coordinated with DOE. It will enable the U.S. physics community to fully participate in the discovery potential of the LHC, to capitalize on the large facility construction investment by the U.S., and to be a good partner in global collaboration.

Maintaining a strong, flexible program of research and education grants to create new ideas and technology and attract and train students, the highest priority in stewardship of the portfolio. Emphasis will be given to increasing the support for cyberinfrastructure and cyberscience, theoretical research across the portfolio, and biological physics.

Changes from FY 2005:

Research and education grants and centers increase by $6.41 million to a total of $152.43 million. PHY will continue to support forefront areas of physics, with expanded emphasis on POU, cyberinfrastructure, theoretical physics, biological physics, and computational physics. Education and outreach activities will receive continued emphasis: enhancing K-12 science teacher training, expanding diversity within the research community, integrating research and education, including the training of young physicists. A new R&D effort to develop a next generation source of x-ray synchrotron radiation is being co-funded by the Physics, Materials Research, and Chemistry Divisions, and the Office of Multidisciplinary Activities.

Facilities decrease by $1.21 million to a total of $77.71 million. This includes:

- Continued support for operations of the **Laser Interferometer Gravitational-Wave Observatory** (LIGO) and for advanced detector R&D at a total of $32.00 million. LIGO, the world's leading effort to discover gravitational waves and use them to study such objects as colliding neutron stars and black holes and to create a new field of gravitational-wave astronomy, is completing commissioning and beginning science runs.
- An increase of $3.0 million for early operations (including data analysis support) of the **LHC** ATLAS and CMS detectors for a total of $13.50 million. The LHC is an energy frontier high-energy particle collider with the potential to discover the Higgs boson, supersymmetric particles, extra spatial dimensions, etc., if these predicted phenomena occur in nature.
- A decrease of $2.30 million for planning activities for the **Rare Symmetry Violating Processes** (RSVP) project, as funding for construction of this project is requested through the MREFC Account in FY 2006.
- Continued support for operations of the **National Superconducting Cyclotron Laboratory** radioactive ion beam facility at Michigan State University at a total of $17.50 million.
- A decrease of $1.91 million for **Cornell Electron Storage Ring** (CESR) operations to a total of $14.71 million, to continue exploration of critical weak and strong elementary particle interaction phenomena and to support important accelerator physics research activity at Cornell University.

MULTIDISCIPLINARY ACTIVITIES $30,000,000

The FY 2006 Request for the Office of Multidisciplinary Activities (OMA) is $30.0 million, an increase of $510,000, or 1.7 percent, over the FY 2005 Current Plan of $29.49 million.

Multidisciplinary Activities Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Multidisciplinary Activities	**$31.07**	**$29.49**	**$30.00**	**$0.51**	**1.7%**
Major Component:					
Research and Education Grants	31.07	29.49	30.00	$0.51	1.7%

About OMA:

The Office of Multidisciplinary Activities enables and facilitates MPS support of particularly novel, challenging, or complex projects of varying scale in both research and education that are not readily accommodated by traditional organizational structures and procedures. This is done primarily in partnership with the five other MPS disciplinary divisions to encourage multidisciplinary proposals from all segments of the MPS community and especially to encourage initiatives by multi-investigator, multidisciplinary teams pursuing problems on a scale that exceeds the capacity of individual investigators. Most often, these cooperative undertakings involve two or more partners – within MPS or beyond – that join with OMA to push in new directions of scientific understanding and that broaden and enrich education and research training activities in the MPS disciplines. Such partnerships are critically important to the pursuit of the strategic goals of the Foundation and of the MPS community and contribute significantly to the preparation of a diverse workforce for the new century that is broadly trained, flexible, and globally competitive. Facilitation by OMA of both disciplinary partnerships and organizational partnerships is vital to the accelerated discovery of new ideas, the development of new tools, and the broadened training necessary to enable the nation's workforce to meet new and rapidly evolving demands.

Because OMA plays a catalytic role in initiating new multidisciplinary activities and enabling broadening participation, the portfolio contains few commitments from prior years. Almost all awards are managed in the MPS divisions with co-funding from OMA.

OMA Priorities for FY 2006:

Enabling the creativity of the MPS community by facilitating partnership-enabled multidisciplinary and high-risk research that extends the intellectual frontiers of the MPS disciplines. Such activities include fundamental multidisciplinary research at the interface between the AST and PHY Divisions that enables advances in our understanding of the physics of the universe, at the interface between the MPS disciplines and the biological sciences that provides insights into the molecular basis of life processes, and by multidisciplinary teams of scientists, mathematicians, and engineers which leads to the development of next-generation instrumentation, particularly instrumentation at the mid-scale level, that enables fundamental advances across a wide spectrum of disciplines.

Catalyzing the development of a diverse, well-prepared, internationally competent, and globally engaged STEM workforce. Effective workforce development is achieved through a portfolio of activities that includes both MPS participation in Foundation-wide programs and MPS-centric activities that leverage the Directorate's research investment to positively impact and enrich the education and training continuum at all levels, that facilitate the formation of research-based partnerships that not only increase diversity and broaden participation in the STEM enterprise directly, but also build the physical and intellectual capacity of educational institutions, particularly minority serving institutions (MSIs), to produce larger, more diverse cohorts of U.S. graduates who are well prepared to both support and to lead the nation's STEM enterprise in the 21st Century.

Changes from FY 2005:
Support for **disciplinary research** will be reduced by $1.20 million to the level of $13.16 million. At this level, particular emphasis will be placed on the support of cooperative, high-risk research at the AST-PHY interface focused on physics of the universe at the level of $2.0 million, and on support of innovative research in multidisciplinary areas that enhance our understanding of the molecular basis of life processes that will be sustained at the FY 2005 level of $1.0 million.

Funding for the MPS-wide **Research Partnerships for Diversity** activity will be increased by $1.0 million to the level of $3.0 million. This co-investment with the five disciplinary MPS divisions enables research-based collaborative activities primarily between MPS-supported centers and facilities and MSIs. These collaborative interactions build research capacity of the MSI faculty, strengthen the research infrastructure of the MSIs, and engage, stimulate, retain, and develop an increasingly diverse cadre of students in the MPS disciplines at the undergraduate and graduate levels.

Support for **collaborative public education and outreach** activities at MPS-supported research centers and facilities will be increased by $1.0 million to the level of $3.0 million. This investment includes the MPS Internships in Public Science Education program and related activities that enable effective leveraging of the MPS research investment for public science education, and clear public articulation of MPS science themes such as Physics of the Universe.

The OMA investment in the **Research Experiences for Teachers** activity (RET) will be increased by $500,000 to the level of $3.0 million, which will provide more than 300 pre-service and in-service K-12 teachers with discovery-based learning experiences in the MPS disciplines. Begun in MPS in FY 1999, there are now RET activities in all Directorates. RET builds long-term collaborative K-12 – Research Community relationships, enriches disciplinary content, builds educational capacity, brings research frontiers to the classroom, develops an intellectual resource network, provides professional development opportunities, builds and sustains interest in STEM disciplines, and catalyzes diversification of the STEM workforce.

The overall investment in postdoctoral researchers will be reduced by $600,000 to the level of $1.0 million. Following the elimination of the MPS **Distinguished International Postdoctoral Fellowships** program in FY 2005, the OMA investment in postdoctorals will focus on (1) co-investment with the Office of International Science and Engineering in international postdoctoral research fellowships (through the International Research Fellowship Program) having strong MPS disciplinary focus, (2) coinvestment with the CHE Division in the **Discovery Corps Fellowship** program, and (3) co-investment with the five MPS disciplinary divisions in postdoctoral activities that promote multidisciplinarity and enhance diversity among young physical scientists and mathematicians.

Funds in the amount of $500,000 previously used in support of the NSF Director's Awards for **Distinguished Teaching Scholars** (DTS) will be reallocated to a similar MPS-level activity that provides a new element in the MPS portfolio for broadening participation through its recognition of diverse teacher-scholar role models.

Social, Behavioral and Economic Sciences

SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES $198,790,000

The FY 2006 Budget Request for the Directorate for Social, Behavioral and Economic Sciences (SBE) is $198.79 million, an increase of $1.89 million, or 1.0 percent, over the FY 2005 Current Plan of $196.90 million.

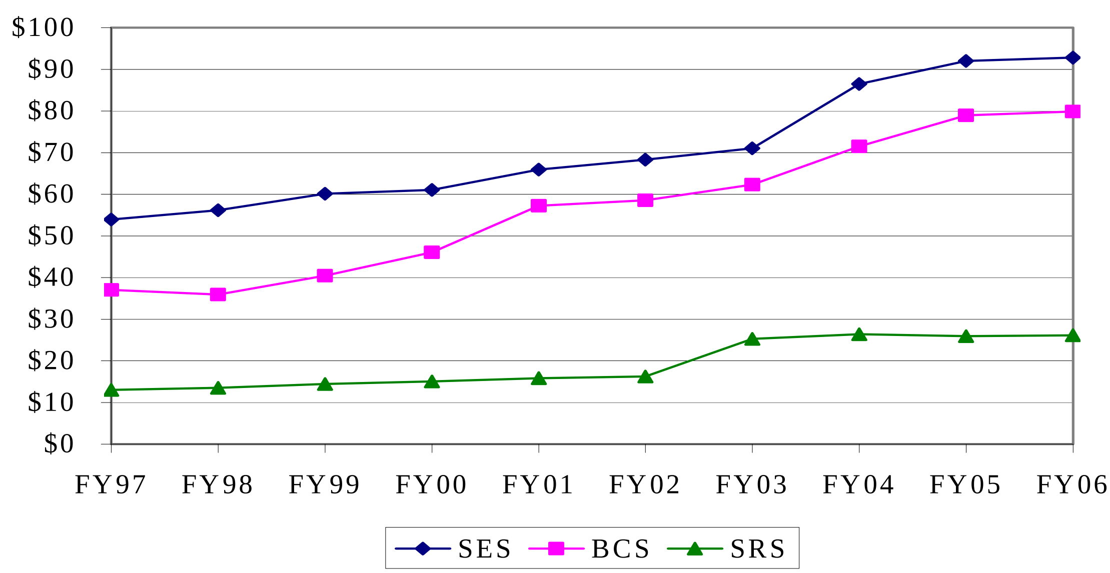
Social, Behavioral and Economic Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Social and Economic Sciences (SES)	86.43	91.99	92.80	0.81	0.9%
Behavioral and Cognitive Sciences (BCS)	71.49	78.97	79.84	0.87	1.1%
Science Resources Statistics (SRS)	26.37	25.94	26.15	0.21	0.8%
Total, SBE	$184.30	$196.90	$198.79	$1.89	1.0%

Totals may not add due to rounding.

The Directorate for Social, Behavioral and Economics Sciences supports research, education, and infrastructure in the social, behavioral, cognitive, and economic sciences, primarily through grants to investigators at universities and other institutions. The research it supports has resulted in substantial advances in our understanding of human and social development, of how people behave, as individuals and as members of groups and other more formal organizations, and of key social and economic institutions. SBE also supports the collection and dissemination of statistics on the science and engineering enterprise.

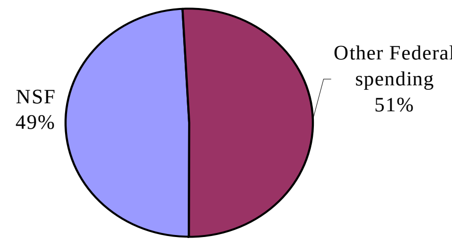
SBE Subactivity Funding
(Dollars in Millions)

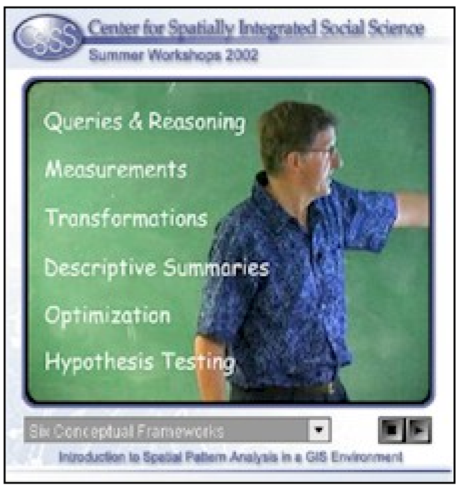


RELEVANCE

SBE is a principal source of federal support for fundamental research on human cognition, behavior, social structures, and social interaction, as well as for research on the intellectual and social contexts that govern the development and use of science and technology. Overall, SBE accounts for 49 percent of federal support for basic research in the social sciences at U.S. academic institutions. In some fields, including anthropology, archaeology, political science, economics, sociology and the social aspects of psychology, it is the predominant or exclusive source of federal basic research support.

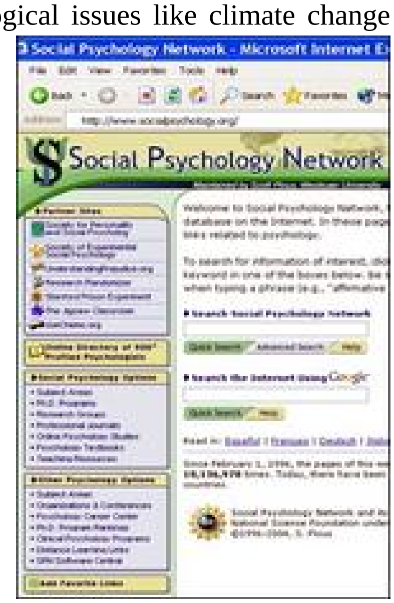
Federal Support for Basic Research in the Social Sciences at Academic Institutions (excludes the Psychological Sciences)





Workshop in Spatial Social Science

The SBE Directorate supports government-wide and cross-agency priorities and initiatives through its ongoing funding activities including work with relevance for Homeland Security R&D, Networking and Information Technology R&D, ecology and climate change, and the societal implications of biotechnology, nanotechnology, and similar areas of scientific breakthroughs. Homeland Security R&D is supported through basic research activities that have applications for the assessment and prevention of and recovery from terrorist activities. Topics of recently funded research include: brain activity associated with truth and deception; network modeling; linking decision making, risk analysis, and engineering to create effective responses in crisis situations; and the effects of terrorism on those who suffer no physical harm but are vicariously connected to terrorist threats. Other recently supported research projects investigate the human dimensions of ecological issues like climate change and the social and ethical issues that surround advances in nanotechnology. SBE also provides statistical data for critical analyses on the role of foreign citizens in the U.S. science and engineering workforce. In addition, SBE awards foster the development of new information technology systems and software, the sharing of data within and across disciplines, the development of new social research infrastructures, and education at all levels in the SBE sciences.



This website is viewed on average more than 35,000 times a day by people in 75 countries.

The Division of Science Resources Statistics (SRS) within SBE is the federal statistical agency responsible for the compilation and analysis of data on the science and engineering enterprise. Major components are surveys of the science and engineering workforce, the education of that workforce, and the nation's research and development portfolio. Results are used to assess the state of the nation's science and engineering workforce, its ability to compete globally, and the outlook for the nation's research capacity. Results also provide critical benchmarking information on facilities and cyberinfrastructure in the academic and biomedical communities. Findings from SRS studies have long helped shape the development of the nation's educational and science policy agendas.

Summary of Major Changes by Division *(Dollars in Millions)*

SBE FY 2005 Current Plan..........……………………………………………………………........$196.90

Social and Economic Sciences +$0.81

Increased funding will be distributed among the following priorities: Building a more effective cyberinfrastructure for the social and economic sciences, augmenting the Human and Social Dynamics priority area, increasing the participation of underrepresented groups in social and economic sciences, supporting research exploring the social dimension of drug abuse and drug violence, and improving funding rates across all programs. Support for the National Consortium on Violence Research will sunset in FY 2005 and funding for the Interagency Education Research Initiative will continue to decrease, making resources available for priorities mentioned above.

Behavioral and Cognitive Sciences +$0.87

Increased funding is marked for the Human and Social Dynamics priority area. Other funds and reallocations will focus on research on human origins, documenting endangered languages, neural substrates of cognition, children's development, and fundamental human social processes as well as broadening the participation of underrepresented groups in the behavioral and cognitive sciences. Support for three of the Children's Research Initiative Centers will end in FY 2005 and funding for the Interagency Education Research Initiative will continue to decrease, making resources available for priorities mentioned above.

Science Resources Statistics +$0.21

Increased support will enhance survey redesign activities on SRS core surveys.

Subtotal, Changes +$1.89

SBE FY 2006 Request………………………………………………………………...….......$198.79

Summary of Major Changes by Directorate-Wide Investments *(Dollars in Millions)*

SBE FY 2005 Current Plan …………………………….…………………………...……......$196.90

Core Research +$2.47

Disciplinary and interdisciplinary research in the core social, behavioral, cognitive, and economic programs will increase to improve funding rates and seed new program initiatives.

Human and Social Dynamics Priority Area +$0.50

In its third full year, SBE will continue to increase funding of the Human and Social Dynamics priority area, reflecting the importance of this agency-wide initiative to transforming research and education in the social, economic, and behavioral sciences. Increased funding will allow more outstanding proposals to be funded. Total SBE funding of the priority area will be $31.40 million in FY 2006.

Broadening Participation +$1.00

Increased funding will support directorate initiatives to encourage women and underrepresented minorities to enter graduate school programs, complete their advanced degrees, and pursue academic careers in the social, behavioral, and economic sciences.

Science Resources Statistics Survey Redesign +$0.11

Increased support will enhance survey redesign activities on SRS core surveys.

SBE Centers -$2.00

The National Center on Violence Research will terminate with FY 2005 funding (-$1.0 million). Support for the Children's Research Initiative Centers will decrease as three centers complete their five-year funding (-$1.50 million) and there will be a new competition for one new CRI center (+$500,000). Support for related activities will continue through core research programs.

Interagency Education Research Initiative -$0.50

Support for the Interagency Education Research Initiative will decrease to allow for additional funding of research and education through core SBE programs.

Organizational Excellence +$0.21

Funding for Organizational Excellence will increase to reflect a rise in administrative costs for activities necessary to achieve NSF's mission and goals. These investments include support for Intergovernmental Personnel Act appointments and for contractors performing administrative functions.

Subtotal, Changes +$1.89

SBE FY 2006 Request……………………………………………………………………...$198.79

PRIORITY AREAS

In FY 2006, SBE will continue to support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

SBE Investments in NSF Priority Areas

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Percent
Biocomplexity in the Environment	$6.27	$2.00	$2.00	$0.00	0.0%
Nanoscale Science and Engineering	$2.59	$1.56	$1.56	$0.00	0.0%
Mathematical Sciences	$1.82	$1.50	$1.50	$0.00	0.0%
Human and Social Dynamics	$21.56	$30.90	$31.40	$0.50	1.6%

Biocomplexity in the Environment: Support will continue at the FY 2005 level for research on the dynamics of coupled human and natural systems, international collaborations, and Materials Use: Science, Engineering, and Society, a competition led by the Directorate for Engineering with some support from SBE. Assistance also continues for activities associated with fundamental research to increase scientific understanding of social and behavioral processes associated with extreme and unpredictable events, and for the social and economic dimensions of materials use research.

Nanoscale Science and Engineering: Within SBE's $1.56 million total contribution, $600,000 will support the Nanoscale Science and Engineering Center on Nanotechnology in Society, a multi-directorate center managed by SBE. The directorate will continue to fund research on the social and economic aspects of nanotechnology including research to ensure the responsible development of nanotechnology, work that explores how nanotechnology can enhance human performance, and research exploring public understanding of and engagement with nanoscale science, engineering, and technology.

Mathematical Sciences: Within this priority area, SBE is supporting collaborative teams consisting of social/behavioral and mathematical/statistical scientists who are working to develop new mathematical and statistical techniques to advance research in the social and behavioral sciences. SBE will also support innovative training activities.

Human and Social Dynamics: Support for the SBE-managed Human and Social Dynamics priority area will increase by $500,000 for a total of $31.40 million to support interdisciplinary approaches to understanding the complex dynamics within and among human and social systems and their environments, at scales ranging from the cellular to the global. Focal areas for this work are the dynamics of human behavior; agents of change; and decision making, risk, and uncertainty. This increase reflects a commitment to the excellent integrative science that is emerging through the Human and Social Dynamics competitions and the value of interdisciplinary collaboration in advancing not only the social, behavioral, and economic sciences, but also other scientific and national priorities.

QUALITY

SBE maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. In FY 2004, the last year for which complete data exist, 97 percent of research funds were allocated to projects that underwent external merit review.

To ensure the quality of its processes for handling proposals and recommending proposals for awards, SBE convenes Committees of Visitors, composed of expert external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the proposal review process and provide a retrospective assessment of the results of NSF's SBE investments. The Division of Behavioral and Cognitive Sciences programs were reviewed in FY 2003. The Division of Social and Economic Sciences programs and the Division of Science Resources Statistics R&D data programs were reviewed in FY 2004.

The Directorate also receives advice from the Advisory Committee for Social, Behavioral, and Economic Sciences (SBEAC) on the missions, programs, and goals that can best serve the scientific community; the promotion of quality graduate and undergraduate education in the social, behavioral, and economic sciences; and priority investment areas for research. The SBEAC meets twice a year. Members represent a cross section of SBE-supported disciplines, with representatives from many different sub-disciplines within the field, including members from institutions and industry. The Committee includes women, members of under-represented minorities and people from all geographic regions.

PERFORMANCE

NSF's FY 2006 budget is aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Social, Behavioral and Economic Sciences
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	10.54	8.59	8.59	-	-
Institutions	1.43	1.43	1.43	-	-
Collaborations	.42	0.0	1.00	1.00	-
	12.39	10.02	11.02	1.00	10.0%
Ideas					
Fundamental Science and Engineering	113.20	133.77	135.74	1.97	1.5%
Centers Programs	14.66	8.70	7.30	-1.40	-16.1%
Capability Enhancement	0.80	0.70	0.70	-	-
	128.66	143.17	143.74	0.57	0.4%
Tools					
Facilities	0.30	0.30	0.30	-	-
Infrastructure and Instrumentation	39.32	39.89	40.00	0.11	0.3%
Polar Tools, Facilities and Logistics	-	-	-	-	-
Federally-Funded R&D Centers	-	-	-	-	-
	39.62	40.19	40.30	0.11	0.3%
Organizational Excellence	3.63	3.52	3.73	0.21	6.0%
Total, SBE	$184.30	$196.90	$198.79	$1.89	1.0%

Totals may not add due to rounding.

SBE will continue its commitments to education, training, and increasing diversity within all of its Divisions. The FY 2006 budget will maintain award size and maintain commitments to multidisciplinary research activities, interagency partnerships, and international activities, as well as attention to broadening participation at all levels.

Recent Research Highlights

Dr. Steven Levitt

2003 John Bates Clark Medal Winner, PECASE: The Economics of Gangs. Steven Levitt of the University of Chicago received the prestigious John Bates Clark Medal from the American Economics Association in 2003 for his pioneering and influential empirical work on the economics of crime. The medal, bestowed every two years, recognizes the nation's most outstanding economist under 40. A Presidential Early Career Award for Scientists and Engineers (PECASE) in 2000 and earlier NSF grants supported Levitt's research. Levitt's work reveals that incarceration time policies have a greater impact on crime rates than previously thought. He explains the recent trend toward youth rather than adult crime as a response to differential incentives. He uses the introduction of sentence increases in California to produce evidence in favor of "deterrence" theories of incarceration in contrast to "incapacitation" theories. In other studies, Levitt found that increasing police numbers reduces violent crime far more than property offenses; that auto owners who install hidden radio transmitter devices create social benefits of general deterrence that dwarf the private benefits they receive; and that even though the wages drug gang members typically receive from illegal activity are low, they are better than what members could expect to earn in the legal job market. Levitt's work and the singular honor he has received illustrate the value of investing in people through CAREER and PECASE awards.

Religion, Politics, and Community in Egypt, Iran and Jordan. It is today not news that we must better understand the beliefs and attitudes of people living in Islamic societies. Mansoor Moaddel, working with social scientists from Egypt, Iran and Jordan, surveyed attitudes toward religion, political liberalism and other issues in these countries. The survey found that while citizens of all three countries are highly religious, there is considerable variation in value orientations, associated in unexpected ways with variations in the political contexts and religious orientations of the ruling regimes. Iranians, despite living under a religious regime for more than two decades, appear to be less religious and more nationalistic than either Egyptians or Jordanians, who live under secular regimes. Iranians also have more liberal attitudes toward marriage and women working outside the home than the respondents from the other two countries and prefer smaller family sizes. Furthermore, Iranians tend to be less concerned with Western cultural invasion than the citizens of the other two countries. This study, particularly the somewhat surprising contrasts between Iranian communities and those in Egypt and Jordan, cautions us against thinking that a regime's religiosity or relationship to the Unites States mirrors the attitudes of its people toward religion and western values.

Discovering the Brain Mechanisms that Cause False Memories. The ease with which people's memories can so easily be distorted is disconcerting. False memories are relevant to serious issues ranging from the validity of eyewitness testimony to recovered repressed memories. Careful investigation of an event through repeated questioning, which may inadvertently suggest a certain outcome or contain misinformation, can significantly affect the memory of the event. Thus, understanding the neural processes involved in false memories is extremely important. This study by Yoko Okado and Craig Stark at Johns Hopkins University demonstrates how significant a role the initial encoding of a memory plays in the false memory process, and how memories from multiple events can be easily integrated into what people believe is a memory for a single event. Further, the study helps show how this process works in the brain, and how the neural processing of true and false memories is similar. This multi-disciplinary research combines methods from psychology, forensic psychology, and cognitive neuroscience. It is innovative in making use of brain imaging (fMRI) to study a highly controversial and important question.

Analysis of Material Remains. Through the analysis of material remains, archaeologists can trace the movement of objects and the ideas which they embody. It is, however, extremely difficult to determine whether observed material patterns result from the flow of ideas or of people themselves. Douglas Price

and James Burton and collaborators at the University of Wisconsin have developed and refined a technique, which can solve this dilemma. The bedrock in individual geographical regions can differ significantly in its isotope ratio and these differences are reflected in food. Thus, because teeth form relatively early in the human lifespan and their enamel is not replaced, their strontium isotope ratio bears a signal related to the geology of childhood geography. In contrast, bone is replaced over the lifetime and reflects later residence history. Measurement of strontium isotope ratios in mammalian tooth and bone can determine regional biological signals – this is an extremely powerful and broadly applicable technique. For example, through analysis of their skeletons one can determine which Icelandic Vikings were born on that island and which, in contrast, retain a childhood Scandinavian isotopic tooth signal.

Reducing Racial Prejudice in Children. Prejudice continues to create barriers for the learning and development of children from all racial and ethnic groups. An international and interdisciplinary team of social and developmental psychologists, led by Sheri Levy of SUNY at Stony Brook, has examined the role of teachers in communicating one of three types of theoretically derived anti-bias messages to school children. First, the colorblind theory suggests that racial prejudice results from an overemphasis on racial differences; thus, children would benefit from ignoring or minimizing race differences. Second, multicultural theory suggests that racial prejudice results from a lack of knowledge about the contributions of different racial and cultural groups; thus, children should benefit from focusing on race and the positive contributions of different racial groups. Third, antiracism theory suggests that racial prejudice results from a lack of knowledge of the history and pernicious effects of racism; thus, children should benefit from learning about the harms racial prejudice has caused. To examine this, white elementary school age children (ages 6 to 11) received a history lesson about Jackie Robinson and Babe Ruth, with the lessons varying to reflect just one of the three messages. Children who were given the antiracism message showed significantly less biased attitudes toward African Americans and developed empathy for African American victims of racial hostility. These findings suggest that teachers can be effective communicators of antibias messages and that antibias messages can easily be incorporated into social studies or history lessons, to effectively reduce prejudice in our nation's youth.

Implementation of the Redesign of the Research Facilities Survey. The National Science Foundation, with support from the National Institutes of Health, completed an extensive redesign of the congressionally mandated Survey of Science and Engineering Research Facilities. The redesign focused on all aspects of the survey, including population coverage, survey content, and survey questionnaire layout and design, as well as development of a web instrument. The result is the collection of more extensive, valid, and reliable information on the status of research facilities at universities and biomedical research organizations, by major field of science and engineering. This information includes the present and planned amount of space available for conducting research, the amount of construction, repair, and renovation of space, and the amount of funds expended on construction, repair, and renovation of research space. In addition to the improvements in the traditional 'bricks and mortar' section of the survey, there also is a new survey section that measures computing and networking capacity. New measures allow NSF to document cyberinfrastructure availability and the capacity of facilities to conduct research.

Implementation of the Redesign of the SESTAT Surveys. The National Science Foundation conducts three surveys of the science and engineering workforce, which collectively provide data for the Scientists and Engineers Statistical Data System (SESTAT). The three surveys are the National Survey of College Graduates (NSCG), the National Survey of Recent College Graduates (NSRCG), and the Survey of Doctorate Recipients (SDR). Following a two-year review of the goals, content, and design of the three surveys, which was accomplished through a series of workshops and meetings with SESTAT stakeholders, surveys were updated to meet the expanding needs of the public, researchers, and science policy community. Improvements to the surveys included (a) revisions to sample designs, to ensure high-quality data that meet analytical goals; (b) a review and update of content to meet new needs; and (c) field testing to validate changes and to make instruments more respondent-friendly. Two of the surveys (NSRCG and SDR) began wide-scale implementation of a web mode. Investment in this methodology allows respondents additional opportunities to answer questions and improves data quality.

Other Performance Indicators

The tables below show the number of people benefiting from SBE funding, trends in award size and duration, number of awards, and funding rates.

Number of People Involved in SBE Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	2,325	2,484	2,508
Other Professionals	403	431	435
Postdoctorates	188	201	203
Graduate Students	1,320	1,410	1,424
Undergraduate Students	604	645	652
K-12 Teachers	0	10	10
Total Number of People	4,840	5,181	5,232

SBE Funding Profile

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	939	1,003	1,013
Funding Rate	20%	22%	22%
Statistics for Research Grants:			
Number of Research Grants	597	637	642
Funding Rate	16%	17%	18%
Median Annualized Award Size	$78,000	$78,000	$78,000
Average Annualized Award Size	$90,413	$90,413	$90,413
Average Award Duration, in years	2.4	2.4	2.4

SOCIAL AND ECONOMIC SCIENCES $92,800,000

The FY 2006 Budget Request for the Division of Social and Economic Sciences (SES) is $92.80 million, an increase of $810,000, or 0.9 percent, over the FY 2005 Current Plan of $91.99 million.

Social and Economic Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Social and Economic Sciences	**$86.43**	**$91.99**	**$92.80**	**$0.81**	**0.9%**
Major Components:					
Research and Education Grants	80.91	85.99	87.80	1.81	2.1%
Centers Programs					
Decision Making Under Uncertainty Centers	4.52	5.00	5.00	0.00	0.0%
National Center for Violence Research	1.00	1.00	0.00	-1.00	-100.0%

Totals may not add due to rounding.

About SES:

The Division of Social and Economic Sciences supports research and related activities aimed at better understanding, both nationally and internationally, political, economic, and social systems and how individuals and organizations function within them. It also supports research and other activities related to risk assessment and decision making by individuals and groups; the nature and development of the various sciences and technologies and their implications for society; methods and statistics applicable across the social, economic, and behavioral sciences; scholarly career development; and broadening participation in the social, behavioral, and economic sciences. Its programs include the classic disciplines of economics, political science, and sociology and such vibrant interdisciplinary fields as decision making and risk, law and social science, and science and technology studies. In many of its program areas, SES is the major if not the only federal funding source of basic social science research as well as an invaluable investor in fundamental data resources and methodological advancement.

About 72 percent of Division funding is available for new awards and activities. The remaining 28 percent funds awards made in previous years.

The SES portfolio has two major modes of support: research and education grants and centers.

- SES research and education grants range in scope from small supplements that allow undergraduates to participate in funded research to multi-million dollar survey grants that provide data used by thousands of researchers and that inform both business and governmental decisions. For example, major activities include:

  - Supporting "gold standard" longitudinal and repeated cross-section surveys, including the Panel Study of Income Dynamics, the American National Election Studies, and the General Social Survey.
  - Supporting, with the Census Bureau, the Research Data Centers.
  - Supporting workshops on topics ranging from Education and Training in the Social, Behavioral and Economic Sciences to Understanding Global Tensions, with a focus on the Middle East.

  - Supporting the National Consortium on Violence Research.
  - Supporting leading interdisciplinary experimental laboratories in political science (Rice), economics (Cal. Tech., Harvard, South Carolina, Virginia) and decision science (Virginia Tech), including projects with emphasis on the use of experimental methods in the classroom (South Carolina, Virginia).
  - Coordinating the Ethics Education in Science and Engineering Program and supporting, with other NSF Directorates, the Online Ethics Center for Engineering and Science.

- Five interdisciplinary centers study decision making under uncertainty (DMUU) in relation to climate change:
  - Arizona State University's Decision Center for a Desert City uses Phoenix as a laboratory to study adaptation strategies, with particular attention to water management in an arid climate.
  - Carnegie Mellon University's Climate Decision Making Center focuses on how to deal with unavoidable uncertainties, including cost and policy decision implications.
  - Columbia University's Center for the Study of Individual and Group Decision Making Under Climate Uncertainty focuses on integrating psychological insights with those from other social sciences to develop tools to help people better understand the impacts of climate change and their response options.
  - The University of Colorado-Boulder's Science Policy Assessment and Research on Climate (SPARC) team examines decision makers' expectations about what science can deliver, whether policy makers can use available information, and what future information might be useful to them.
  - The Rand Corporation research team conducts fundamental research on different characterizations of uncertainty and develops quantitative tools to deal with robust decision making.

SES Priorities for FY 2006:

- Build a more effective cyberinfrastructure (1) by increasing support for major social science surveys to counter lower response rates, improve quality, and take advantage of new technologies, and (2) through methodological planning and other investments aimed at improving or bringing online a wide range of cybertechnologies with the potential to transform social research. Supported activities allow scientists to take the “social pulse” of the nation. Not only does this advance basic science, but it also provides information regularly used by governmental policy makers at all levels and has become increasingly important in understanding the complex relationship between social location and health outcomes.

- Support the Human and Social Dynamics priority area to allow research on a scale that cannot be achieved through standard SES grants and to promote broadly interdisciplinary research that can foster major breakthroughs in understanding social change, organizational action, and decision making and risk.

- Increase support for core programs to improve funding rates. Support for programmatic research not only advances fundamental science but also supports work on issues of immediate relevance to national priorities, ranging from curbing interpersonal violence, to discovering terrorist networks, to effectively communicating risks of earthquakes and tsunamis.

- Focus new support to promote the development of rigorous qualitative research, particularly in conjunction with sophisticated quantitative analyses. Not all information can be captured in quantitative form. Qualitative research has made important contributions to richer understandings of such social behaviors as job performance, gang violence, and classroom education. New technologies that allow the more rigorous analysis of qualitative data and the blending of qualitative and quantitative data must be exploited.

- Maintain or enhance efforts to better understand organizations, including the initiation of an organizational survey and the establishment of widely accessible organizational databases. Organizations mediate most social activities and drive the economy, but they are understudied relative to individuals. Publicly available archival data that is often widely scattered could be brought together and made generally accessible, and new survey-based information is needed. Other organizational data are considered proprietary or otherwise held confidential. Social scientists need ways of accessing these data while guaranteeing organizational confidentiality.

- Increase investments in education for the social and economic sciences, particularly with respect to underrepresented segments of the population. Rigorous training in sophisticated quantitative methodologies and the use of computer programs and other cybertools is increasingly essential in social science scholarship. Building these essential skills can be and has been enhanced by special training or mid-career retraining programs. Broadening participation is also essential. Doing so increases the diversity of investigators which feeds directly into the portfolio of problems explored within a discipline and, in some cases, affects the ability of investigators to access and interpret data.

Changes from FY 2005:

- Increase core social and economic sciences research programs by $1.30 million to improve funding rates across these areas and seed initiatives. A portion of this increase may support a jointly funded research activity with the National Institute on Drug Abuse exploring the social dimensions of drug abuse and drug violence.

- Add $250,000 to the Human and Social Dynamics priority area for a total of $15.70 million to support an additional number of outstanding proposals addressing the dynamics of human change over several time scales. This follows an increase in FY 2005.

- Contribute $450,000 to broadening participation by supporting NSF efforts to encourage underrepresented groups to enter graduate programs in one of the social or economic sciences and to complete advanced degrees or to launch academic careers in these disciplines.

- Reallocate $1.0 million from the National Consortium on Violence Research Center (NCOVR) upon expiration of its grant in FY 2005. The Center received one renewal and is ineligible for another.

- Decrease funding for the Interagency Education Research Initiative (IERI) by $250,000 for a total of $250,000.

BEHAVIORAL AND COGNITIVE SCIENCES $79,840,000

The FY 2006 Budget Request for the Division of Behavioral and Cognitive Sciences (BCS) is $79.84 million, an increase of $870,000, or 1.1 percent, over the FY 2005 Current Plan of $78.97 million.

Behavioral and Cognitive Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Behavioral and Cognitive Sciences	**$71.49**	**$78.97**	**$79.84**	**$0.87**	**1.1%**
Major Components:					
Research and Education Grants	63.99	76.47	78.34	1.87	2.4%
Centers Programs					
Children's Research Initiative Center	2.50	2.50	1.50	-1.00	-40.0%
Decision Making Under Uncertainty Centers	5.00	0.00	0.00	0.00	0.0%

Totals may not add due to rounding.

About BCS:

The Division of Behavioral and Cognitive Sciences supports research and related activities that advance fundamental understanding in the behavioral, cognitive, anthropological, and geographic sciences. The Division seeks to develop and advance scientific knowledge and methods focusing on human cognition and behavior, including perception, social behavior, language, and learning as well as across levels from neural through individual, family, and group levels. The Division supports research and related activities that focus on human variation at the scales of society, culture, and biology, and how these variations and patterns develop over time. It supports efforts to increase basic understanding and capabilities to explore geographic distributions and interactions of human, physical, and biotic systems on the Earth's surface. Through a convergence of new technologies and theoretical developments, behavioral and cognitive scientists are exploring new areas of inquiry and innovatively addressing longstanding questions. Strong core disciplinary programs are complemented by capitalizing on increased ability to support collaborative and interdisciplinary projects to advance knowledge and build capacity across multiple fields.

About 65 percent of Division funding is available for new awards and activities. The remaining 35 percent funds awards made in previous years.

The BCS portfolio has two major modes of support: research and education grants and centers.

- BCS research and education grants range in scope from individual-investigator awards for research based at the investigator’s home institution to larger group projects that span multiple disciplines and institutions. For example, major activities include:
  - Integrating qualitative and quantitative analyses to understand cultures.
  - Understanding fundamental human processes, including language, cognition, perception and social interaction, in relation to adult and childhood developmental processes.
  - Using a geographic framework for understanding social, political, and economic transformations.
  - Using non-linear models to understand dynamics of human behavior on time scales from the instantaneous to the millennial.

  - Creating platforms for annotating and archiving textual, audio, and video language samples, as well as accessing the material for analyses.
  - Understanding human biological variation, human adaptation, and human ontology.
  - Providing fundamental understanding of human social behavior, including attitude formation and change, social cognition, and personality processes.
  - Facilitating research that advances the understanding of the complexity in human-environmental interactions.

- BCS Centers will include two Children's Research Initiative Centers funded in previous years as well as one new Center.
  - The *Center for Research on Culture, Development and Education* (New York University) conducts research designed to identify pathways to success for all children, with a particular emphasis on children from diverse backgrounds. The scientific mission is to use an integrative conceptual framework, cross-disciplinary collaborations, and multiple methods to link children's early experiences with their academic engagement and performance.
  - The *Center for the Analysis of Pathways from Childhood to Adulthood* (University of Michigan) focuses on analyzing the longitudinal, interactive impact of contextual and personal factors on how children move successfully into adulthood. Innovative interdisciplinary research, using several already existing national and international databases, is addressing fundamental questions about sensitive developmental periods, contexts, discontinuities, and cross-generational similarities. ($500,000 in FY 2006)

BCS Priorities for FY 2006:

Initiatives within Behavioral and Cognitive Sciences include special competitions for investigating human and social dynamics, for documenting endangered languages, and for learning about human origins. Opportunities for advances in cognitive and behavioral sciences are recognized to be afforded by advances in cyberinfrastructure. New methods are transforming how we understand the links between behavior, cognition, and their biological substrates. These advances are strengthening the core programs and their relations to each other.

- The BCS Division plays an active role in the Human and Social Dynamics priority area, which supports larger-scale, interdisciplinary research on human action and development, as well as organizational, cultural, and societal adaptation and change. The Division is especially involved in promoting research on the dynamics of human behavior and on anthropological and geographic facets of human and social change.

- Documenting Endangered Languages is a joint undertaking of the National Science Foundation, the National Endowment for the Humanities, and the Smithsonian Institution. This competition supports projects that develop and advance knowledge concerning endangered human languages. Made urgent by the imminent death of an estimated half of the 6,000-7,000 currently used human languages, which are evidence of the information design capacities of the human brain, this effort aims also to exploit advances in information technology. Funding will support fieldwork and other activities relevant to recording, documenting, and archiving endangered languages, including the preparation of lexicons, grammars, text samples, and databases.

- The Human Origins competition aims to enhance basic knowledge about the complex biological, physical, and behavioral interrelationships that led to the development of the human species, and that are responsible for both the shared and variable features that characterize living human populations. This competition recognizes that understanding of the processes and pathways of human evolution requires the integration of research across a wide range of disciplines. Because projects examine human origins from multiple perspectives and across both time and space, larger-scale, longer-duration projects are supported.

- Integrating development of cyberinfrastructure with advances in the fundamental understanding of the complexity of human behavior addresses critical national needs. Investments harness advances in processing power, storage capacity, input options, analyses of complexity and networking for the understanding of human behavior.

- Behavioral and cognitive sciences are being transformed by new research methods that can be used to investigate the links between behavior and its biological bases. Cognitive neuroscience is partnering with other social and behavioral sciences to understand, for example, the brain mechanisms underlining social and economic decision making.

- Core disciplinary research is strongly supported both to advance fundamental understanding and to serve as foundational work for critical national issues, including disaster response, national security, and the promotion of individual well-being.

- Behavioral and Cognitive Sciences is strongly committed to broadening participation in the scientific community, particularly by approaches focused at institutions and collaborations among institutions.

Changes from FY 2005:

- Increase by $1.27 million core research in behavioral and cognitive sciences to enable additional research on human origins, documenting endangered languages, the neural substrates of cognition, children's development, and fundamental human social processes.

- Add $250,000 to the Human and Social Dynamics priority area for a total of $15.70 million to support an additional number of outstanding proposals addressing the dynamics of human change over several time scales. This follows an increase in FY 2005.

- Increase by $450,000 research-related activities focusing on human diversity, including those designed to more effectively broaden participation of underrepresented groups in behavioral and cognitive science activities.

- Reduce by $1.0 million support for the Children's Research Initiative (CRI) Centers, reflecting the completion of funding for the first cohort of three centers and competition for funding of one new center.

- Reduce by $250,000 support for the Interagency Education Research Initiative (IERI) to a total of $250,000, thus making funds available for greater investments in other core activities.

SCIENCE RESOURCES STATISTICS $26,150,000

The FY 2006 Request for the Division of Science Resources Statistics (SRS) is $26.15 million, an increase of $210,000 or 0.8 percent, over the FY 2005 Current Plan of $25.94 million.

Science Resources Statistics Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Percent
Science Resources Statistics	**$26.37**	**$25.94**	**$26.15**	**$0.21**	**0.8%**

About SRS:

The legislative mandate for the Division of Science Resources Statistics as stated in the National Science Foundation Act of 1950, as amended, is "…to provide a central clearinghouse for the collection, interpretation, and analysis of data on scientific and engineering resources and to provide a source of information for policy formulation by other agencies of the federal Government…." To meet this mandate, SRS provides policymakers, researchers, and other decision makers with high quality data and analysis for making informed decisions about the nation's science, engineering, and technology enterprise. The work of SRS involves survey development, methodological and quality improvement research, data collection, analysis, information compilation, dissemination, web development and customer service to meet the statistical and analytical demands of a diverse user community, as well as preparation of the congressionally mandated *Science and Engineering Indicators* and *Women, Minorities and Persons With Disabilities in Science and Engineering* biennial reports.

The funding portfolio for SRS includes ongoing, cyclical surveys, reports, and projects accomplished primarily through contracts and also a few standard grants. Funding is provided annually; SRS makes limited use of multi-year commitments. In FY 2005 only $120,000 of the budget is committed from prior years for continuing obligations. In FY 2006 SRS will:

- Continue to conduct surveys and analytic activities that produce information for carrying out NSF's statutory mandate, for meeting NSF strategic goals and for developing *Science and Engineering Indicators* and *Women, Minorities and Persons with Disabilities in Science and Engineering*. In FY 2006, SRS will continue activities designed to improve the relevance and quality of the data it collects and the information it disseminates. Such activities will lead to further needed quality improvements and additions to current activities in subsequent years.

  - Continue to improve the *Survey of Graduate Students and Postdoctorates in Science and Engineering* with ongoing implementation of redesigned efforts on a flow basis after significant pilot and testing activities.

  - Support a module of the *General Social Survey* to obtain high quality information on public understanding and knowledge of science and technology. This effort is one of a series initiated by SRS beginning in FY 2004 to significantly improve the quality of information obtained on public understanding of science which is used in the *Science and Engineering Indicators* report.

  - Continue collection and dissemination of breakthrough data collections on the characteristics of cyberinfrastructure in the nation's academic and biomedical facilities. First time ever data was collected in FY 2004 and published in FY 2005. The pace of change with respect to cyberinfrastructure is so rapid that the survey instrument will have to be updated prior to each fielding.

- Maintain continuous improvement in the relevance and quality of all its products. Priorities for FY 2006 are implementing the results of prior methodological, analytical and planning activities directed toward improving the quality, relevance, timeliness, and accessibility of all SRS products, including implementing both redesigns and improvements to the major components of the ongoing suite of SRS statistical surveys and continuing the exploration of the feasibility of new information collection efforts initiated in prior years.

- Continue efforts to enhance its capabilities to understand the science and engineering enterprise in Asia.

SRS Priorities for FY 2006:

As the office responsible for the primary data set on the U.S. scientific and engineering workforce, SRS will:

- Continue to disseminate the 2003 cycle of data collections for the redesigned *National Survey of College Graduates*, *National Survey of Recent College Graduates*, and the *Survey of Doctorate Recipients*. Data from the three surveys comprise the Scientists and Engineers Statistical Data System (SESTAT). Dissemination of data from the 2003 surveys will begin in FY 2005 and continue in FY 2006 through detailed analyses, statistical reports, and ongoing products on the SRS website. A component of the analysis will be reporting on the major methodological activities undertaken by SRS to improve the response rates and quality of these surveys. In FY 2006, SRS will commence the 2006 cycle of the SESTAT suite of surveys. Incorporated into this cycle will be a number of methodological improvements based on experiments and experience in the 2003 cycle.

- Develop feasibility and potential pilot activities on two new projects begun in FY 2004 with continued development in FY 2005. One is an activity to gather information about individuals in postdoctorate positions, including individuals with foreign doctorates. The second is a program examining how to obtain information on research instrumentation, as mandated by the NSF Authorization Act of 2002.

- Continue research and methodological activities begun in FY 2005 to improve the relevance and quality of data collected on the conduct of research and development (R&D). SRS is engaged in a long-term effort to devise collection instruments that more accurately measure the economic output of R&D than is presently captured in the Industry Research and Development Expenditures Survey. Activities include: methodological research on how best to capture R&D activities in the service sector, the role of innovation, new forms of conducting R&D, and the globalization of R&D. In FY 2005, the National Academy of Sciences completed a major review of the SRS R&D surveys portfolio. In FY 2006, SRS will initiate plans to address and prioritize some report recommendations

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- Continue activities examining the present taxonomies in place for describing fields of study/science. SRS is leading a cross-agency effort to update the 1978 OMB Directive No. 16 - Standard Classification of Fields of Science and Engineering. Of major concern are developing crosswalks between existing taxonomies and any potential new taxonomy, developing methods to better include cross-disciplinary and multi-disciplinary fields.

- Complete the final draft of the *2006 Science and Engineering Indicators* report. The report will include an enhanced State chapter and a restructured Public Attitudes chapter.

Changes from FY 2005:

- Funding increases by $110,000 to a total of $26.15 million to enhance survey redesign activities on SRS core surveys.

- Funding for activities to broaden participation is set at $100,000. SRS directly supports grants for research on the development of science and technology (including workforce) indicators and survey methodology. SRS also provides support to the grants programs of the Association for Institutional Research (AIR) and the American Educational Research Association (AERA). Both of these programs support detailed analysis of data and participation in the science and engineering workforce. In addition SRS supports, jointly with the National Center for Education Statistics, the AIR Database Institute that instructs educational researchers from a broad spectrum of institutions, including minority serving institutions, on how to use SRS data for program evaluation and internal planning. The two grants programs encourage the development of new researchers with expertise in the analysis of science and engineering education and workforce issues, with particular attention to encouraging participation by students and researchers from underrepresented minority groups.

Office of International Science and Engineering

OFFICE OF INTERNATIONAL SCIENCE AND ENGINEERING $34,510,000

The FY 2006 Request for the Office of International Science and Engineering (OISE) is $34.51 million, an increase of $780,000, or 2.3 percent, over the FY 2005 Current Plan of $33.73 million.

Office of International Science and Engineering Funding

(Dollars in Millions)

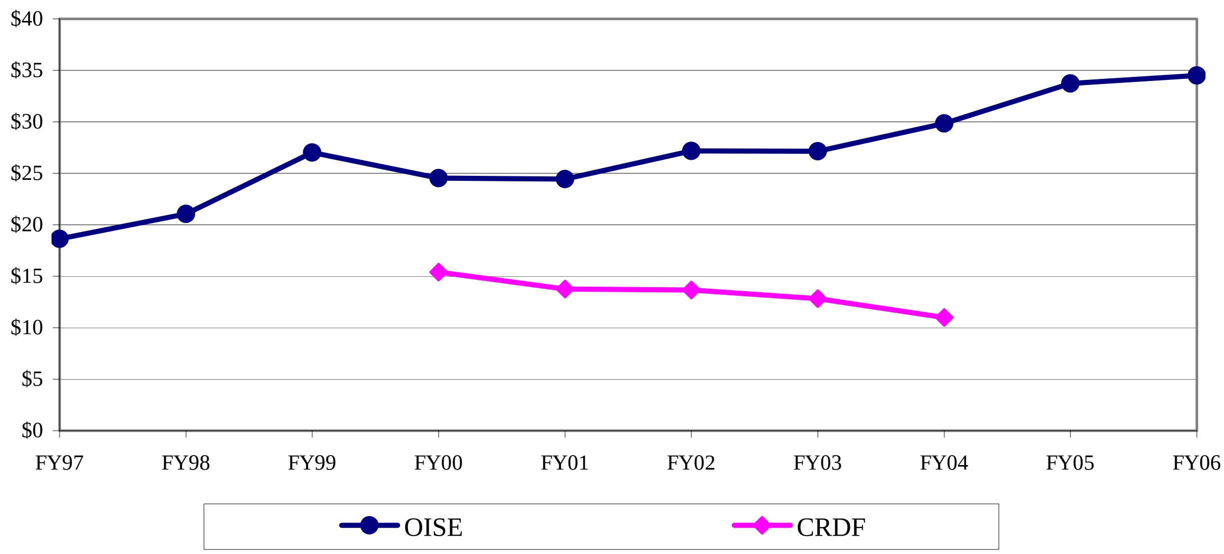
	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
OISE	29.84	33.73	34.51	0.78	2.3%
U.S. Department of State transfer	10.99	0.00	0.00	0.00	0.0%
Total, OISE	$40.83	$33.73	$34.51	$0.78	2.3%

Funds provided by the U.S. Department of State were for an award to the U.S. Civilian Research and Development Foundation.

The Office of International Science and Engineering serves as the focal point, both inside and outside NSF, for international science and engineering 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. In November 2001, after an extensive examination of the international role of the Foundation and U.S. Government, the National Science Board (NSB) called on NSF to make international leadership a high priority with a much stronger programmatic focus both in core disciplines and in Foundation-wide activities. Consistent with the NSB's recommendation, OISE was moved in October 2004 from the Directorate for Social, Behavioral, and Economic Sciences to the Office of the Director.

OISE Funding

(Dollars in Millions)



The bottom line shows additional funds provided by the U.S. Department of State for an award to the U.S. Civilian Research and Development Foundation (CRDF) in FY 2000 ($15.40 million), FY 2001 ($13.75 million), FY 2002 ($13.66 million), FY 2003 ($12.83 million), and FY 2004 ($10.99 million).

RELEVANCE

Science and engineering are, and will continue to be, international enterprises critical to American competitiveness and security. NSF – as the nation's core source of academic support for fundamental science, mathematics and engineering research and education – plays a unique role in leading the worldwide efforts of the U.S. science, engineering, and education communities.

OISE programs are designed to complement and enhance the Foundation's broader research and education portfolio and to overcome barriers involved in international collaboration. America's next generation of scientists and engineers must be able to work effectively in the global arena and marketplace. OISE maintains a range of activities that enables researchers to experience and engage in international research throughout their training. Bold exploration at the frontiers of science and engineering requires international partnerships. The Office carries out its functions by working closely with the other NSF Directorates and Offices as well as through its own program activities.

Summary of Major Changes by Office-Wide Investments *(Dollars in Millions)*

OISE FY 2005 Current Plan ……………………………….……………………….…......…$33.73

Research and Education

Broadening Participation +$1.00

Funding will support initiatives to enhance collaboration, particularly to encourage women and underrepresented groups to enter graduate programs, complete advanced degrees, and incorporate international experiences in their academic careers.

Disciplinary and Interdisciplinary Research -$0.22

A decrease will result in slightly fewer workshops, planning visits, and co-funding activities with the NSF research Directorates. The reduction compensates for other priorities described above.

Subtotal, Changes $0.78

OISE FY 2006 Request…………………………………………………………………...... $34.51

Specific NSF-Wide Investments

Human and Social Dynamics +$0.50

The Human and Social Dynamics area is becoming increasingly international. The program has demonstrated the U.S. research community's interest in tackling complex human and social problems in partnership with international scientists with strong social science expertise and with nations sharing common concerns. The increase provides added support to international collaborative efforts.

Nanoscale Science and Engineering -$0.26

OISE has supported nanosciences for the past seven years. This area has an established record of international partnership. FY 2006 will be its last year as an NSF priority area. OISE will continue to pursue opportunities to support nanosciences through other programs.

Biocomplexity in the Environment -$0.25

OISE has contributed to the Biocomplexity priority area since FY 2001. Funding is reduced in order to shift investments to the newer HSD priority. OISE will continue to pursue opportunities to support Biocomplexity through other program activities.

OISE Priorities for FY 2006:

During the past two years, OISE has been shifting its portfolio to better define its priorities. The Office implemented changes to better link OISE to overall NSF goals and to move toward larger, more innovative and more competitive awards. In addition, OISE developed approaches to facilitate co-funding partnerships with the research Directorates. As a result, two key themes emerged for FY 2006:

- promoting research excellence through international collaboration; and
- providing U.S. students and junior faculty with international research and education experiences.

These themes reflect the fact that the process of discovery and the scientific/engineering workforce are increasingly global. The United States needs to strongly engage in the global research community through collaborative research and must ensure that its young scientists and engineers are capable of operating in an international research environment and a global market.

The OISE portfolio, which is made up of awards to U.S. researchers and institutions, reflects programs managed by OISE and investments made in partnership with other NSF Directorate programs. In general, 40 percent of OISE's portfolio is available for new awards and activities. The remaining 60 percent funds awards made in previous years.

Specific emphases in FY 2006 are to:

- Continue major investments to promote research excellence through international collaboration. In FY 2005, OISE launched a pilot program – **Partnerships for International Research and Education**. This program builds international collaborative research projects that link institutions and provide support for U.S. researchers and students to engage in longer-term international projects. In FY 2006, OISE will fund the second year of the five-year Partnership for International Research and Education awards which total approximately $5.0 million per year. OISE will also invest $1.0 million in cyberinfrastructure research. Other OISE investments to advance research excellence include supporting workshops and planning visits to explore and develop collaborative efforts as well as fellowships for international research and education at the graduate and postdoctoral level.

- Support U.S. students and junior faculty **international research and education experiences**. This includes the East Asia and Pacific Summer Institutes, assistance to postdoctoral fellows and students in international collaborative activities, ongoing awards for the five-year Partnerships for International Research and Education, and co-funding and supplemental funding to highly competitive NSF awards in international work.

- Provide U.S. Government support to key **multilateral organizations**, enabling U.S. scientists to participate in these global efforts. Multilateral groups expected to be funded include the Human Frontier Science Program, Global Biodiversity Information Facility, International Council of Science, and International Institute for Applied Systems Analysis.

- Continue efforts to develop greater collaboration with **developing countries**.

PRIORITY AREAS

OISE will shift its investments in priority areas in FY 2006. OISE will fund $500,000 for Human and Social Dynamics research where the potential for international collaboration is rapidly expanding. OISE will discontinue dedicated funding for Nanoscale Science and Engineering, which is in its last year as an NSF priority area. Support to Biocomplexity in the Environment will be reduced from $500,000 to $250,000. OISE's investments in the priority areas are used in a catalytic fashion to ensure that the international dimensions of these important research areas are highlighted and developed.

OISE Investments in NSF Priority Areas

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change Over FY 2005 Amount	Change Over FY 2005 Percentage
Biocomplexity in the Environment	$0.50	$0.50	$0.25	-$0.25	-50.0%
Nanoscale Science and Engineering	$0.00	$0.26	$0.00	-$0.26	-100.0%
Human and Social Dynamics	$0.15	$0.00	$0.50	$0.50	-

QUALITY

The Office of International Science and Engineering maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. Within the existing portfolio, the percentage of funds allocated to projects that undergo merit review was 45 percent in FY 2004 and is estimated at 45 percent in both FY 2005 and FY 2006. The majority of projects that did not undergo external merit review were supplements that added an international dimension to projects already reviewed and funded in Foundation disciplinary research programs.

To ensure the highest quality in processing and recommending proposals for awards, a Committee of Visitors, composed of qualified external experts, is reviewing OISE in FY 2005. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

Additionally, an interdisciplinary International Advisory Subcommittee, composed of members that represent the U.S. research and education community across disciplines, meets twice a year and advises the Office on its program and its broader coordination role across the Foundation. The Subcommittee includes a balanced representation of women, members of under-represented minorities and geographic regions.

PERFORMANCE

NSF's FY 2006 budget is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

By Strategic Outcome Goal and Investment Category

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	5.15	7.00	7.00	0.00	0.00
Institutions	-	-	-	-	-
Collaborations	-	-	1.00	1.00	-
	5.15	7.00	8.00	1.00	14.3%
Ideas					
Fundamental Science and Engineering [1/]	34.75	24.38	24.16	-0.22	-0.9%
Centers Programs	-	-	-	-	-
Capability Enhancement	-	-	-	-	-
	34.75	24.38	24.16	-0.22	-0.9%
Tools					
Facilities	-	-	-	-	-
Infrastructure and Instrumentation	-	-	-	-	-
Polar Tools, Facilities and Logistics	-	-	-	-	-
Federally-Funded R&D Centers	-	-	-	-	-
	-	-	-	-	-
Organizational Excellence	0.93	2.35	2.35	-	-
Total, OISE	$40.83	$33.73	$34.51	$0.78	2.3%

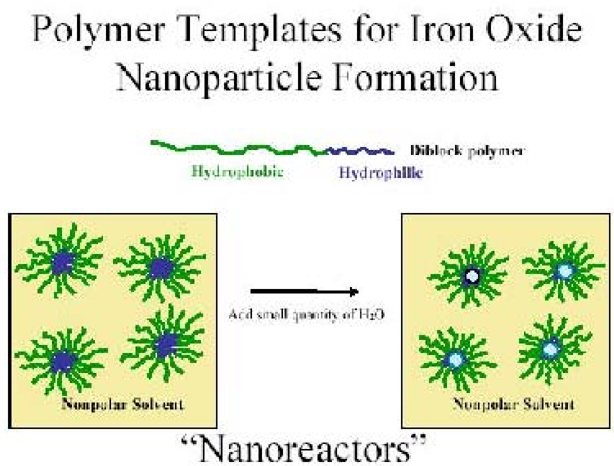
[1/] The FY 2004 total for Fundamental Science and Engineering includes $10.99 million provided to NSF by the U.S. Department of State for an award to the U.S. Civilian Research and Development Foundation.

Recent Research Highlights

Computer-generated image of a now extinct mammal found in Africa 24 million years ago next to a man.

Ethiopian Fossils Fill in Gaps. An international team of researchers led by Dr. John Kappelman, a University of Texas paleontologist, has discovered new fossils from the highlands of Western Ethiopia that fill a long-standing gap in scientists' understanding of the evolution and distribution of African mammals. The period from 24 to 32 million years ago, when Africa and Arabia were still joined as a single continent that was isolated from the other landmasses, has long been one of the most poorly known for all of Africa and Arabia. Kappelman and his team of scientists from the University of Michigan, Washington University in Saint Louis, Addis Ababa University and the National Museum in Ethiopia, used high-resolution satellite imagery to identify potentially rich fossil beds, and then later recorded the position of the fossils with GPS technology. Several of the newly discovered fossils mark the earliest evidence for some of today's African mammals, while others represent the last holdouts of species previously thought to be extinct long before this period. The team discovered that one group of proboscideans, distantly related to elephants, were living side by side with more advanced species that are the ancestors of today's elephants. The fossils also confirm the long-held conjecture that early elephant evolution and divergence occurred entirely in Africa. Perhaps the most unusual fossil mammal discovered is the arsinoithere, an animal larger than today's rhino with a pair of massive bony horns protruding sideways from its snout. The project, funded by NSF, the National Geographic Society, the Leakey Foundation, and the Ethiopian Ministry of Culture, was reported in *Nature* magazine.

Synthesis of Novel Magnetic Nanoparticles. Dr. Linda A. Harris, a synthetic polymer chemist from Virginia Tech and recipient of a prestigious NSF International Research Fellowship Program award funded by OISE, is working with physicist Dr. Tim St. Pierre, an expert in biomagnetics, and other researchers at the University of Western Australia to synthesize a series of organic polymers that will serve as nanoreactors for the controlled formation of iron oxide nanoparticles. Iron oxide nanoparticles are among a group of materials that exhibit magnetic properties only in the presence of a magnetic field. This interdisciplinary research collaboration could remove a major hurdle in understanding nanomagnetic behavior, and eventually lead to the development of a drug delivery system in which a magnetic field guides drugs through the body to a specfic disease site. Drugs could be delivered directly to a cancerous tumor, for instance, and destroy cancer cells without harming other parts of the body, a side effect of most current anticancer treatments. The NSF International Research Fellowship Program provides opportunities for young investigators to work in collaboration with renowned researchers worldwide, providing them with access to the use of unique or complementary facilities, expertise and experimental conditions abroad.



These images illustrate part of the method required to form novel nanoparticles that could eventually be used to deliver drugs to cancerous tumors.

Engineering Historic Preservation. The Czech Republic has some of the richest and best documented cultural objects in the world, like the early 18th century grand Baroque Chateau of Veltrusy located north of Prague and pictured here. Many of the country's best scientists, engineers, and artisans — who have considerable experience with restoration of historic buildings — are part of an international collaborative research team that is tackling major challenges to preserving the Czech Republic's cultural heritage from the engineering viewpoint. According to Dr. Bo Kasal, Professor of Wood Engineering and Mechanics at North Carolina State University, this project combines state-of-the art technologies for in-situ evaluation of wood structures with development of new, sensitive preservation techniques aimed at conserving original structures able to survive natural and manmade threats. This project sparked added funding from the European Commission and Deutsche Forschungsgemeinschaft to extend the collaboration to additional Italian, German and Czech researchers working on earthquake resistant wood structures. A combination of high-strength composites such as glass, carbon and Kevlar materials with laminated wood has been investigated, and a series of shake table tests of wood frames were performed. American, Czech, and German students participating in the project take field measurements and gain unique first-hand experience in applying various state-of-the-art, non-destructive evaluation techniques to priceless structures. Many of the buildings are listed with UNESCO and the World Monument Fund. The U.S. students, both graduate and undergraduate, have the opportunity with NSF support to be a part of an international team of experienced researchers, designers, historians, and restorers, and to learn how to work in a multi-country research environment while performing highly specialized tasks in wood science and engineering. These NSF-supported students bring back to the United States critical knowledge and skills that will prove invaluable to efforts to restore and revitalize America's own historic sites.


Exterior photo of Chateau Veltrusy

Process Chains for Replicating Complex Optical Components. Imagine a world of manufacturing where extremely precise and complex optical elements for products ranging from camera lenses and eye glasses to solar panels and car dashboard displays can be mass-produced at low cost. A unique partnership between an America research group and a large German-funded research center is doing just that. This NSF-funded project enables Dr. Don Lucca and students from Oklahoma State University to engage in an extensive collaboration with the universities of Aachen and Bremen in Germany. The resulting U.S.-Germany Transregional Collaborative Research Center involves technical projects focused on the development of processes for the manufacture of complex, high-quality optical components for next generation applications in information technology and telecommunications, health care, the life sciences, sensing, lighting, and energy conversion. There are other projects in the areas of design, hard coatings, replication techniques, and measurement science and technology. The German center has a substantial


Coating research with future potential applications for mass production of ultraprecision polymer and glass optics.

budget for leading-edge equipment, which is available to members of the U.S. group. Dr. Lucca's specific research is "High Resolution Surface Zone Analysis," the investigation of the near-surface mechanical nature of coatings, which will be used in the volume production of ultraprecision optics of polymers and glasses. Nanoindentation will be used to study the near-surface mechanical properties including elastic modulus and hardness, and the surface residual stress state of the hard coatings. One result of the collaborative research will be the development of molds capable of mass-producing surfaces at a level of precision only achievable on an individual, custom basis today. In the end, this Transregional Collaborative Research Center will help enable the mass production of extremely precise optical surfaces for defense, automotive, aerospace and communications uses.

Land Use Implications of a Tropical Forest Ecosystem. What role do tropical terrestrial ecosystems play in the global balance of carbon dioxide (CO_2)? To answer that question, Dr. George Vourlitis, California State University, San Marcos, and Dr. Nicolau Priante Filho at Universidade Federal de Mato Grosso in Cuiaba, Brazil are working together to study the land use implications on the net ecosystem production and energy balance of a Brazilian tropical forest ecosystem. U.S. researchers with NSF support, working with their Brazilian partners, measured the net ecosystem production (NEP) of an Amazonian tropical transitional forest. NEP is the forest assimilation of atmospheric carbon dioxide through gross primary production minus ecosystem CO_2 loss to the atmosphere by plant and soil respiration. In conjunction with other research conducted as part of the NASA-Instituto Nacional de Pesquisas Espaciais Large-scale Biosphere-Atmosphere Experiment in Amazonia, this project provides a much-needed set of observations for processes that occur in the transition region between the more heavily studied rain forest and savanna ecosystems. This region is currently within the so-called 'arc of deforestation,' and this research provides the framework to determine how land-cover change will alter these heavily impacted tropical ecosystems. The research has already added significantly to important regional syntheses, and will help provide a more comprehensive understanding of how climatic gradients and land-cover change alter the structure and function of Amazon Basin. It fills a gap in our understanding of tropical ecosystem carbon cycling. The project has quantified the seasonal patterns of, and controls on, mass (CO_2 and water vapor) and energy exchange of an Amazonian transitional tropical forest. Thus, it significantly contributes to the scant body of knowledge on tropical forest function. This effort involved a diverse interdisciplinary team of researchers and students that benefited significantly from a constant 'cross-fertilization' of backgrounds and ideas in ecology, agronomy, micrometeorology, environmental physics, and climatology.

A 40-meter tall research platform in the rain forest near Sinop Mato Grosso, Brazil, is used to study the role that tropical ecosystems play in the global balance of carbon dioxide (CO_2).

Other Performance Indicators

The first table below shows the number of individuals supported through research awards where stipend and salaries are provided. In addition, OISE funds other research activities for post-doctoral and graduate students through fellowships (not shown on chart). In FY 2004, awards funded solely by OISE supported a total of 445 postdoctorates, 703 graduate students, and 336 undergraduates. OISE's East Asia Graduate Research Summer Institutes program alone placed 146 U.S. graduate students in research projects in Japan, Taiwan, Korea, China, and Australia, while the Office's International Research Fellowship Program supported the research activities of 34 postdoctoral fellows from 17 states in 18 countries around the world.

Number of People Involved in OISE Activities[1/]

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	138	110	115
Other Professionals	28	25	25
Postdoctorates	10	35	35
Graduate Students	82	120	125
Undergraduate Students	27	50	56
Total Number of People	285	340	356

[1/] This table shows salary and stipend support awards only

The second table shows OISE's funding profile. The funding rate in FY 2006 is estimated to decrease, chiefly due to plans to increase award size.

OISE Funding Profile

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	384	325	330
Funding Rate	45%	45%	35%
Statistics for Research Grants:			
Number of Research Grants	206	200	205
Funding Rate	45%	45%	35%
Median Annualized Award Size	$10,000	$15,000	$25,000
Average Annualized Award Size	$15,018	$40,000	$40,000
Average Award Duration, in years	2.3	2.8	2.8

Office of Polar Programs

OFFICE OF POLAR PROGRAMS $386,930,000

The FY 2006 Budget Request for the Office of Polar Programs (OPP) is $386.93 million, an increase of $42.57 million, or 12.4 percent, over the FY 2005 Current Plan of $344.36 million. The increase includes a transfer of $48.0 million for U.S. icebreaking operations in polar regions, formerly the responsibility of the U.S. Coast Guard.

Office of Polar Programs Funding

(Dollars in Millions)

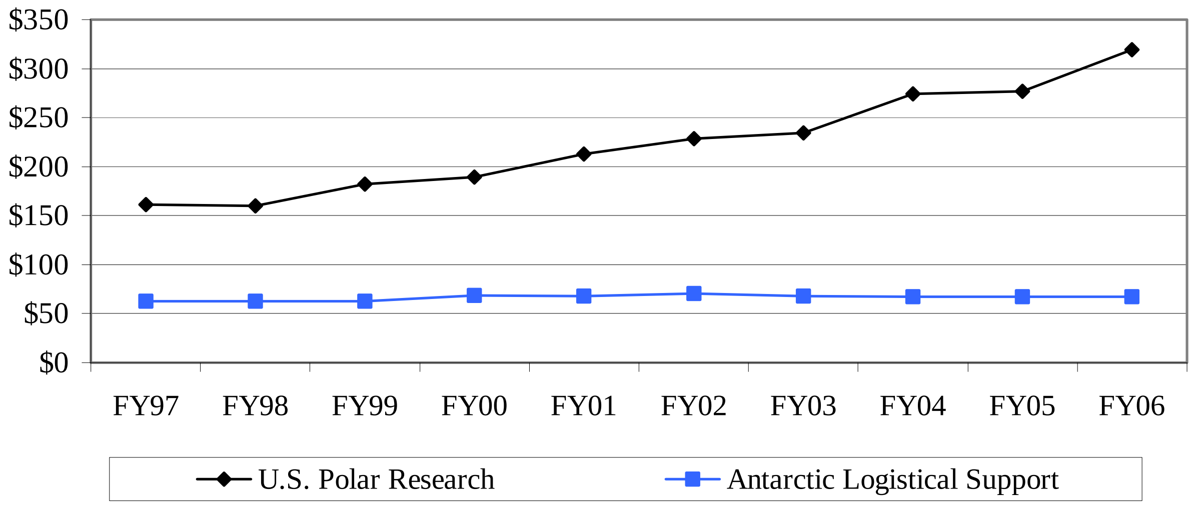
	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
U.S.Polar Research Programs	274.18	276.84	319.41	42.57	15.4%
U.S. Antarctic Logistical Support	67.54	67.52	67.52	0.00	0.0%
Total, OPP	341.72	$344.36	$386.93	$42.57	12.4%

Totals may not add due to rounding.

The Office of Polar Programs supports most of the research in polar regions funded by the National Science Foundation. The Arctic and Antarctic are premier natural laboratories whose extreme environments and geographically unique settings enable research on phenomena and processes not feasible elsewhere. For example, the cold dry environment and high altitude at the South Pole make it the world's best location for certain astrophysics measurements. Polar regions also offer unusual opportunities for environmental research both because polar ecosystems' sensitivity to small changes in climate renders them important bellwethers for potential future change and also because the polar regions provide information about how organisms adapt to environmental change. With this Budget Request, NSF will assume the responsibility from the U.S. Coast Guard for funding the costs of icebreakers that support scientific research in polar regions.

OPP Subactivity Funding

(Dollars in Millions)



RELEVANCE

Polar research addresses the solid earth, glacial and sea ice, terrestrial and marine ecosystems, the oceans, atmosphere and the universe. Key OPP support will broaden and deepen the fundamental observations of Arctic and Antarctic systems, including land, ice, atmosphere, ocean, and social/human systems, as well as natural records of those systems, in order to understand the components, interrelationships, and overall functioning of these systems. Increased observations, analysis and research on polar systems is critical for understanding global climate phenomena and will have ready applicability to Arctic residents, many of whom are currently experiencing a changing natural environment. OPP-sponsored research in polar regions also accesses disciplinary phenomena that cannot be studied as effectively elsewhere. The study of such phenomena in polar regions is changing the forefront of research in many fields of study. NSF is one of twelve federal agencies supporting Arctic research and logistics and provides interagency leadership for research planning as directed by the Arctic Research Policy Act of 1984. In addition, NSF is responsible for managing all U.S. activities in the Antarctic as a single, integrated program, making possible research in Antarctica by scientists supported by NSF and by U.S. mission agencies including National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, U. S. Geological Survey and Department of Energy. The U.S. Antarctic Program supports the U.S. governance role through the Antarctic Treaty.

In FY 2006, U.S. federal agencies will initiate funding for research to be conducted during the International Polar Year (IPY), 2007-2008. The National Academy of Sciences/Polar Research Board has commented that, "The International Polar Year (2007-2008) is envisioned to be an intense, coordinated campaign of polar observations, research and analysis that will be multidisciplinary in scope and international in participation….IPY 2007-2008 will benefit society by exploring new frontiers and increasing understanding of the key roles of the polar regions in globally linked systems."

As the lead agency supporting polar research NSF will be expected to provide U.S. leadership in this activity, and the FY 2006 Budget Request empowers that leadership. FY 2006 will see the first installment of funding in preparation for International Polar Year activities. Major emphasis will be placed on studies of Polar Ice Sheet Dynamics and Stability and on the Study of Environmental Arctic Change (SEARCH). Both projects will be conducted in coordination with other federal agencies. A special program solicitation is planned to provide support for such work.

Much of the research supported under IPY will be consistent and supportive of the goals of the U.S. Climate Change Science Program, particularly Goal 1, "Extend knowledge of the Earth's past and present climate and environment, including its natural variability, and improve understanding of the causes of observed changes," and Goal 2, "Improve understanding of the forces bringing about changes in the Earth's climate and related systems." Climate change research is also highlighted as a FY 2006 Research and Development Budget Priority by the Administration.

In concert with IPY efforts, support will be provided for a special Polar Genomics effort. The National Academy of Sciences/Polar Research Board report *Frontiers in Polar Biology in the Genomic Era* frames this activity, which will enable aspects such as functional genomics for overall ecosystem understanding. Research on genomics is another of the Administration's FY 2006 Research and Development Priorities under Biology of Complex Systems.

Priorities for FY 2006:

- FY 2006 activities implementing the federal research program SEARCH will include Arctic/Subarctic Ocean Fluxes, the Arctic Freshwater Cycle: Upper Ocean Linkages, and the initial phase of the Bering Sea Ecosystem Study (BEST). These research studies will provide new insight into the causes of climate change and their impacts. A special solicitation will call for proposals to implement an Arctic Observing System consistent with recommendations emerging from the National Academy of Sciences.

- Research and infrastructure to better understand how the large polar ice sheets have and will impact global systems will be initiated under the IPY Ice Sheet Dynamics and Stability project. Activities under this program will include the West Antarctic Ice Sheet Divide Drill (ice core) Project. In addition, the climate history of the Antarctic continent will be sampled through the ANDRILL sediment core project.
- The FY 2006 budget will also provide funding for IPY research addressing new research opportunities identified in the report by the National Academy of Sciences/Polar Research Board entitled *Frontiers in Polar Biology in the Genomic Era.* Through studies uniquely possible in polar regions this research will take advantage of newly developed techniques for biological research to provide an understanding at a fundamental level of how organisms cope with life in the cold and dark. This activity aligns with the Biocomplexity in the Environment priority area, and may be done as an OPP-wide partnership in collaboration with the Directorates for Biological Sciences, Geosciences, and others.

Summary of Major Changes in Office-Wide Investments	*(Dollars in Millions)*
Polar Programs FY 2005 Current Plan……………………………………………………...	**$344.36**
U.S. Polar Research Programs	
NSF will assume the responsibility, from the U.S. Coast Guard, for funding the costs of icebreakers that support scientific research in polar regions.	+$48.00
Program offsets made in other areas provide funding for the above activities. If costs for icebreaking operations exceed what is currently budgeted, additional offsets will become necessary:	
• Reallocated funds and funding made available from completed research projects	-$2.43
• Defer procurement of vehicles for full traverse, the Williams Field Relocation Project and replacement of the Trades/Carpentry Shops at McMurdo Station.	-$3.00
U.S. Antarctic Logistical Support	
Level with FY 2005 Current Plan	---
Subtotal, Changes	+$42.57
FY 2006 Request, OPP…….…………………………………………………………………..	**$386.93**

Polar Programs Funding by Major Area
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Arctic Sciences	75.32	75.89	74.37	-1.52	-2.0%
Antarctic Sciences	45.06	45.50	44.59	-0.91	-2.0%
Antarctic Operations, Science Support, Logistics	214.58	216.58	213.58	-3.00	-1.4%
Polar Environment, Safety, and Health	5.10	5.20	5.20	-	0.0%
Polar Icebreaking Base Budget Transfer[1/]	-	-	48.00	48.00	N/A
Arctic Research Commission	1.66	1.19	1.19	-	0.0%
Total, Office of Polar Programs	$341.72	$344.36	$386.93	$42.57	12.4%

[1/] Polar Icebreaking Base Budget Transfer represents new funds for icebreaking. Other icebreaking costs are included in Antarctic Operations, Science Support, Logistics.

Summary of Major Changes by Section *(Dollars in Millions)*

Polar Programs FY 2005 Current Plan…………………………………………………………… **$344.36**

NSF/OPP +$48.00
- Assume the responsibility, from the U.S. Coast Guard, for funding the costs of icebreakers that support scientific research in polar regions.

Arctic Sciences -$1.52
- Initiate International Polar Year Activities at a moderate level;
- Initiate planning for science facilities at Barrow, Alaska;
- Reallocate funds from program base, including funding made available from completed research projects.

Antarctic Sciences -$0.91
- Initiate International Polar Year Activities at a moderate level;
- Slow progress on the 10-meter telescope at the South Pole, preventing researchers from beginning their work exploring the origin and structure of the universe via the Sunyaev-Zel'dovich effect. This instrument contributes to the study of Dark Energy, one of the highest priorities in the National Science and Technology Council report "A 21st Century Frontier of Discovery: The Physics of the Universe" a report of the Interagency Working Group on the Physics of the Universe;
- Reallocate funds from program base, including from completed research projects.

Antarctic Operations and Science Support	-$3.00

- Provide infrastructure and operational support for the U.S. WAIS-Divide Drill project, 10m telescope at the South Pole, and ANDRILL;
- Complete the "proof of concept" for the South Pole Traverse that will diversify Antarctic transportation and logistics;
- Complete the McMurdo Power Plant;
- Procure equipment to enable initial traverse cargo resupply mission to the South Pole;
- Building on preliminary studies, fund design for additional fuel storage at McMurdo Station to enable two-years' storage;
- Upgrade the Long Duration Balloon facilities in support of NASA missions. These facilities support research such as the project called Boomerang, which was one of the first two experiments (the other was the DASI telescope at South Pole Station) to provide convincing evidence that the geometry of the universe is flat. This research is considered "ready for immediate investment and direction known" by the National Science and Technology Council Interagency Working Group on the Physics of the Universe report "A 21st Century Frontier of Discovery: The Physics of the Universe."
- Enhance security in the U.S. Antarctic Program network;
- Defer procurement of vehicles for full traverse; and
- Defer Williams Field Relocation Project and replacement of the Trades/Carpentry Shops at McMurdo Station.

Polar Environment, Safety, and Health	---
This section was established in FY 2005 to manage and oversee the environmental, safety, and health (ES&H) aspects of research and operations conducted in polar regions. The ES&H Section will have overall responsibility for guiding the implementation of: OPP research, operational, and logistic activities from an environmental perspective that provides appropriate protection and stewardship of the environment; and research and operational activities in polar regions from a safety and health perspective, including oversight of medical activities. The exact ES&H funding requirements will be reviewed during the coming months, but are not estimated to vary radically from FY 2004 and FY 2005.	---
U.S. Antarctic Logistical Support	
Level with FY 2005 Current Plan	---
Subtotal Changes	+$42.57
FY 2006 Request, OPP……………………………………………………………………………..	**$386.93**

PRIORITY AREAS

In FY 2006, OPP will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Mathematical Sciences, and Human and Social Dynamics.

Office of Polar Programs Investments in NSF Priority Areas
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biocomplexity in the Environment	1.55	1.55	1.55	0.00	0.0%
Mathematical Sciences	0.18	0.20	0.20	0.00	0.0%
Human and Social Dynamics	-	-	0.20	0.20	N/A

Biocomplexity in the Environment will include support for polar genomics consistent with areas of research identified in the National Academy of Sciences/Polar Research Board report *Frontiers in Polar Biology in the Genomic Era*, including enabling aspects such as functional genomics for overall ecosystem understanding.

Mathematical Sciences will include support for modeling activities associated with polar research.

Human and Social Dynamics will support innovative research on the dynamics of human social-cultural systems and individual behavior, as well as, human decision making and risk in the polar regions.

QUALITY

OPP maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The share of research funds that were allocated to projects that undergo external merit review was approximately 86 percent in FY 2004, the last year for which complete data exist. OMB's definition of competitive, merit-based review does not include contracts, therefore support for the U.S. Antarctic Program support contract, although a competitively bid contract that undergoes a high degree of review, both internal and external, is not considered competitive, merit-based review for this calculation. If included, the support contract would raise the percentage significantly.

To ensure the highest quality in processing and recommending proposals for awards, OPP convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

OPP also receives advice from the OPP Advisory Committee on such issues as: the mission, programs, and goals that can best serve the scientific community; how OPP can promote quality graduate and undergraduate education in the sciences it supports; and priority investment areas in polar research. The Advisory Committee meets twice a year. Members represent a cross section of polar research with representatives from different disciplines and include a balanced representation of gender, members of under-represented minorities and geographic regions.

PERFORMANCE

In developing the FY 2006 Budget Request, NSF completed the PART for the investment category of Polar Tools, Facilities and Logistics. Overall, the PART assessment found Polar Tools, Logistics and Facilities to be an "effective" program, the highest rating, with recommendations to perform a targeted review through a Committee of Visitors (completed), continue to improve performance targets and monitoring, and further promote the use of Earned Value Management in facilities construction. Additional information on major OPP-supported facilities is available in the Major Multi-User Research Facilities Chapter of this document.

Office of Polar Programs
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	5.15	5.15	5.15	0.00	0.0%
Institutions	1.18	1.18	1.18	0.00	0.0%
Collaborations	0.00	0.00	1.00	1.00	N/A
	6.33	6.33	7.33	1.00	15.8%
Ideas					
Fundamental Science and Engineering	76.29	77.61	76.01	-1.60	-2.1%
Centers Programs	1.52	1.42	1.42	0.00	0.0%
	77.81	79.03	77.43	-1.60	-2.0%
Tools					
Polar Tools, Facilities and Logistics	256.04	257.46	300.63	43.17	16.8%
	256.04	257.46	300.63	43.17	16.8%
Organizational Excellence	1.53	1.53	1.53	0.00	0.0%
Total, OPP	$341.72	$344.36	$386.93	$42.57	12.4%

Totals may not add due to rounding.

Recent Research Highlights

Evidence of a "Lost World": Antarctica Yields Two Unknown Dinosaur Species.

Against incredible odds, researchers working in separate sites, thousands of miles apart in Antarctica found within the same week the fossilized remains of what they believe are two species of dinosaurs previously unknown to science. One of the finds is an early carnivore that would have lived many millions of years after the other, a plant-eating beast, roamed the Earth. One was found at the sea bottom, the other on a mountaintop.

Working on James Ross Island off the coast of the Antarctic Peninsula, veteran dinosaur hunters Judd Case, James Martin, and their research team believe they have found the fossilized bones of an entirely new species of carnivorous dinosaur related to the enormous meat-eating tyrannosaurs and the equally voracious, but smaller and swifter, velociraptors that terrified movie-goers in the film "Jurassic Park." Features of the animal's bones and teeth led the researchers to surmise the animal may represent a population of carnivores that survived in the Antarctic long after they had been succeeded by other predators elsewhere on the globe.

At the same time, thousands of miles away, a research team led by William Hammer of Augustana College in Rock Island, Illinois, was working in the Antarctic interior on a mountaintop roughly 3,900 meters (13,000 feet) high and near the Beardmore Glacier. They found embedded in solid rock what they believe to be the pelvis of a primitive sauropod, a four-legged, plant-eating dinosaur similar to better-known creatures such as brachiosaurus and diplodocus. Now known as Mt. Kirkpatrick, the area was once a soft riverbed before millions of years of tectonic activity elevated it skyward.

A research team at work on James Ross Island, near the Antarctica Peninsula, where the bones of what scientists believe is a previously unknown carnivorous dinosaur were found. *Credit: NSF Photo*

The pelvis of what researchers believe is a previously unknown plant-eating dinosaur exposed on the rock where it was preserved. *Credit: William Hammer / NSF*

Hammer said several lines of evidence point to the conclusion that his and the discovery by Case and Martin represent two new species yielded up by the rocks of the "Harsh Continent." "This site is so far removed geographically from any site near its age, it's clearly a new dinosaur to Antarctica," Hammer said. "We have so few dinosaur specimens from the whole continent, compared to any other place, that almost anything we find down there is new to science."

The Alaska Lake Ice and Snow Observatory Network (ALISON): A Statewide K-12 and University Science Education and Research Partnership.

The Alaska Lake Ice and Snow Observatory Network (ALISON) is a science education and scientific research partnership between the University of Alaska Fairbanks and K-12 education community in Alaska. The project is a blending of science and science education in rural and urban classrooms throughout Alaska. Utilizing a planning grant from NSF, Dr. Martin Jeffries has created a network of classroom observatories in seven Alaskan communities, four in rural regions serving primarily Alaska Native students. The results of the pilot network may be reviewed at the very comprehensive ALISON web site http://www.gi.alaska.edu/alison/. This project continues and expands the very innovative concept of research scientists partnering with science and math teachers and their students by facilitating the students themselves collecting, analyzing and interpreting data that is used in the Principal Investigator's (PI's) continuing research project on ice, snow and water. The PI's research is to determine variability and change of ice, snow, and water over the course of one winter and of multiple winters. In this way, students and their teachers learn about the nature of scientific inquiry involving questions, simple investigation, data gathering, data analysis, explanation, and communication of investigations and explanations.

The ALISON project brings an innovative science project to rural Alaskan schools where the population is primarily Alaska Native students. In this way, the project attracts students from underrepresented groups to science and engineering, prepares students for the workforce, provides both students and teachers with opportunities in continuous learning and career development, and promotes public understanding of science and engineering fields.

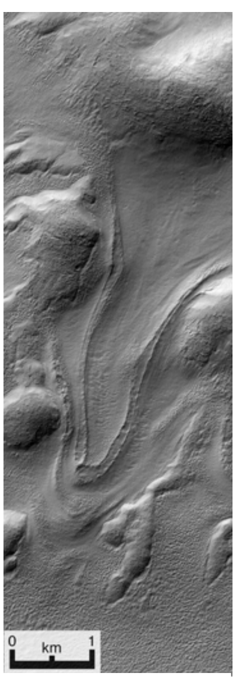
An Ice-Tethered Profiling Instrument for Sustained Observation of the Arctic Ocean.

The PIs of this GEO/OPP-supported project designed and built an automated, easily deployed Ice-Tethered Profiler (ITP) capable of returning daily high-vertical-resolution measurements of upper ocean temperature and salinity in the Arctic Ocean during all seasons over a three-year lifetime. The first prototype Ice-Tethered Profiler has now been deployed and appears to be working very well. Installation was made in late August in a ~4-m thick multi-year ice floe. The unit is operating on a fast sample schedule of six one-way profiles between 10-m and 750-m depth each day so the researchers can test endurance. Once operational, they plan on setting up ITPs to average one profile per day in order to achieve multi-year endurance. At the completion of each one-way traverse, data are sent from the underwater unit to the surface controller via an inductive modem, and then to a data server at Woods Hole Oceanographic Institution (WHOI) using the Iridium communications satellite system. Measurements taken so far clearly show the shallow temperature maximum due to the Pacific waters entering the Arctic through Bering Strait and the deeper maximum of the Atlantic Water. When completely operational, the buoy will transmit data in near-real time and be low-cost, allowing systems to be considered expendable, avoiding the need for expensive recovery operations.

Landscapes on Buried Glaciers in Antarctica's Dry Valleys Help Decipher Recent Ice Ages on Mars.

Studies of the unique landscape in the Dry Valleys of Antarctica provide new insights into the origin of similar features on Mars and provide one line of evidence that suggests the Red Planet has recently experienced an ice age, according to a paper published in the journal *Nature*. The distribution of hexagonal mounds and other features on the Martian surface at mid-latitudes similar to those in the Dry Valleys also supports previous scientific assertions that a significant amount of ice lies trapped beneath the Red Planet's surface.

Buried glacier ice in the Beacon Valley, Antarctica.
Credit: David Marchant / NSF



A debris-covered glacier on Mars

The floor of Antarctica's Beacon Valley, in particular, is covered with hexagonal mounds that, from the air, resemble the patterns of cracked mud on a dry lakebed. The Dry Valleys mounds, however, often measure meters in diameter. Although these polygon-shaped features occur throughout the Arctic and Antarctic, an unusual variety found in the western Dry Valleys region has received particular attention because it forms only in perennially frozen soils with significant ice content. These polygons form as sub-freezing temperatures fluctuate, causing the underlying ice to contract in a hexagonal pattern. As the ice contracts, fine sediments sift down into the cracks, leaving a coarse-grained deposit covering the ice.

The research reported in *Nature* shows that similar mounds and other formations that appear in the mid-to-high latitudes on Mars could indicate ice buried near the planet's surface as well. If the analogy between the geologic processes on Mars and those in the Dry Valleys holds true, then Mars may be more hospitable to microbial life than previously suspected. Biologists continue to make discoveries that push back the boundaries at which conditions are too extreme to support life. NSF-funded researchers, for example, have offered evidence that microbes can survive in extremes of cold and darkness between ice crystals at the South Pole. Although the Dry Valleys were thought to be a virtual dead zone when first explored a century ago, new evidence suggests that the lakes and other landscape features support microscopic life.

Other Performance Indicators

The tables below show the change in the number of people benefiting from OPP funding, and trends in award size, duration, number of awards and funding rate.

Number of People Involved in OPP Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	843	845	840
Other Professionals	643	645	640
Postdoctorates	153	155	155
Graduate Students	395	395	395
Undergraduate Students	270	270	270
Total Number of People	2,304	2,310	2,300

OPP Funding Profile

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	267	270	265
Funding Rate	39%	39%	39%
Statistics for Research Grants:			
Number of Research Grants	219	220	215
Funding Rate	35%	35%	37%
Median Annualized Award Size	$141,229	$141,200	$141,200
Average Annualized Award Size	$189,193	$189,200	$189,200
Average Award Duration, in years	2.7	2.7	2.7

U.S. POLAR RESEARCH PROGRAMS $319,410,000

The FY 2006 Request for the U.S. Polar Research Programs Subactivity is $319.41 million, an increase of $42.57 million, or 15.4 percent, over the FY 2005 Current Plan of $276.84 million. The increase includes a transfer of $48.0 million and responsibility, from the U.S. Coast Guard, for funding the costs of icebreakers that support scientific research in polar regions.

U. S. Polar Programs Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Arctic Research Program	37.93	38.49	37.72	-0.77	-2.0%
Arctic Research Support and Logistics	37.39	37.40	36.65	-0.75	-2.0%
Arctic Research Commission	1.66	1.19	1.19	0.00	0.0%
Antarctic Research Grants Program	45.06	45.50	44.59	-0.91	-2.0%
Antarctic Operations and Science Support	147.04	149.06	146.06	-3.00	-2.0%
Polar Environment, Safety, and Health	5.10	5.20	5.20	0.00	0.0%
Polar Icebreaking Base Budget Transfer[1/]			48.00	48.00	N/A
Total, U.S. Polar Research Programs	$274.18	$276.84	$319.41	$42.57	15.4%

Totals may not add due to rounding.

[1/] Polar Icebreaking Base Budget Transfer represents new funds for icebreaking. Other icebreaking costs are included in Antarctic Operations, Science Support, Logistics.

<u>About U.S. Polar Research Programs:</u>

The U.S. Polar Research Programs Subactivity supports both Arctic and Antarctic research. The U.S. Arctic Research Program supports research on the Arctic Ocean, atmosphere, and land areas – including their people, and marine and terrestrial ecosystems. In addition to research in individual disciplines, an Arctic System Science component focuses on interdisciplinary approaches to understanding the Arctic region, including its role in global climate. It has become widely recognized that the Arctic is in the midst of a change over the last decade. Changes have been measured in the ice cover, atmosphere, some terrestrial parameters, and northern ecosystems. Residents of the North are seeing these environmental changes affecting their lives. It is important to determine whether these changes are correlated with a short-term shift in regional atmospheric circulation or whether they signal long-term global change.

Antarctic support includes funding for NSF-supported researchers as well as for meeting NSF responsibilities as manager of the entire federal Antarctic program, including special requirements for operations and science support. The program provides grants to fund scientific research related to Antarctica and to the Southern Ocean. This fundamental research will provide new information on the ozone hole, how extreme environments affect gene expression, the effects of ultraviolet radiation on living organisms, changes in the ice sheet and impacts on global sea level, global weather, climate, and ocean circulation, and on the early evolution of our universe as well as its current composition.

Polar Programs is also responsible for managing several activities funded out of the Major Research Equipment and Facilities Construction (MREFC) Account, including IceCube and South Pole Station Modernization. The new station will provide the infrastructure required for imaginative new science on the drawing board. Taking full advantage of the new station will require new efficiencies in delivering scientists and science supplies to remote locations and the South Pole and fuel to the South Pole. See the MREFC Chapter for further information on these projects.

In general, approximately 45 percent of the U.S. Polar Research Programs portfolio is available for new awards and activities. The remaining 55 percent funds commitments to awards made in previous years.

U.S. Polar Research Programs has two major modes of support: research and education grants and polar facilities and logistics.

- OPP research and education grants range widely in scope and include individual-investigator awards for field research in the Arctic and Antarctica or the investigator's home institution; large collaborative awards with numerous investigators and institutions; awards for projects with international partners; awards for provision of science support in the polar regions; and agreements with other government agencies for logistic support in the polar regions. In FY 2004, OPP received 688 competitive proposals and funded 267, for a funding rate of 39 percent.

- OPP is also responsible for operating and maintaining the three U.S. stations in Antarctica as well as supporting research in the Arctic, making research possible in these remote, but scientifically unique regions. With the FY 2006 Budget Request, NSF will assume the responsibility, from the U.S. Coast Guard, for funding the costs of icebreakers that support scientific research in polar regions.

U.S. ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES $67,520,000

The FY 2006 Budget Request for U.S. Antarctic Logistical Support Activities is $67.52 million, unchanged from the FY 2005 Current Plan.

U. S. Antarctic Logistical Support Activities Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change from FY 2005 Amount	Change from FY 2005 Percent
U.S. Antarctic Logistical Support	$67.54	$67.52	$67.52	$0.00	0.0%

U.S. Antarctic Logistical Support is provided by U.S. Department of Defense components. The major elements are:

- Military personnel of the 109th Airlift Wing (AW) of the New York Air National Guard.
- 109th AW LC-130 flight activity and aircraft maintenance.
- Transportation and training of personnel in connection with the U.S. Antarctic Program.
- Support for air traffic control, weather forecasting, and electronic equipment maintenance.
- The charter of Air Mobility Command Airlift and Military Sealift Command ships for the re-supply of McMurdo Station, as well as surface freight charges.
- Fuel purchased from the Defense Logistics Agency.
- Reimbursement for use of Department of Defense satellites for communications.

Integrative Activities

INTEGRATIVE ACTIVITIES $134,900,000

The FY 2006 Budget Request for Integrative Activities (IA) is $134.90 million, an increase of $4.99 million, or 3.8 percent, above the FY 2005 Current Plan of $129.91 million.

Integrative Activities Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Integrative Activities	$163.52	$129.91	$134.90	$4.99	3.8%

RELEVANCE

Integrative Activities supports emerging cross-disciplinary research and education, recognizing the importance of these types of integrative efforts to the future of science and engineering. IA is a source of federal funding for the acquisition and development of research instrumentation at U.S. academic institutions. It also funds a number of integrative research and education centers and programs that support and enhance NSF research investments in discovery and workforce development.

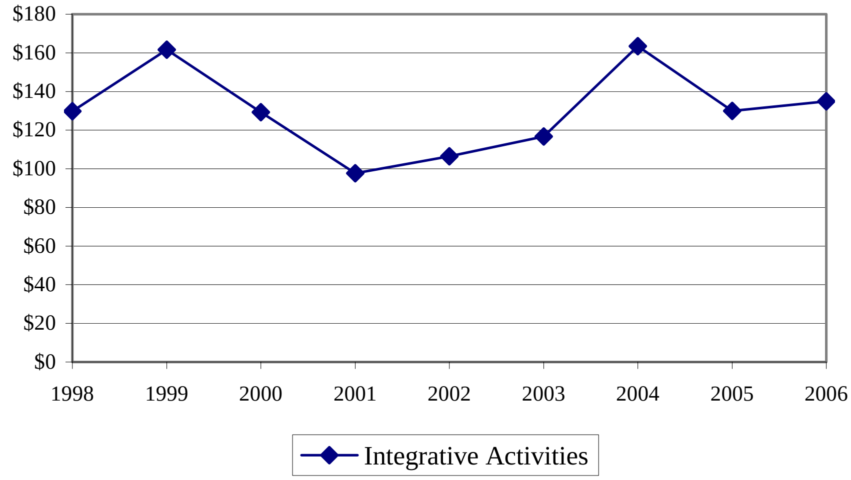
Funds requested and appropriated to IA are managed by a variety of organizations within NSF, which provides the Foundation the flexibility needed to broaden support for emerging cross-disciplinary research programs and activities. For example, the Science and Technology Centers program currently supports 13 Centers and is managed cooperatively by six NSF directorates/offices and the Office of Integrative Activities. The Centers are interdisciplinary, they use high-risk approaches, provide access to state-of-the-art instrumentation and facilities, and graduate students capable of pursuing innovation in industry, government and academe.

Integrative Activities Funding by Program
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Science of Learning Centers	37.56	19.84	23.00	3.16	15.9%
Science and Technology Centers	2.37	6.90	8.90	2.00	29.0%
Major Research Instrumentation	109.63	89.28	89.53	0.25	0.3%
Partnerships for Innovation	9.94	9.92	9.50	-0.42	-4.2%
Science and Technology Policy Institute/RaDiUS	4.02	3.97	3.97	0.00	0.0%
Total, Integrative Activities	$163.52	$129.91	$134.90	$4.99	3.8%

Totals may not add due to rounding.

Integrative Activities Funding
(Dollars in Millions)



Summary of Major Changes *(Dollars in Millions)*

IA FY 2005 Current Plan……………………………………………………………….. $129.91

Science of Learning Centers (SLC) +$3.16

The $3.16 million increase brings FY 2006 funding for the SLCs to $23.0 million. NSF's investment builds on the Foundation's support for multidisciplinary research that advances fundamental knowledge about the science of learning. SLCs are built around a unifying research focus and incorporate a diverse, multidisciplinary environment involving appropriate partnerships with academia, industry, international partners, all levels of education, and other public and private entities.

In FY 2006, NSF continues the third of five initial years of support for four Centers awarded in the program's first competition and provides startup support for a second cohort of up to four SLCs. This funding level is designed to support a diverse portfolio of research projects, providing leadership across a broad range of science and engineering approaches to the science of learning research.

Science and Technology Centers (STC) +$2.00

An increase of $2.0 million to a total of $8.90 million continues funding for two Centers initiated in FY 2005. NSF created the Science and Technology Centers program in 1987. STCs are university-based research efforts that foster partnerships and collaborative cultures among researchers and educators at all levels of academia, industry, government laboratories, and other public and private organizations. Centers provide opportunities to explore complex research problems that often require interdisciplinary expertise and high-risk approaches, access to state-of-the-art instrumentation and facilities, and a commitment of high levels of support for sustained periods of time. FY 2005 support of the STC program at a level of $6.90 million provides $6.0 million startup funding (to initiate recruitment of new faculty and staff and acquisition of major equipment) for two Centers selected in the FY 2005 competition; and $900,000 for ongoing administrative support of 13 STCs (e.g., annual site visits, contractor support costs, meetings, workshops). The $2.0 million increase above FY 2005 enables the two new Centers to become fully operational in FY 2006.

Major Research Instrumentation (MRI) +$0.25

An increase of $250,000 brings FY 2006 funding for MRI to $89.53 million. Funding supports a diverse portfolio of projects that emphasizes (1) funding for the acquisition and development of major state-of-the-art instrumentation, that is too costly to support through regular NSF programs, for research, research training, and integrated research and education activities at U.S. institutions, (2) improving access to and increasing use of modern research and research training instrumentation by scientists, engineers, graduate and undergraduate students, (3) enabling academic departments or cross-departmental units to create well-equipped learning environments that integrate research with education, (4) promoting partnerships between academic researchers and private sector instrument developers, and (5) ensuring that at least $20.0 million goes to support teaching-intensive institutions and minority-serving institutions, including Historically Black Colleges and Universities, Tribal Colleges, and community colleges, with a focus on research training for American students.

In the FY 2004 MRI competition, NSF received 838 proposals and funded 324 (a funding rate of 39%). Included within this group were 56 proposals from minority-serving institutions (both Ph.D. granting and non-Ph.D. granting) and 311 proposals from non-Ph.D. granting institutions (including minority-serving institutions.) Minority-serving institutions received 26 awards that totaled $6.10 million and non-Ph.D. granting institutions received 132 awards that totaled $32.02 million. Funding provided for FY 2005 (Current Plan) and requested for FY 2006 will enable NSF to make approximately 260 awards each year.

Partnerships for Innovation (PFI) -$0.42

A decrease of $420,000 for the Partnerships for Innovation program brings funding to a total of $9.50 million. PFI funding will support partnership grants that seek to (1) stimulate the transformation of knowledge created by the national research and education enterprise into innovations that create new wealth, build strong local, regional and national economies and improve the national well-being, (2) broaden the participation of all types of academic institutions and all citizens in NSF activities to more fully meet the broad workforce needs of the national innovation enterprise, and (3) catalyze or enhance enabling infrastructure necessary to foster and sustain innovation in the long-term. These awards are up to $600,000 for a maximum of three years, and more than 90 percent involve academic institutions that do not normally receive a large amount of funding from NSF. This budget level supports from 15 to 25 PFI awards.

Science and Technology Policy Institute (STPI)/RaDiUS No Change

NSF's FY 2006 budget provides $2.98 million for the Science and Technology Policy Institute (STPI), and $990,000 for a research and development database (RaDiUS), which is unchanged from the FY 2005 Current Plan level. STPI is a Federally-Funded Research and Development Center established by Congress in 1992 to support the complex task of devising and implementing science and technology policy. The Institute provides analytical support to the Office of Science and Technology Policy (OSTP) to identify near-term and long-term objectives for research and development and to identify options for achieving those objectives. In addition, the Institute supports OSTP by assembling and analyzing information regarding significant science and technology developments and trends. Since 2003, the Institute for Defense Analysis (IDA) has operated STPI. RaDiUS (Research and Development in the United States) is a database that was developed and is maintained by RAND Corporation in cooperation with NSF to support the work of OSTP.

Subtotal, Changes	+$4.99
FY 2006 Request, IA ………………………………………………………………..…….	**$134.90**

QUALITY

NSF uses various internal and external mechanisms to ensure the quality and relevance of existing and proposed programs and to help identify new and emerging opportunities that support agency-specific goals. These mechanisms include merit-based review of proposals, Committees of Visitors, advisory committees and other expert panels, academy and other reports, workshops, and long-range planning documents.

NSF maximizes the quality of the R&D it supports through the use of a competitive, merit-based process. To ensure the highest quality in processing and recommending proposals for awards, NSF convenes Committees of Visitors, composed of qualified external evaluators, to review each program. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments. IA programs undergoing Committees of Visitor expert reviews in FY 2005 include the Major Research Instrumentation (MRI) program.

Programs such as the Science and Technology Centers (STC): Integrative Partnerships program maintain a variety of ongoing practices that ensure quality during the 10-year tenure of each project. These practices include strategic planning, annual review by an external team of expert site visitors, fourth-year in-depth, competitive review of renewal proposals, training of NSF technical coordinators, and shared governance between research directorates and the Office of Integrative Activities. Additionally, each Center is required to submit an annual report to NSF, participate in annual workshops developed for Center directors and the center education network, provide ethics training, provide specialized communications equipment, and maintain and convene annually a conflict-free external advisory board that provides guidance, advice and oversight.

PERFORMANCE

NSF's FY 2006 budget is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Integrative Activities
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	-	-	-	-	-
Institutions	-	-	-	-	-
Collaborations	9.94	9.92	9.50	-0.42	-4.2%
	9.94	9.92	9.50	-0.42	-4.2%
Ideas					
Fundamental Science and Engineering	-	-	-	-	-
Centers Programs	39.93	26.74	31.90	5.16	19.3%
Capability Enhancement	-	-	-	-	-
	39.93	26.74	31.90	5.16	19.3%
Tools					
Facilities	-	-	-	-	-
Infrastructure and Instrumentation	109.63	89.28	89.53	0.25	0.3%
Polar Tools, Facilities and Logistics	-	-	-	-	-
Federally-Funded R&D Centers	4.02	3.97	3.97	-	-
	113.65	93.25	93.50	0.25	0.3%
Organizational Excellence	-	-	-	-	-
Total, IA	$163.52	$129.91	$134.90	$4.99	3.8%

Totals may not add due to rounding.

Recent Research Highlight

Partnerships for Innovation Program, University of Washington,
Professor Gretchen Kalonji

The University of Washington (UW) **Partnerships for Innovation** program focuses on building multi-sector, multinational alliances on environmental education and research between the U.S. and the People's Republic of China. Teams of professors and students on both sides are working together with state and local government, industrial partners and non-profit organizations on research projects which address water quality and wastewater treatment, the development of solid oxide fuels, and the design of more environmentally-friendly materials processing technologies. Partners in the state of Washington include the Washington State Office of Trade and Economic Development, the Northwest Environmental Business Council, the Washington State China Relations Council, the Washington–Sichuan Friendship Association and EarthTech.

A similar set of organizations has been mobilized on the Chinese side, where the academic headquarters of the project is at Sichuan University, in Chengdu. Support from the National Science Foundation is matched with a generous grant from the Natural Science Foundation of China.

Education and Human Resources

EDUCATION AND HUMAN RESOURCES $737,000,000

The FY 2006 Budget Request for the Directorate for Education and Human Resources (EHR) is $737.0 million, a decrease of $104.42 million, or 12.4 percent, below the FY 2005 Current Plan of $841.42 million.

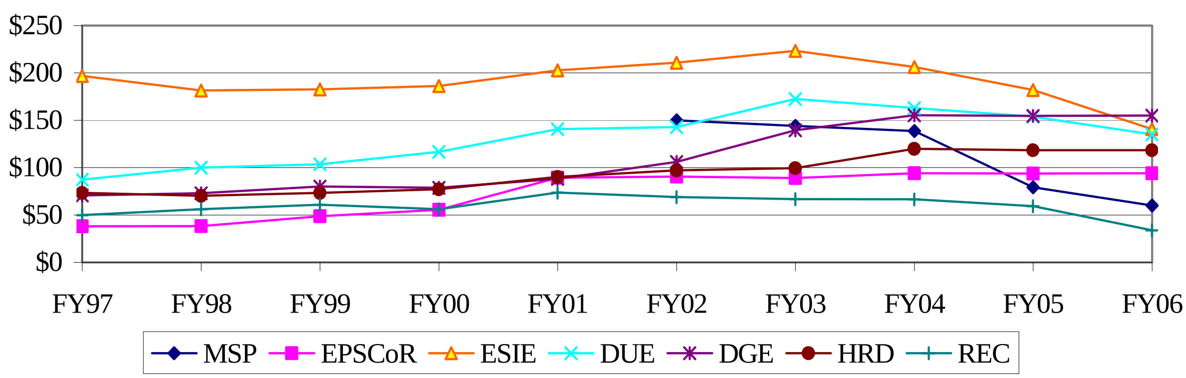
Education and Human Resources Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Math and Science Partnership (MSP)	138.71	79.36	60.00	-19.36	-24.4%
Experimental Program to Stimulate Competitive Research (EPSCoR)	94.24	93.68	94.00	0.32	0.3%
Elementary, Secondary and Informal Education (ESIE)	206.39	181.95	140.80	-41.15	-22.6%
Undergraduate Education (DUE)	162.91	153.67	135.00	-18.67	-12.1%
Graduate Education (DGE)	155.35	154.70	155.00	0.30	0.2%
Human Resource Development (HRD)	120.09	118.54	118.40	-0.14	-0.1%
Research, Evaluation and Communication (REC)	66.41	59.52	33.80	-25.72	-43.2%
Total, EHR [1]	$944.10	$841.42	$737.00	-$104.42	-12.4%

Totals may not add due to rounding.
[1] Excludes $57.28 million in FY 2004 and an estimated $100.0 million in FY 2005 and FY 2006 from H-1B Nonimmigrant Petitioner Fees.

NSF, in accordance with the NSF Act of 1950, is the principal federal agency charged with promoting science and engineering (S&E) education. In support of this mission, EHR promotes the development of a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians and educators and a well-informed citizenry that have access to the ideas and tools of science and engineering. The EHR Directorate supports education, research, and infrastructure development in all science, technology, engineering and mathematics (STEM) disciplines. The purpose of these activities is to enhance the quality of life of all citizens and the health, prosperity, welfare and security of the nation.

EHR Subactivity Funding
(Dollars in Millions)



Appropriation Language

EDUCATION AND HUMAN RESOURCES

For necessary expenses in carrying out science and engineering education and human resources programs and activities pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services as authorized by 5 U.S.C. 3109, and rental of conference rooms in the District of Columbia, ~~$848,207,000~~*$737,000,000*, to remain available until September 30, ~~2006: *Provided*, That to the extent that the amount of this appropriation is less than the total amount authorized to be appropriated for included program activities, all amounts, including floors and ceilings, specified in the authorizing Act for those program activities or their subactivities shall be reduced proportionally: *Provided further*, That not to exceed $5,500,000 of these funds shall be for all costs, direct and indirect, associated with personnel assignments under the Intergovernmental Personnel Act~~*2007*. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2005.)*

Explanation of proposed changes to appropriation language:

- Deletes language related to allocating funds proportionately across programs and ceilings on funding for Intergovernmental Personnel Act appointments. Each of these issues is more appropriately addressed through administrative measures.

Education and Human Resources
FY 2006 Summary Statement
(Dollars in Millions)

	Enacted / Request	Rescission	Carryover / Recoveries	Transfers	Total Resources	Obligations Incurred / Estimated
FY 2004 Appropriation	944.55	-5.57	6.53	--	945.51	944.10
FY 2005 Current Plan	848.21	-6.79	1.41	--	842.83	842.83
FY 2006 Request	737.00	--	--	--	737.00	737.00
$ Change from FY 2005	-111.21				-105.83	
% Change from FY 2005	-13%				-13%	

Totals may not add due to rounding.

Explanation of Carryover

Within the Education and Human Resources (EHR) appropriation $1.41 million was carried forward into FY 2005. This includes $1.0 million for the Louis Stokes Alliances for Minority Participation (LSAMP), $214,807 for Graduate Fellowships and $140,000 for the Presidential Awards for Excellence in Science, Mathematics, and Engineering Mentoring Program (PAESMEM). The remaining amounts are from several awards in various programs that were not ready for obligation in FY 2004.

RELEVANCE

EHR is a principal source of federal support for strengthening STEM education. EHR programs support technological innovation to enhance economic competitiveness and new job growth. EHR addresses the workforce needs of the nation to ensure a scientifically literate population and a robust supply of qualified experts.

Critical issues face the nation's STEM educational system. Too few K-12 teachers are knowledgeable in science or mathematics. By high school, unacceptably low numbers of students are motivated to enroll in physics or chemistry, and only 20-25 percent of graduating high school seniors have completed enough mathematics to be ready to study science or engineering. In addition, the individuals who continue on to obtain baccalaureate or graduate degrees in S&E fields do not adequately reflect the nation's diverse population. Importantly, the U.S. Department of Labor estimates that 60 percent of the new jobs being created in our economy today will require technological literacy, while only 22 percent of the young people entering the job market now actually possess those skills.

EHR activities help strengthen U.S. education at all levels and help ensure continued U.S. economic and research preeminence. These activities respond to the need expressed in the recent National Science Board report, <u>The Science and Engineering Workforce: Realizing America's Potential</u>, "to ensure our country's capacity in S&E in an increasingly competitive and changing global labor market."

In addressing these issues, the EHR portfolio focuses on four goals. They are to:

- Prepare the next generation of STEM professionals and attract and retain more Americans in STEM careers.
- Develop a robust research community that can conduct rigorous research and evaluation that will support excellence in STEM education and will integrate research and education.
- Increase the technological, scientific and quantitative literacy of all Americans so that they can exercise responsible citizenship and live productive lives in an increasingly technological society.
- Broaden participation (individuals, geographic regions, types of institutions, STEM disciplines) and close achievement gaps in all STEM fields.

For each of these goals, key programmatic strategies have been developed. The FY 2006 Budget Request provides support for a broad range of educational activities:

- Math and Science Partnerships bridge K-12 and higher education through a focus on the engagement of disciplinary faculty in K-12 activities.
- EPSCoR's goal is to maximize the potential inherent in a state's science and technology resources and use those resources as a foundation for economic growth.
- K-12 programs that develop effective instructional materials and provide preparation and professional development for teachers. Development of instructional materials that promote scientific and technological literacy and develop life-long skills for learners of all ages enhance these projects.
- Undergraduate programs focus on: developing courses, curricula and laboratory experiences for two- and four-year colleges and universities, expanding the nation's STEM talent, addressing federal workforce needs for cybersecurity specialists, fostering STEM education capacity at minority-serving institutions, and promoting the advancement of women and minority students to increase their participation in the STEM enterprise.
- Graduate programs provide support to attract and prepare U.S. students for STEM careers.
- Evaluation and research on education are emphasized throughout the EHR portfolio to inform improvements in educational practice. EHR emphasizes the use of information technology in education and the translation of research results into educational practice.

Summary of Major Changes by Division *(Dollars in Millions)*

EHR FY 2005 Current Plan..........…………………………………………………………..$841.42

Math and Science Partnership Program (MSP) -$19.36

MSP funds support awards made in previous years, plus data collection, evaluation, knowledge management and dissemination. No new partnership awards will be made in FY 2006.

Experimental Program to Stimulate Competitive Research (EPSCoR) +$0.32

EPSCoR is funded at a similar level to the FY 2005 Current Plan.

Division of Elementary, Secondary, and Informal Education (ESIE) -$41.15

Within the ESIE reduction of $41.15 million, major changes include: The Teacher Professional Continuum program is reduced by $27.20 million and few new awards will be supported in FY 2006. The Instructional Materials Development program is decreased by $9.52 million, supporting fewer awards. Curricula evaluations and materials development will be reduced. The Centers for Learning and Teaching program request is $21.80 million, a decrease of $4.57 million from the FY 2005 Current Plan.

Division of Undergraduate Education (DUE) -$18.67

Within the DUE reduction of $18.67 million, major changes include: The Course, Curriculum, and Laboratory Improvement program is reduced by $9.64 million, down from the FY 2005 Current Plan of $40.64 million. In FY 2006 the Federal Cyber Service: Scholarship for Service Program is decreased by $4.12 million to $10.0 million. The National STEM Education Digital Library Request is $15.0 million, a decrease of $3.43 million from the FY 2005 Current Plan. As a result of these reductions, fewer awards will be supported in FY 2006. The Higher Education Centers for Learning and Teaching are increased by $140,000 over the FY 2005 Current Plan to a total of $1.0 million. NSF Director's Award for Distinguished Teaching Scholars is discontinued in FY 2006; it was supported at $1.31 million in the FY 2005 Current Plan.

Division of Graduate Education (DGE) +$0.30

Increased funding will be distributed equally among the Graduate Research Fellowship Program, the Integrative Graduate Education and Research Traineeship Program, and the Graduate Teaching Fellows in K-12 Education program.

Division of Human Resource Development (HRD) -$0.14

FY 2006 funding will be similar to the FY 2005 Current Plan with two exceptions: The Model Institutions for Excellence (MIE) program has met its funding obligations and no funds are being requested for FY 2006. The MIE funds ($2.49 million) will be reallocated to the Centers of Research Excellence in Science and Technology (CREST) program, bringing CREST to a total of $18.50 million.

Division of Research, Evaluation and Communication (REC) -$25.72

In FY 2006, REC will continue support for awards made in FY 2005 and earlier years. No new awards are expected in FY 2006.

Subtotal, Changes -$104.42

FY 2006 Request, EHR……………………………………………………………...…..$737.00

Directorate-Wide Investments

- ***Special FY 2006 Emphasis on Broadening Participation in the Science and Engineering Workforce.*** The FY 2006 Request places special emphasis on programs with a proven track record of broadening participation in the science and engineering workforce. Three highly successful programs are focal points for linking activities in NSF's EHR Directorate with NSF's R&RA Directorates to strengthen collaborations that integrate research and education:

  - The Louis Stokes Alliances for Minority Participation (LSAMP),
  - Alliances for Graduate Education and the Professoriate (AGEP), and
  - Centers of Research Excellence in Science and Technology (CREST).

Support for these highly successful and respected programs will aid in addressing the S&E workforce needs of the nation to ensure a scientifically literate population and a robust supply of qualified experts across all fields. FY 2006 funds ($8.0 million) in the Research and Related Activities Account will be used to support activities that foster integration and collaboration with these programs.

PRIORITY AREAS

In FY 2006, EHR will support research and education efforts related to broad, Foundation-wide priority areas in Nanoscale Science and Engineering and Mathematical Sciences.

EHR Investments in NSF Priority Areas
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Human and Social Dynamics	0.99	0.00	0.00	0.00	N/A
Nanoscale Science and Engineering	2.29	3.07	2.90	-0.17	-5.5%
Mathematical Sciences	5.00	2.72	2.22	-0.50	-18.4%

Nanoscale Science and Engineering. EHR's contribution to NSE decreases by $170,000 to $2.90 million in FY 2006 to support undergraduate education and K-12 nanoscience education.

Mathematical Sciences. FY 2006 support totals $2.22 million, a decrease of $500,000 from the FY 2005 Current Plan. It will provide continuing support for mathematical sciences education activities.

QUALITY

EHR maximizes the quality of the research and education it supports through the use of a competitive, merit-based review process. Project evaluation is required with projects reporting their progress and impact through annual and final reports to NSF. In addition, external program evaluations are conducted for EHR-managed activities.

To ensure the highest quality in processing and recommending proposals for awards, EHR convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Education and Human Resources (EHRAC) on such issues as: the mission, programs, and goals that can best serve the scientific community; how EHR can promote quality graduate and undergraduate education in science, technology, engineering and mathematics (STEM); and priority investment areas in STEM education research. The EHRAC meets twice a year and members represent a cross section of STEM disciplines; a cross section of institutions including industry; broad geographic representation; and balanced representation of women and underrepresented minorities.

PERFORMANCE

The table below shows the strategic planning and evaluation framework for activities funded through the Education and Human Resources (EHR) appropriation. This framework was established in the NSF Strategic Plan for FY 2003-2008. The Advisory Committee for GPRA Performance Assessment assesses NSF's strategic outcome goals annually. The investment categories are assessed using the Program Assessment Rating Tool (PART). Additional information on these activities is available in the Performance Information section of this document.

Education and Human Resources
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	242.69	237.57	206.23	-31.34	-13.2%
Institutions	140.08	137.27	118.34	-18.93	-13.8%
Collaborations	363.55	275.14	244.27	-30.87	-11.2%
	746.32	649.98	568.84	-81.14	-12.5%
Ideas					
Fundamental Science and Engineering	54.32	50.20	29.30	-20.90	-41.6%
Capability Enhancement	114.08	109.55	112.50	2.95	2.7%
	168.40	159.75	141.80	-17.95	-11.2%
Tools					
Infrastructure and Instrumentation	18.00	18.43	15.00	-3.43	-18.6%
	18.00	18.43	15.00	-3.43	-18.6%
Organizational Excellence	11.39	13.26	11.36	-1.90	-14.3%
Total, EHR	$944.10	$841.42	$737.00	-$104.42	-12.4%

Totals may not add due to rounding.

In developing the FY 2006 Budget Request, NSF completed the PART for two investment categories that receive EHR funding. Both were rated "effective," the highest rating.

- **Institutions.** Major activities in EHR include Advanced Technological Education; Course, Curriculum and Laboratory Improvement; Instructional and Assessment Materials Development; and the STEM Talent Expansion program. Overall, the PART found Institutions to be an "effective" program and that additional attention should continue to be focused on achieving performance and efficiency targets.

- **Collaborations.** Major activities in EHR include Centers for Learning and Teaching, Evaluation, the Historically Black Colleges and Universities Undergraduate Program (HBCU-UP), Informal Science Education, the Louis Stokes Alliances for Minority Participation (LSAMP), the Math and Science Partnership Program (MSP), the Alliances for Graduate Education and the Professoriate (AGEP), the Research in Disabilities Education (RDE) program, the Program for Gender Equity (PGE), and the Tribal Colleges Undergraduate Program. Overall, the PART found Collaborations to be an "effective" program and that additional attention should continue to be focused on achieving performance and efficiency targets.

Recent Research Highlights

Graduate Research Fellow at the University of California, Riverside. Sonia Zarate, a Graduate Research Fellow at the University of California, Riverside, is researching how plants such as tomatoes and squash respond to and defend themselves from herbivores that are not leaf-eaters but that feed from phloem – the conduit for carrying nutrients a plant needs to grow. In an effort to understand this complex plant-insect interaction, Ms. Zarate is using the model plant *Arabidopsis thaliana (At)* and infesting it with silverleaf whitefly (SLWF). She has determined that *At* perceives this insect as a pathogen (virus, bacteria/fungi) and that it can respond to adults feeding and or their egg deposition. She has also utilized a gene/enhancer trap collection and has identified a novel, plant-specific gene that is regulated by SLWF. In 2003, she gave a talk at the American Society of Plant Biologists and also presented her research to President Dynes of the University of California. Last year, Ms. Zarate was honored as the best graduate student presenter within her subfield of Molecular/Developmental Biology at The Society for the Advancement of Chicano and Native Americans in Science (SACNAS, www.sacnas.org) conference.

Sonia Zarate, winner of best graduate student presentation award for molecular / developmental biology at The Society for the Advancement of Chicano and Native Americans in Science October 2004 conference in Austin, Texas.

Computer Science students at Armstrong Atlantic used J2ME to wirelessly control a Bluetooth equipped racecar from a cell phone. The project combined cutting edge Bluetooth wireless technology to control the miniature racecar with cell phone programming to create the control application.

Handheld Computing is Everywhere in the Undergraduate Curriculum. How do we prepare students today to develop applications for tomorrow's computing platforms? Devices like cell phones and personal digital assistants are the computing platforms of tomorrow. Over the last four years, with funding from the NSF, IBM, and Motorola, a project at Armstrong Atlantic State University in Savannah, Georgia began to address software engineering challenges in the undergraduate Computer Science curriculum. This project has developed course and laboratory materials to introduce pervasive computing into Armstrong's introductory Computer Science sequence. The labs use arcade and logic games to motivate students while teaching them important concepts such as application development and cryptography. The capstone course prepares students to develop sophisticated, all-encompassing computing solutions for a variety of devices through hands-on-labs involving: secure computing using Java Card smart cards, wireless Personal Area Networks using Bluetooth, and cell phone development using Sun's Java 2 Micro Edition (J2ME).

Teacher Leaders from the Santa Ana Unified School District look on as a Teacher Leader from the Compton Unified School District tosses a set of dice as part of a probability activity.

Teacher Institutes for the 21st Century. STEM disciplinary faculty at institutions of higher education, working with K-12 teachers of mathematics and the sciences, meet a national need for a new generation of experienced teacher-leaders at a time when many teachers of similar stature are retiring. Colleges and universities open their doors for MSP *Institute Partnerships: Teacher Institutes for the 21st Century* to provide imaginative and stimulating multi-year summer and academic year programs that deepen and update teachers' content knowledge, instructional strategies and leadership skills. Teachers prepare to become intellectual leaders in their fields and catalysts for reforming the mathematics and science programs in their schools. Their schools and districts commit to providing the time and resources commensurate with the positions of increased responsibility that the emerging teacher-leaders are expected to assume upon completion of an Institute program. Collectively, the Institutes support courses and experiences that span all K-12 grade levels and disciplines within the sciences and mathematics. Tufts University, for example, delivers a distance-learning program for K-8 science teachers, while Rice University offers mathematics for high school teachers and Florida Atlantic University focuses on middle school mathematics.

Phase I Scholars attend DO-IT Summer Study Session

The **Research in Disabilities Education** program funds the Northwest Alliance, led by the University of Washington's award-winning DO-IT (Disabilities, Opportunities, Internetworking and Technology) program. This program has conducted successful NSF projects since 1992. Regional site teams at UW and Washington State University, the two largest STEM research institutions in the State of Washington, are collaborating with K-12 and postsecondary schools, employers, and leading STEM research institutions in neighboring states, including Idaho, Oregon, Hawaii and Alaska. Through September of 2004, Northwest Alliance presentations had been given to over 100 faculty, counselors and outreach program staff. Additionally, at least 655 postsecondary faculty and staff received NW Alliance project information. NW Alliance staff also created the AccessSTEM Knowledge Base, a searchable collection of web-based questions and answers, case studies and promising practices that focus on K-12 and postsecondary teaching strategies, universal design of instruction, disability-related accommodations, strategies for making STEM classes accessible to all students, adaptive technology for computers, and other assistive technologies for students with disabilities. Northwest Alliance efforts have increased awareness among staff working in women and racial/ethnic minority programs that individuals with disabilities and members of other underrepresented groups face similar issues.

Other Performance Indicators

The table below shows the number of people benefiting from EHR funding.

Number of People Involved in EHR Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	5,900	5,500	4,800
Other Professionals	3,800	2,200	1,700
Postdoctorates	450	290	150
Graduate Students	3,400	3,400	3,400
Undergraduate Students	21,000	19,000	13,000
K-12 Students	14,000	10,500	7,000
K-12 Teachers	85,500	73,000	56,000
Total Number of People	134,050	113,890	86,050

MATH AND SCIENCE PARTNERSHIP $60,000,000

The FY 2006 Request for the Math and Science Partnership (MSP) program is $60.0 million, a decrease of $19.36 million, or 24.4 percent, from the FY 2005 Current Plan of $79.36 million.

Math and Science Partnership Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Math and Science Partnership	$138.71	$79.36	$60.00	-$19.36	-24.4%

About MSP:

In launching the Math and Science Partnership (MSP) program in FY 2002, the NSF assumed important responsibilities for building the capacity to implement a key facet of the President's *No Child Left Behind* (NCLB) vision for K-12 education. The MSP program at NSF is a research and development effort for building capacity and integrating the work of higher education – especially its disciplinary faculty in mathematics, the sciences and engineering – with that of K-12, to strengthen and reform science and mathematics education. The MSP seeks to improve student outcomes in mathematics and science for all students, at all K-12 levels.

All FY 2006 MSP funds support awards made in previous years, plus data collection, evaluation, knowledge management and dissemination. No new partnership awards will be made in FY 2006.

In FYs 2002-2004, the MSP program received almost 900 proposals in response to a series of solicitations. From external merit review, 80 awards were made during these three years, for an overall funding rate of approximately 9 percent.

Collectively, the funded Partnerships bring together about 150 institutions of higher education with some 450 K-12 school districts and a host of other stakeholders. Corporate and business partners include Pfizer, Inc.; Ford Motor Company; Texas Instruments, Inc.; Xerox Corporation; GlaxoSmithKline; Progress Energy; International Business Machines Corporation; Merck & Company, Inc.; Synopsys, Inc.; Agilent Technologies and Intel Corporation.

MSP is comprised of three distinct components:

- *Comprehensive and Targeted Partnerships* collectively address K-12 and preservice science and mathematics education. *Comprehensive Partnerships* implement change across the K-12 continuum in mathematics, science, or both. *Targeted Partnerships* focus on improved student achievement in a narrower grade range or disciplinary emphasis within mathematics and/or science.
- *Institute Partnerships* will build on the acknowledged strengths of the original NSF *Teacher Institutes*, while giving attention to the changing needs of teachers in our time. These partnerships develop teachers that are school-based intellectual leaders with deep content expertise in mathematics, science and related technologies and who engage their colleague teachers and motivate students towards continued study of mathematics and science.
- The *MSP-Research, Evaluation and Technical Assistance* component of the portfolio assists Partnership awardees in the implementation and evaluation of their work through (a) the conduct of focused research and studies designed to guide improvements in educational practice and learning, (b)

the development of tools and resources to assess progress and make educational work more strategic and (c) increased capacity-building to engage in educational evaluation and research.

The MSP portfolio is distinguished from other efforts with a focus on K-12 mathematics and science education by its emphasis on (a) partnerships between institutions of higher education – especially their disciplinary faculty in mathematics, science and/or engineering – and local school districts; and (b) institutional/organizational change in all core partners that ensures the sustainability of promising policies and practices derived from evidence collected in project work. The degree and the means of engagement of disciplinary faculty are notable. Not only do disciplinary faculty provide in-service professional development in mathematics and the sciences for teachers, they also engage in the redesign of undergraduate courses to better prepare the next generation of teachers, work directly with K-12 students in summer camps and other venues, bring to their university classes a willingness to be more reflective about their own teaching practice and engage in numerous and varied experiences that challenge and precipitate a rethinking of their traditional beliefs about K-12 education.

The MSP portfolio is supplemented by contracts for data collection through the MSP Management Information System (MSP-MIS) and for an overall program evaluation (MSP-PE).

MSP Priorities for FY 2006:

- Core activity in the MSP program supports effective oversight and management of a significant portfolio of existing awards to maximize their effectiveness in meeting project and program goals and their production of evidence-based outcomes that contribute to better understanding of (a) how students effectively learn mathematics and science and (b) what teachers need to know and be able to do in order to facilitate effective student learning.

- Priority will be given to deepening the MSP infrastructure for data collection, program evaluation, knowledge management and dissemination. Support will be continued for (a) the development of data collection modules in the MSP Management Information System (MSP-MIS); (b) MSP Program Evaluation (MSP-PE); (c) MSPnet, the electronic community for MSP projects; (d) knowledge management that synthesizes findings from MSP work and integrates them into the larger knowledge base for educational reform, thus strengthening the potential bonds between educational research and practice and contributing to the nation's capacity to understand and engage in large-scale education innovation; and (e) dissemination of key findings and promising policies and practices derived from MSP project work and evaluation.

- NSF collaboration with the U.S. Department of Education will continue as the two agencies manage their separate but parallel MSP programs for greatest effectiveness.

Changes from FY 2005:

MSP -$19.36 million

The MSP program at NSF made its last awards for new Partnerships in FY 2004. No awards for new Partnerships will be made in FY 2006. The FY 2006 Request of $60.0 million supports (a) out-year commitments to existing Partnerships and (b) data collection, program evaluation, knowledge management and dissemination.

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH $94,000,000

The FY 2006 Request for the Experimental Program to Stimulate Competitive Research (EPSCoR) is $94.0 million, an increase of $320,000, or 0.3 percent, from the FY 2005 Current Plan of $93.68 million.

Experimental Program to Stimulate Competitive Research Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
EPSCoR Funding	$94.24	$93.68	$94.00	$0.32	0.3%

About EPSCoR:

The Experimental Program to Stimulate Competitive Research (EPSCoR) has the mission of assisting the Foundation in its statutory function "to strengthen research and education throughout the United States and to avoid undue concentration of such research and education." Hence, the primary goal of the NSF EPSCoR program is to stimulate sustainable improvements in Research and Development (R&D) capacity and competitiveness within the major research universities of designated EPSCoR jurisdictions.

NSF EPSCoR currently operates in twenty-five states, the Commonwealth of Puerto Rico, and the Territory of the Virgin Islands. The States are: Alabama, Alaska, Arkansas, Delaware, Hawaii, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, West Virginia, and Wyoming.

EPSCoR's programmatic objectives are to:

- Catalyze selective efforts within each jurisdiction's research enterprise that can power knowledge generation, dissemination, and application;
- Activate collaborations among academic, governmental, and private sector stakeholders that advance innovation and its multiple benefits to society; and
- Broaden participation through enhanced STEM opportunities for institutions, organizations, and people within the EPSCoR jurisdictions.

In general, 35 percent of the EPSCoR portfolio is available for new awards and activities. The remaining 65 percent funds awards made in previous years.

EPSCoR Priorities for FY 2006:

To address its goal and objectives, the EPSCoR Office currently employs a portfolio of three complementary investment strategies: (1) the Research Infrastructure Improvement (RII) grants program; (2) the EPSCoR co-funding mechanism, which is a major cross-directorate NSF activity that involves EPSCoR participation with meritorious proposals submitted for co-funding consideration from all the Directorates and the Offices of Polar Programs, Integrative Activities, and International Science and Engineering; and (3) the EPSCoR Outreach program, which supports travel to EPSCoR jurisdictions and events by NSF personnel from all the Directorates and Offices, including staff from administrative units such as the Division of Grants and Agreements and the Division of Information Systems.

- **Research Infrastructure Improvement (RII) awards** are 36-48 month awards of up to a total of $9.0 million for research infrastructure improvements in science and technology (S&T) areas identified by the jurisdiction's EPSCoR governing committee as critical to future R&D competitiveness and innovation plans. In addition to continuing the RII focus on long-term, strategic capacity-building within the jurisdictions, the EPSCoR Office will encourage universities to align a significant part of their R&D base with regional innovation efforts. These new Regional Innovation Collaboratives (RICs) encourage exploration of the hypothesis that modern universities in EPSCoR jurisdictions can play a key role in the promotion of economic diversity at not only the local level, but at the regional level as well. RICs will establish critical foundations for the successful pursuit of broad interdisciplinary research projects and new collaborative educational programs that together can foster innovation-driven economic development. These RIC clusters will function by generating new ideas, expanding human talent and capital, and forming powerful partnerships with other universities, industry, community organizations, and governmental allies, across jurisdictional lines.

  The modifications to the RII/RIC program are expected to result in increased proposal submissions, awards, and total award amounts, along with the formation of new regional cluster groups that will facilitate interdisciplinary research and innovation-based activities. Further flexibility will be initiated both in the total amount of these RII/RIC awards and their duration (e.g., up to 5 years, with an intensive review during the 3rd year).

- **EPSCoR co-funding** – Efforts at NSF involve joint support of research and education proposals submitted by investigators from EPSCoR jurisdictions to the Foundation's regular grant programs. These proposals are reviewed under the normal NSF peer review process and are then forwarded for co-funding consideration if they satisfy criteria specified by the EPSCoR Office. EPSCoR co-funding accelerates the movement of EPSCoR researchers and institutions into the mainstream of federal and private sector R&D support.

  During the period of FYs 1998-2004, researchers from EPSCoR states received over 1,452 awards totaling $465.5 million through this mechanism. NSF research programs provided $262.6 million of this total, with the remainder contributed by the EPSCoR Office. Co-funding remains an EPSCoR priority during FY 2006, with the EPSCoR Office encouraging co-funding of multi-investigator, interdisciplinary research projects and centers.

  EPSCoR co-funding continues in FY 2006 at about the same level targeted for FY 2005, i.e., ~$30 million. However, co-funding for NSF programs with high impact potential on research collaborations, new interdisciplinary areas, university/industry partnerships, regional centers, technology-based entrepreneurship, innovation, and STEM graduate student recruitment/retention will be selectively emphasized in FY 2006.

- NSF program officers and staff coordinate a **comprehensive outreach program** to universities, industry, and state government in EPSCoR states to inform researchers and Science & Technology administrators of NSF funding opportunities, program priorities, and policy. Since the program's inception in FY 1998, NSF staff members have made ~1,000 visits to EPSCoR jurisdictions to foster successful participation by institutions and researchers in NSF-supported activities. Given the magnitude of the impact from this relatively small investment, the Outreach Initiative will remain a priority during FY 2006; however, it will be secondary compared to RII and co-funding.

  The EPSCoR outreach program complements the other two components in the EPSCoR portfolio. EPSCoR seeks maximum leveraging of its outreach investments, with particular attention to the development of the Regional Innovation Collaboratives within and between EPSCoR jurisdictions.

ELEMENTARY, SECONDARY, AND INFORMAL EDUCATION $140,800,000

The FY 2006 Request for the Division of Elementary, Secondary, and Informal Education (ESIE) is $140.80 million, a decrease of $41.15 million, or 22.6 percent, from the FY 2005 Current Plan of $181.95 million.

Elementary, Secondary, and Informal Education Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Instructional and Assessment Materials Development	29.32	28.52	19.00	-9.52	-33.4%
Teacher Development	114.94	90.37	58.80	-31.57	-34.9%
Informal Science Education	62.13	63.06	63.00	-0.06	-0.1%
Total, ESIE	$206.39	$181.95	$140.80	-$41.15	-22.6%

Totals may not add due to rounding.

About ESIE:

ESIE's research-based program portfolio – unique within federal agencies in its comprehensive coverage of grade levels, STEM disciplines, and learning venues – provides cutting-edge resources and strategies that advance the nation's preK-12 and informal STEM education agenda.

Instructional materials and student assessments that promote active investigation, together with new models for teacher education, broaden access to high quality STEM instruction and contribute to classrooms that serve all students well. Media, exhibit, and community-based efforts increase scientific literacy; bring cutting-edge research to the nation's citizens; and develop life-long skills for learners of all ages. Programs promote high standards in content, pedagogy, and assessment, as well as capitalize on the combined strengths of formal and informal education, research and practitioner communities, and major stakeholders (e.g., higher education, school districts, state agencies). By increasing student achievement, reducing achievement gaps, and promoting interest in STEM disciplines, ESIE programs work to create a solid education foundation for the future research, instructional, and technological workforce.

In general, 40 percent of the ESIE portfolio is available for new awards and activities. The remaining 60 percent funds awards made in previous years. In FY 2005, ESIE will support about 100 new awards – a funding rate of about 13 percent – and provide oversight for over 550 continuing projects.

ESIE Priorities for FY 2006:

In FY 2007, *No Child Left Behind* adds science to its assessment battery. In anticipation of needs for challenging instructional materials and a highly qualified instructional workforce, ESIE will develop and evaluate content-rich elementary curricula, companion professional development resources for preparing teachers, and district-wide enhancement strategies that promote high-quality instruction. This effort strategically integrates resources of the Instructional Materials Development and Teacher Professional Continuum programs; and builds on knowledge from work of the Centers for Learning and Teaching and NSF's Math and Science Partnership programs.

Instructional Materials Development (IMD) projects focus on developing the next generation of standards-based, elementary science instructional materials, incorporating advances in education technologies, embedded assessments for guiding classroom instruction, experiential learning, and literacy. Curriculum models are built on a growing understanding of the needs of today's diverse student population and research on how children learn. In FY 2006, these projects support fewer large-scale evaluations of K-12 curricula developed with NSF support, and support no new activities to create materials for high school science and laboratory experiences, or for engineering and technology education.

Funds for **Teacher Professional Continuum (TPC)** are reduced by over 45 percent. TPC initiates research and development on models and resources that promote large-scale, district efforts to enhance teacher quality; incorporates best practices on adult professional learning; addresses strategies for cost-effectiveness; and focuses on content, teacher leadership and reduction of achievement gaps. The program will focus on elementary science in FY 2006. Research on strategies to effectively address needs of underserved populations and capitalize on use of scientific communities in developing teacher content knowledge and new mathematics efforts will be limited.

Centers for Learning and Teaching (CLT) places priority on continuing existing centers at a level that allows them to maintain on-going efforts to develop national leadership capacity for preparing highly qualified teachers; to research issues in STEM education facing the nation; and to translate this research into practice. In FY 2006 CLT will not make new awards.

Informal Science Education (ISE) will emphasize projects that level the playing field for institutions, advance informal STEM education nationally, as well as build on lessons learned from prior work and findings from education research. Priority is placed on projects that strengthen infrastructure; engage underserved audiences, including young children and older adults; incorporate inquiry in after-school programs; involve the public in the scientific process; and apply new technologies to informal learning.

Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST) provides national career recognition for exemplary elementary and secondary teachers.

Changes from FY 2005:

The FY 2006 Request includes a decrease of $41.15 million that will be directed towards the following:

- **IMD.** In FY 2004, ESIE received 84 proposals, and was able to fund approximately 20 percent. In FY 2006, 10 new awards are likely in this strategically-focused program. The EHR FY 2006 Request for IMD is $19.0 million, a decrease of $9.52 million from the FY 2005 Current Plan.

- **TPC.** In FY 2004, ESIE received 198 proposals, and was able to fund approximately 14 percent. In FY 2006, 30 new awards are likely in this strategically-focused program. The EHR FY 2006 Request for TPC is $33.0 million, a decrease of $27.20 million from the FY 2005 Current Plan.

- **CLT.** In FY 2004, ESIE received 14 Center proposals, and was able to fund approximately 21 percent of them. No new awards will be supported in FY 2006. The EHR FY 2006 Request for CLT is $21.80 million, a decrease of $4.57 million from the FY 2005 Current Plan.

- **ISE.** FY 2006 funding for ISE is $63.0 million, a decrease of $60,000 from the FY 2005 Current Plan. About 60 new awards will be supported in FY 2006, about the same number as in FY 2005.

- **PAEMST.** The EHR FY 2006 Request for PAEMST is $4.0 million, an increase of $200,000 over the FY 2005 Current Plan.

UNDERGRADUATE EDUCATION $135,000,000

The FY 2006 Request for the Division of Undergraduate Education (DUE) is $135.0 million, a decrease of $18.67 million, or 12.1 percent, from the FY 2005 Current Plan of $153.67 million.

Undergraduate Education Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Curriculum, Laboratory and Instructional Development	94.16	94.41	80.00	-14.41	-15.3%
Workforce Development	68.75	59.26	55.00	-4.26	-7.2%
Total, DUE	$162.91	$153.67	$135.00	-$18.67	-12.1%
Authorized Programs:					
Robert Noyce Scholarship Program	8.00	7.89	8.00	0.11	1.4%
Scholarship for Service	15.84	14.12	10.00	-4.12	-29.2%
STEM Talent Expansion Program	25.00	25.28	25.00	-0.28	-1.1%

Totals may not add due to rounding.

About DUE:

DUE serves as NSF's focal point for the improvement of undergraduate science, technology, engineering, and mathematics (STEM) education. The DUE Portfolio has two major emphases: (a) curriculum, laboratory and instructional development, and (b) workforce development.

DUE provides leadership and leveraged project support for efforts that promote engagement in inquiry-based learning by all undergraduate students, including disciplinary majors, prospective preK-12 teachers, prospective technicians, and non-majors/citizens in an increasingly technological society. Most supported projects are based at 2- and 4-year colleges and universities. The objectives are to improve STEM learning across the undergraduate spectrum through the reform of courses, laboratories, curricula, and instructional materials, and to increase the quality and quantity of the science and engineering workforce.

In general, 72 percent of the DUE portfolio is available for new awards and activities. The remaining 28 percent funds awards made in previous years.

Each year DUE receives over 2,300 proposals – more than can be funded.

DUE priorities for FY 2006:

- The **Course, Curriculum, and Laboratory Improvement** (CCLI) Program strengthens NSF's efforts to assure access to high-quality STEM education for all undergraduate students. Based on a cyclic model of knowledge production and improvement of practice, the CCLI Program supports efforts that conduct research on undergraduate STEM teaching and learning, create new learning materials and teaching strategies, develop faculty expertise, implement educational innovations, assess learning, and evaluate innovations.

- The **Robert Noyce Scholarship Program** seeks to encourage talented STEM majors and professionals to become K-12 mathematics and science teachers by offering scholarships for juniors and seniors majoring in mathematics, science or engineering, and stipends for science, mathematics, or engineering professionals seeking to become teachers. Projects help recipients obtain certification and become successful math and science teachers in high-need K-12 schools.

- The **STEM Talent Expansion Program** (STEP) supports efforts at colleges and universities to increase the number of U.S. citizens and permanent residents receiving associate or baccalaureate degrees in established or emerging STEM fields. The program also supports educational research projects on associate or baccalaureate degree attainment in STEM.

- The **National STEM Education Digital Library** (NSDL) supports a national digital library that constitutes an online network of learning environments and resources for STEM education at all levels, in both formal and informal settings. The program supports projects that provide stewardship for the content and services needed by major communities of learners or that develop services which support users, collection providers, and integration efforts, and which enhance the impact, efficiency, and value of the library.

- The **Federal Cyber Service: Scholarship for Service** (SfS) program seeks to build a cadre of individuals in the federal sector with the skills needed to protect the nation's critical information infrastructure. Scholarships provide full tuition, fees and stipends in exchange for service in federal agencies after graduation. Capacity building grants improve the quality of academic programs and increase the number of information assurance and computer security professionals.

- With an emphasis on two-year colleges, **Advanced Technological Education** (ATE) supports improvement in technician education in science- and engineering-related fields that drive the nation's economy. The ATE program supports the design and implementation of new curricula, courses, laboratories, educational materials, opportunities for faculty and student development, and collaboration among educational institutions and partners from business, industry, and government. The program also supports articulation between two-year and four-year programs for K-12 prospective teachers in technological education and applied research relating to technician education.

Changes from FY 2005:

Approximately 220 new awards will be supported in FY 2006 – about 10 percent of proposals received. The FY 2006 Request includes a decrease of $18.67 million and will be implemented as follows:

<u>Curriculum, Laboratory, and Instructional Development Programs</u>

- The FY 2006 Request for **CCLI** is $31.0 million, a decrease of $9.64 million from the FY 2005 Current Plan of $40.64 million. Fewer new awards will be supported in FY 2006.

- FY 2006 funding for the **Noyce Scholarship** program is $8.0 million, an increase of $110,000 from the FY 2005 Current Plan. Approximately 15 new awards will be supported in FY 2006, about the same number as in FY 2005.

- The FY 2006 Request for **STEP** is $25.0 million, a decrease of $280,000 from the FY 2005 Current Plan. Approximately 20 new awards will be supported in FY 2006, about the same number as in FY 2005.

- The FY 2006 Request for **NSDL** is $15.0 million. This is a decrease of $3.43 million from the FY 2005 Current Plan of $18.43 million. Fewer new awards will be supported in FY 2006.

<u>Workforce Development Programs</u>

- FY 2006 funding for **SfS** is decreased by $4.12 million from the FY 2005 Current Plan level to $10.0 million. Approximately 660 students will be supported in FY 2006.

- In FY 2006, funding for **ATE** is decreased by $140,000 from the FY 2005 Current Plan to $45.0 million. Fewer new awards will be supported in FY 2006.

- FY 2006 funding for the **Higher Education Centers for Learning and Teaching** will increase by $140,000 to $1.0 million in FY 2006 and will fund the final continuing grant increment for this cross-directorate program.

- The **Distinguished Teaching Scholars** program is eliminated in FY 2006, a savings of $1.31 million.

GRADUATE EDUCATION $155,000,000

The FY 2006 Request for the Division of Graduate Education (DGE) is $155.0 million, an increase of $300,000, or 0.2 percent, from the FY 2005 Current Plan of $154.70 million.

Graduate Education Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Graduate Education	$155.35	$154.70	$155.00	$0.30	0.2%
Major Components:					
Integrative Graduate Education and Research Traineeships (IGERT)	25.29	24.50	24.60	0.10	0.4%
Graduate Research Fellowships (GRF)	87.92	88.47	88.57	0.10	0.1%
Graduate Teaching Fellowships in K-12 Education (GK-12)	42.14	41.73	41.83	0.10	0.2%

Totals may not add due to rounding.

About DGE:

DGE investments support graduate students and innovative graduate programs to prepare tomorrow's leaders in science and engineering. DGE support for science, technology, engineering, and mathematics (STEM) graduate education supports the creation of a diverse STEM workforce to meet the needs of the nation in the 21st century. DGE accomplishes this by providing fellowships and traineeships, by supporting innovations in STEM graduate education to prepare students for the challenges of the new century, and by building stronger links between higher education and K-12 education. These efforts help strengthen U.S. education at all levels and help ensure continued U.S. economic and research preeminence.

DGE meets its objectives through three large graduate education programs: the Integrative Graduate Education and Research Traineeship Program (IGERT), the Graduate Research Fellowship Program (GRF), and the Graduate Teaching Fellows in K-12 Education program (GK-12). Approximately 4,600 graduate fellowships and traineeships will be supported NSF-wide in FY 2006.

In general, 47 percent of the DGE portfolio is available for new awards and activities. The remaining 53 percent funds awards made in previous years.

DGE Priorities for FY 2006:

- The **Integrative Graduate Education and Research Traineeship** (IGERT) program is an NSF-wide program administered by DGE. IGERT prepares U.S. doctoral students to lead the nation in advancing knowledge in emerging areas of research and to pursue successful careers in academia, industry or the public sector. IGERT (institutional) awardees prepare doctoral students by integrating research and education in innovative ways that are tailored to the unique requirements of newly emerging interdisciplinary fields and new career options. IGERT campuses train students to be leading scientists and engineers in the 21st century, while also providing selected Trainees with international experiences and focusing on broadening participation. Funds for this program are increased by $100,000. Approximately 1,385 IGERT trainees will be supported across NSF in FY 2006.

- The **Graduate Research Fellowship** (GRF) Program strategically invests in intellectual capital, providing support to individuals who are pursuing graduate education. It prepares the most promising science, mathematics, and engineering students in the U.S. for a broad range of disciplinary and cross-disciplinary careers. It offers three years of financial support, which may be used over a five-year period, providing a flexible operational framework. In FY 2006, priorities include broadening participation in the applicant and awardee pools.

  Since 1952, over 41,000 U.S. students have received GRFs. In FY 2006, DGE support for this program is increased by $100,000. NSF-wide, approximately 2,280 fellows will be supported, primarily with DGE funds. The Directorates for Engineering and Computer and Information Science and Engineering also provide support for the GRF program. Although at early stages of their careers, Fellows begin to build distinguished records of accomplishment.

- The **Graduate Teaching Fellows in K-12 Education** program (GK-12) supports fellowships and associated training that enable graduate students in NSF-supported STEM disciplines to acquire additional skills that will broadly prepare them for professional and scientific careers in the 21st century. Through interactions with teachers in K-12 schools, graduate students improve communication and teaching skills while enriching STEM instruction in these schools. With an increase of $100,000 in DGE, and including support from other NSF Directorates, approximately 935 graduate fellows will be supported in FY 2006.

Changes from FY 2005

Approximately 995 new awards will be made in FY 2006, a funding rate of approximately 10.7 percent. IGERT and GK-12 awards are made to institutions and GRF awards are made to individuals. The FY 2006 Request includes an increase of $300,000 that will be directed towards the following:

- **IGERT.** Each year IGERT receives more excellent proposals than can be funded. In the current FY 2005 competition, the IGERT program received 114 full proposals and a funding rate of 21 percent is expected. Approximately 22 new awards will be supported in FY 2006. The EHR FY 2006 Request for IGERT is $24.60 million, an increase of $100,000 over the FY 2005 Current Plan. NSF-wide, support for IGERT is $69.07 million.

- **GRF.** In FY 2005, DGE received 9,121 applications, and was able to fund approximately 11 percent of them. Approximately 945 new awards will be supported in FY 2006. The EHR FY 2006 Request for GRF is $88.57 million, an increase of $100,000 over the FY 2005 Current Plan. NSF-wide, support for GRF is $96.63 million.

- **GK-12.** Each year GK-12 receives more excellent proposals than can be funded. In the FY 2005 competition, the GK-12 program received 96 proposals, and a funding rate of approximately 21 percent is expected. Approximately 28 new awards will be supported in FY 2006. The EHR FY 2006 Request for GK-12 is $41.83 million, an increase of $100,000 over the FY 2005 Current Plan. NSF-wide, support for GK-12 is $49.99 million.

HUMAN RESOURCE DEVELOPMENT $118,400,000

The FY 2006 Request for the Division of Human Resource Development (HRD) is $118.40 million, a decrease of $140,000, or 0.1 percent, from the FY 2005 Current Plan of $118.54 million.

Human Resource Development Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Undergraduate/Graduate Student Support	67.64	70.37	70.40	0.03	0.0%
Research and Education Infrastructure	37.54	33.15	33.50	0.35	1.1%
Opportunies for Women and Persons with Disabilities	14.91	15.02	14.50	-0.52	-3.5%
Total, HRD	$120.09	$118.54	$118.40	-$0.14	-0.1%

Totals may not add due to rounding.

About HRD:

HRD supports programs and activities that enhance the quantity, quality and diversity of individuals engaged in U.S. science, technology, engineering, and mathematics (STEM). HRD plays a central role in increasing opportunities in STEM education for individuals from historically underserved populations – particularly minorities, women and persons with disabilities – as well as the educators, researchers, and institutions dedicated to serving these populations. HRD's current portfolio of programs serves to build the knowledge base in educational research on issues of access and success regarding diversity in STEM; strengthen the educational capacity of minority-serving institutions; support far-reaching alliances of institutions, industry and government to produce high-quality graduates at the baccalaureate and graduate levels; strengthen the research capacity of individuals and institutions; and promote the recognition and broad dissemination of successful practices.

In general, 37 percent of the HRD portfolio is available for new awards and activities. The remaining 63 percent funds awards made in previous years.

Assuming no increase in proposal submissions, HRD expects to fund a similar number of projects in each program in FY 2006. However, CREST will likely fund an increased number of awards and the Gender Equity programs will likely be able to fund fewer awards.

HRD Priorities for FY 2006:

Special FY 2006 Emphasis on Broadening Participation in the Science and Engineering Workforce. The FY 2006 Request places special emphasis on programs with a proven track record of broadening participation in the science and engineering workforce. Three highly successful programs are focal points for linking activities in NSF's EHR Directorate with NSF's R&RA Directorates to strengthen collaborations that integrate research and education:

- The Louis Stokes Alliances for Minority Participation (LSAMP),
- Alliances for Graduate Education and the Professoriate (AGEP), and
- Centers of Research Excellence in Science and Technology (CREST).

The demand for these programs exceeds NSF's recent capacity and support for these highly successful and respected programs will aid in addressing the S&E workforce needs of the nation to ensure a scientifically literate population and a robust supply of qualified experts across all fields. FY 2006 funds ($8.0 million) in the Research and Related Activities Account will be used to support activities that foster integration and collaboration with these programs.

Core activities in HRD support education and research programs that address three constituencies underserved in STEM – minorities, women and persons with disabilities. HRD programs address three priorities: (1) expanding upon and using a strong educational research and evaluation base to foster broad implementation of innovative and effective strategies for increasing participation and achievement of minorities, women, and persons with disabilities in STEM education and research activities; (2) strengthening the synergy among key minority-focused programs and the interactions among grantees within these programs and with other NSF programs in research and education; and (3) increasing substantially the diversity of the STEM professoriate.

The dual goals of nurturing diversity and developing human potential are largely achieved by increasing support to minority-serving institutions. Programs focusing on building the capacity of Tribal and Historically Black Colleges and Universities also contribute to the production of STEM graduates with a focus on national, regional, and cultural needs.

Programs addressing the STEM academic and workforce experiences of women and persons with disabilities make mainstream efforts more inclusive, broaden the pool of STEM professionals with new ideas, and promote the development of tools to enable discovery and learning.

Crosscutting initiatives in HRD recognize exemplary individual and institutional efforts in mentoring that benefit all students, strengthen the research capacity of minority-serving institutions, and enhance the Foundation-wide effort to promote a diverse workforce of scientists, engineers, mathematics, technologists and STEM educators.

Changes from FY 2005:

Undergraduate/Graduate Student Support

- **Louis Stokes Alliances for Minority Participation** (LSAMP) strengthen and encourage STEM baccalaureate degree production of students from underrepresented populations by utilizing the knowledge, resources, and capabilities of a broad range of organizations. In FY 2005, LSAMP received 10 proposals and expects to fund about 70 percent of them. Additionally, 19 Bridge to the Doctorate supplements are anticipated in FY 2005. The Bridge to the Doctorate initiative supports graduate activities for selected LSAMP baccalaureate degree recipients during the initial two years of graduate study. This initiative broadens participation by attracting underrepresented minorities in STEM disciplines at some of the nation's top institutions. LSAMP funding for FY 2006 is $35.0 million, a decrease of $20,000 from the FY 2005 Current Plan.

- **Historically Black Colleges and Universities-Undergraduate Program** (HBCU-UP) provides awards to enhance the quality of undergraduate STEM programs through curricular reform and enhancement, faculty development, research experiences for undergraduates, upgrade of scientific instrumentation, and improvement of research infrastructure. In FY 2005, the program received 21 proposals and anticipates funding approximately 40 percent of them. The total HBCU-UP funding for FY 2006 is $25.0 million, a decrease of $220,000 from the FY 2005 Current Plan.

- **Tribal Colleges and Universities Program** (TCUP) promotes the improvement of STEM instructional and community outreach programs, with an emphasis on the leveraged use of information technologies, at Tribal Colleges and Universities, Alaska Native-serving institutions and Native Hawaiian-serving institutions. The total TCUP funding for FY 2006 is $10.0 million, an increase of $160,000 over the FY 2005 Current Plan.

- **Presidential Awards for Excellence in Science, Mathematics, and Engineering Mentoring** (PAESMEM), administered by NSF on behalf of the White House, identify outstanding mentoring efforts/programs designed to enhance the participation of groups underrepresented in science, mathematics and engineering. The total PAESMEM funding for FY 2006 is $400,000, an increase of $110,000 over the FY 2005 Current Plan.

<u>Research and Education Infrastructure</u>

- **Alliances for Graduate Education and the Professoriate** (AGEP) implement innovative models for increasing STEM Ph.D. attainment among students from underrepresented minority populations and encouraging those students to enter the professoriate. Currently, there are 20 Alliances and approximately 7 additional alliances are anticipated in FY 2005. The total AGEP funding for FY 2006 is $15.0 million, an increase of $210,000 over the FY 2005 Current Plan.

- **Centers of Research Excellence in Science and Technology** (CREST) serve as hubs for conducting competitive research at minority institutions, including those that produce well-trained doctoral students in STEM. The HBCU Research University Science and Technology (THRUST) program (commonly known as RISE) strengthens the research capacity of doctoral degree granting Historically Black Colleges and Universities in STEM disciplines by investing in collaborative research, training, equipment and doctoral student support. In FY 2005, 14 Centers and 11 THRUST/RISE sites will be supported. The total CREST funding within EHR for FY 2006 is $18.50 million, an increase of $2.63 million over the FY 2005 Current Plan. This increase will be used for evaluation and to support one additional center.

- **Model Institutions for Excellence** (MIE) support minority model institutions with a strong track record of attracting and graduating underrepresented African American, Hispanic and Tribal College students at the baccalaureate level, providing undergraduate research, student support, faculty development, improved campus infrastructure, and encouraging those students to pursue graduate degrees. FY 2006 marks the end of this long-term (11-year) initiative, which received almost $99 million in support over its lifetime. The MIE program has supported four MIE sites, and partnered throughout its lifetime with two NASA funded sites. Funding obligations for this program have been met and no funds are being requested for FY 2006.

<u>Opportunities for Women and Persons with Disabilities</u>

- The **Program for Gender Equity** (PGE), also known as Research on Gender in Science and Engineering (GSE), supports research, dissemination and adaptation projects that lead to change in education policy and practice with the aim of broadening the participation of females STEM. PGE funding for FY 2006 is $9.0 million, a decrease of $820,000 from the FY 2005 Current Plan.

- The **Research in Disabilities Education** (RDE) program, formerly the Program for Persons with Disabilities, supports efforts to increase the participation and achievement of individuals with disabilities in STEM education and careers. The total RDE funding for FY 2006 is $5.50 million, an increase of $300,000 over the FY 2005 Current Plan.

RESEARCH, EVALUATION AND COMMUNICATION $33,800,000

The FY 2006 Request for the Division of Research, Evaluation and Communication (REC) is $33.80 million, a decrease of $25.72 million, or 43.2 percent, below the FY 2005 Current Plan of $59.52 million.

Research, Evaluation, and Communication Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Research	54.31	50.20	29.30	-20.90	-41.6%
Evaluation	12.10	9.32	4.50	-4.82	-51.7%
Total, REC	$66.41	$59.52	$33.80	-$25.72	-43.2%

Totals may not add due to rounding.

About REC:

REC supports research that strengthens and undergirds education efforts at all levels, including programs that the Directorate for Education and Human Resources (EHR) offers. REC funds evaluations of EHR programs and communicates research findings and accomplishments from EHR programs to the public. Among the research elements of the division are programs aimed at discovering and describing the conceptual learning, cognitive affective processes needed for lifelong STEM learning, and programs that support the development of innovative and effective curriculum, materials, and assessments that enhance the learning of STEM by all Americans. In addition, this division supports development and refinement of new education research and evaluation methods and increased capacity in the research and evaluation communities. The evaluation function supports contracts and grants for assessing the merit and value of EHR programs, the design and oversight of independent, third party evaluations, and provision of evaluative information (to EHR staff and decision-makers) that is useful for the improvement of programs and the refinement of policies.

There is a wide range of sources of interest or origination of an evaluation including: Congress, NSF management, and EHR staff. Currently there are over 30 active evaluation task orders, many either wholly or partially funded by other NSF organizations. REC staff are often asked to design evaluations in collaboration with program staff.

In FY 2006 approximately 6 awards will be supported, about 70 fewer awards than in FY 2004.

The REC Portfolio has two major modes of support – research awards and support for evaluation projects. Each year REC receives approximately 400 proposals, which is more than can be funded.

REC Priorities for FY 2006:

In FY 2006, REC will continue support for awards made in FY 2005 and earlier years. No new awards are anticipated in FY 2006. Funding for awards within the following REC programs are FY 2006 priorities.

- The **Research on Learning and Education** (ROLE) Program helps advance progress toward EHR's goals through the development and application of new scientific knowledge related to education at all levels. To enhance STEM education, ROLE seeks to develop research-based learning tools, pedagogical approaches and materials, and also to examine the overall curriculum structure (including selection, ordering, and prioritizing of topics). It is important to understand how pre-kindergarten through secondary teacher and post-secondary faculty content knowledge and pedagogy relate to the implementation that innovative and effective curricula, materials, and assessments require. New education research methods also need to be developed and refined and the research capacity of the field increased, especially the development of new researchers and research oriented education practitioners. Also, data must be collected, analyzed and used to inform researchers, decision makers and the general public. If the full participation of all Americans in the STEM enterprise is to be attained, then the factors that enhance and the approaches that increase this participation must be understood. Finally, it is important to increase the knowledge of learning, teaching and organizational models that lead to substantial and large-scale improvement in the efficiency, efficacy, and cost-effectiveness of the United States educational system. ROLE funding for FY 2006 is $24.0 million, $14.20 million below the FY 2005 Current Plan.

- The **Interagency Education Research Initiative** (IERI) is an interagency program managed by leaders from NSF, the Department of Education's Office of Institute of Education Sciences (IES) and the National Institutes of Health (NIH). Initiated as a response to a 1997 report to the President, it had as its primary goal the improvement of preK-12 student learning and achievement in reading, mathematics and science. IERI funds research on the scaling up to real school environments of STEM technology-based learning interventions that have been proven successful in small, well-controlled studies. IERI is being phased out. The total IERI funding within EHR for FY 2006 is $5.30 million, a decrease of $6.70 million from the FY 2005 Current Plan. No new awards will be made in FY 2006.

- Evaluation is also a responsibility for REC, primarily planning and overseeing third-party evaluations of EHR programs. These evaluations have been held on a rotating schedule to evaluate old and new EHR programs in order to provide information to benefit the programs in as timely a fashion as possible, with recent emphasis on newer programs or ones of higher visibility. REC provides technical assistance to other EHR divisions and to other Directorates in NSF in responding to GPRA mandates and broader evaluation and information and knowledge management concerns.

  One component of the Evaluation portfolio is the **Evaluative Research and Evaluation Capacity Building** (EREC) program, which began in FY 2002. It is designed to support evaluative studies that build the knowledge base about effective STEM education policy and practice, and to increase the size and capacity of the evaluation community to respond to the needs of STEM education. EREC aims to add diversity of content to the evaluation portfolio, and to reach a broader set of performers from the evaluation and research community. There are two major components: (1) a focus on the development of "evaluative research" studies and partnerships for education, and (2) a focus on the development of evaluative capacity of the field, meaning both human resource development, and the methods, tools, and theories for performing high quality evaluation. Total Evaluation funding for FY 2006 is $4.50 million, a decrease of $4.82 million from the FY 2005 Current Plan. This reduction will result in no new awards in the EREC program.

H-1B NONIMMIGRANT PETITIONER FEES $100,000,000

The FY 2006 H-1B Nonimmigrant Petitioner Fees are projected to be $100.0 million, equivalent to the FY 2005 projection.

H-1B Nonimmigrant Petitioner Fees Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Estimate	Change over FY 2005 Amount	Percent
H-1B Nonimmigrant Receipts	$57.28	$100.00	$100.00	$0.00	0.0%

Beginning in FY 1999, Title IV of the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277) established an H-1B Nonimmigrant Petitioner Account in the general fund of the U.S. Treasury for fees collected for each petition for alien nonimmigrant status. That law required that a prescribed percentage of funds in the Account be made available to NSF for the following activities:

- Computer Science, Engineering, and Mathematics Scholarships (CSEMS). The program supported grants for scholarships to academically-talented, financially needy students pursuing associate, baccalaureate, or graduate degrees in computer science, computer technology, engineering, engineering technology, or mathematics. Grantee institutions awarded scholarships of up to $2,500 per year for two years to eligible students.

- Grants for Mathematics, Engineering, or Science Enrichment Courses. These funds were intended to provide opportunities to students for enrollment in year-round academic enrichment courses in mathematics, engineering, or science.

- Systemic Reform Activities. These funds supplemented the rural systemic reform efforts administered under the Division of Educational System Reform (ESR).

In FY 2001, Public Law 106-311 increased the funds available by increasing the Petitioner fees. Also, the American Competitiveness in the 21st Century Act (P.L. 106-313) amended P.L. 105-277 and changed the way petitioner fees were to be expended.

- The Computer Science, Engineering, and Mathematics Scholarships (CSEMS) activity continued under P.L. 106-313 with a prescribed percentage of H-1B receipts. The maximum scholarship duration was four years and the annual stipend was $3,125. Funds for this scholarship program totaled 59.5 percent of the total H-1B funding for NSF.

- Private-Public Partnerships in K-12. P.L. 106-313 directed the remaining 40.5 percent of receipts toward K-12 activities involving private-public partnerships in a range of areas such as materials development, student externships, and mathematics and science teacher professional development.

- Information Technology Experiences for Students and Teachers (ITEST) developed as a partnership activity in K-12 to increase the opportunities for students and teachers to learn about, experience, and use information technologies within the context of STEM, including Information Technology (IT) courses. ITEST included three major components: (a) youth-based projects with strong emphases on career and educational paths; (b) comprehensive projects for students and teachers; and (c) Resource Centers that engaged in research related to funded projects, provided technical support and had responsibilities for national dissemination of project models, instructional materials, and best practices.

Approximately $26.25 million of funds remain, nearly all to fund the upcoming ITEST competition.

In FY 2005, Public Law 108-447 reauthorized H-1B funding. NSF is provided with 40 percent of the total H-1B receipts that are collected. Thirty percent of H-1B receipts (75 percent of the receipts that NSF receives) are to be used for the Low-income Scholarship Program, formerly CSEMS. Ten percent of receipts (25 percent of the receipts that NSF receives) are designated for support of the Grants for Mathematics, Science, or Engineering Enrichment Courses.

Low-income Scholarship Program, which has been called CSEMS at NSF. Eligibility for the scholarships has been expanded from the original fields of computer science, engineering, and mathematics to include “other technology and science programs designated by the Director.” The maximum annual scholarship award amount has been raised from $3,125 to $10,000. NSF may use up to 50 percent of the funds “for undergraduate programs for curriculum development, professional and workforce development, and to advance technological education.”

Since its inception the **CSEMS** program has received 1,475 proposals from all types of colleges and universities and has made awards for 553 projects. Approximately 28,000 students have received scholarships ranging from one to four years. In addition to scholarships, projects include student support activities featuring close involvement of faculty, student mentoring, academic support, and recognition of the students. Such activities are important in recruiting and retaining students in high-technology fields through graduation and into employment.

ITEST Grants for Mathematics, Science, or Engineering Enrichment Courses. K-12 activities under the Consolidated Appropriations Act, 2005 will support the ITEST program, which invests in informal education programs for middle and high school students and teachers that are intended to stimulate interest in high technology fields and that emphasize IT-intensive STEM subject areas. ITEST provides substantive learning opportunities that expand upon science experiences received as part of formal classroom instruction. The three categories of awards include: (1) *Youth Projects* for school-age children, grades 7-12; (2) *Comprehensive Projects* that include opportunities for STEM teachers to gain familiarity with IT that can be transported to their classrooms; and (3) the *ITEST Learning Resource Center* that serves as a national resource disseminating best practices, research on student learning, and strategies for project evaluation.

The ITEST portfolio consists of 32 community-based projects that allow students and teachers to work hand-in-hand with scientists and engineers on extended research projects, ranging from biotechnology to environmental resource management to programming and problem-solving. Projects draw on a wide mix of local resources, including universities, industry, museums, science and technology centers, and school districts. ITEST engages both informal and formal communities in order to identify the characteristics of informal settings – content and format – that make them successful for a wide range of young people, especially those not successful in traditional school settings. In FY 2004, funded projects will reach more than 14,000 students, 600 parents and other caregivers, and 1,100 teachers.

Interest in ITEST continues to grow. In FY 2005, ITEST expects to receive over 160 proposals, an increase of nearly 64 percent over FY 2004, with a success rate of about 15 percent.

Major Research Equipment and Facilities Construction

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION $250,010,000

The FY 2006 Budget Request for the Major Research Equipment and Facilities Construction (MREFC) Account is $250.01 million, an increase of $76.36 million, or 44.0 percent, above the FY 2005 Current Plan of $173.65 million.

Major Research Equipment and Facilities Construction Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change Over FY 2005 Amount	Change Over FY 2005 Percent
Major Research Equipment and Facilities Construction	$183.96	$173.65	$250.01	$76.36	44.0%

The MREFC Account supports the acquisition, construction and commissioning of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. Initial planning and design, and follow on operations and maintenance costs of the facilities are provided through the Research and Related Activities (R&RA) Account.

There can be no doubt that a modern and effective research infrastructure is critical to maintaining U.S. leadership in science and engineering (S&E). The future success of entire fields of research depends upon their access to new generations of powerful research tools. Increasingly, these tools are large and complex, and have a significant information technology component.

Among Federal agencies, NSF is a primary supporter of forefront instrumentation and facilities for the academic research and education communities. In recent years, NSF has received an increased number of requests for major research facilities and equipment from the S&E community. Many of these requests have received outstanding ratings from research peers, program staff, management and policy officials, and the National Science Board. NSF's Request for the MREFC Account positions the agency to meet the future needs and opportunities of the research community.

In February 2004, the National Academies released a report on "Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation". This report recommends an open process for selecting new projects to be funded, establishing well-defined criteria and including maximum community input. The results of this final prioritization should be "discussed, explained and documented". NSF concurs with these recommendations and is currently refining the MREFC process to ensure that decisions are clearly documented and explained, and selection criteria clearly articulated.

The National Science Board (NSB) provisionally approved a joint NSB-NSF management document on Setting Priorities for Large Research Facility Projects at its October 2004 meeting (http://www.nsf.gov/nsb/documents/2005/memo.pdf)[1]. This document outlines in general terms the changes NSF will implement over the next year.

At the December 2004 National Science Board (NSB) meeting, NSF announced that new guidelines for the development, review and approval of major research facilities will be available by about June 2005.

[1] This document is currently available at this location for public comment for a limited period of time. Afterwards, it will be available upon request through the National Science Board website (http://www.nsf.gov/nsb/contact.htm).

In addition, an NSF Facility Plan will be released in March of each year, beginning in 2005, that will contain information about facilities under construction, as well as facilities under consideration for future support.

Once a project is submitted for MREFC funding, it must undergo a multi-phase review and approval process. The process will continue to include a review by the internal NSF MREFC Panel, comprised of the Deputy Director, the Assistant Directors, the Head of the Office of Polar Programs, and the Chief Financial Officer. The Deputy for Large Facility Projects attends Panel meetings and provides advice and assistance. The MREFC Panel makes recommendations to the NSF Director with attention to criteria such as scientific merit, importance, readiness and cost-benefit. These criteria are being modified to align with the criteria recommended by the National Academies. The Director then selects candidates to send to the National Science Board (NSB) for consideration. The NSB then approves, or not, projects for inclusion in future budget requests and establishes priorities in May of each year. The Director selects from the group of NSB-approved projects those appropriate for inclusion in a particular budget request to OMB, and after discussion with OMB, to the Congress.

In order for a project to be considered for MREFC funding, NSF requires that it represent an exceptional opportunity that enables research and education. In addition, the project should be transformative in nature, in that it should have the potential to shift the paradigm in scientific understanding and/or infrastructure technology. NSF believes that all the projects included in this Budget Request meet these criteria.

As a general framework for priority setting, NSF assigned priority to projects based on the following criteria:

> First Priority: Ongoing Projects – Projects that have received funding for implementation and where outyear funding for the full project has already been included in a Budget Request to Congress.
>
> Second Priority: NSB-Approved New Starts – New projects that have received NSB approval for inclusion in a budget request but which have not yet been included in a budget request or have not yet received funding.

NSF believes that the highest priority within the MREFC Account must be the current projects. To that end, highest priority in FY 2006 is to continue to request funding for the Atacama Large Millimeter Array ($49.24 million); EarthScope ($50.62 million); the IceCube Neutrino Observatory ($50.45 million); the Scientific Ocean Drilling Vessel ($57.92 million); and Rare Symmetry Violating Processes ($41.78 million).

NSF is requesting no new starts in FY 2006.

Two new starts are requested in FY 2007, and one new start is requested in FY 2008. In priority order, these are: Ocean Observatories in FY 2007; the Alaska Region Research Vessel in FY 2007; and Advanced LIGO in FY 2008[2].

[2] The National Science Board (NSB) established the priority of all unfunded but NSB-approved projects at the May 2004 NSB meeting, prior to the FY 2005 Omnibus Appropriation. SODV and RSVP received MREFC funds in the Omnibus and are now ongoing projects. NEON received R&RA funding and is also an ongoing project. AdvLIGO received NSB approval for inclusion in a future Budget Request in October 2004 (http://www.nsf.gov/nsb/meetings/2004/1004/major_action_1004_updt.pdf) and is as yet unranked.

MREFC Account[1]

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate
Ongoing Projects							
ALMA Construction	50.70	49.30	49.24	47.89	46.49	37.37	20.91
EarthScope	43.24	46.97	50.62	26.80			
HIAPER	12.54						
IceCube Neutrino Observatory	38.36	47.62	50.45	28.65	21.78	11.33	0.95
National Ecological Observatory Network				12.00	12.00	20.00	
Network for Earthquake Engineering Simulation	8.05						
Rare Symmetry Violating Processes		14.88	41.78	48.00	30.75	15.00	8.00
Scientific Ocean Drilling Vessel		14.88	57.92	42.20			
South Pole Station	21.03						
Terascale Computing Systems	10.05						
New Starts							
Ocean Observatories Initiative				13.50	42.00	65.50	66.90
Alaska Region Research Vessel				49.32	32.88		
Advanced LIGO					28.48	42.81	46.31
Totals	$183.96	$173.65	$250.01	$268.36	$214.38	$192.01	$143.07

Totals may not add due to rounding.

Estimates for 2007 and beyond do not reflect policy decisions and are presented for planning purposes only.

[1]The FY 2005 total includes $37.13 million carried forward from previous years. This includes $29.87 million for the South Pole Station Modernization project, $115,000 for Polar Support Aircraft upgrades, $34,418 for the South Pole Safety project, and $7.11 million for IceCube.

APPROPRIATION LANGUAGE

For necessary expenses for the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets pursuant to the National Science Foundation Act of 1950, as amended, including authorized travel, ~~$175,050,000~~ *$250,010,000*, to remain available until expended. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2005.)*

Major Research Equipment and Facilities Construction Account Funding
FY 2006 Summary Statement

(Dollars in Millions)

	Enacted/ Request	Rescission	Carryover/ Recoveries	Transfers	Total Resources	Obligations Incurred/ Estimated
FY 2004 Appropriation	155.90	-0.92	66.11	--	221.09	183.96
FY 2005 Current Plan	175.05	-1.40	37.13	--	210.78	210.78
FY 2006 Request	250.01	--	--	--	250.01	250.01
$ Change from FY 2005	74.96				39.23	
% Change from FY 2005	43%				19%	

Explanation of Carryover:

Within the Major Research Equipment and Facilities Construction (MREFC) appropriation $37.13 million was carried forward into FY 2005. This includes $37.13 million for the Office of Polar Programs (OPP) activity (i.e., $29.87 million for the South Pole Station Modernization, $115,000 for Polar Support Aircraft upgrades, and $34,418 for the South Pole Safety project, and $7.11 million for IceCube).

FIRST PRIORITY: ONGOING PROJECTS IN FY 2006

Atacama Large Millimeter Array

Project Description: Originally referred to as the Millimeter Array (MMA) in the United States, this international project will be an aperture-synthesis radio telescope operating in the wavelength range from 3 to 0.4 mm. ALMA will be the world's most sensitive, highest resolution, millimeter-wavelength telescope, combining sub-arcsecond angular resolution with the sensitivity of a single antenna nearly 100 meters in diameter. The array will provide a testing ground for theories of star birth and stellar evolution, galaxy formation and evolution, and the evolution of the universe itself. The interferometer will be located at 5,000 meter altitude near San Pedro de Atacama in the Second Region of Chile, the ALMA host country.

The Atacama Large Millimeter Array (ALMA) VertexRSI test antenna, one of two prototypes constructed at the site of the Very Large Array near Socorro, New Mexico. *Credit: NRAO/AUI.*

Principal Scientific Goals: To function as the most capable imaging radio telescope ever built, ALMA will bring to millimeter and submillimeter astronomy the high-resolution aperture synthesis techniques of radio astronomy. ALMA will image at 1 millimeter wavelength with the same 0.1 arcsecond resolution achieved by the Hubble Space Telescope at visible wavelengths, and will form a critical complement to the leading-edge optical, infrared, ultraviolet and x-ray astronomical instruments of the twenty-first century.

Principal Education Goals: ALMA will play a central role in the education and training of U.S. astronomy and engineering students; at least 15 percent of ALMA’s approximately 1,000 yearly users are expected to be students. There is already substantial involvement by graduate students in applied physics and engineering at universities participating in the ALMA Design and Development program.

Partnerships and Connections to Industry: North America and Europe were equal partners in ALMA as originally planned (the baseline ALMA). Japan joined ALMA as a third major partner in 2004, and will deliver a number of enhancements to the baseline instrument. The North American side of the project, consisting of the U.S. and Canada, is led by Associated Universities, Incorporated/National Radio Astronomy Observatory (AUI/NRAO). Funding and execution of the project in Europe is carried out through the European Southern Observatory (ESO). Funding of the project in Japan is carried out through the National Institutes of Natural Sciences of Japan and project execution is the responsibility of the National Astronomical Observatory of Japan. ALMA instrumentation will push gallium arsenide and indium phosphide transistor amplifier technology to high frequencies, will challenge production of high-density, high-speed integrated circuits for computational uses, and can be expected to stimulate commercial device and communication technologies development.

Management and Oversight: Programmatic management is the responsibility of the ALMA Staff Associate in the Division of Astronomical Sciences (AST) in the Directorate for Mathematical and Physical Sciences (MPS). An NSF advisory group, consisting of representatives from the Office of General Counsel, the Office of Budget, Finance, and Award Management, and the Office of Legislative and Public Affairs, serves as a standing ALMA Project Advisory Team (PAT). The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. AST's external MMA Oversight Committee has been advising NSF on the project since early 1998, and comprises half of the International ALMA Management Advisory Committee. Management of the NRAO effort on ALMA is carried out under Cooperative Agreement with AUI.

Project Status and Milestones: Significant project events during FY 2004 included:

- Groundbreaking at the site near San Pedro de Atacama in the second region of Chile in November 2003.
- The completion of all project agreements with the government of Chile.
- The completion the ALMA construction camp at the site of the mid-altitude Operations Support Facility (OSF), and ongoing progress with road and other site works.
- The establishment by the Government of Chile of a radio quiet zone centered on the ALMA site.
- The entry of Japan into an Enhanced ALMA project in September 2004.
- The receipt and evaluation of bids for the ALMA production antennas.

The current baseline schedule for ALMA is specified in version 1 of the ALMA Project Plan, adopted by the ALMA Board in February 2003 following the signature of the ALMA Agreement. The Project Plan is now under configuration control by the Joint ALMA office. Level 1 construction milestones (i.e., milestones specified in the international ALMA Agreement and in the Project Plan) are:

FY 2005 Milestones:
Central back end system ready to install at Array site
Initial Phase of Civil Works in Chile Complete
First Antenna-based Backend Subsystem ready for installation at site Operations Support Facility (OSF)

FY 2006 Milestones:
First Production Antenna available in Chile at OSF
Initial Front End Subsystem available at OSF

FY 2007 – FY 2011 Milestones:
Start Early Science Observations (FY 2007)
Continue construction schedule

FY 2012 Milestones
Completion of Construction Project
Start Full Science Operations

It should be noted that the current project schedule was developed prior to the start of ALMA construction activities and the entry of Japan into the project. A thorough reexamination of the project baseline and schedule are planned in FY 2005 and may result in a rebaselining.

Funding Profile: The current project schedule calls for U.S.-funded construction activities to continue through 2010, with full project completion at the end of calendar 2011, and full operation beginning in early 2012. Early science with the array is presently scheduled to begin at the end of 2007. The estimated cost to construct ALMA is $702.0 million. The U.S. share of the joint array construction is estimated to be $344.21 million.

A $26.0 million, three-year Design and Development Phase was originally planned for the MMA project. However, since the original three-year plan was initiated, the U.S. entered into a partnership with a European consortium to develop ALMA. Because of the expanded managerial and technical complexity of the ALMA concept, an additional year of Design and Development was supported in FY 2001, at a budget level of $5.99 million. U.S. construction was initiated in FY 2002.

Appropriated and Requested MREFC Funds for ALMA

(Dollars in Millions)

	FY 01 & Earlier	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Total
ALMA R&D	31.99										31.99
ALMA Construction		12.50	29.81	50.70	49.30	49.24	47.89	46.49	37.37	20.91	344.21
Total, ALMA	$31.99	$12.50	$29.81	$50.70	$49.30	$49.24	$47.89	$46.49	$37.37	$20.91	$376.20

ALMA Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation[1]		Operations & Maintenance		Totals		**Grand**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	**Total**
FY 2001& Earlier	6.50	31.99					$6.50	$31.99	**38.49**
FY 2002				12.50				$12.50	**12.50**
FY 2003				29.81				$29.81	**29.81**
FY 2004				50.70				$50.70	**50.70**
FY 2005 Current Plan				49.30	1.00		$1.00	$49.30	**50.30**
FY 2006 Request				49.24	2.00		$2.00	$49.24	**51.24**
FY 2007 Estimate				47.89	5.00		$5.00	$47.89	**52.89**
FY 2008 Estimate				46.49	10.00		$10.00	$46.49	**56.49**
FY 2009 Estimate				37.37	14.00		$14.00	$37.37	**51.37**
FY 2010 Estimate				20.91	19.00		$19.00	$20.91	**39.91**
FY 2011 Estimate					23.00		$23.00		**23.00**
FY 2012 Estimate					23.00		$23.00		**23.00**
Subtotal, R&RA	$6.50				$97.00		$103.50		
Subtotal, MREFC		$31.99		$344.21				$376.20	
Total, Each Stage		**$38.49**		**$344.21**		**$97.00**			**$479.70**

NOTE: The expected operational lifespan of this project is at least 30 years. A steady state of about $23.0 million annually is anticipated for operations support beginning in FY 2012. Operations estimates for FY 2007 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available. Operations funding is provided through the National Radio Astronomy Observatory.

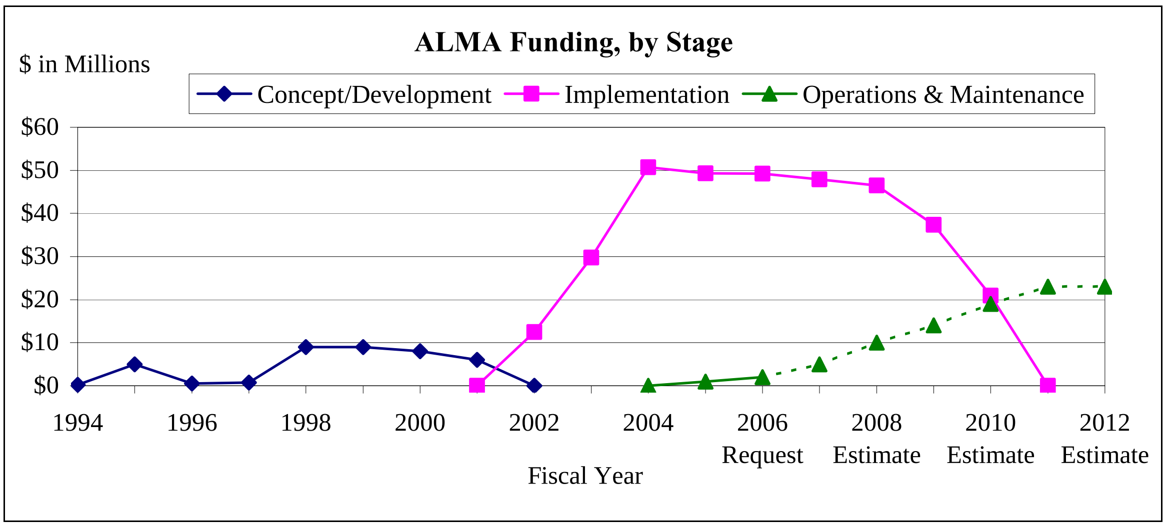
[1]Based on cost review of the original MMA and then projected to ALMA.

Information pertaining to the data in the table is included below.

- Concept/Development: Prior to FY 1998, NRAO utilized funds provided through the R&RA account to advance the conceptual development of the Millimeter Array, the U.S.-only antecedent to ALMA. Funds were spent on planning workshops, array design and optimization, developing project construction and operations costs, and on site searches and surveys. The planning, design and development supported through the MREFC Account achieved the goals set for (i) a refined and audited cost estimate with project milestones, (ii) the selection of a site, (iii) the development of an international partnership with defined shared costs, and (iv) the procurement of prototype antennas.

- Implementation: Implementation funds an array of up to 64 12-meter antennas having a total collecting area of 7,200 square meters, with 4 receiver bands extending into the submillimeter. The exact amount will be determined after a baseline review which will be conducted in 2005. The table describes the U.S. contribution to ALMA. It does not include funds resulting from Canada's participation.

- Operations and Maintenance: Operations and maintenance funds begin to phase in as initial site construction is completed and antennas begin to be delivered. Funds will be used to manage and support site and instrument maintenance, array operations in Chile, early and eventually full science operations, and in support of ALMA observations by the U.S. science community. The first full year of ALMA science operations is anticipated to be FY 2012.



Future Science Support: Along with direct operations and maintenance support for ALMA, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $10 million once the facility reaches full operations.

EarthScope

Project Description: The EarthScope Facility is a distributed, multi-purpose geophysical instrument array that will make major advances in our knowledge and understanding of the structure and dynamics of the North American continent. EarthScope instrumentation is expected to inhabit nearly every county within the U.S. over the life span of the program.

Principal Scientific Goals: Enhanced understanding of the structure and evolution of the North American continent, including earthquakes and seismic hazards, magmatic systems and volcanic hazards, lithospheric dynamics, regional tectonics, continental structure and evolution, fluids in the crust, and associated educational aspects.

Principal Education Goals: To engage science and non-science students in geosciences discovery through the use of technology in real time or retrospectively with the aim of integrating research and education.

Partnerships and Connections to Industry: The U.S. Geological Survey (USGS), the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and the International Continental Scientific Drilling Programme are funding partners, with USGS and NASA expected as operating partners. Project partners may also include state and local governments, geological and engineering firms, and Canadian and Mexican agencies. Over 3000 earth scientists and students are expected to use the facility annually. Geotechnical and engineering firms directly use data and models, which will be enabled by EarthScope. Instrumentation firms will collaborate on development for state-of-the-art seismic systems, down-hole instrumentation, and high-precision GPS antenna designs.

Management and Oversight: The EarthScope Program Director, located in the Earth Sciences (EAR) Division in the Directorate for Geosciences (GEO), provides NSF oversight. The Deep Earth Processes Section Head (EAR) and a Project Advisory Team including the NSF Deputy for Large Facility Projects and staff from GEO, the Office of the General Counsel and the Office of Budget, Finance and Award Management, provide other internal oversight. Following the recommendations of a National Academies review of EarthScope, an EarthScope Science and Education Advisory Committee (ESEC) was formed to provide an advisory structure to ensure coordination of facility construction and operation, science, education and outreach, and information technology efforts.

EarthScope Education and Outreach includes displays at National Parks such as Sunset Crater and professional meetings, such as the 2004 National Science Teachers Association National Convention, pictured here. *Credit: EarthScope*

Current Project Status: Phase 1 drilling at the San Andreas Fault Observatory at Depth (SAFOD) site successfully concluded in September 2004. The main SAFOD hole is logged, sampled, tested, and cased to 10,010 feet; 26 feet of core was obtained at 4,796 feet; and 38 feet of core was obtained at 10,025 feet (the bottom of the Phase 1 hole). Passive systems have been deployed for monitoring until drilling resumes in June 2005. The long anticipated magnitude 6.0 Parkfield earthquake occurred approximately 20 km southeast of the SAFOD site on September 28, 2004. There was no damage at the site, but seismic and GPS deployment plans were altered and accelerated in response to the earthquake. Overall, GPS and seismic station equipment acquisition and installation are slightly behind schedule. GPS and seismic data become available to the community as each installation is completed. Data from EarthScope has already been used in earthquake studies, earthquake responses, presentations at professional meetings, and in some university and other educational settings. FY 2004 highlights also include dedicated workshops to refine the EarthScope science plan, organize education and outreach activities, strengthen coordination with EarthScope partners at NASA and the USGS, and refine communications/information technology capabilities. The Facility project office was opened and staffed in 2004 and has created a reporting/management system that is earned value management based. One of the most important accomplishments of 2004 is the creation of an R&RA funded Education and Outreach program. A national search for the EarthScope Education and Outreach Manager is underway.

The EarthScope project has been represented at over a dozen professional meetings and conferences through an exhibit booth, presentations, and scientific sessions. In the fall, EarthScope also hosted a well-publicized tour of the SAFOD site for the NSF Director, staff, the media, and Congressional staff.

The EarthScope Facility Project Execution Plan has been reviewed and updated. The initial milestones are listed below. These milestones will be reviewed quarterly and the project will undergo a baseline review in the fall of 2005. Thus, these milestones may be revised as the project continues.

FY 2003 Milestone:

Award for EarthScope MREFC construction phase (Completed);

FY 2004 Milestones:

Compete and award contracts for broadband and short-period seismic systems (Completed);
Community planning on permanent seismic sites and first array deployment (Completed);
San Andreas Fault Observatory at Depth (SAFOD) main hole drilling contract competed and awarded;
Down-hole monitoring equipment constructed;
Phase 1 drilling of SAFOD main hole (Completed);
Installation of 90 equivalent permanent GPS, 6 equivalent borehole strain, and 1 equivalent long baseline strainmeter systems;
Equipment for 28 portable GS sites available;
Installation of 14 equivalent Advanced National Seismic System (ANSS) and 28 equivalent Transportable Array stations;
Equipment for 240 Flexible Array sites available; and
NSF conducts first annual review of EarthScope.

FY 2005 Milestones:

Main hole Phase 2 drilling completed at SAFOD;
Down-hole monitoring instrumentation installed;
Installation of 300 equivalent permanent GPS, 30 equivalent borehole strain, and 3 equivalent long baseline strainmeter systems;
Equipment for 50 portable GS sites available;
Installation of 29 equivalent ANSS and 80 equivalent Transportable Array stations;
Equipment for 720 Flexible Array sites available; and
NSF conducts annual review of project status.

FY 2006 Milestones:

San Andreas Fault site characterization studies carried out;
Installation of 540 equivalent permanent GPS and 100 equivalent borehole strain systems;
Complete installation of 5 long baseline strainmeters;
Equipment for 100 portable GS sites available;
Complete installation of 39 equivalent ANSS stations;
Installation of 220 equivalent Transportable Array stations;
Equipment for 1,200 Flexible Array sites available; and
NSF conducts annual review of project status.

FY 2007 Milestones:

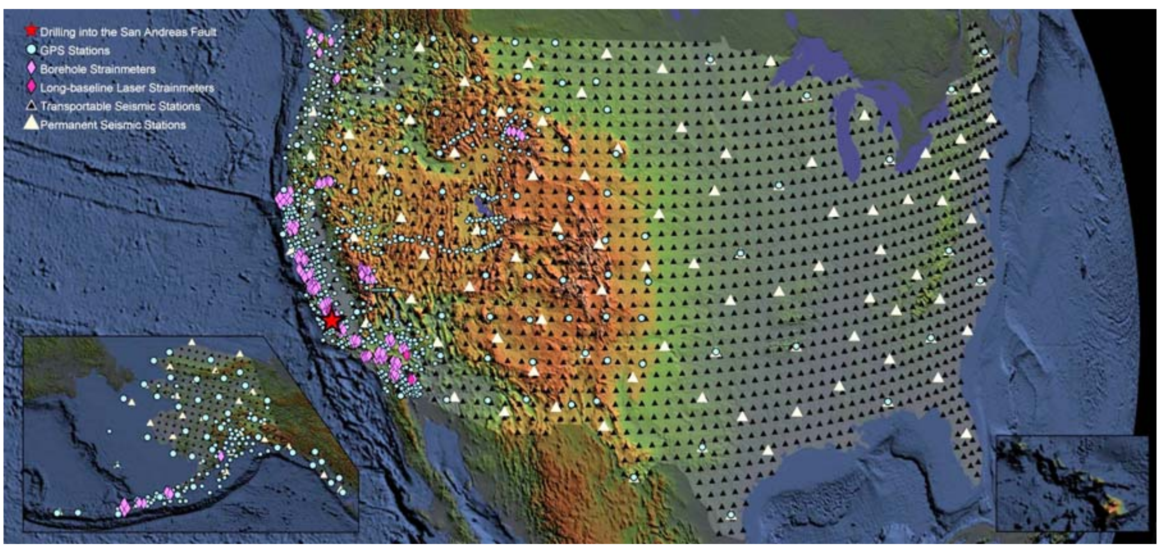
Use site characterization and monitoring data to choose four coring intervals at depth in San Andreas Fault Observatory;
Main hole Phase 3 drilling begins at SAFOD;
Installation of 780 equivalent permanent GPS and 162 equivalent borehole strain systems;

Complete first footprint of USArray (400 Transportable Array stations);
Equipment for 1,680 Flexible Array sites available; and
NSF conducts annual review of project status.

FY 2008 Milestones:
Redeployment of USArray begins;
Main hole Phase 3 drilling completed at SAFOD;
Install permanent monitoring instrumentation in four core intervals and main hole of SAFOD;
Complete installation of 875 equivalent permanent GPS and 175 equivalent borehole strain systems;
Equipment for 2,400 Flexible Array sites available; and
NSF conducts annual review of project status.

FY 2009 – FY 2013 Milestones:
Redeployment of USArray on a continual basis;
Analysis of San Andreas Fault cores, cuttings and logs completed. Continue monitoring at depth;
Ongoing operation and maintenance of the PBO; and
NSF conducts biennial reviews of project status.

Funding Profile: Conceptual planning for the EarthScope project developed over the past decade. NSF funded planning, design and development since FY 1998, and began the implementation of a five-year period of acquisition, construction and commissioning in FY 2003. The total project cost for EarthScope implementation is $197.44 million.



The complete EarthScope footprint. 1600 of the transportable sites (moving west to east) and all 2400 campaign stations will continue to be deployed after the conclusion of the MREFC project. Locations of the 2400 campaign stations will be determined through the annual proposal review process; many of these sites likely will change annually. *Credit: EarthScope*

Appropriated and Requested MREFC Funds for EarthScope
(Dollars in Millions)

FY 2003	FY 2004	FY 2005	FY 2006 Request	FY 2007	Total
$29.81	$43.24	$46.97	$50.62	$26.80	$197.44

EarthScope Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	**Total**
FY 1998	1.00						$1.00		**1.00**
FY 1999	1.00						$1.00		**1.00**
FY 2000	1.00						$1.00		**1.00**
FY 2001	2.00						$2.00		**2.00**
FY 2002	1.00						$1.00		**1.00**
FY 2003	3.36			29.81	0.40		$3.76	$29.81	**33.57**
FY 2004				43.24	1.70		$1.70	$43.24	**44.94**
FY 2005 Current Plan				46.97	4.69		$4.69	$46.97	**51.66**
FY 2006 Request				50.62	7.32		$7.32	$50.62	**57.94**
FY 2007 Estimate				26.80	12.52		$12.52	$26.80	**39.32**
FY 2008 Estimate					23.41		$23.41		**23.41**
FY 2009 Estimate					24.00		$24.00		**24.00**
Subtotal, R&RA	$9.36				$74.04		$83.40		
Subtotal, MREFC				$197.44				$197.44	
Total, Each Stage		**$9.36**		**$197.44**		**$74.04**			**$280.84**

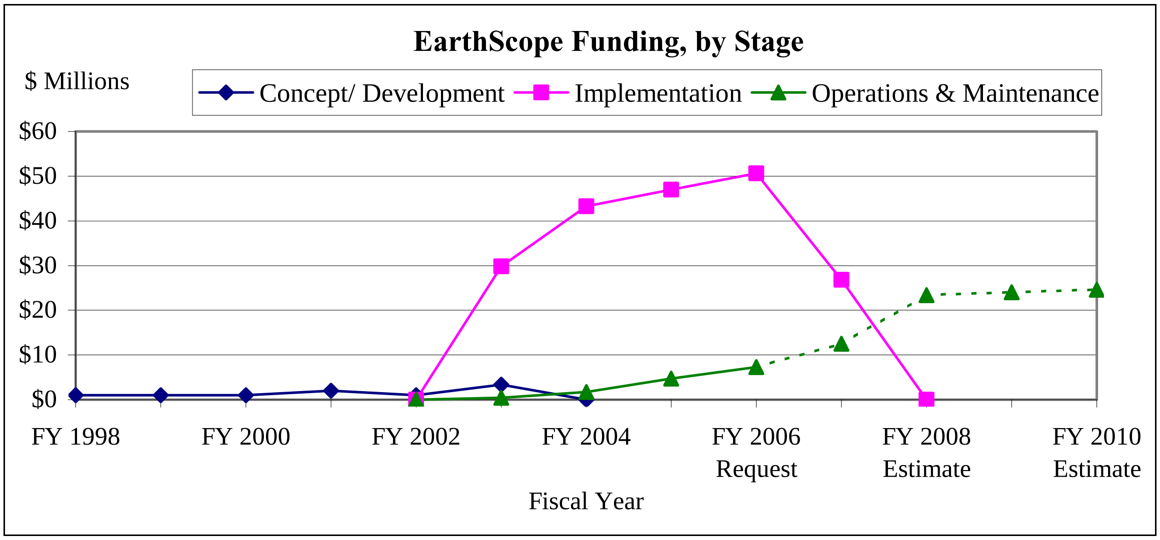
NOTE: Operations and maintenance support is anticipated to increase after FY 2008. The expected operational lifespan of this project is 15 years after construction is complete in FY 2007. Operations estimates for FY 2007 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available.

Information pertaining to the data in the table is provided below.

- Concept/Development: FY 1998-2000 funds were used to support workshops, instrument development, and installation technique development appropriate to EarthScope, from existing programs within EAR. Dedicated funding was established for FY 2001-2003 supporting pre-EarthScope activities that facilitated the construction and installation. This funding supported meetings, workshops, instrumentation prototype development, installation technique development, and site selection activities.

- Implementation: The project will put in place three components of the distributed EarthScope system: (1) the USArray - portable seismometers for deployment across North America; (2) the San Andreas Fault Observatory at Depth - to monitor fault conditions; and (3) the Plate Boundary Observatory – an array of GPS monitors and borehole strain systems to monitor crustal deformation.

- Operations and Maintenance: Operations and maintenance will begin to phase-in during the first year of construction. When EarthScope is completed it will be managed, operated and maintained by a consortium including participation from host institutions, affiliate organizations, and the user community.



Future Science Support: Along with direct operations and maintenance support for the EarthScope Facility, NSF will support research performed utilizing the facility through ongoing research and education programs. The annual support for such activities is estimated to be about $15 million once the facility reaches full operations.

High performance Instrumented Airborne Platform for Environmental Research (HIAPER)

Final MREFC funding for HIAPER was appropriated in FY 2003. $12.54 million was carried over into FY 2004 for instrument development. For information on the operation of HIAPER, please see the section on the National Center for Atmospheric Research (NCAR) in the Facilities chapter of this document.

IceCube Neutrino Observatory

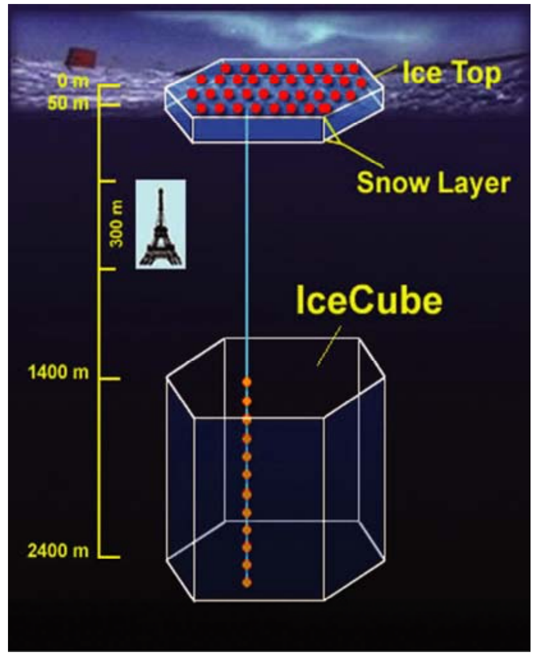
Project Description: IceCube will be the world's first high-energy neutrino observatory and will be located under the ice at the South Pole. It represents a new window on the universe, providing unique data on the engines that power active galactic nuclei, the origin of high energy cosmic rays, the nature of gamma ray bursters, the activities surrounding supermassive black holes, and other violent and energetic astrophysical processes. IceCube construction is being carried out by the IceCube Consortium, led by the University of Wisconsin (UW). Approximately one cubic kilometer of ice is being instrumented with photomultiplier (PM) tubes to detect neutrino-induced, charged reaction products produced when a high energy neutrino interacts in the ice within or near the cubic kilometer fiducial volume. An array of Digital Optical Modules (DOMs), each containing a PM and associated electronics, will be distributed uniformly from 1.5 km to 2.5 km beneath the surface of the South Pole ice cap, a depth where the ice is highly transparent and bubble-free. When completed, IceCube will record the energy and arrival direction of high-energy neutrinos ranging in energy from 100 GeV (10^{11} electron Volts[eV]) to 10 PeV (10^{16} eV). The principal tasks in the IceCube Project are: production of the needed DOMs and associated electronics and cables; production of an enhanced hot water drill and a DOM deployment system capable of drilling holes for and deploying DOM strings in the ice at the Pole; installation of a surface array of air shower detectors to both calibrate and eliminate background events from the IceCube DOM array; construction of a data acquisition and analysis system; and associated personnel and logistics support.

Principal Scientific Goals: IceCube will be the world's first observatory capable of studying the universe with high-energy neutrinos. Measurement of the number, direction, timing, and energy spectrum of such neutrinos will provide unique new insights regarding the dynamics of active galactic nuclei, the acceleration mechanisms and locations of the sources of high energy cosmic rays, the properties and dynamics of gamma ray bursters, and the types of processes that take place near the event horizon of supermassive black holes at the centers of galaxies. Many of these phenomena take place at cosmological distances in regions shielded by matter and shrouded by radiation. Since neutrinos carry no charge and interact very weakly with matter, easily passing through the entire earth, they are unique messenger particles for understanding the astrophysics of such extreme phenomena and are capable of bringing us information about previously undiscovered cosmic objects, ones that are invisible to existing observatories that record electromagnetic signals or charged particles. IceCube data on sources will also complement data from existing astrophysical observatories in the optical, x-ray, and gamma ray regions of the electromagnetic spectrum, providing new tests of theories of the underlying dynamics of these objects.

January 9, 2005: Tower, drill cable connected, hose end in tower. Second drill shift installing a windbreaker to reduce heat loss. *Credit: the United States Antarctic Program.*

Principal Education Goals: IceCube provides a vehicle for helping to achieve national and NSF education and outreach goals based on the conduct of visionary science in the exciting South Pole environment. These goals include broadening the scientific workforce base in the U.S. and creating a technologically facile work force with strong ties to fundamental research that is the core of a strong economy. Specific outcomes will include: the education and training of next generation leaders in astrophysics, including undergraduate students, graduate students, and postdoctoral research associates; K-12 teacher scientific/professional development, including development of new inquiry-based learning materials; increased diversity in science through partnerships with minority institutions; and enhanced public understanding of science through broadcast media and museum exhibits (one is currently under construction). Some of these outcomes will result from separate R&RA grants to universities and other organizations for work associated with IceCube, selected following the standard NSF merit review process.

Partnerships and Connections to Industry: The IceCube Collaboration consists of 12 U.S. institutions and institutions in three other countries, Belgium, Germany, and Sweden. The U.S. Department of Energy, through its Lawrence Berkeley Laboratory, is also participating.



IceCube will occupy a volume of one cubic kilometer. Here we depict one of the strings of optical modules (number and size not to scale). IceTop located at the surface, comprises an array of sensors to detect air showers. It will be used to calibrate IceCube and to conduct research on high-energy cosmic rays. *Credit: NSF/University of Wisconsin and Darwin Rianto, University of Wisconsin.*

Management and Oversight: The strong project management structure at UW, which includes international participation, provided the framework for the Start-up Project funded in FY 2002 and FY 2003, and the initiation of full construction with FY 2004 funding. The University of Wisconsin has in place an external Scientific Advisory Committee, an external Project Advisory Panel, and a high-level Board of Directors (including the Chancellor) providing for their oversight of the project. IceCube is managed by a Project Director and a Project Manager. Internally, NSF has appointed a Project Coordinator to manage and oversee the NSF award, and established an internal Project Advisory Team (PAT) comprised of representatives from the Office of Budget, Finance, and Award Management, the Office of General Counsel, the Directorate for Mathematical and Physical Sciences (MPS), and the Office of Polar Programs (OPP), and chaired by the Project Coordinator. The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. A comprehensive external baseline review of the entire project (including cost, schedule, technical, and management) was carried out in February 2004. There was a follow-up external cost review in the Fall 2004, and comprehensive annual external reviews are planned for each subsequent spring following the annual deployment season. This is interspersed with written monthly progress reports and quarterly reports, site visits, weekly teleconferences, and weekly internal NSF project oversight and management meetings. Oversight and funding responsibility for IceCube construction are the responsibility of OPP; support for operations, research, education, and outreach using IceCube will be shared by OPP and MPS as well as other organizations and international partners.

Current Project Status: The primary IceCube Project tasks carried out to date are: (1) completion and testing of the Enhanced Hot Water Drill (EHWD) system for drilling the required deep-ice holes into which the strings of DOMs will be placed; (2) completion and commissioning of the three planned DOM production and low temperature (-80^{o}C) testing facilities in the US, Germany, and Sweden; (3) production and testing of the DOMs needed for deployment of four DOM strings this austral summer season (November 2004 to mid-February 2005) at Pole; (4) shipping and assembly of the entire drilling and deployment camp at Pole, including the shipment and re-testing at Pole of the needed DOMs and cables; (5) design, construction, and installation of the initial data acquisition system at Pole; (6) completion of plans for commissioning and verification of the initial DOM strings; and (7) placement at Pole of the building that will serve as the IceCube permanent counting house next season (2005/2006).

Major milestones for IceCube are below:

FY 2004 and 2005 Milestones:

- Begin production of digital optical modules and data acquisition and handling system (DAQ) (Completed);
- Deliver EHWD system and DOM deployment system to the South Pole (Completed);
- Deliver initial DOM strings, IceTop modules, and initial elements of the DAQ to South Pole (Completed);
- Assemble the EHWD and DOM deployment systems (Completed);
- Establish drill camp and move new counting house building into place (Completed); and
- Drill, deploy, and test initial DOM strings and corresponding IceTop modules [pending].

FY 2006 Milestones:

- Ramp up to near-full DOM production at all facilities and IceTop module production;
- Drill, deploy and test up to 12 DOM strings and corresponding IceTop modules, including installing and testing the associated DAQ elements; and
- Commission new counting house.

Projected outyear milestones (FY 2007-2010) are based on current project planning and represent a general outline of anticipated activities. These activities are also dependent on weather conditions and the Antarctic logistics schedule.

FY 2007-10 Milestones:

- Continue DOM and IceTop module production; and
- Continue to drill, deploy and test DOM strings (up to 18 strings per season) and the corresponding IceTop modules (two for each DOM string), including installing and testing of the associated DAQ elements;
- Begin initial operations of IceCube with strings available in FY 2007;
- Complete installation and commissioning of IceCube.

FY 2011 Milestones:

- Commence full operations of IceCube for science.

<u>Funding Profile</u>: $15.0 million was appropriated in FY 2002 for startup activities for IceCube; $24.54 million was appropriated in FY 2003 for continuation of startup activities; $41.75 million was appropriated in FY 2004 to initiate construction; and $47.62 million was appropriated in FY 2005 for continued construction. The FY 2006 Request is $50.45 million for continued construction of IceCube. The total project cost for IceCube is $271.80 million. Of this amount, $242.07 million will be from the U.S. and $29.70 million will come from foreign contributions.

Appropriated and Requested MREFC Funds for IceCube
(Dollars in Millions)

FY 2002	FY 2003	FY 2004	FY 2005	FY 2006 Request	FY 2007	FY 2008	FY 2009	FY 2010	Total
$15.00	$24.54	$41.75	$47.62	$50.45	$28.65	$21.78	$11.33	$0.95	$242.07

The funding profile table below reflects actual obligations for past years and anticipated obligations for future years. The differences between these two tables are due to carryover from prior year appropriations.

IceCube Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand Total**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 2001	0.50						$0.50		**0.50**
FY 2002				10.12				$10.12	**10.12**
FY 2003				25.75				$25.75	**25.75**
FY 2004				38.36				$38.36	**38.36**
FY 2005 Current Plan				47.62				$47.62	**47.62**
FY 2006 Request				50.45				$50.45	**50.45**
FY 2007 Estimate				35.71	3.50		$3.50	$35.71	**39.21**
FY 2008 Estimate				21.78	7.00		$7.00	$21.78	**28.78**
FY 2009 Estimate				11.33	9.00		$9.00	$11.33	**20.33**
FY 2010 Estimate				0.95	11.00		$11.00	$0.95	**11.95**
FY 2011 Estimate					12.00		$12.00		**12.00**
FY 2012 Estimate					12.00		$12.00		**12.00**
Subtotal, R&RA	$0.50				$54.50		$55.00		
Subtotal, MREFC				$242.07				$242.07	
Total, Each Stage		**$0.50**		**$242.07**		**$54.50**			**$297.07**

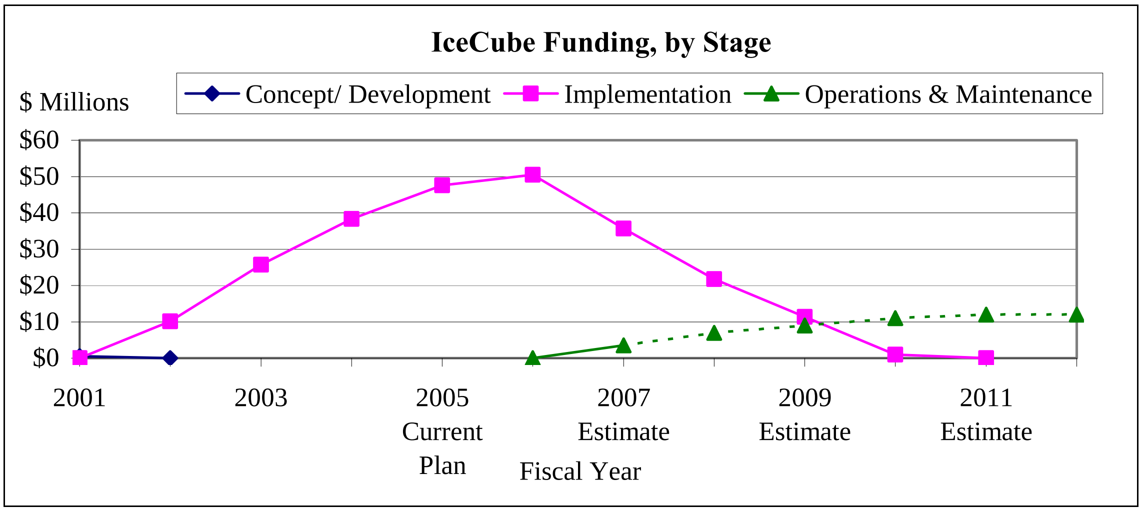
NOTE: The expected operational lifespan of this project is 25 years after construction is complete in FY 2010. Operations support begins in FY 2007. Operations support is estimated at $3.5 million for FY 2007 and ramps up to an estimated level of $12.0 million in FY 2011 and beyond. These operations estimates are developed for planning purposes and are based on current cost profiles. Efforts are underway to further develop operating cost estimates; they will be updated as new information becomes available.

Information pertaining to the data in the table is provided below.

- Concept/Development: $500,000 was provided in FY 2001 through the R&RA Account to support drill conceptual development and design, R&D on advanced data acquisition and analysis techniques, and development of interface electronics and associated software for digital detector electronics readout. IceCube builds on the work of the Antarctic Muon and Neutrino Detector (AMANDA), which demonstrated proof-of-principle. NSF's FY 2002 appropriation included $15.0 million for 'start-up' design and development of the IceCube project. NSF's FY 2003 appropriation included $24.50 million for continued startup activity. Those investments focused on state-of-the art drill and electronics development and acquisition.

- Implementation: The total project cost of the IceCube construction project is estimated currently at $271.77 million. Of this amount $242.07 will be from NSF, and $29.70 million from foreign partners. Construction is planned to extend through FY 2010. A comprehensive baseline review of the IceCube project was conducted in February 2004 to provide a solid project baseline scope, cost, and schedule. The FY 2006 funding Request is $50.45 million. The plan is to drill holes and deploy strings of DOMs in each austral summer season (November through mid-February), beginning in the FY 2005 austral summer season (2004/2005). With good EHWD drill performance, and barring weather-induced complications of logistics support, the full complement of DOMs should be in place by about the end of FY 2010.

- Operations and Maintenance: Full operation of the IceCube Neutrino Observatory is planned to commence in FY 2011 following completion of drilling and DOM deployment and full detector commissioning planned for FY 2010. Initial operations will begin in FY 2007, ramping up in subsequent years to full science operations in FY 2011. These costs will be shared by the collaborating institutions, domestic and foreign. Of the amounts shown in the table for operations, approximately half is for data analysis that will be carried out by the collaborating U.S. and foreign IceCube institutions, the other half being for direct operations and maintenance support (IceCube-specific logistics, system engineering, operation and maintenance of the data acquisition and data handling data systems, data quality monitoring, IT upgrades, and calibrations). The general operations of South Pole Station, reported in a separate section, also contribute to supporting IceCube. Costs included for IceCube here include only those that are project specific and incremental to general operations. The expected operational lifespan of this project is 25 years beginning in FY 2011.



Future Science Support: NSF will support activities at U.S. institutions working on more refined and specific data analyses, data interpretation (theory support), and instrumentation upgrades, through ongoing research and education programs. The annual support for such activities is estimated at $2.0 million once the facility reaches full operations.

Associated Research and Education Activities: Besides the training of next generation astrophysicists, IceCube will encourage the creation of new links to K-12 teachers for the purpose of scientific/professional development of secondary school teachers, reaching into the classroom with new inquiry-based IceCube learning materials, as well as using the unique South Pole environment to convey the excitement of astrophysics and science generally to K-12 students. Extra measures will be undertaken to interest underrepresented minorities in science. The plan includes partnership with two largely minority institutions (Clark-Atlanta University, Atlanta GA, and Southern University, Baton Rouge, LA). Public outreach will be carried out through broadcast media and museum exhibits based on the IceCube science and the South Pole environment. Funding for Education and Outreach (E&O) activities will come from the R&RA account. Annual E&O budgets are estimated at $400,000.

National Ecological Observatory Network

Project Description: NEON will be a continental scale research instrument platform consisting of geographically distributed infrastructure that is networked via state-of-the-art communications technology. Cutting-edge lab and field instrumentation, site-based experimental infrastructure, natural history archive facilities and/or computational, analytical and modeling capabilities, linked via a network will compose NEON.

NEON will transform ecological research by enabling studies on major environmental challenges at regional to continental scales. Scientists and engineers will use NEON to conduct real-time ecological studies spanning all levels of biological organization and temporal and geographical scales. NSF disciplinary and multi-disciplinary programs will support NEON research projects and educational activities. Data from standard measurements made using NEON will be publicly available.

Principal Scientific Goals: Collectively, the network of observatories will allow comprehensive, continental-scale experiments on ecological systems and will represent a virtual laboratory for research to obtain a predictive understanding of the environment. Important ecological questions confronting the U.S. will be addressed using NEON.

The National Ecological Observatory Network (NEON), a collaborative research platform of geographically distributed infrastructure, will be connected via the latest information technology. NEON will address pressing environmental questions on regional to continental scales. *Credit: The Directorate for Biological Sciences, NSF.*

Principal Education Goals: NEON's knowledge base, real time and continuous network data, simulation and observation capabilities, and networked communication will be an asset for formal and informal education and training. NEON will serve as a model to foster the NSF goal of integration of research and education by creating a research-intensive and collaborative learning environment. NEON will provide a creative and innovative educational platform to address the NSF Directorate for Biological Sciences education goals (experiential learning, biosphere literacy, and broadening career horizons).

Partnerships and Connections to Industry: Several federal agencies have expressed interest in partnering with NEON, including the National Park Service, the National Forest Service, NASA, NOAA, USGS, EPA, National Marine Sanctuaries and the USDA Agricultural Research Sites. Private foundations, such as the Santa Fe Institute, the Turner Foundation, Nature Serve, and The Nature Conservancy have also expressed interest. NEON-generated information will be useful to natural resource industries, such as forestry and fisheries. NEON's technological and networking infrastructure will be forging new technological frontiers and thus, will require partnerships with industry for development, deployment, and operation.

Management and Oversight: The Division of Biological Infrastructure within the BIO Directorate manages NEON. The NEON Program Officer in consultation with a BIO-NEON committee, which includes the Deputy for Large Facility Projects, formulates the programmatic development of NEON, i.e. drafting, release and review of program announcements, etc. A NEON Project Advisory Team, which includes individuals from all NSF directorates and the Office of Budget, Finance and Award Management, the Office of General Counsel, the Office of Legislative and Public Affairs, and the Office of Polar Programs, provides internal oversight. The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. In addition, a sub-committee of the BIO Advisory Committee will provide external advice to the NEON Program Officer about specific programmatic elements.

The NEON Program Officer ensures NEON coordination with other NSF observatories and networks by serving on the NSF Networks and Observing Systems for the Environment (NOSE) working group and on the PATs for other large facility projects, such as the Network for Earthquake Engineering Simulation (NEES) and Ocean Observatories Initiative (OOI). Coordination with other Federal Agencies occurs through the NEON Federal Agency Coordinating Committee. In addition, NEON is represented on the Architecture subcommittee of the Interagency Working Group for Global Earth Observation System, an activity of the National Science and Technology Council, Committee on Environment and Natural Resources.

<u>Current Project Status</u>:

Planning activities over the past year: The American Institute of Biological Sciences (AIBS) organized six community workshops between August and September 2004 to identify NEON-specific science questions and requirements based on the environmental grand challenges identified in the NRC NEON report "NEON: Addressing the Nation's Environmental Challenges", the NSB Environment report and the NRC report "Grand Challenges in Environmental Sciences"[3].

Award for NEON Design Consortium and Project Office: In FY 2004 and FY 2005, Congress instructed NSF to continue planning and development activities for NEON through the Research and Related Activities (R&RA) Account. On September 15, 2004, BIO made a 2-year, $6.0 million award to the AIBS to establish a NEON Design Consortium and Project Office, funding the award through R&RA. The NEON Design Consortium is refining the science and education requirements, developing the reference design, designing the baseline for the networking and cyberinfrastructure, drafting the Project Execution Plan and defining the governance and management structures for NEON.

Fostering Technology and Cyberinfrastructure Development: Two workshops were conducted in coordination with the Ocean Observatories Initiative, and the Long Term Ecological Research program to define the cross cutting needs, challenges, and opportunities in sensors and cyber infrastructure. The workshops addressed emerging issues of interoperability among evolving observing systems, leveraging emerging technologies and research frontiers, fostering collaboration, and stimulating robust technology development.

Major milestones for NEON are listed below.

FY 2004 Milestones:
- Held a prospective PI meeting for the NEON Design Consortium and Project Office competition
- Awarded NEON Design Consortium and Project Office (Completed)
- Held six workshops to formulate science questions from the NRC Grand Challenges
- Held two workshops to identify and evaluate options for NEON governance and management

FY 2005 Milestones:
- Establish NEON Design Consortium and Project Office (completed)
- Appoint NEON Advisory Board and Design Consortium subcommittees (completed)
- Refine the NEON requirements, facilities and infrastructure reference design, and develop the governance and management structures for NEON. (Ongoing)
- Research and development on environmental sensors, networks, and cyber tools that will advance the development of NEON as a network of nationally deployed infrastructure (Ongoing)

[3] These reports can be found on the National Academies Press website:
NEON: Addressing the Nation's Environmental Challenges (http://www.nap.edu/books/0309090784/html/)
Grand Challenges in Environmental Challenges (http://www.nap.edu/books/0309072549/html/)

FY 2006 Milestones:
- Final NEON Science Plan and Requirements
- Baseline Networking and Informatics Plan and Review
- Preliminary Project Execution Plan for NEON research infrastructure
- Evaluation of the NEON Design Consortium and Project Office
- Research and development on environmental sensors, networks, and cyber tools that will advance the development of NEON as a network of nationally deployed infrastructure

FY 2007 Milestones:
- Final Project Execution Plan for NEON
- Baseline NEON Infrastructure and Review
- Initiate construction of NEON networking, informatics, and education, training and outreach infrastructure
- Initiate construction of NEON research infrastructure
- Research and development on environmental sensors, networks, and cyber tools for NEON

FY 2008 – FY 2011 Milestones:
- Continued construction of NEON research, networking, informatics, and education, training and outreach infrastructure
- Research and development on environmental sensors, networks, and cyber tools for NEON

Funding Profile: In FY 2005, NSF requested $12.0 million in the MREFC Account and $4.0 million in R&RA to baseline and develop the final design for NEON infrastructure and initiate construction of NEON networking and informatics infrastructure. While the FY 2005 omnibus appropriation did not provide MREFC funding, Congress instructed NSF to continue NEON planning through the R&RA Account. In FY 2005 the NEON Design Consortium and Project Office was established to refine the NEON requirements, develop the facilities and infrastructure reference design, the preliminary baseline definition for networking and informatics, the infrastructure requirements for education, training, and outreach and design the governance and management structures for NEON.

In FY 2006, the NEON Design Consortium and Project Office will complete the final NEON Science Plan and Requirements, baseline the Networking and Informatics Plan, and review, and complete the preliminary Project Execution Plan for NEON.

Requested MREFC Funds for NEON

(Dollars in Millions)

FY 2006 Request	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	Total
$0.00	$12.00	$12.00	$20.00	$30.00	$26.00	$100.00

NEON Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation[1]		Operations & Maintenance		Totals		Grand Total
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1998	0.01						$0.01	$0.00	**0.01**
FY 1999	0.03								
FY 2000	0.17								
FY 2001	0.10						$0.10	$0.00	**0.10**
FY 2002	1.00						$1.00	$0.00	**1.00**
FY 2003	0.92						$0.92	$0.00	**0.92**
FY 2004	3.60						$3.60	$0.00	**3.60**
FY 2005 Current Plan	5.95						$5.95	$0.00	**5.95**
FY 2006 Request	6.00						$6.00	$0.00	**6.00**
FY 2007 Estimate	6.00			12.00			$6.00	$12.00	**18.00**
FY 2008 Estimate	4.00			12.00	4.00		$8.00	$12.00	**20.00**
FY 2009 Estimate	4.00			20.00	8.00		$12.00	$20.00	**32.00**
FY 2010 Estimate	3.00			30.00	16.00		$19.00	$30.00	**49.00**
FY 2011 Estimate	2.00			26.00	20.00		$22.00	$26.00	**48.00**
Subtotal, R&RA	$36.78		$0.00		$48.00		$84.58		
Subtotal, MREFC		$0.00		$100.00		$0.00		$100.00	
Total, Each Stage		**$36.78**		**$100.00**		**$48.00**			**$184.58**

NOTE: The expected operational lifespan of this project is 30 years after construction is complete in FY 2011. A steady state of $20.0 million in operations support is anticipated by FY 2011. Annual operations and maintenance estimates for FY 2008 and beyond are developed strictly for planning purposes and are calculated as 20% of the estimated MREFC costs summed to that year. They will be updated as new information becomes available.

[1]FY 2007-11 implementation funding level will be contingent upon the Project Execution Plans for research infrastructure, networking and informatics, and education, outreach, and training.

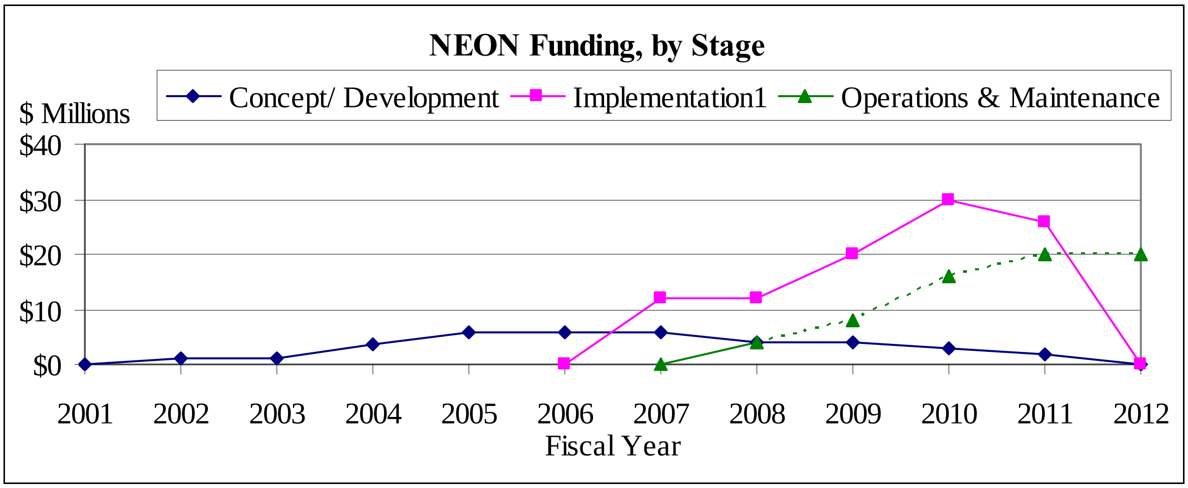
Information pertaining to the data in the table is provided below.

- Concept/Development: In FY 2001-2003 workshops were funded to address the information technology needs, instrument array design and development, and data, information management architectures and synthesis of a region-based implementation of NEON. In FY 2003, the National Research Council's study endorsed the concept for a continent-wide implementation of NEON along with a central governance management structure. In FY 2004 a solicitation was released and an award made for the NEON Design Consortium and Project Office to provide the central management for NEON planning and to develop the preliminary project execution plan for a continental implementation strategy based on nationally significant ecological research challenges. In FY 2005, support continues for the NEON Design Consortium and Project Office to continue the preliminary project execution plan development and

NEON will apply emerging technologies (sensor, analytical, communication and information) to investigate the structure and dynamics of U.S. ecosystems and to forecast biological change. *Credit: The Bigfoot Project* www.fsl.orst.edu/larse/bigfoot) funding for NEON research and development on enabling technologies. In FY 2006, support will be provided to complete the final NEON Science Plan and Requirements, baseline the Networking and Informatics Plan and review, and complete the preliminary Project Execution Plan. Support will be continued for research and development of NEON enabling technologies from FY 2006 through the construction phase.

- Implementation: Total construction costs for NEON will be determined from the project execution plan developed for research, networking, and education infrastructure. In FY 2007, MREFC funds will be used to baseline and develop the final design for NEON infrastructure. Initial construction of NEON networking and informatics infrastructure will begin in FY 2007.

- Operations and Maintenance: Initial operations support will commence in FY 2008 as construction is completed on NEON networking, and informatics infrastructure. Operations and maintenance support will increase as NEON is brought online.



Future Science Support: Along with direct operations and maintenance support for NEON, NSF will support research performed using the NEON platform through ongoing research and education programs. The annual support for such activities once the research platform reaches full operations is estimated to be at least $12.0 million annually.

It is estimated that 1,400 field biologists will use NEON annually. A larger number of scientists, students, resource managers and decision makers will make use of NEON data, both directly and indirectly, through the network capabilities and data distribution and sharing technologies via the network and the internet.

George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES)

Final MREFC funding for NEES was appropriated in FY 2004. For information on this project, please see the Facilities chapter of this document.

Rare Symmetry Violating Processes

Project Description: A collaboration representing almost 30 institutions from the U.S., Canada, Switzerland, Italy, Japan, and Russia submitted a proposal through New York University for RSVP in FY 2000. This project will address new physics at the cutting edge of the sensitivity frontier and represents an investment that is complementary to that at the energy frontier (e.g., the Large Hadron Collider).

RSVP is an NSF-funded, university-led project that uses the national laboratory infrastructure developed by the U.S. Department of Energy (DOE) to advance the frontiers of particle physics. As such, RSVP represents a new paradigm for university/national laboratory collaboration and for NSF/DOE interagency collaboration in this field. Significant effort is being invested early in RSVP planning to define the appropriate management interfaces in order to reflect the roles and responsibilities of all the parties – government agencies, project management, universities, national laboratories, scientists, students, and technicians.

The RSVP experiments address two great mysteries, the predominance of matter over antimatter in the Universe today and the difference between the electron and the muon, the former by studying matter-antimatter symmetry (CP)-violating decays of K-mesons and the latter by searching for muon-to-electron conversion. By extending current sensitivities for these rare processes by orders-of-magnitude, RSVP could shed light on the existence of atomic matter in the Universe, the nature of dark matter, and even provide evidence for superstrings.

At the sensitivity frontier, reactions occur very rarely. Therefore, the RSVP experiments will be performed at the DOE's Brookhaven National Laboratory (BNL) Alternating Gradient Synchrotron (AGS), which has the highest beam intensity in the world at the energies required. The AGS is currently being used as an injector for the Relativistic Heavy Ion Collider (RHIC), for which it is needed only a few hours per day.

Principal Scientific Goals: RSVP consists of two complementary experiments:

- A search for the conversion of muons to electrons that would be able to detect this process even if it is as rare as 1 event for 10^{17} detected muons.
- A study of the decay of a kaon to a pion, a neutrino, and an anti-neutrino.

Recently, a High Energy Physics Advisory Panel (HEPAP) subpanel produced the report "Quantum Universe, The Revolution in 21st-Century Particle Physics." Quantum Universe identified nine interrelated questions that define the field. RSVP addresses three of these questions. The report also re-affirmed RSVP experiments as integral to the national program for addressing the fundamental questions that define elementary particle physics.

Principal Education Goals: RSVP will be used as a vehicle to enhance education at the K-16 levels, to stimulate public interest in science, and to involve members of underrepresented groups. Planning for education and outreach activities is part of the scope of the RSVP FY 2004 pre-construction awards. BNL and SUNY-Stony Brook are contributing to this planning. In addition to new education and outreach activities, RSVP will also participate in other successful educational efforts such as QuarkNet and Cyberinfrastructure Grid Projects such as iVDGL.

Partnerships and Connections to Industry: RSVP will have strong connections to industry through instrument development and construction and through magnet construction.

Management and Oversight: RSVP will be a university-led, NSF-supported activity, running at a DOE laboratory, with NSF providing only incremental AGS operating costs. AGS "landlord responsibilities" rest with the DOE Nuclear Physics program, as defined in a Memorandum of Understanding.

Management and oversight of RSVP will be provided through the Physics (PHY) Division in the Mathematical and Physical Sciences (MPS) Directorate. A designated Program Officer in PHY has been assigned to maintain primary oversight responsibility, with assistance from the Physics Project Advisory Team (PHY/PAT) with representation from MPS, the Office of Budget, Finance and Award Management, the Office of General Counsel, the Office of International Science and Engineering and the Office of Legislative and Public Affairs. The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance.

A Project Execution Plan (PEP) is being developed. The successful experience of the U.S. LHC detector project, now nearing completion, provides a model for the management of large projects involving leadership by university researchers and partnership with DOE laboratories.

Current Project Status: Planning for RSVP has been conducted with NSF support beginning in FY 2001. Significant concept and design work was carried out with DOE support prior to this. The activities to date include R&D for the technology needed for the project, simulations of the data expected, and design of major components. This work was largely carried out by the scientific collaborations that developed the major RSVP experiments through project managers hired by specific sub-projects.

In FY 2004, a Project Director was appointed to provide overall management of the RSVP project. The Project Director set up an RSVP Project Office at Columbia University and recruited a Deputy Project Director. Both have extensive experience in project management. The Project Office organized a series of focused reviews by external experts to examine the subsystems of RSVP that they identified as representing the most significant cost and schedule drivers. This series of reviews will be completed by the spring of 2005, with its final product being a detailed technical, cost, and schedule baseline design for RSVP. The baseline design will provide the basis for NSB approval to initiate the construction project. Milestones for the construction and operation of RSVP will be specified in detail in the baseline design.

The preliminary milestones listed below will be revised as the project's baseline is established.

FY 2005 Milestones:
- Complete cost, schedule, and technical baseline reviews of all subsystems.
- Complete magnet engineering design.
- Establish final baseline for cost, schedule, and scope.
- Submit baseline for NSF/NSB review and approval to initiate construction.

FY 2006 Milestones:
- Finalize and document designs.
- Complete detailed project execution plan.
- Initiate procurement process.
- Initiate construction of subsystems.
- Conduct NSF oversight review.

FY 2007 Milestones:
- Complete construction of AGS beams for RSVP.
- Begin detector installation.
- Complete technical design work.
- Conduct NSF oversight review.

FY 2008 Milestones:
Complete detector construction and installation.
Complete delivery and installation of magnet coils.
Conduct magnet acceptance tests.
Complete testing of detector components.
Conduct NSF oversight review.

FY 2009 Milestones:
Complete construction and installation.
Perform engineering runs.
Conduct NSF oversight review.

FY 2010 Milestones:
Initiate first data runs.
Conduct NSF oversight review.

Funding Profile: Through FY 2004, $10.0 million has been provided for concept and design development of RSVP through the R&RA Account. The total construction cost of the project is estimated at $158.41 million over six years, an increase over the original estimate of $13.50 million that results from stretching the proposed construction schedule from five to six years and taking into account the reduced initial year funding in the FY 2005 appropriated level. The current funding plan is presented below.

Appropriated and Requested MREFC Funds for RSVP
(Dollars in Millions)

FY 2005	FY 2006 Request	FY 2007	FY 2008	FY 2009	FY 2010	Total
$14.88	$41.78	$48.00	$30.75	$15.00	$8.00	$158.41

RSVP Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 2001	0.90						$0.90	$0.00	**0.90**
FY 2002	1.20						$1.20	$0.00	**1.20**
FY 2003	1.90						$1.90	$0.00	**1.90**
FY 2004	6.00						$6.00	$0.00	**6.00**
FY 2005 Current Plan	2.30			14.88			$2.30	$14.88	**17.18**
FY 2006 Request				41.78			$0.00	$41.78	**41.78**
FY 2007 Estimate				48.00			$0.00	$48.00	**48.00**
FY 2008 Estimate				30.75	5.30		$5.30	$30.75	**36.05**
FY 2009 Estimate				15.00	8.50		$8.50	$15.00	**23.50**
FY 2010 Estimate				8.00	8.50		$8.50	$8.00	**16.50**
FY 2011 Estimate					13.50		$13.50	$0.00	**13.50**
FY 2012 Estimate					14.30		$14.30	$0.00	**14.30**
FY 2013 Estimate					14.80		$14.80	$0.00	**14.80**
FY 2014 Estimate					15.20		$15.20	$0.00	**15.20**
Subtotal, R&RA	$12.30		$0.00		$80.10		$92.40		
Subtotal, MREFC		$0.00		$158.41		$0.00		$158.41	
Total, Each Stage		**$12.30**		**$158.41**		**$80.10**			**$250.81**

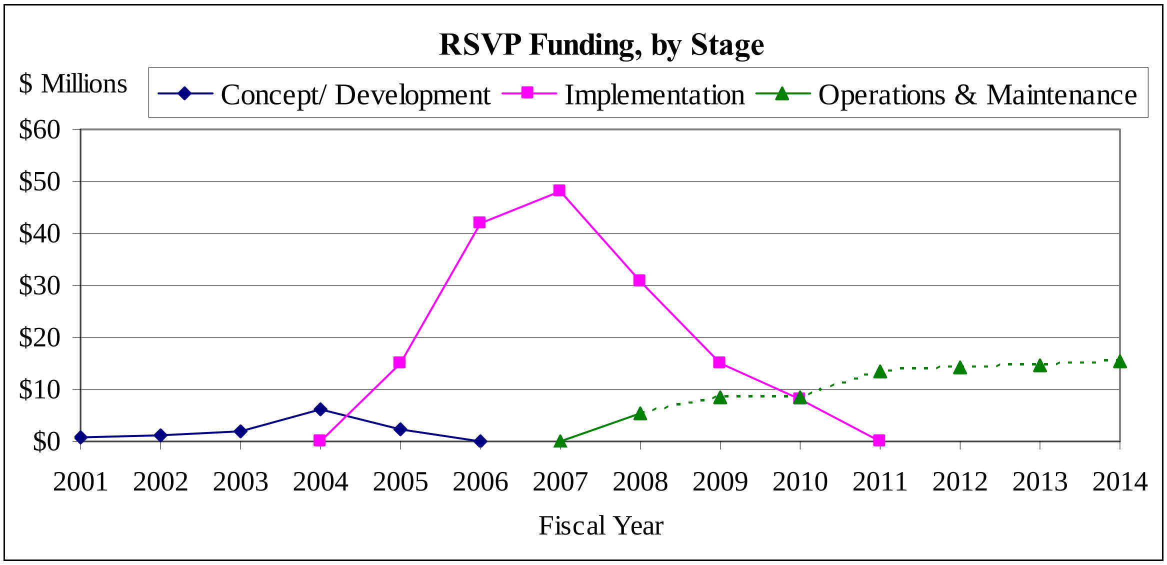
NOTE: Operations estimates for FY 2008 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available.

Information on the data in the table is provided below.

- Concept/Development: The major tasks for FY 2005 include finalizing the cost, schedule, and scope baseline that will be used to manage the construction project and completion of a technical design and documented cost estimate for the major solenoid magnet system required for the muon-to-electron conversion detector. This work is now under the direction of the Project Director and Deputy Project Director appointed in FY 2004. All R&D and planning work is under periodic review by technical panels convened by the Project Director. NSF will convene an independent panel of experts to review the baseline plan prior to seeking NSB approval for initiation of construction.

- Implementation: Funding during this phase of the project will provide support for the construction of two beamlines at the AGS and associated beam instrumentation at the site. For the K-meson decay detector, universities will construct the critical beam, catcher, radiator and veto counter assemblies. The muon-to-electron conversion experiment involves novel, state-of-the-art superconducting magnets that will be constructed by industry after a full technical design is complete. Other components of the latter experiment, e.g., collimators, targets, beam stops, and calorimeters, will be constructed at universities.

- Operations and Maintenance: Support for operations and maintenance will phase in as the project is under construction. Initial funds provided through R&RA in FY 2004 supported project managers for the three RSVP sub projects and a project management office. Test beam operations are expected to begin in FY 2008 and will ramp up as detector elements are completed. Operations costs will rise to an estimated level of $15 million in FY 2013. A baseline estimate and NSF review of these costs will be conducted in FY 2006.



Future Science Support: Along with direct support for operations and maintenance, NSF will also support physics research performed at this facility, through ongoing physics research and education grants. The baseline to be completed in FY 2005 will quantify these costs, which are subject to review and concurrence by the NSF.

Other Project Support: Canadian RSVP funding consists of three parts from the National Sciences and Engineering Council of Canada (NSERC), the Canada Foundation for Innovation (CFI), and the TRIUMF Laboratory, Canada's national laboratory for particle and nuclear physics, operated as a joint venture by a consortium of Canadian universities. To date, approximately $7.0 million in project support has been secured by Canadian research groups from these institutions.

Scientific Ocean Drilling Vessel

Project Description: This project is to support the contracting, conversion, outfitting and acceptance trials of a deep-sea drilling vessel for long-term use in a new international scientific ocean drilling program. Commercial drillships are not routinely configured or equipped to meet the requirements of scientific research. It will be prepared for year-around operations and will be capable of operating in all ocean environments. The vessel will accommodate a scientific and technical staff of approximately 50. The converted drillship will provide the United States facility contribution to the Integrated Ocean Drilling Program, which began on 1 October 2003. The IODP is co-led by the NSF and the Ministry of Education, Culture, Sport, Science and Technology (MEXT) of Japan. European and Asian nations are also participating in the program.

Principal Scientific Goals: The IODP will recover sediment and crustal rock from the seafloor using scientific ocean drilling techniques, and emplace observatories in drillholes to study the deep biosphere, the flow of fluids in sediments and the crust, the processes and effects of environmental change, and solid earth cycles and geodynamics. MEXT will provide a heavy drillship for deep drilling objectives of the programs. NSF will provide a light drillship and science support services for high-resolution studies of environmental and climate change, observatory and biosphere objectives.

Pictured above is the *JOIDES Resolution*, the current drillship of the Ocean Drilling Program. MREFC funds are requested in FY 2007 to modify this or a similar ship to provide the Integrated Ocean Drilling Program with light drillship capability. *Credit: Joint Oceanographic Institutions (JOI).*

Principal Education Goals: To engage students and the public in geoscience discovery through distance learning initiatives, preparation of classroom modules on IODP research initiatives, and outreach displays at museums and educational/teaching institutions.

NSF Management and Oversight: The project is managed and overseen by a project manager in the Division of Ocean Sciences in the Directorate for Geosciences. The project manager receives advice and oversight support from a NSF Project Advisory Team, which consists of representatives from GEO, the Office of Polar Programs, the Office of Budget, Finance and Award Management, and the Office of General Counsel. The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. A conversion oversight committee has been established to provide technical, financial and scheduling recommendations and advice for the SODV project.

Current Project Status: In September 2003, NSF awarded a contract to Joint Oceanographic Institutions, Inc. (JOI) for IODP drilling operations, which included as one task the planning and implementation of the SODV project. JOI has issued an RFP to acquire, upgrade and operate a commercial vessel for scientific ocean drilling and Contract Award is anticipated by mid-2005. The SODV Project received $14.88 million in FY 2005. Engineering design, science lab development and long lead item equipment procurement activities will be the primary FY 2005 SODV activities. The project schedule is outlined below:

FY 2004 Milestones:
- Solicited Drilling Contractor capabilities, recommendations, interest (Completed)
- Developed initial MREFC Project Execution Plan (Completed)
- Prepared RFP for Drilling Contractor (Completed)

FY 2005 Milestones:
- Release RFP for SODV Drilling Contractor and Evaluate Responses
- Determine Competitive Range of Offerors – Initiate SODV MREFC project
- Vessel Decision and Drilling Contractor Award
- Initiate Engineering Design Phase
- Initiate Long Lead Item Equipment Procurement

FY 2006 Milestones:
- Complete Engineering Design Phase
- Issue Drilling Contractor Solicitation for Conversion Shipyard
- Shipyard Contract Award
- Initiate Shipyard Conversion of Drillship

FY 2007 Milestones:
- Outfit Scientific Laboratories
- Vessel Acceptance Trials
- Vessel Commissioning and Acceptance –Terminate SODV MREFC project

Vessel Scientific Operations Begin

Funding Profile: Planning through FY 2004 cost approximately $3.60 million. In FY 2005, approximately $5.40 million will be provided to initiate contract activity, planning and design. In FY 2005 - FY 2007, approximately $110.0 million of funds from the MREFC account will be required for conversion/equipping/testing of the drillship.

Appropriated and Requested Funds for SODV
(Dollars in Millions)

FY 2005	FY 2006	FY 2007	Total
$14.88	$57.92	$42.20	$115.00

SODV Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	**Total**
FY 2000	0.10						$0.10	$0.00	**0.10**
FY 2001	0.20						$0.20	$0.00	**0.20**
FY 2002	0.30						$0.30	$0.00	**0.30**
FY 2003	1.50				1.80		$3.30	$0.00	**3.30**
FY 2004	2.10				33.65		$35.75	$0.00	**35.75**
FY 2005 Current Plan	0.50	4.88		10.00	27.22		$27.72	$14.88	**42.60**
FY 2006 Request				57.92	30.00		$30.00	$57.92	**87.92**
FY 2007 Estimate				42.20	40.00		$40.00	$42.20	**82.20**
FY 2008 Estimate					54.70		$54.70	$0.00	**54.70**
FY 2009 Estimate					58.60		$58.60	$0.00	**58.60**
FY 2010 Estimate					60.70		$60.70	$0.00	**60.70**
Subtotal, R&RA	$4.70		$0.00		$306.67		$311.37		
Subtotal, MREFC		$4.88		$110.12		$0.00		$115.00	
Total, Each Stage		**$9.58**		**$110.12**		**$306.67**			**$426.37**

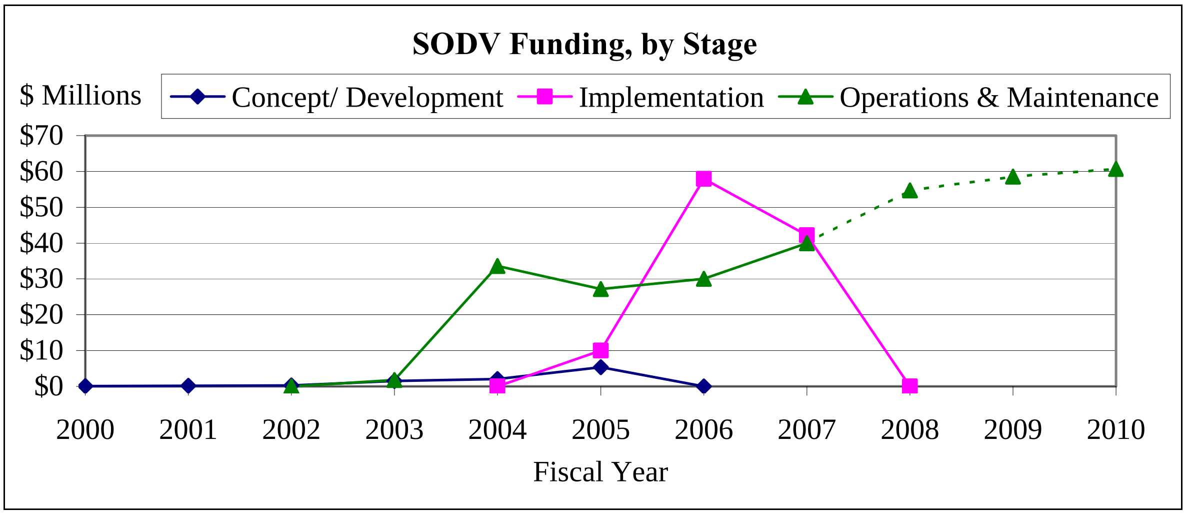
R&RA operations funds in 2005 and 2006 will support drilling operations from the *JOIDES Resolution*. A steady state of about $55 million in operations support is expected to occur beginning in FY 2008 as the SODV vessel begins full operations, but these estimates are developed based on current cost profiles and will be updated as new information becomes available. The expected operational lifespan of this project is 15 years, beginning in FY 2007.

Information pertaining to the data in the table is provided below.

- Concept/Development: Activities supported by the R&RA Account began immediately upon awarding the contract in September 2003. This included: coordination and planning efforts necessary for SODV planning with Japanese partners and the scientific user community; development of the SODV Project Execution Plan by the contractor; scoping of the environmental requirements and permitting issues for the SODV drilling vessel; initiation of planning for shipboard and shore-based support of the program, including laboratory configuration, core storage, data management systems, and logistics.

- Implementation: The MREFC funds in FY 2005-07 are required for the vessel conversion, including construction of laboratory and other scientific spaces, equipping of laboratories with instrumentation, computers and support equipment, and modifications to the drilling equipment of the contracted vessel. Funding is also required for vessel lease during modification and for sea-trial operations in FY 2007.

- Operations and Maintenance: Following conversion, the drillship will be managed, operated and maintained by JOI (and subcontractors) with funding from the R&RA account, for use in the Integrated Ocean Drilling Program. Operations cost estimates are based on NSF experience in management of the IODP precursor, the Ocean Drilling Program. Specific missions will be reviewed and prioritized by a science advisory committee composed of representatives from IODP member nations. Significant coordination and integration of planning, procedures and operations is occurring with Japanese operators of their drillship in the IODP.



Future Science Support: Along with direct operations and maintenance support for IODP, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $31 million.

South Pole Station

Project Description: South Pole Station Modernization (SPSM) provides a new station to replace the current U.S. station at the South Pole, built 30 years ago and currently inadequate in terms of capacity, efficiency, and safety. The new station is an elevated complex with two connected buildings, supporting 150 people in the summer, and 50 people in the winter.

Principal Scientific Goals: Support science at the South Pole and maintain U.S. presence at the South Pole in accord with U.S. policy.

Principal Education Goals: Support education associated with the research projects at the South Pole.

Connections to Industry: There are approximately 385 separate subcontractors for supplies and technical services. The U.S. Antarctic Program prime support contractor is Raytheon Polar Services Company (RPSC).

Progress continues on the new U.S. research station at the South Pole. This season marked completion of all steel and panel enclosure work for all wings. On January 30, 2005, the project accepted for conditional occupancy the wings for housing, science space, and emergency power. *Credit: USAP*

Management and Oversight: The Office of Polar Programs (OPP) has the overall management responsibility for SPSM, including development of the basic requirements, design, procurement and construction. OPP has contracted for procurement and construction management for all phases of the project, including design reviews of all drawings and specifications; conformance of the designs and procurements with established standardization criteria; assistance in establishing functional interfaces; transition from the existing to the new facilities; and systems integration. Naval Facilities Engineering Command, Pacific Division (PACDIV) selects, monitors, and manages architectural and engineering firms for design, post-construction services, and construction inspection for the project. The project status, including cost expenditures and cost projections, is monitored on a periodic basis by OPP staff and the project's Project Advisory Team with members from OPP and the Office of Budget, Finance and Award Management. The NSF Deputy Director for Large Facility Projects is a member of the PAT and provides advice and assistance.

Current Project Status: The original estimate for SPSM was $127.90 million. NSB approved a change in project scope, increasing station capacity from 110 people to 150 people, as well as a project schedule extension, increasing the cost estimate to $133.44 million (+$2.52 million for increased scope; +$3.02 million due to weather-induced schedule delays). Weather delays in previous years adversely impacted planned material deliveries resulting in revised schedules. The estimated projection has been for conditional acceptance (i.e., occupation and operations) of the entire station by the end of FY 2007, with demolition/retrograde of the old station and work on punchlist items occurring in FY 2008. The current status of the project, both schedule and budget, is currently under review. The milestones shown below will be updated based on the new projections.

Activity	Procurement	Transport to Antarctica	Airlift to South Pole	Start Construction	Conditional Acceptance
Vertical Circular Tower	FY98	FY99	FY99/00 (00)	FY00 (01)	FY02
Quarters/Galley	FY98	FY99	FY00/FY01	FY01 (02)	FY03
Sewer Outfall	FY98	FY99	FY00	FY01	FY02 (01)
Fuel Storage (100K gallons)	FY98	FY98	FY99	FY99	FY99
Medical/Science	FY99 (98)	FY00 (99)	FY01/02 (00)	FY02	FY04
Communications/Administration	FY99 (98/99)	FY01 (00)	FY02/03 (01)	FY03 (02)	FY05 (03)
Dark Sector Lab	FY98	FY99	FY99/00 (00)	FY00 (01)	FY04 (01)
Water Well	FY00 (98)	FY01 (99)	FY01/02 (00)	FY02 (01)	FY02
Remote RF Building	FY99 (98/99)	FY00	FY01	FY01 (02)	FY01 (03)
Emergency Power/Quarters	FY99	FY01	FY02/03 (01/02)	FY03	FY05
Liquid nitrogen and helium facility	FY02 (99)	FY03 (00)	FY04 (01)	FY04 (02)	FY04 (03)
Quarters/Multipurpose	FY99 (00)	FY02 (01)	FY04 (02/03)	FY05	FY06
Electronic Systems and Communications	FY00/03 (99/00)	FY01/04 (00/01)	FY01/05 (01/02)	FY01 (03)	FY06 (04)
Warehousing, SEH and Waste Management	FY99 (01)	FY02/03 (02)	FY04 (03)	FY06 (04)	FY07 (05)
Station Equipment	FY02/03 (01)	FY03/04 (03)	FY04/05 (04)		FY05

<u>Funding Profile</u>: SPSM has received appropriations totaling $133.78 million through FY 2004, exceeding the most recent NSB-approved cost estimate of $133.44 million. Using the last updated schedule, the estimated total cost of SPSM is $136.96 million. An updated project cost and schedule review will be completed shortly after the end of the 2004/2005 operating season. No funds are being requested in for FY 2006.

Appropriated and Requested MREFC Funds for SPSM

(Dollars in Millions)

FY 2003 and Prior Years	FY 2004	FY 2005 Current Plan	FY 2006 Request	Estimated Future Requests	Total
$132.49	$1.29	$0.00	$0.00	$3.18	$136.96

Advance funding provided in the project's early years made possible advance bulk buys of materials, which is ultimately more cost-efficient. However, this project's overall outlay is relatively slow due to the unusual logistics and shortened Antarctic season. As a result, the project has carried over fairly significant amounts each year since FY 1998, resulting in obligations that are significantly lower than appropriated amounts.

The following funding profile chart includes actual obligations for past years and anticipated obligations for future years. SPSM expenditures to date total $116.13 million, through the first quarter of FY 2005.

South Pole Station Modernization Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand Total**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1997 & Earlier	16.40						$16.40		**16.40**
FY 1998				24.93				$24.93	**24.93**
FY 1999				4.28				$4.28	**4.28**
FY 2000				15.49				$15.49	**15.49**
FY 2001				10.14				$10.14	**10.14**
FY 2002				15.03				$15.03	**15.03**
FY 2003				12.65				$12.65	**12.65**
FY 2004				21.03				$21.03	**21.03**
FY 2005 Current Plan				16.98				$16.98	**16.98**
FY 2006 Request				10.00				$10.00	**10.00**
FY 2007 Estimate				2.91	15.00		$15.00	$2.91	**17.91**
FY 2008 Estimate					15.38		$15.38		**15.38**
FY 2009 Estimate					15.76		$15.76		**15.76**
Subtotal, R&RA	$16.40				$46.14		$62.54		
Subtotal, MREFC				$133.44				$133.44	
Total, Each Stage	**$16.40**		**$133.44**		**$46.14**				**$195.98**

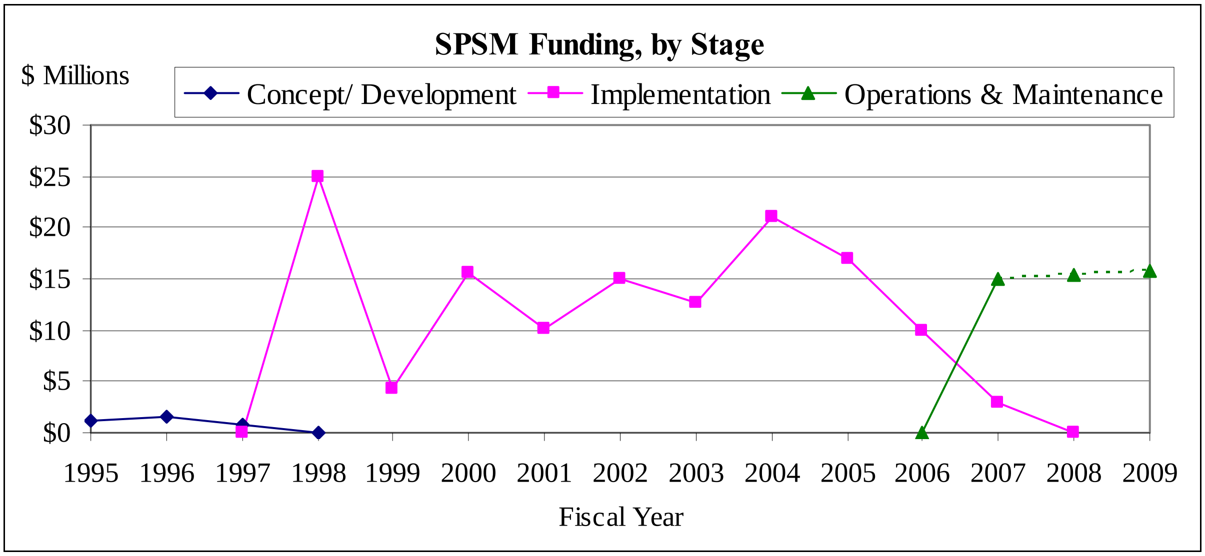
NOTE: A steady state of operational support is anticipated at $15 million by FY 2007, slightly higher than the current operational costs. The expected lifespan of the modernized station is 25 years, through FY 2031. Operations estimates for FY 2007 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available.

Information on the data in the table is provided below.

- Concept/Development: Design, development, planning and closely related activities in support of this project included preparation of more than 40 engineering studies and reports. The documents ranged widely in subject matter including subjects such as snowdrift minimization modeling, detailed analysis of power and heating requirements, preparation of a draft Environmental Impact Statement, energy conservation measures, efficiency and maintainability of diesel generators, fuel storage support system evaluation, design code criteria matrix, concept for signal/communication systems, gray-water system evaluation, minimization of ventilation requirements, control of diesel engine exhaust emissions, and jacking plan and concept.

- Implementation: Funding supports construction of an elevated station complex with two connected buildings, supporting 150 science and support personnel in the Austral summer, and 50 science and support personnel in the winter. Costs include materials, labor, logistics for transportation of all material and personnel to the South Pole, construction support, inspection, and equipment, as well as demolition and disposal of the existing station.

- Operations and Maintenance: This support represents the continued presence of a U.S. station at South Pole rather than new funds. Operational costs of the modernized station are expected to be higher than operational costs of the current station, with some lower costs due to efficiencies gained, and some higher costs due to increased station size and increases in Science Support and Information Systems. A steady state of operational support is anticipated at $15.0 million by FY 2007. The expected lifetime of the modernized station is 25 years, through FY 2031. These estimates are currently being reviewed to improve accuracy, taking into account estimated station population and cargo loads.



Future Science Support: Along with direct operations and maintenance support for South Pole Station, NSF will support science and engineering research through ongoing research and education programs. The annual support for such activities is currently estimated to be approximately $8.0 million.

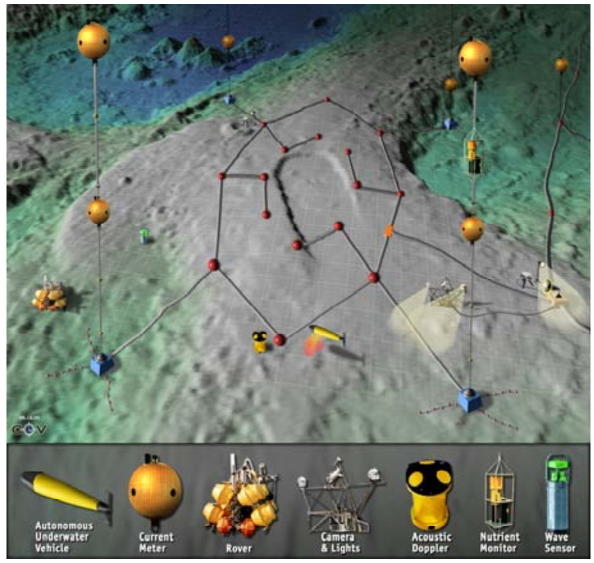
Terascale Computing Systems

Final MREFC funding for Terascale Computing Systems was appropriated in FY 2004. For information on this project, please see the Facilities chapter of this document.

SECOND PRIORITY: NEW STARTS IN FY 2007 AND FY 2008

Ocean Observatories Initiative

Project Description: This project will construct an integrated observatory network that will provide the oceanographic research and education communities with continuous and interactive access to the ocean. The OOI will have three elements: 1) a global-scale array of relocatable deep-sea buoys, 2) a regional-scaled cabled network consisting of interconnected sites on the seafloor spanning several geological and oceanographic features and processes, and 3) an expanded network of coastal observatories, developed through new construction or enhancements to existing facilities. The primary infrastructure for all components of the OOI consists of an array of seafloor junction boxes connected to cables running along the seafloor to individual instruments or instrument clusters. Depending upon proximity to the coast and other engineering requirements, the junction box is either terminated by a long dedicated fiber-optic cable to shore, or by a shorter cable to a surface buoy that is capable of two-way communications with a shore station. The observatory infrastructure of the OOI will be operated as a shared-use facility with open community access to data.



Example of a seafloor cabled observatory experimental site, part of the Ocean Observatories MREFC project. Moorings from seafloor nodes extend observational capabilities from the seafloor and below to within the water column. Associated instrumentation including underwater vehicles are also shown. *Credit: Division of Ocean Sciences, NSF.*

<u>Principal Scientific Goals</u>: Scientific problems requiring OOI infrastructure are broad in scope and encompass nearly every area of ocean science. Once established, seafloor observatories will provide earth, atmospheric, and ocean scientists with unique opportunities to study multiple, interrelated processes over timescales ranging from seconds to decades; to conduct comparative studies of regional processes and spatial characteristics; and to map whole-earth and basin scale structures. This project will establish facilities to meet the following goals: continuous observations at frequencies from seconds to decades; spatial scales of measurement from millimeters to kilometers; high power and bandwidth capabilities as well as two-way data transmission for interactive experimentation; an ability to operate during storms and in harsh conditions; an ability to easily connect sensors, instruments, and imaging systems; profiling systems for cycling instruments up and down the water column, either autonomously or on command; docking stations enabling autonomous underwater vehicles to download data and recharge batteries; ability to assimilate data into models and make three-dimensional forecasts of the oceanic environment; means for making data available in real time to researchers, schools, and the public over the Internet; and low cost relative to the cost of building and maintaining ships and manned submersible systems.

<u>Principal Education Goals</u>: Scientific discoveries arising from the OOI will provide new opportunities for ocean education and outreach through the capabilities for real-time data transmission and, particularly, real-time display of visual images from the seafloor. Educational links will be made with GEO's Digital Library for Earth Science Education (DLESE), and the Division of Ocean Science's (OCE's) Centers for Ocean Science Education Excellence (COSEE). In addition, with the planned establishment of the National Integrated Ocean Observing System, there will be an unprecedented need for oceanographers skilled in the use and manipulation of large, oceanographic, time-series datasets. The facilities comprising the OOI will provide the ideal platforms to train this new generation of oceanographers.

<u>Partnerships and Connections to Industry</u>: Some of the component technologies that are part of the OOI are currently in use or in development as part of the telecommunication and exploration industries. These groups have been involved in conceptual design reviews of proposed OOI components and systems and will be important participants in the construction and implementation phase of the OOI.

<u>Management and Oversight</u>: The project will be managed and overseen by a program manager in OCE in the Directorate for Geosciences (GEO). The program manager will receive advice and oversight support from an NSF Project Advisory Team (PAT) that includes representatives from GEO, the Biological Science , Engineering, the Office of Budget, Finance and Award Management, the Office of International Science and Engineering, the Office of General Counsel, and the Office of Legislative and Public Affairs. The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. The management structure proposed for the acquisition and implementation phase of the OOI is based on a structure that has been successfully used by the Ocean Drilling Program. In this structure, management, coordination, and oversight of the OOI will be the responsibility of the Executive Director of the Ocean Observatory Project Office established through a cooperative agreement with NSF. This Director will be

accountable to an Executive Steering Committee under which will be established Scientific and Technical Advisory Committees. The Executive Steering and Advisory Committees will draw their membership from individuals with expertise in ocean observing science and engineering. The design of the OOI network and experiments utilizing OOI infrastructure will be selected on a peer-reviewed basis. This project will be coordinated with the National Integrated Ocean Observing System (IOOS) that will support operational mission objectives of agencies such as the National Oceanic and Atmospheric Administration (NOAA), Navy, the National Aeronautics and Space Administration (NASA), and the Coast Guard.

Current Project Status: Numerous community workshops have been held and reports written since 2000 to define the scientific rationale, determine the technical feasibility, and develop initial implementation plans for the OOI. These include two NRC reports as well as two reports for each of the three components of the OOI. These planning activities were followed by a large, multi-disciplinary workshop held in January 2004 to develop an initial science plan for the OOI across coastal, regional, and global scales. In March 2004 a cooperative agreement was awarded to establish the Ocean Observatory Project office. The primary tasks of this office are: to identify and facilitate committees for continued refinement of the OOI network design; to develop a consensus vision for the OOI organizational structure, governance, and operating plans; to identify and engage all constituencies of the ocean science research community in consensus-building activities; and to operate an interactive web site for communicating with the ocean science community in regard to OOI activities and planning. The Project Office has established an Executive Steering Committee that provides a direct link between Project Office planning and the research community.

Using R&RA funds, the Ocean Technology Program has continued to provide support for proposals whose goals are to ensure that the infrastructure needed to enable OOI experimentation is available for the implementation phase of the OOI. As part of this process, an announcement is being released by NSF to advance interactive observing technologies and understanding of the coastal benthic boundary layer. To accomplish this goal, one or more pilot/testbed study sites will be established to develop and enhance new and technologies are needed to investigate coastal processes at appropriate temporal and spatial scales. Furthermore, to continue community planning for OOI implementation, detailed conceptual proposals for ocean science research experiments are being solicited through the Ocean Observatories Project Office. These proposals will be used to further refine designs for OOI and to identify specific experimental instrumentation needs of the user community. A primary goal of this request is to determine the nature and cost of ocean observatory science and enabling infrastructure to be constructed though the OOI.

The construction schedule for this project is still under review and therefore the milestones listed below will likely be revised as the project's schedule is finalized.

FY 2005 Milestones:
- Project Management
  - Completion of OOI Science Plan
  - Release call for Community Experiments
  - Completion of OOI Internal Management Plan

FY 2006 Milestones:
- Project Management
  - Systems engineering review of OOI
  - Complete design of data management and archiving system
  - Completion of OOI Project Execution Plan
- Coastal Observatories
  - Issue Program Solicitation for establishment of coastal observing infrastructure

FY 2007 Milestones:
- Project Management
  - Submission of Project Execution Plan to Large Facilities Office
  - Implementation of data management and archiving system
- Deep-Sea Buoys
  - Design and testing of moored buoyed systems
- Regional Cabled Network
  - Cable-route surveys and planning
  - Issue Program Solicitation for establishment of regional cabled network

FY 2008 Milestones:
- Coastal Observatories
  - Issue Program Solicitation for establishment of coastal observing infrastructure
  - Construction and deployment of coastal observing infrastructure
- Deep-Sea Buoys
  - Design and testing of capabilities needed for buoy installation
- Regional Cabled Network
  - Design, inspection and testing of cables, connectors, nodes, and shore equipment
  - Purchase of fiber optic cable
  - Physical (hardware and software) system integration and testing prior to deployment
  - Preparation of shore facilities and installation of equipment

FY 2009 Milestones:
- Coastal Observatories
  - Issue Program Solicitation for establishment of coastal observing infrastructure
  - Construction and deployment of coastal observing infrastructure
- Deep-Sea Buoys
  - Design and testing of capabilities needed for buoy installation
  - Issue Program Solicitation for establishment of moored buoy infrastructure
- Regional Cabled Network
  - Installation and subsequent inspection of cable backbone section
  - Installation of science nodes on backbone section

FY 2010 Milestones:
- Coastal Observatories
  - Construction and deployment of coastal observing infrastructure
- Deep-Sea Buoys
  - Design and testing of capabilities needed for buoy installation
  - Installation of deep-sea buoys
  - Issue Program Solicitation for establishment of moored buoy infrastructure
- Regional Cabled Network
  - Testing and commissioning of backbone section

FY 2011 Milestones:
- Deep-Sea Buoys
  - Installation of deep-sea buoys
- Regional Cabled Network
  - Final system testing and commissioning

Funding Profile: NSF expects to spend approximately $30 million in concept and development activities through FY 2005. The total construction cost for OOI is $269.10 million beginning in FY 2007. Management, operations and maintenance will be funded through the R&RA Account.

Requested MREFC Funds for OOI

(Dollars in Millions)

FY 2007 Request	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	Total
$13.50	$42.00	$65.50	$66.90	$46.20	$35.00	$269.10

OOI Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 2003 & Earlier	15.50						$15.50	$0.00	**15.50**
FY 2004	3.00						$3.00	$0.00	**3.00**
FY 2005 Current Plan	4.00						$4.00	$0.00	**4.00**
FY 2006 Request	4.00						$4.00	$0.00	**4.00**
FY 2007 Estimate	4.00			13.50	3.00		$7.00	$13.50	**20.50**
FY 2008 Estimate				42.00	7.00		$7.00	$42.00	**49.00**
FY 2009 Estimate				65.50	12.00		$12.00	$65.50	**77.50**
FY 2010 Estimate				66.90	20.00		$20.00	$66.90	**86.90**
FY 2011 Estimate				46.20	30.00		$30.00	$46.20	**76.20**
FY 2012 Estimate				35.00	50.00		$50.00	$35.00	**85.00**
FY 2013 Estimate					50.00		$50.00	$0.00	**50.00**
Subtotal, R&RA	$30.50		$0.00		$172.00		$202.50		
Subtotal, MREFC		$0.00		$269.10		$0.00		$269.10	
Total, Each Stage		**$30.50**		**$269.10**		**$172.00**			**$471.60**

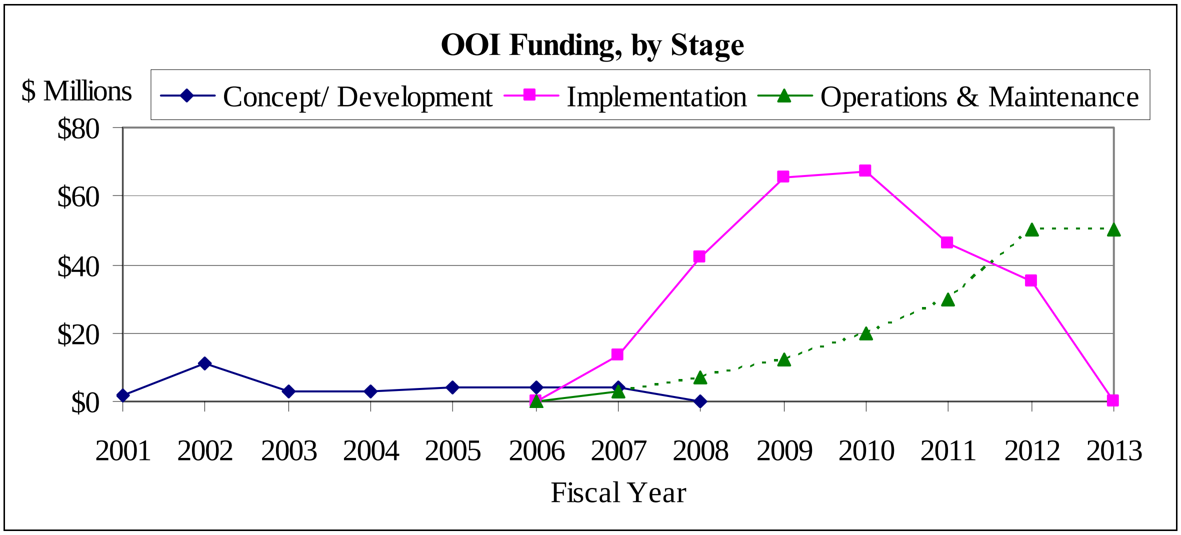
NOTE: A steady state of about $50.0 million in operations support is expected to occur in or about FY 2012. The expected operational lifespan of this project is 30 years, beginning in FY 2011. Operations estimates for FY 2008 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available.

Information pertaining to the data in the table is provided below.

- Concept/Development: R&RA funding has supported workshops to identify the observatory infrastructure needed to address the high priority science requiring time-series measurements. Specific design characteristics and platform requirements were developed through conceptual design reviews and best practices consultations with industry and academic experts. In FY 2002 a proposal from the Monterey Bay Aquarium Research Institute resulted in a $6.90 million award to establish an advanced cabled observatory in Monterey Bay to both advance scientific goals as well as create a valuable systems and instrumentation testbed for potential future cabled ocean observing systems. R&RA funds are also being used to support the ocean observatories project office.

- Implementation: Funds requested for this phase will construct a regional cabled network consisting of interconnected sites on the seafloor spanning several geological and oceanographic features and processes; several relocatable deep-sea buoys; and new construction or enhancements to existing facilities leading to an expanded network of coastal observatories.

- Operations and Maintenance: Access to OOI Infrastructure will be determined by peer review and all data will be openly accessible. OOI Infrastructure will be maintained and operated by the OOI Program Office. Future development of more complex sensor packages for the OOI infrastructure will be funded using R&RA funds within OCE. Observing platforms of the OOI will accommodate instrumentation from other agencies, international partners, as well as new instruments that are developed.



Future Science Support: Along with direct operations and maintenance support for the OOI, NSF will support research performed using this infrastructure through ongoing research and education programs. The annual support for such activities is estimated to be about $50 million, once the network is fully implemented.

Alaska Region Research Vessel

Project Description: The Alaska Region Research Vessel (ARRV) is proposed to replace the R/V *Alpha Helix*, which, at 39 years is the oldest ship in the national academic research fleet. At present, science activities in this region are limited by the capabilities of the R/V *Alpha Helix*, which cannot operate in ice, or in severe winter weather in the open seas. The ARRV will operate in the challenging waters of the Chukchi, Beaufort, and Bering Seas, as well as the open Gulf of Alaska, coastal Southeast Alaska and Prince William Sound.

As we strive to understand a variety of complex regional and global ecosystem and climate issues, the need to conduct research at the ice edge and in seasonal (up to three feet thick) ice has become increasingly urgent. The ARRV will provide improved access to the region, enabling further exploration to address critical issues. With an operating year of 275-300 days, the ARRV could accommodate upwards of 500 scientists and students at sea annually.

Principal Scientific Goals: Satellite observations have shown the perennial ice in the arctic thinning at 9 percent per decade, which will have major regional and global consequences. Research is urgently needed on topics ranging from climate change, ocean circulation, ecosystem studies and fisheries research to natural hazards and cultural anthropology. Most of these cutting edge science projects require an oceanographic platform in the Alaska region to conduct field research.

Principal Education Goals: The ARRV will provide a sophisticated and larger platform for scientists, graduate and undergraduate students to participate in complex multidisciplinary research activities and will train the next generation scientists with the latest equipment and technology. Broadband connections capable of relaying data including high definition video from tools such as remotely operated vehicles, which explore under the ice and the ocean depths, will bring research into the K-12 classroom and to the general public.

Connections to Industry: Research results facilitated by the ARRV will enhance Arctic climate variability predictions, including the opening up of Arctic global shipping trade routes as the ice continues to recede in the Arctic Ocean. Geophysical studies will optimize U.S. Arctic oil and gas exploration, and fisheries oceanography research will promote optimal management of the richest U.S. fishery resource, which is in the Bering Sea region.

An artist's rendition of the Alaska Region Research Vessel (ARRV), planned to replace the aging R/V *Alpha Helix*. The ice-strengthened ARRV would operate in the challenging seasonal ice covered Alaskan waters, expanding current capabilities in the region. *Credit: Glosten Associates, Inc*

Management and Oversight: The NSF Coordinator will be the Program Director for Ship Acquisition and Upgrade Program, Integrative Programs Section (IPS) in the Division of Ocean Sciences, with other staff in IPS providing program management assistance. The Section Head (IPS) and another Section member hold the Master's Certificate in Project Management through NSF-sponsored training. Internal oversight for the construction cooperative agreement will be provided by a Project Advisory Team (PAT) including staff from GEO, the Office of Budget, Finance and Award Management, and the Office of the General Counsel (OGC). The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. The Awardee will hire a Systems Integration Manager to establish and staff an Office to provide management oversight to the vessel construction phase and to report to the NSF Coordinator. In addition, the University-National Laboratory System (UNOLS) Fleet Improvement Committee, an external committee composed of representatives from the community that meets several times a year, will review progress and provide advice regarding vessel construction.

Current Project Status: Final model tank testing and data analysis were successfully completed in 2003. Results from model testing concluded that the current design has excellent sea-keeping and enhanced icebreaking capabilities. In addition, acoustic testing demonstrated that the vessel will have sufficient "quieting" characteristics to support unique fisheries research. Results from the design studies have been shared with the community on several occasions, offering opportunities for interactive exchanges to take place between potential vessel users and the naval architects. Following minor design adjustments based upon these inputs, the design phase was completed in 2004. A meeting of the Oversight Committee and agency representatives held at the Seattle offices of the Naval Architects (Glosten Associates) in December 2004 reviewed and accepted the final "contract design" document. This document provides the complete list of specifications and drawings from which a shipyard could make a construction bid. The next action will be for NSF to issue a solicitation for a cooperative agreement for the construction and operation of this ship.

The Federal Oceanographic Facilities Committee (FOFC) continues to endorse the ARRV as the next vessel needed to help renew the aging national academic research fleet, as they originally stated in their 2001 report (Charting the Future for the National Academic Research Fleet: A long-range plan for renewal) submitted to the National Ocean Research Leadership Council)[4].

Milestones for ARRV are outlined below:

FY 2006 Milestones:
- Prepare and issue a solicitation to build and operate the ARRV via a cooperative agreement.
- Select the winning proposal through an external merit review process.

FY 2007 Milestones:
- Establish the Systems Integration Office and issue the shipyard construction bid package.
- Adjudicate the construction bids and select the winner.
- Initiate vessel construction.
- Establish quarterly in depth reviews of construction progress.

FY 2008 Milestones:
- Continue construction of vessel.
- Continue detailed reviews of progress.
- Launch vessel, continue interior habitability and scientific outfitting.

FY2009 Milestones:
- Complete construction and scientific outfitting
- Undergo sea trials.
- Finalize acceptance and delivery of vessel to awardee.
- Incorporate vessel into the UNOLS ship scheduling process.
- Vessel begins operations on NSF and other agency funded scientific missions.
- NSF conducts final review of project.

Funding Profile: Recognizing from the outset that the R/V *Alpha Helix* was of marginal size and capability for Alaskan waters, replacement planning has been ongoing since the 1980s. NSF funded design studies in 1980 and 1995, but neither were implemented. After community-derived science mission requirements were developed in 1999, NSF has since funded the concept design, detailed design and model testing for a replacement vessel and is prepared to initiate a two-year construction phase.

Requested MREFC Funds for ARRV
(Dollars in Millions)

FY 2007 Request	FY 2008	Total
$49.32	$32.88	$82.20

[4] This report is available online: http://www.geo-prose.com/projects/fleet_rpt_2.html

ARRV Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand Total**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 2003 & Earlier	1.61						$1.61	$0.00	**1.61**
FY 2004	0.30						$0.30	$0.00	**0.30**
FY 2005 Current Plan	0.30						$0.30	$0.00	**0.30**
FY 2006 Request	0.30						$0.30	$0.00	**0.30**
FY 2007 Estimate				49.32			$0.00	$49.32	**49.32**
FY 2008 Estimate				32.88			$0.00	$32.88	**32.88**
FY 2009 Estimate					6.50		$6.50	$0.00	**6.50**
FY 2010 Estimate					6.70		$6.70	$0.00	**6.70**
Subtotal, R&RA	$2.51		$0.00		$13.20		$15.71		
Subtotal, MREFC		$0.00		$82.20		$0.00		$82.20	
Total, Each Stage		**$2.51**		**$82.20**		**$13.20**			**$97.91**

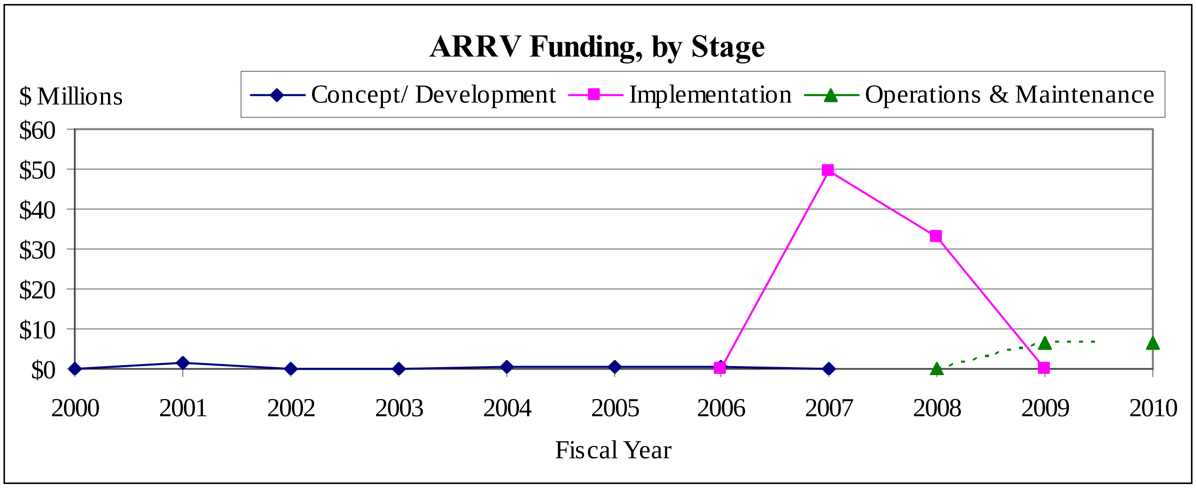
Ship Operations are estimated to be approximately $6 million per year. The expected operational service life of the ARRV is 30 years after construction is complete. Operations estimates for FY 2009 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available.

Information on the data in the table is provided below.

- Concept/Development: In 1999, science mission requirements were developed by the user community to provide a basis for designing a vessel to replace the R/V Alpha Helix. In FY 2000, Division of Ocean Sciences funds were used to develop preliminary designs for an Alaska region research vessel. In FY 2001, Congress appropriated $1.0 million to further the vessel concept design and conduct model tank testing. Additional OCE funds were used during the concept and development stage to further the design process.

- Implementation: The project will be prepared to go into the construction phase in FY 2007. It is anticipated that the vessel will be constructed over a two-year period and will be ready for sea trials and commissioning and to conduct science activities in two years after construction is initiated.

- Operations and Maintenance: Following commissioning, the ship will be managed by the awardee institution which will maintain and operate the vessel for NSF through a Cooperative Agreement. The vessel will be scheduled through the University-National Oceanographic Laboratory System process, which will allow NSF-funded scientists access to the vessel to conduct research and train students. The annual ship operation costs are estimated to be about $6 million.



Future Science Support: Along with direct operations and maintenance support for the ARRV as part of the Academic Research Fleet, NSF will support research performed using this infrastructure through ongoing research and education programs. It is anticipated that the ARRV will greatly expand research capabilities in the region, going from about 160 ship operating days with the Alpha Helix, up to 275-300 days with the ARRV. It is anticipated that the vastly increased capability of the ARRV, both with regard to its ability to accommodate much larger interdisciplinary research teams and greatly enlarged geographical and seasonal ranges, will dramatically increase the number of proposals addressed to NSF for its utilization.

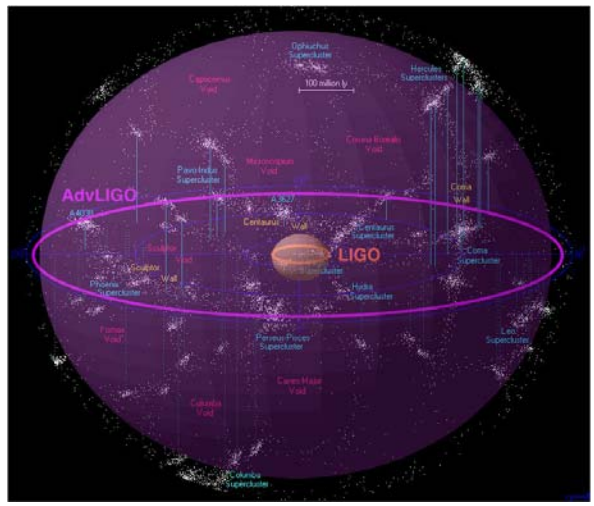
Advanced LIGO

Project Description: Advanced LIGO is the upgrade of the Laser Interferometer Gravitational Wave Observatory (LIGO) that will allow LIGO to approach the ground-based limit of gravitational wave detection. LIGO consists of the world's most sophisticated optical interferometers, operating at two sites (Hanford, WA and Livingston, LA). Each interferometer has two 4-km arms at 90 degrees to one another. In addition, the interferometer at Hanford contains a 2-km interferometer within the same vacuum enclosure used for the 4-km interferometer. These interferometers are designed to measure the changes in arm lengths resulting from the wave-like distortions of space-time caused by the passage of gravitational waves. The changes in arm length that can be detected by the present, Phase I LIGO are a thousand times smaller than the diameter of a proton over the 4-km arm length. AdvLIGO is expected to be at least 10 times more sensitive. The frequency range for which LIGO and AdvLIGO are designed will be sensitive to many of the most interesting cataclysmic cosmic phenomena believed to occur in the universe. Furthermore, because LIGO and AdvLIGO will push the sensitivity of gravitational wave detection orders-of-magnitude beyond existing frontiers, the potential for making discoveries of completely new phenomena is significant. LIGO will achieve its objectives as planned and may detect the first gravitational waves. AdvLIGO will greatly increase the sensitivity to ensure the detection of gravitational waves and to launch the new field of gravitational-wave astronomy.

The LIGO project was planned in two phases from the very beginning. Phase I would produce a gravitational wave detector that would be as sensitive as possible with the technology available in the early 1990s on a platform that could be upgraded to the ultimate sensitivity as the critical technologies were further developed. The goal of Phase I was to obtain a year's worth of accumulated data at the design sensitivity for Phase I (expressed as a dimensionless strain $h \sim 10^{-21}$, the ratio of the change in arm length to the length of the arm). The LIGO Laboratory expects to have those data in 2006. The second phase or AdvLIGO project will upgrade LIGO to enable attainment of the ultimate sensitivity of an Earth-based gravitational wave observatory, limited only by the irreducible effects of fluctuations in the Earth's gravitational field. From the outset, the overall LIGO strategy was to produce a broadband gravitational wave detector with an unprecedented astronomical reach and then to upgrade the initial facility to achieve the most sensitive gravitational wave detector possible on Earth.

The LIGO program has strongly stimulated the interest in gravitational-wave research around the world, producing very vigorous programs in other countries that provide strong competition. LIGO has pioneered the field of gravitational-wave measurement, and a timely upgrade is necessary to reap the fruits of this bold initiative. International partners are contributing significant human and financial resources.

Principal Scientific Goals: Einstein's theory of general relativity predicts that cataclysmic processes involving super-dense objects in the universe will produce gravitational radiation that will travel to Earth. Detection of these gravitational waves is of great importance, both for fundamental physics and for astrophysics. And, although the universe is believed to be filled with gravitational waves from a host of cataclysmic cosmic phenomena, scientists have never detected a gravitational wave and measured its waveform.



Sky map showing locations of superclusters, walls, and voids of galaxies within about 500 million light years. Superimposed circles show the range of LIGO (orange inner circle) and the 10 times larger range of AdvLIGO (purple outer circle). The milky way is at the center in this representation. *Credit: the underlying black and white image with names of clusters and voids is by Richard Powell; the superimposed color circles were added by Beverly Berger, Division of Physics, NSF.*

The principal scientific goals of the LIGO – AdvLIGO project are to detect gravitational waves on Earth for the first time and to develop this capability into gravitational wave astronomy — a new window on the universe — through which we can observe phenomena such as the inspiral and coalescence of neutron stars in binary orbit, black hole collisions, unstable dynamics of newborn neutron stars, supernovae, a stochastic background from the early universe, and a host of more exotic or unanticipated processes.

Principal Education Goals: LIGO has been a significant source of highly trained Ph.D. graduates for the country's workforce. In addition, LIGO has a diverse set of educational activities at its different sites, activities that involve a large number of undergraduates and outreach activities for the public. In 2004 NSF entered into a cooperative agreement with Caltech and Southern University/Baton Rouge to build a Visitor's Center at the Livingston, LA site.

Connections to Industry: Substantial connections with industry have been required for the state-of-the-art construction and measurements involved in the LIGO projects. Some have led to new products. Areas of involvement include novel vacuum tube fabrication technology, seismic isolation techniques, ultrastable laser development (new product introduced), development of new ultra-fine optics polishing techniques, and optical inspection equipment (new product).

Management and Oversight: LIGO is sponsored by NSF and managed by Caltech under a cooperative agreement. Under the current agreement, NSF oversight is coordinated internally by a dedicated LIGO program director in the Division of Physics (MPS), who also participates in the Physics Division Project

Advisory Team (PAT), comprising staff from the Office of General Counsel, the Office of Legislative and Public Affairs, the Office of Budget, Finance and Award Management, and the Office of International Science and Engineering. The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. NSF conducts annual scientific and technical reviews involving external reviewers and participates in meetings of the LIGO Scientific Collaboration (LSC) as well as making site visits to the Hanford, WA and Livingston, LA interferometers. During the AdvLIGO construction phase, NSF will continue the activities described above and exercise more intensive oversight through more frequent reporting requirements, stepped up interaction with the project personnel, scheduled reviews and site visits at least twice yearly and more frequently if need arises. The NSF LIGO program director will work closely with the LIGO Deputy Director for the AdvLIGO Project who has already been named. Project management techniques used in the successful completion of the initial LIGO construction will be employed to benefit management of the AdvLIGO construction.

Current Status of Phase I: All three LIGO interferometers were fully operational by the spring of 2002. Since then, activity has been divided between improving the sensitivity of the interferometers and collecting scientific data. The first science run, S-1, accumulated nearly 100 hours of triple coincidence data in the period from August 23, 2002 to September 9, 2002, with a sensitivity of about a factor of 100 from the design goal. Results from S-1 have been reported in five published articles. Work on instrumental refinements between the end of S-1 and the beginning of S-2 in February 2003 produced sensitivities about ten times better than those observed in S-1, i.e., only a factor of about 10 from the design goal. S-2 lasted 59 days (February 14, 2003 – April 14, 2003) with over 300 hours in triple coincidence accumulated. Results from S-2 were presented in 2004 at major scientific conferences. In S-3 (October 31, 2003 – January 8, 2004), the sensitivity achieved with the best of the three interferometers was only about a factor of 3.5 from the design goal, strengthening expectations that the sensitivity for S-4 that should commence sometime early in 2005 will be at or very near the targeted level.

Current Status of AdvLIGO: The LIGO Laboratory submitted a proposal for AdvLIGO in early 2003. The proposal was reviewed in June 2003 and the project was considered to be ready for construction. The AdvLIGO upgrade will include the laser, suspension, seismic isolation, and optical subsystems. Advanced detector R&D has proceeded to the point where technology needed for the upgrade is well in hand. In particular the development of the laser subsystem has achieved performance levels essentially at the final specifications and part of the AdvLIGO seismic isolation system is already in operation at the Livingston site where it has successfully eliminated excess vibration from various sources. $40.74 million of R&RA funds will have been spent from FY 2000 – 2007 on advanced R&D for AdvLIGO within the LIGO Laboratory.

Major milestones for Advanced LIGO include:

FY 2006-2007 Milestones:
- Finalize concept design and development of instrumentation

FY 2008 Milestones
- Place orders for long lead time items such as test mass optics; continue design of remaining instrumentation

FY 2009 Milestones:
- Acquisition of all components needed to begin installation in FY 2010
- Prepare for installation

FY 2010 Milestones:
- Installation begins at Livingston

FY 2011 Milestones:
Installation begins at Hanford

FY 2012 Milestones:
Commissioning begins at Livingston
Commissioning begins at Hanford

FY 2013 Milestones:
Livingston operational
Hanford operational

Funding Profile:

Requested MREFC Funds for AdvLIGO
(Dollars in Millions)

FY 2008 Request	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total
$28.48	$42.81	$46.31	$36.25	$22.90	$7.60	$184.35

AdvLIGO Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand Total**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 2007 & Earlier	40.74						$40.74		**40.74**
FY 2008 Request				28.48	26.55		$26.55	$28.48	**55.03**
FY 2009 Estimate				42.81	26.78		$26.78	$42.81	**69.59**
FY 2010 Estimate				46.31	24.42		$24.42	$46.31	**70.73**
FY 2011 Estimate				36.25	23.70		$23.70	$36.25	**59.95**
FY 2012 Estimate				22.90	20.94		$20.94	$22.90	**43.84**
FY 2013 Estimate				7.60	33.26		$33.26	$7.60	**40.86**
FY 2014 Estimate					39.00		$39.00		**39.00**
Subtotal, R&RA	$40.74				$194.65		$235.39		
Subtotal, MREFC				$184.35				$184.35	
Total, Each Stage		**$40.74**		**$184.35**		**$194.65**			**$419.74**

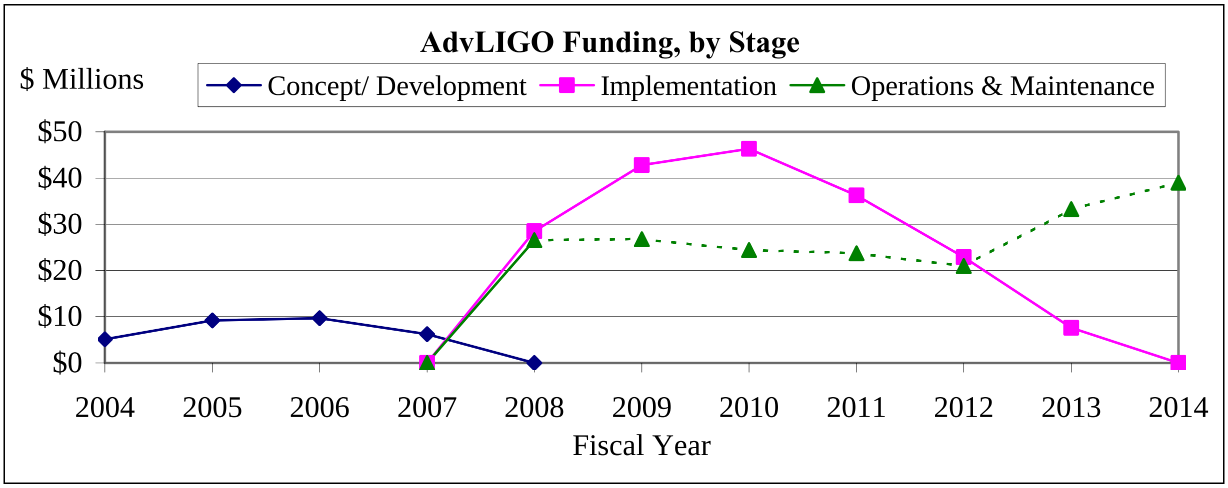
Note: Operations estimates for FY 2007 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Concept/Development: In the period of FY 2000 to FY 2007 the amount of $40.74 million will have been spent by the LIGO Laboratory for advanced R&D for concept development of AdvLIGO. The additional development work during the construction period would be directed to design development.

- Implementation: Funding during the MREFC phase of the project will provide for construction of the new instrumentation, including the laser, suspension, seismic isolation, and optical subsystems.

- Management and Operations: R&RA funds will be used to maintain the existing experimental facilities and infrastructure during the construction and installation of the new instrumentation to continue the analysis of the data obtained during the operation of the original LIGO.



Associated Research and Education Activities: Active Outreach programs have been developed at both the Livingston and Hanford sites. Teams at both sites have provided visual displays, hands-on science exhibits, and fun activities for visiting students and members of the public. In the last three years an average of over 2,000 students per year have taken advantage of this opportunity. More formal programs at the sites include participation in the Research Experience for Teachers (RET) Program, a set of "scientist-teacher-student" research projects in support of LIGO, and participation in the SURF/REU programs for college students. In collaboration with RET participants and networks of local educators, both sites have developed Web-based Resources for teachers that includes information on research opportunities for schools and a set of standards-based classroom activities, lessons, and projects related to LIGO science. Of special note this year is the project to build the Visitor's Center at the Livingston, LA site that will be filled with Exploratorium exhibits and will be the focal point for augmenting teacher education at Southern University and other student-teacher activities state-wide through the Louisiana Systematic Initiative Program. Outreach coordinators have been hired at each site to augment the existing activities.

Science Support: Along with direct operations and maintenance support for LIGO, NSF supports science and engineering research directly related to LIGO activities by members of the LIGO Scientific Collaboration from universities through ongoing research and education programs. The annual support for such activities is estimated to be about $5 million.

In 1997 LIGO founded the LIGO Scientific Collaboration (LSC) to organize the major international groups doing research that was supportive of LIGO. The LSC now has 44 collaborating institutions with over 440 participating scientists. The role and membership responsibilities of each participating institution are determined by a MOU between the LIGO Laboratory and the institution. The LSC plays a major role in many aspects of the LIGO effort including: R&D for detector improvements, R&D for Advanced LIGO, data analysis and validation of scientific results, and setting priorities for instrumental improvements at the LIGO facilities.

Organizational Excellence

ORGANIZATIONAL EXCELLENCE

The NSF Strategic Plan for FY 2003-2008 established Organizational Excellence (OE) as a fourth strategic goal for the agency, on a par with the agency's previously-established goals of People, Ideas, and Tools. This reflects the fact that excellence in NSF's internal operations is essential to achieving the Foundation's mission and accomplishing its goals.

The activities that advance NSF's OE goal are funded through five appropriations accounts:

Salaries and Expenses (S&E) increase by $45.80 million, or 20.5 percent, to $269.0 million in FY 2006. These resources include funding for personnel compensation and benefits, IT-enabled business systems, administrative travel, training, rent, and other operating expenses necessary for effective management of NSF's research and education activities.

Office of Inspector General (OIG) increases by $1.47 million, or 14.7 percent, to $11.50 million in FY 2006. These resources include funding for personnel compensation and benefits, contract audits, training and operational travel, office supplies, materials, and equipment. Most of the budget increase requested for the OIG will fund the annual audit of NSF's financial statements, which was funded previously from NSF's program accounts (R&RA & EHR). The move improves the alignment of audit management with audit resources. The Appropriation Summary for the OIG provides more information on this adjustment.

National Science Board (NSB) increases by approximately $30,000, or 0.8 percent, to $4.00 million in FY 2006. These resources include funding for personnel compensation and benefits, contract, training and operational travel, office supplies, materials, and equipment.

Support costs funded in the **Program Accounts - Research and Related Activities** (R&RA) and **Education and Human Resources** (EHR) - decrease by $1.34 million, or 2.5 percent, to $51.25 million in FY 2006. These costs include funding for personnel appointments under the Intergovernmental Personnel Act (IPAs), administrative contracts, and requisitions that directly support programs. Support costs also include funding for Foundation-wide evaluation contracts and other related activities.

Organizational Excellence by Appropriations Account
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over 2005 Amount	Percent
Salaries and Expenses	218.92	223.20	269.00	45.80	20.5%
Office of Inspector General[1]	9.47	10.03	11.50	1.47	14.7%
National Science Board	2.22	3.97	4.00	0.03	0.8%
R&RA Appropriation	37.14	39.33	39.89	0.56	1.4%
EHR Appropriation[2]	11.39	13.26	11.36	-1.90	-14.3%
Subtotal, Program Support	48.53	52.59	51.25	-1.34	-2.5%
Total	$279.13	$289.79	$335.75	$45.96	15.9%

Totals may not add due to rounding.

[1] The FY 2006 request for the OIG includes $1.1 million for the NSF financial statement audit, previously funded through NSF accounts. For more information, see the OIG appropriation summary.

[2] Excludes OE expenses for H-1B Nonimmigrant Petitioner Receipts.

More detailed information on the Program Support costs is shown in the table below. These funds are part of NSF's R&RA and EHR appropriations and account for roughly 15 percent of the total OE portfolio. The Program Support includes support for Intergovernmental Personnel Act (IPA) appointments, travel funding for IPAs, and the costs of administrative activities directly related to program activities. Note that the overall decrease results from a $1.90 million reduction in EHR's Program Support costs.

Summary of IPA and Program Support
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over 2005 Amount	Percent
IPA Costs	28.01	31.00	32.00	1.00	3.2%
Program Related Administration	20.52	21.59	19.25	-2.34	-10.8%
Total, Program Support Costs	$48.53	$52.59	$51.25	-$1.34	-2.5%

IPA Costs by Appropriations
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over 2005 Amount	Percent
R&RA					
IPA Compensation	19.19	20.67	20.97	0.30	1.5%
IPA Lost Consultant & Per Diem	1.84	2.15	2.24	0.09	4.2%
IPA Travel	2.06	2.83	3.04	0.21	7.4%
Subtotal, R&RA Costs	$23.09	$25.65	$26.25	$0.60	2.3%
EHR					
IPA Compensation	4.08	4.26	4.58	0.32	7.5%
IPA Lost Consultant & Per Diem	0.50	0.76	0.81	0.05	6.6%
IPA Travel	0.35	0.33	0.36	0.03	9.1%
Subtotal, EHR Costs	4.92	5.35	5.75	$0.40	7.5%
Total, IPA Costs	$28.01	$31.00	$32.00	$1.00	3.2%

Totals may not add due to rounding.

NSF Workforce
Full-Time Equivalents (FTE)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
NSF FTE[1]	1,198	1,260	1,283	23	1.8%
Office of the Inspector General[2]	62	60	61	1	1.7%
National Science Board[3]	10	12	13	1	8.3%
Arctic Research Commission[4]	4	4	4	0	0.0%
Total, Federal Employees	1,274	1,336	1,361	25	1.9%
IPAs	148	170	170	0	0.0%
Detailees to NSF	6	6	6	0	0.0%
Contractors Performing Adm. Functions	210	210	210	0	0.0%
Total, Workforce	1,638	1,722	1,747	25	1.5%

[1]These NSF FTE totals include students. Details of FTEs funded through the S&E appropriation are available in the S&E section.

[2]The Office of Inspector General is described in a separate section of this Chapter and is funded through a separate appropriation.

[3]The National Science Board is described in a separate section of this Chapter and is funded through a separate appropriation.

[4]The Arctic Research Commission is described and funded in the Research and Related Activities section of the justification under Office of Polar Programs.

The staffing profile the table above shows that a small but significant percentage of the NSF workforce – 170 people or roughly 10 percent – consists of temporary employees hired through the authority provided by the Intergovernmental Personnel Act (IPA). A smaller number of visiting staff – roughly 40 people annually – are employed through NSF's own Visiting, Scientist, Engineer, and Educator Program (VSEE).

The use of IPAs and VSEEs, commonly referred to as rotators, has been a defining characteristic of NSF since its inception in 1950. As is noted in the most recent NSF Strategic Plan:

> "Over one half of NSF's Program Officers are non-permanent employees, either "on loan" from their host institutions as visiting scientists, engineers, and educators (VSEEs) or employed through grants to the home institutions under the terms of the Intergovernmental Personnel Act (IPA). These employees are a unique set of human resources, providing NSF with increased flexibility, new ideas and fresh science and engineering perspectives."

IPAs are considered federal employees for many purposes during their time at NSF, even though they remain employees of their home institutions. They are not paid directly by NSF and are not subject to federal pay benefits and limitations. NSF reimburses the home institution for the IPA's salary and benefits using the traditional grant mechanism. IPAs are also eligible to receive *per diem*, relocation expenses, and reimbursement for any income foregone because of their assignment at NSF (i.e. lost consulting). VSEEs, by contrast, receive a salary directly from NSF (through the S&E appropriation), although they continue to receive benefits through their home institutions, which is reimbursed by NSF.

While at NSF, rotators function in a manner virtually identical to the Foundation's permanent staff – leading the merit review process, overseeing awards, and shaping future program directions. To smooth their transition and help them appreciate their responsibilities at NSF, the NSF Academy leads a set of intensive training activities, including a three-day, off-site Program Management Seminar offered several times each year for new rotators and permanent staff.

The April 2004 report from the National Academy of Public Administration (NAPA), "National Science Foundation: Governance and Management for the Future," reviewed the role of rotators at NSF. The NAPA report comments extensively on the value of temporary personnel to the NSF mission, and the excerpt below summarizes its major findings:

> "NSF's long-standing practice of engaging scientists, engineers, and educators from the scientific community as rotating members of the NSF's staff is likely to serve the agency well as it faces the challenges of managing an increasing number of grant proposals effectively."

Performance Highlights

With the addition of OE to the NSF Strategic Plan in FY 2003, NSF for the first time conducted a comprehensive assessment of its OE activities in FY 2004 as part of its GPRA reporting activities. Further information on the OE assessment is available in the Performance Information chapter of this document and in the FY 2004 NSF Performance and Accountability Report (NSF-05-01).

NSF has established the following four indicators to assess its progress toward the OE goal:

- Operate a credible, efficient merit review system.
- Utilize and sustain broad access to new and emerging technologies for business application.
- Develop a diverse, capable, motivated staff that operates with efficiency and integrity.
- 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.

The OE assessment activities included input from the NSF Advisory Committee for GPRA Performance Assessment (AC/GPA) and the NSF Advisory Committee for Business and Operations (AC/B&O). NSF conducted a self-assessment for the second, third, and fourth indicators, which was then reviewed by the AC/B&O. The AC/GPA led the assessment of the merit review indicator.

The results of this assessment process were summarized as follows in the AC/GPA report:

> *The AC/B&O supported NSF's determination that the agency had demonstrated significant achievement for the three indicators it considered. The AC/B&O also made a number of comments to improve the approach, methodology and analysis for the assessment of performance in subsequent years. The letter and the revised assessment are found below. The OE subgroup of the AC/GPA reviewed the letter and the assessment and performed its own review of the merit review indicator. The results of this analysis were presented to the full AC/GPA for its consideration.*
>
> *With regard to Merit Review, the OE subgroup reviewed data and information from the Report to the National Science Board on the Merit Review Process Fiscal Year 2003, supporting documentation provided by the NSF including a customer survey conducted by Booz, Allen, Hamilton, and the reports from a number of Committees of Visitors (COVs). We concluded that NSF had demonstrated significant achievement for this indicator. While the Merit Review Process will always, in our view, require vigilance and a commitment to continuous improvement, when taken as a whole and when one looks at the results as illustrated in the People, Ideas, and Tools portfolios, clearly, the process remains a major positive force in advancing the frontiers of science, mathematics, and engineering.*

Salaries and Expenses

SALARIES AND EXPENSES $269,000,000

The FY 2006 Budget Request for Salaries and Expenses (S&E) is $269.0 million, an increase of $45.80 million, or 20.5 percent, over the FY 2005 Current Plan of $223.20 million. Adequate funding for Salaries and Expenses, particularly for Staffing and Information Technology, is critical to the efficient operations of the agency.

Summary of Salaries and Expenses by Function

(Dollar in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Human Capital					
Personnel Compensation & Benefits	139.58	150.73	161.33	10.60	7.0%
Management of Human Capital	4.00	3.47	7.50	4.03	116.1%
Operating Expenses	10.10	5.72	5.17	-0.55	-9.6%
Travel	4.79	7.26	8.75	1.49	20.5%
Subtotal, Human Capital	158.47	167.18	182.75	15.57	9.3%
Technology and Tools					
Information Technology	32.20	26.93	52.60	25.67	95.3%
Space Rental	18.69	19.70	21.58	1.88	9.5%
Other Infrastructure	7.48	7.31	9.57	2.26	30.9%
Subtotal, Technology and Tools	$58.37	$53.94	$83.75	29.81	55.3%
Business Analysis	2.08	2.08	2.50	0.42	20.2%
Total, Salaries and Expenses [1]	$218.92	$223.20	$269.00	$45.80	20.5%

Totals may not add due to rounding.

[1] The FY 2004 Actual includes a transfer of $260,500 from the Department of State for processing an award to the U.S. Civilian Research and Development Foundation.

S&E Funded NSF Workforce

(Full-Time Equivalents (FTE) and Other Staff)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
NSF S&E -- Regular	1,166	1,225	1,248	23	1.9%
NSF S&E -- Student	32	35	35	0	0.0%
Subtotal, FTE	1,198	1,260	1,283	23	1.8%
Detailees to NSF	6	6	6	0	0.0%
Contractors Performing Adm. Functions	210	210	210	0	0.0%
Total, Workforce	1,414	1,476	1,499	23	1.6%

Appropriation Language

For salaries and expenses necessary in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); services authorized by 5 U.S.C. 3109; hire of passenger motor vehicles; not to exceed $9,000 for official reception and representation expenses; uniforms or allowances therefor, as authorized by 5 U.S.C. 5901-5902; rental of conference rooms in the District of Columbia; and reimbursement of the General Services Administration for security guard services; ~~$225,000,000~~*$269,000,000*: Provided, That contracts may be entered into under "Salaries and expenses" in fiscal year ~~2005~~*2006* for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year. (Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2005.)

Adjustments to Base

Salaries and Expenses
FY 2006 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Rescission	Transfers[1]	Total Resources	Lapsed	Obligations Incurred/Est.
FY 2004 Appropriation	220.00	-1.30	0.26	218.96	0.04	218.92
FY 2005 Current Plan	225.00	-1.80	-	223.20	-	223.20
FY 2006 Request	269.00	-	-	269.00	-	269.00
$ Change from FY 2005	44.00			45.80		
% Change from FY 2005	20%			20.5%		

[1] Transferred to NSF from the Department of State for an award to the Civilian Research and Development Foundation.

Summary of Major Changes *(Dollars in Millions)*

S&E FY 2005 Current Plan..........………………………………………………………..$223.20

Human Capital +15.57

Funding for Human Capital increases by $15.57 million to a total of $182.75 million, a 9.3 percent increase over FY 2005. The major components of this increased investment are:

- $161.33 million for Personnel Compensation and Benefits, an increase of $10.60 million, which includes an increase of 23 full-time equivalent (FTE) employees as well as comparability and locality pay and costs related to employee benefits.
- $7.50 million for Management of Human Capital, an increase of $4.03 million. The increased funding includes $3.05 million for Strategic Human Capital Management and $980,000 for the NSF Academy.
- $5.17 million in general operating expenses associated with NSF's programmatic responsibilities, a decrease of $550,000; and
- $8.75 million for Travel, an increase of $1.49 million over the FY 2005 Current Plan.

Technology and Tools +29.81

Funding for Technology and Tools increases by $29.81 million or 55.3 percent to a total funding level of $83.75 million in FY 2006. The major components of this investment are:

- $52.60 million for Information Technology, an increase of $25.67 million. The major components of this increase are IT Security ($2.80 million increase), Next Generation Grants Management and eGovernment ($7.90 million), Applications Maintenance ($4.70 million), and IT Infrastructure Maintenance and Operations ($8.07 million).
- $21.58 million for Space Rental, an increase of $1.88 million, which includes costs for rent increases as well as additional space needs.
- $9.57 million for Other Infrastructure needs, an increase of $2.26 million. The largest increase, $990,000, is for ongoing administrative contracts.

NSF Business Analysis +0.42

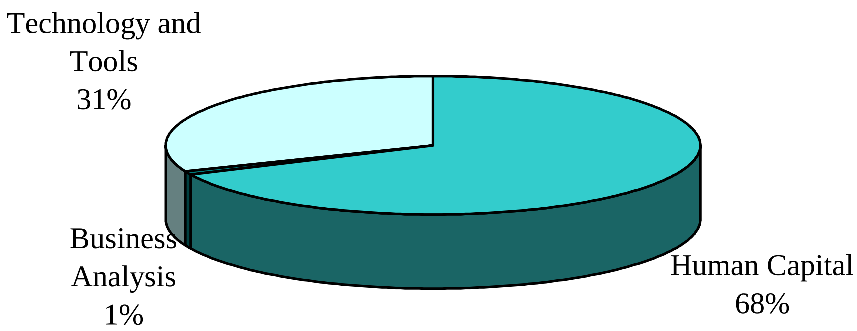
Funding increases by $420,000 to a total Request of $2.50 million in FY 2006, which will complete funding for the multi-year Business Analysis effort, a comprehensive assessment of NSF's core business processes, human capital, and technology management.

Subtotal, Changes +45.80

FY 2006 Request, S&E…………………………………………………………...…..$269.00

SALARIES AND EXPENSES – FY 2006 REQUEST BY MAJOR FUNCTION

FY 2006 S&E Request of $269.0 Million



The rapid pace of discovery in science and engineering research and education creates unprecedented opportunities for investment, but also increases the NSF workload. With the rapidly changing character of research, new demands are placed on NSF staff and systems. Proposals today address more complex scientific questions, involve a wider array of collaborations, and increasingly, cross disciplinary boundaries.

NSF maintains its commitment to excellent, results-oriented management and stewardship. To solidify this endeavor, the NSF Strategic Plan was modified in FY 2003 to incorporate Organizational Excellence (OE) as a strategic goal, on a par with NSF's established science and engineering goals of People, Ideas, and Tools. Organizational Excellence reinforces the idea that excellence in management underpins all of the Foundation's activities and calls on us to be "an agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices." The focus of the Organizational Excellence goal on human capital, business processes, and technologies and tools resonates strongly with the President's Management Agenda (PMA) goals in critical business disciplines and adds momentum to our ongoing efforts.

Many OE initiatives are derived directly from the multi-year NSF Business Analysis, which is important in supporting our integrative, multidisciplinary approach to management excellence and to achieving results. These efforts, directly or indirectly, help NSF provide first-rate customer service to proposers, reviewers, and grantees.

The increase requested in FY 2006 supports additional staffing to handle the growing workload and additional travel funds to ensure adequate management and oversight of our portfolio. This increase will also provide for existing and overdue investments that foster NSF's continuing commitment to outstanding customer service.

HUMAN CAPITAL ($182.75 million)

The FY 2006 Request for Human Capital totals $182.75 million, an increase of $15.57 million or 9.3 percent, over the FY 2005 Current Plan of $167.18 million. These investments consist of four major components: Personnel Compensation and Benefits, Management of Human Capital, Operating Expenses, and Travel.

Human Capital Funding
(Dollars in Millions)

	FY 2004 Actual	Fy 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Personnel Compensation and Benefits	139.58	150.73	161.33	10.60	7.0%
Management of Human Capital	4.00	3.47	7.50	4.03	116.1%
Operating Expenses	10.10	5.72	5.17	-0.55	-9.6%
Travel	4.79	7.26	8.75	1.49	20.5%
Total, Human Capital	$158.47	$167.18	$182.75	$15.57	9.3%

Totals may not add due to rounding

Personnel Compensation and Benefits ($161.33 million)

Personnel Compensation & Benefits
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount[3]	Change over FY 2005 Percent
Regular FTEs	*1,166*	*1,225*	*1,248*	*23*	*1.9%*
Regular Salary					
Base Salary	$104.90	$112.41	$116.15	3.74	3.3%
Salary Cost of Additional FTE	-	-	2.27	-	-
COLA & Locality Pay[1]	-	-	2.34	-	-
Subtotal, Regular FTE Salary	$104.90	$112.41	$120.76	$8.35	7.4%
Student FTEs	*32*	*35*	*35*	*0.00*	*0.0%*
Student Salary	$0.91	$0.99	$1.01	$0.02	2.0%
Total, FTEs	*1,198*	*1,260*	*1,283*	*23*	*1.8%*
Subtotal, FTE Pay	$105.81	$113.40	$121.77	$8.37	7.4%
Benefits and Other Compensation[2]	33.77	37.33	39.56	2.23	6.0%
Total, PC&B	$139.58	$150.73	$161.33	$10.60	7.0%

[1]The pay increase includes the prior budget year's COLA and Locality Pay increase, nine months of the budget year's COLA and Locality Pay increase, within grade and adjustments to FTE payroll hours.

[2]This category includes employee benefits, detailees to NSF, terminal leave, awards, and other benefits.

[3]The $3.74M increase in the FY 06 base salary reflects the full annual cost of employees hired throughout FY 2005.

$161.33 million for Personnel Compensation and Benefits, an increase of $10.60 million, which includes an increase of 23 full-time equivalent (FTE) employees as well as comparability and locality pay and costs related to employee benefits.

Management of Human Capital ($7.50 million)

Summary of Management of Human Capital by Function
(Dollars in Millions)

Management of Human Capital	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Strategic Human Capital Management	2.00	1.95	5.00	3.05	156.4%
NSF Academy	2.00	1.52	2.50	0.98	64.5%
Total, Management of Human Capital	$4.00	$3.47	$7.50	$4.03	116.1%

The FY 2006 Management of Human Capital request is $7.5 million, an increase of $4.03 million from the FY 2005 Current Plan. This level will enable the Foundation to implement an enhanced, integrated human capital system that incorporates eGovernment solutions and addresses the President's Management Agenda. These efforts support the Office of Personnel Management's Human Resource Line of Business, expand eLearning initiative offerings, and more fully develop the curricula, content and knowledge management aspects of NSF's Learning Management System.

- **Strategic Human Capital Management**
  Strategic Human Capital Management encompasses a range of activities related to the planning and management of NSF internal workforce. In FY 2006, NSF will more than double spending on these activities, from $1.95 million to $5.0 million. In addition, $2.5 million is requested in the Technology and Tools function of the S&E account for the IT infrastructure necessary to support these activities. This increased investment is needed to sustain an overdue effort to transform how NSF plans for and manages its internal human capital needs. This will take initial steps toward providing managers with powerful workforce analytic and planning capabilities, providing NSF employees with direct access to employment information, and supporting NSF's transition to a competency-based human resource system. When implemented, this new human capital system will provide a suite of interconnected capabilities, including enhanced workforce planning, position classification and management, competency management, recruiting, and performance management.

  FY 2006 is a vital year in this effort, as NSF will be analyzing the services offered by different providers of the Human Resource Line of Business (HR LOB), the government-wide initiative being led by the Office of Personnel Management (OPM). To determine the best fit for NSF among the different providers, FY 2006 funding will be used to: analyze and select from among the service providers; provide project oversight for the implementation of HR LOB-approved Human Resource Information System service provider; assist in the identification of alternative services to fill gaps not available through the selected shared service provider, but that are essential to a comprehensive human capital system; pay for necessary service fees charged by one or more service providers; and provide HR-related support for implementation of OPM's President's Management Agenda eGovernment systems including its electronic personnel folders, Workforce Analysis Support System, Civilian Forecasting System, and Business Intelligence Tool initiatives.

- **NSF Academy**
  In FY 2006, NSF will increase spending from $1.52 million to $2.50 million. This increase of $980,000 allows NSF to develop and implement a wide range of programs recommended in a recent OPM audit, continue its multi-year effort to implement an OPM eGovernment Learning Management System, provide a comprehensive project management certificate program, including an Earned Value Management component, and implement a series of proprietary eLearning program and online tutorials to increase the capabilities of permanent and rotator program officers to effectively monitor, examine and administer grant proposals.

Operating Expenses ($5.17 million)
Operating Expenses decrease by $550,000, or 9.6 percent, to $5.17 million in FY 2006. These include direct costs of supplies, equipment, and other operating expenses necessary for the management of NSF's research and education activities.

Travel ($8.75 million)
Travel increases by $1.49 million, or 20.5 percent, to $8.75 million in FY 2006. These resources fund travel required for an enhanced oversight of existing awards as recommended by the agency's Inspector General. These funds will also be used to intensify management and oversight activities, enable staff to participate in national and international science and engineering conferences and workshops, and provide access to strategic training opportunities.

TECHNOLOGY AND TOOLS ($83.75 million)

Funding for Technology and Tools increases by $29.81 million or 55.3 percent to a total funding level of $83.75 million in FY 2006.

Technology and Tools Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Information Technology	32.20	26.93	52.60	25.67	95.3%
Space Rental	18.69	19.70	21.58	1.88	9.5%
Other Infrastructure	7.48	7.31	9.57	2.26	30.9%
Total, Technology and Tools	$58.37	$53.94	$83.75	29.81	55.3%

Information Technology ($52.60 Million)

The FY 2006 Information Technology Request is $52.60 million, an increase of $25.67 million, or 95.3 percent, from the FY 2005 Current Plan. This level will enable the Foundation to address key President's Management Agenda initiatives, support a world-class, secure infrastructure that is responsive to customer needs, address management challenges identified through internal review and oversight, and implement recommendations stemming from the NSF's multi-year Business Analysis.

Summary of Information Technology by Function
(Dollars in Millions)

Information Technology	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
IT Security	1.50	2.20	5.00	2.80	127.3%
Next Generation Grants Mgmt & eGov	5.30	2.30	10.20	7.90	343.5%
Human Capital System	1.00	0.70	2.50	1.80	257.1%
Enterprise Architecture	0.50	0.70	1.10	0.40	57.1%
Applications Maintenance	12.90	9.40	14.10	4.70	50.0%
- Finance and Administrative Applications	*5.10*	*4.10*	*5.30*	1.20	29.3%
- FastLane and Legacy Grants Applications	*7.80*	*5.30*	*8.80*	3.50	66.0%
IT Infrastructure Maintenance and Operations	11.00	11.63	19.70	8.07	69.4%
Total, Information Technology	$32.20	$26.93	$52.60	$25.67	95.3%

- **IT Security ($5.0 million)**
  In FY 2006, NSF will more than double spending on IT security, from $2.20 million to $5.0 million – a level consistent with the high priority the Foundation places on IT security. These investments allow NSF to acquire and deploy automated configuration management tools that manage patches, virus updates and other security related configuration elements; to fully fund scheduled certification and accreditation activities, including security risk assessments, security plans, and contingency plans; to maintain a comprehensive NSF systems inventory for security purposes; support program-specific security improvements such as the US Antarctic Program security initiatives; to increase contract support to monitor for intrusions and attacks; and to support rapid responses to incidents. Without this level of investment, NSF will not be able to deploy tools and practices to address emergent threats and defend in-depth capabilities needed to assure a sound security posture.

  Notably, NSF received an "A" on the most recent Federal Computer Security Score Card issued by the Government Reform Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census. NSF is one of two Federal agencies ever to receive an "A" on the report card since scores were released.

- **Next Generation Grants Management and eGovernment Initiatives ($10.20 million)**
  In FY 2006, NSF increases support from $2.30 million to $10.20 million, a more than four-fold increase. Since funding was reduced from FY 2004 to FY 2005, virtually all-significant new capability in the grants management area was deferred until FY 2006. It is a high priority to restore and enhance investment in this area. While NSF has had great success with its customer facing systems, notably FastLane for receiving proposals and managing progress and financial reporting, the rest of the end-to-end proposal processing systems have not received such investment. NSF currently relies on legacy applications that vary widely in their functional support capability, application age, sustainability, and integration with other applications to support work. Specific areas for investment include migrating and integrating with eGovernment initiatives (notably Grants.gov), support for internal grants administration (proposal, review, and award management), property management, eTravel, records management, eAuthentication, strategic information assets management, and customer relationship systems. These applications will eliminate the need for manual processing, printing and storage of copies of proposal processing files for approximately 70 percent of the proposals received by NSF. Additionally, this funding strengthens proposal review and authentication; timely review and decision; award management and oversight; and closeout.

- **Human Capital System ($2.50 million)**
  In FY 2006, NSF will increase support from $700,000 to $2.50 million, a more than three-fold increase. Capital investments in broad-scope eHuman Capital will provide an integrated technology solution set to address all aspects of Human Capital related requirements, including: automated and integrated recruitment, classification, performance management and employment processes; workforce planning and long-term forecasting services; development and electronic management of a comprehensive array of strategically aligned learning experiences; compliance with standards adoption systems and processes developed under eGovernment initiatives; and related time and attendance and benefits services. FY 2006 will be a year of acquiring automated tools to support the initiatives for improved human capital management identified in the NSF Human Capital Plan, automate critical human resource functions, and maintain the new Learning Management System that is being deployed in FY 2005.

- **Enterprise Architecture ($1.10 million)**
  In FY 2006, NSF will increase support from $700,000 to $1.10 million, a 57 percent increase. While spending on Enterprise Architecture will remain close to steady at $600,000, an increase of $400,000 will support OMB mandated requirements for an Earned Value Management System to improve management of major IT projects and to support more integrated investment planning. Ongoing investments are for consulting services for planning and analysis resulting in the recommended NSF current, transitional, and future Enterprise Architectures. These funds will complement the Enterprise architecture initiatives from the multi-year Business Analysis.

- **Applications Maintenance ($14.10 million)**
  In FY 2006, NSF will increase support from $9.40 to $14.10 million, an increase of $4.70 or 50 percent. Increased funding will support Finance and Administrative Applications and FastLane and Legacy Grants Applications. This investment allows required maintenance for these critical grants management applications and provides funding to integrate FastLane with Grants.gov applications.

- **IT Infrastructure Maintenance and Operations ($19.70 million)**
  In FY 2006, support for IT Infrastructure Maintenance and Operations will increase from $11.63 million to $19.70 million. This restores reductions required in FY 2004 and FY 2005 that required maintenance and operations below optimal levels. Increases will support new efforts essential to system modernization such as directory services and tools to manage configuration, quality assurance and software testing; it will support added infrastructure that support new applications such as Grants.gov activities and the enhanced website service; it will support increased costs for help desk services that are currently under-funded and require new services to support new applications; and it will support improvements to desktop configuration management that will enable lowering per seat costs while improving security and performance. At reduced levels, normal infrastructure upgrade and modernization of 25-30 percent of equipment would be deferred, resulting in decreased availability of IT services.

Space Rental & Other Infrastructure ($31.15 million)

Summary of Space Rental & Other Infrastructure by Function

(Dollars in Millions)

Space Rental & Other Infrastructure	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change Over FY 2005 Amount	Change Over FY 2005 Percent
Space Rental	$18.69	$19.70	$21.58	1.88	9.5%
Other Infrastructure	$7.48	$7.31	$9.57	2.26	30.9%
- *Administrative Contracts*	*$3.21*	*$3.30*	*$4.29*	0.99	30.0%
- *Government Goods and Services*	*$1.76*	*$1.90*	*$2.52*	0.62	32.6%
- *Administrative Services Equipment & Supplies*	*$2.61*	*$2.11*	*$2.76*	0.65	30.8%
Total, Space Rental & Other Infrastructure	$26.17	$27.01	$31.15	$4.14	15.3%

- **Space Rental**
  The FY 2006 Request for Space Rental is $21.58 million, an increase of $1.88 million, or 9.5 percent, over FY 2005. These resources are needed to offset escalating GSA rental costs and real estate taxes and for the annualized cost of space acquired during FY 2005. The additional space leased in FY 2005 gives NSF four contiguous floors of space in Stafford II. No additional leasing agreements are planned at this time.

  The increase of $1.88 million for Space Rental in FY 2006 is itemized into the following categories: about $1 million for increased space acquired at the end of FY 2005, $650,000 increase due to escalation in rent, and $250,000 increase due to increase in real estate taxes and Federal Protective Services guards.

- **Other Infrastructure**
  In FY 2006, support of Other Infrastructure increases from $7.31 million to $9.57 million, an increase of $2.26 or 31 percent. This request is necessary to offset rising costs associated with physical security of the facilities, including contract security guards. Funds are also needed to accommodate rising facility maintenance costs and facility management services necessary to accommodate the continued growth in the volume of proposals submitted. This funding supports three major sets of activities:

  - Administrative Contracts support increases from $3.30 million to $4.29 million in FY 2006 and is primarily to meet the requirements of Homeland Security Presidential Directive #12 (HSPD-12: Policy for a Common Identification Standard for Federal Employees and Contractors). NSF plans to initiate a project to replace the existing physical security systems and all employee and contractor proximity cards.
  - *Government Goods and Services* support increases from $1.90 million to $2.52 million in FY 2006. As NSF acquires additional space, there is a corresponding increase, in security costs as well as routine renovation costs agency-wide.
  - *Administrative Services Equipment & Supplies* increases from $2.11 million to $2.76 million in FY 2006. To keep productivity high, equipment is routinely rotated out and replaced by new equipment; this normal equipment replacement schedule is being severely curtailed in FY 2005. Additionally, access licenses to electronic scientific databases and journals will be purchased, a vital service to the NSF scientific community.

NSF BUSINESS ANALYSIS ($2.50 Million)

In FY 2002, NSF initiated a comprehensive, multi-year Business Analysis, the outcomes of which are informing Organizational Excellence investments for the foreseeable future. The FY 2006 Request for the Business Analysis is $2.50 million, an increase of $420,000 from FY 2005.

This study is addressing the fundamental challenges facing NSF, such as the management of an increasingly multi-disciplinary research and education portfolio. The key to this study is a concurrent analysis of human capital, business practices, and technology and tools.

As the Business Analysis winds down during FY 2006, efforts will address the following:

- ***Business Process*** – Business process team members will provide integration support as necessary to the other Business Analysis work streams -- Human Capital and Technologies and Tools. The Business Analysis will also continue to provide implementation-planning support for NSF's Knowledge Management projects and processes moving into FY 2006.

- ***Human Capital*** – As part of the ongoing development of the Human Capital Management Plan, the Business Analysis team will help NSF continue to move from a task-based to a competency-based human resource management organization. In FY 2006, it is envisioned that NSF will begin to integrate competencies throughout the human capital lifecycle. The Business Analysis team will help identify the best implementation strategy (prioritizing high-impact human capital processes) and begin working with NSF to carry out the strategy and design of competency-based systems. Much of this work will involve a strong collaboration with the program Directorates and Offices, as well as defining flexible practices that maintain policy/regulation standards but allow for process/execution adaptability.

- ***Technology and Tools*** – The Technology and Tools team has developed an Enterprise Architecture (EA) that documents all the information systems within NSF, their functions and relationships to other systems, and how they interact to fulfill the organization's mission. An EA provides the organization with the ability to understand and analyze its operations and allows managers to address inconsistencies and redundancies in business process and technologies. In FY 2006, the Technologies and Tools team will focus on the following tasks:

    - Maintenance and continuing definition of NSF Enterprise Architecture business and technical services in accordance with business process and human capital work streams (including re-baselining major NSF systems);
    - Refinement of the NSF Information Technology Implementation Plan in accordance with business process and human capital work streams; and
    - Maintenance of Enterprise Architecture tool and integration with application/system development systems (i.e., Rational).

The Business Analysis continues to have a significant positive impact on how NSF conducts its business.

General Operating Expenses by Object Class

The following table shows the planned distribution of general operating expenses by object class and is followed by brief explanations of each category.

General Operating Expenses by Object Class
(Dollars in Thousands)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Travel and Transportation of Persons	4,905	7,046	8,770	1,724	24.5%
Transportation of Things	167	200	200	0	0.0%
Rental Payments to GSA	18,689	19,700	21,580	1,880	9.5%
Communications, Utilities and Misc. Charges	1,732	1,447	1,447	0	0.0%
Printing and Reproduction	302	175	175	0	0.0%
Advisory and Assistance Services	8,918	5,313	9,213	3,900	73.4%
Other Services	7,029	7,861	9,435	1,574	20.0%
Purchases of Goods & Srvcs from Gov't. Accts	1,794	1,896	2,515	619	32.6%
Medical Care	485	530	530	0	0.0%
Operations and Maintenance of Equipment	24,480	17,954	35,957	18,003	100.3%
Supplies and Materials	3,129	3,069	2,319	-750	-24.4%
Equipment	7,450	7,247	15,509	8,262	114.0%
Total	$79,080	$72,438	$107,650	$35,212	48.6%

Totals may not add due to rounding

Description of categories:

- **Travel and Transportation of Persons** includes an increase in FY 2006. These resources fund travel required for increased oversight of existing awards as recommended by the agency's Inspector General.
- **Transportation of Things** consists of household moves associated with bringing new scientists and engineers to NSF.
- **Rental Payments to GSA** includes the rent charged by GSA for NSF's facility in Arlington, Virginia, and four floors in an adjacent building. The increase in FY 2006 is required to fund GSA's estimate for currently occupied space, real estate taxes, an increase in Federal Protective Service guard costs, and a modest increase in leased space.
- **Communications, Utilities, and Miscellaneous Charges** includes all costs for telephone lines and services, both local and long distance, postage, and charges for centrally managed photocopying equipment.
- **Printing and Reproduction** includes contract costs of composition and printing of NSF's publications, announcements, and forms, as well as printing of stationery and specialty items. These costs have been comparatively low for the past several years due to NSF's efforts in web publishing and electronic dissemination.

- **Advisory and Assistance Services** includes development, learning, and career enhancement opportunities offered through the NSF Academy, contracts for position classifications, work life initiatives, outreach, contractual costs for the Business Analysis study, and related services. The increase of $3.90 million reflects the expansion of the Strategic Human Capital and NSF Academy programs.

- **Other Services** include warehousing and supply services, mail handling, proposal processing, equipment repair and maintenance, building-related costs, furniture repair, contract support for conference room services, security investigations, and miscellaneous administrative contracts. These costs increase by $1.07 million in FY 2006, as funds are required to begin to implement physical security programs associated with the Homeland Security Presidential Directive #12.

- **Purchases of Goods and Services from Government Accounts** includes reimbursable services purchased from GSA. These costs include security guard services, off-hours heating and air conditioning support, and some construction services. The increase of $619,000 is driven largely by costs for security guards as well as costs for building renovations.

- **Medical Care** includes costs associated with the health services contract, providing limited on-site medical services to the agency's staff. This includes performing physical examinations for the NSF staff on assignment at the South Pole. These costs are unchanged in FY 2006.

- **Operations and Maintenance of Equipment** includes management and operation of the central computer facility 24 hours/day, 365 days/year; operation of the customer service center and FastLane help desk; maintenance of database server hardware and related peripherals; software licensing fees; data communications infrastructure and network systems support; electronic mail support; and remote access (e.g., Internet and World Wide Web). The increase of $18.0 million reflects increasing costs for ongoing maintenance and operations and new Information Technology programs and initiatives.

- **Supplies and Materials** include office supplies, library supplies, paper and supplies for the NSF central computer facility, and miscellaneous supplies. This category decreased by $750,000 to $2.32 million.

- **Equipment** costs includes new and replacement computing equipment, desktop computers, data communications equipment, video-teleconferencing equipment, office furniture, file cabinets, and support equipment such as audio-visual equipment. Also included are software development costs associated with developing and maintaining central application systems that support proposal, award, financial, and administrative activities. These costs increase by $8.26 million for upgrades associated with next generation grants management and e-government.

National Science Board

NATIONAL SCIENCE BOARD $4,000,000

The National Science Foundation Appropriations Act of 2002 provided for a separate appropriation line item for the National Science Board (NSB, the Board) beginning in FY 2003. Accordingly, this FY 2006 NSB Budget Request identifies the resources needed to support the Board, including amounts for personnel compensation and benefits, authorized travel, employment of experts and consultants, and other appropriate expenses. The NSB Request is $4.0 million, an increase of $30,000 or 0.8 percent over the FY 2005 budget of $3.97 million. The FY 2006 Budget Request will enable the NSB to fulfill its policy-making and oversight responsibilities for the NSF and provide advice to the President and the Congress on significant national policy issues in science and engineering (S&E) research and education.

National Science Board Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Personnel Compensation and Benefits	1.13	1.62	1.65	0.03	1.9%
Other Operating Expenses	1.09	2.35	2.35	-	0.0%
Total	$2.22	$3.97	$4.00	0.03	0.8%
Full-Time Equivalent Employees	10	12	13	1	8.3%

Totals may not add due to rounding.

Appropriation Language

For necessary expenses (including payment of salaries, authorized travel, hire of passenger motor vehicles, the rental of conference rooms in the District of Columbia, and the employment of experts and consultants under section 3109 of title 5, United States Code) involved in carrying out section 4 of the National Science Foundation Act of 1950 (42 U.S.C. 1863) and Public Law 86-209 (42 U.S.C. 1880 et seq.), $4,000,000: Provided, That not more than $9,000 shall be available for official reception and representation expenses. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2005.)*

National Science Board
FY 2006 Summary Statement
(Dollars in Millions)

Fiscal Year	Enacted/ Request	Rescission	Total Resources	Lapsed	Obligations Incurred/Estimated
FY 2004 Appropriation	$3.90	-0.02	$3.88	-1.66	$2.22
FY 2005 Current Plan	$4.00	-0.03	$3.97	-	$3.97
FY 2006 Request	$4.00	-	$4.00	-	$4.00
$ Change from FY 2005	-		$0.03		$0.03
% Change from FY 2005	0.0%		0.8%		0.8%

Totals may not add due to rounding.

Adjustments to Base

Within the Office of the National Science Board FY 2004 appropriation a total unobligated balance of $1.66 million lapsed, due to unexpected delays in NSB-sponsored activities and in hiring of NSB staff.

Background on the National Science Board

As an independent Federal agency, NSF does not fall under any cabinet department; rather NSF's activities are guided by the NSB. The NSB was established by the Congress both to serve as an independent national science policy body, and to oversee and guide the activities of the NSF. It has dual responsibilities to: a) provide national science policy advice to the President and the Congress; and b) establish policies for the NSF. The NSB has 24 Members appointed by the President and confirmed by the Senate. NSB Members, who serve six-year terms in intermittent appointments, are drawn from industry and universities, and represent a variety of S&E disciplines and geographic areas. They are selected for their preeminence in research, education or public service. The NSF Director is also a full voting member (*ex officio*) of the Board.

In recent years, the NSB has met about six times a year to review and approve major NSF awards and new programs, oversee and provide policy direction to NSF, and deal with significant science and engineering related policy issues. It initiates and conducts studies and reports on a broad range of policy topics, and publishes occasional policy papers or statements on issues of importance to U.S. science and engineering. The Board analyzes NSF's budget to ensure progress and consistency along the strategic direction set for NSF and to ensure balance between initiatives and core programs. It also identifies issues that are critical to NSF's future, and approves NSF's strategic budget directions and the annual budget submission to the Office of Management and Budget (OMB).

National Science Board Activities

Because it is required to establish the Foundation's policies within the framework of applicable national policies as set forth by the President and the Congress, the NSB supports the strategic Government Performance and Results Act (GPRA) goals of the Foundation, including those identified in the President's Management Agenda (PMA). The Board conducts continuous assessment of the quality, relevance and performance of the Foundation's award making, as called for in the Research and Development Investment Criteria of the PMA. The NSF Director's report on Merit Review is presented to the Board each year, allowing the NSB to monitor the quality and effectiveness of this keystone Foundation process. The Board has received reports from the chairs of the Foundation's Advisory Committee on GPRA Performance Assessment, and reviews and approves the summary results of the Foundation's annual GPRA performance goals and the updates of the NSF Strategic Plan.

The NSB issues policy guidance in the form of official statements and resolutions dealing with topics such as the Foundation's merit review criteria, cost sharing with universities, and funding and oversight of major research infrastructure projects. The Board is also responsible for direct review and approval of the largest Foundation awards, and is responsible for the review and approval of major research infrastructure projects at all stages of development, including budget planning, review of proposals and management effectiveness, and approval of awards.

Much of the work of the Board is accomplished in committees, which make recommendations to the full Board for approval. The standing Committee on Audit and Oversight oversees the operations of the Foundation's Office of Inspector General (OIG), as well as NSF compliance with new procedures for financial accountability and information technology security. The members of the Committee on

Programs and Plans (CPP) review proposals for major awards, the health of the Foundation's peer review system, and program performance and accountability. The Board monitors the critical infrastructure that supports research in Antarctica through the CPP Subcommittee on Polar Issues.

The Board established a Committee on Strategy and Budget (CSB) in 2001 to focus on strategic planning and budget initiatives for NSF. Review of the Foundation's Budget Request is also vested in CSB. The Committee on Education and Human Resources (EHR) focuses on Foundation activities in such priority areas as S&E workforce development, math and science education, and underrepresented populations and regions in S&E programs. The EHR Subcommittee on S&E Indicators manages the process for development and review of the Board's biennial statistical report, *S&E Indicators*.

During the last year, the Board has accomplished a great deal in terms of its mission to provide oversight and policy direction to the Foundation, including: reviewed and endorsed the OIG Semi-annual Reports to Congress and approved NSF management responses; approved the NSF FY 2006 Budget Request for transmittal to OMB; approved the Foundation's Merit Review Report; provided review and decisions on nine major awards or proposal funding requests; developed a broad set of recommendations for allocation of authorized increases in funding resources to the Foundation; and reprioritized NSB-approved but not-yet-funded Major Research Equipment and Facilities Construction (MREFC) account projects.

In terms of advice to the President and the Congress, the Board published the *S&E Workforce Report* (NSB-03-69); developed and delivered a budget expansion report in accordance with Section 22 of the NSF Act of 2002; prepared, approved and published the 2004 *S&E Indicators Report*; provided testimony to Congressional Hearings; interacted with the White House Office of Science and Technology Policy in meetings and forums on S&E issues; and responded to specific questions and inquiries from Senators and Representatives. Board meetings and deliberations have also become much more open in accord with the Government in the Sunshine Act, as directed by the NSF Act of 2002. The NSB initiated a major effort to increase and improve its outreach and communications with the Congress, other agencies, various interest groups and the outside S&E research and education community. During the past year the Board also initiated examinations of major issues related to the process by which MREFC proposals are developed, prioritized and funded; NSF policies for Long-lived Data Collections; and NSF policies for the identification, development and funding of transformative, innovative or high-risk research.

National Science Board FY 2006 Budget Request

The Board's Budget Request for FY 2006 seeks resources to carry out its statutory authority and to strengthen the Board's oversight responsibilities for the Foundation. Enhanced Board responsibilities established in the NSF Authorization Act of 2002 and directed by Congressional Report language include: an expanding role in prioritizing and approving MREFC projects; new requirements for meetings open to the public; and responsibilities for reporting on the Foundation's budgetary and programmatic expansion, with specific focus on the projected impact on the science and technology (S&T) workforce, research infrastructure, size and duration of grants, and under-represented populations and regions.

Effective communications and interactions with our constituencies contribute to the Board's work of identifying priority S&T policy issues, and developing policy advice and recommendations to the President and Congress. To this end, the Board will increase communication and outreach with the university, industry and the broader S&E research and education community, Congress, Federal S&T agencies, and the public. These activities will support U.S. global leadership in discovery and innovation based on a continually expanding and evolving S&T enterprise in this country, and will ensure a principal role for NSF programs in providing a critical foundation for S&E research and education.

In FY 2006, the Board will, *inter alia*, expand its ongoing examinations of its role and responsibilities regarding the NSF's MREFC program as it finalizes the development and implementation of a new protocol for the process by which major research equipment and facilities proposals are developed, prioritized, and funded; NSF policies for Long-lived Data Collections; NSF policies regarding the identification, development and funding of transformative or high-risk research; and policies to ensure an adequate and diverse S&E workforce for the future. The Board will continue to review and approve NSF's actions for creating major NSF programs and funding large projects. Special attention will be paid to budget growth impacts on the S&T workforce, broadening participation in higher education, national S&T infrastructure, and the size and duration of NSF grants.

Essential to the conduct of Board business is a small and independent, yet adequate, core of full-time senior policy, clerical and operations staff, supplemented by short-term temporary contractual support as needed for various NSB endeavors. This core of NSB support is augmented by the Foundation as it continues to provide accounting, logistical and other necessary resources in support of the NSB and its missions, including continued Foundation support for Board activities through the cadre of Executive Secretaries to Board Committees and Task Forces.

By statute, the Board is authorized five professional positions and other clerical staff as necessary. In consultation with the Congress, the Board has defined these five professional positions as NSB senior S&E policy staff, and the clerical positions as NSB staff that support Board operations and related activities associated with the conduct of its meetings and oversight responsibilities. In August 2003, the NSB Chair charged the new NSB Executive Officer, who reports directly to the NSB Chair and also serves as the Director of the NSB Office (NSBO), with identifying options for broadening the NSBO staff capabilities to better support the broad mission of the NSB. The NSBO staff provides both the independent resources and capabilities for coordinating and implementing S&E policy analyses and development, and the operational support that are essential for the Board to fulfill its mission. The full impact of increasing the number of professional positions closer to the statutory level, along with necessary clerical and support staff, is expected to occur in FY 2006, with increased attention to addressing new skill requirements.

Personnel Compensation and Benefits and General Operating Expenses
(Dollars in Thousands)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Percent
Personnel:					
Personnel Compensation and Benefits	1,125	1,620	1,650	30	1.9%
General Operations:					
NSBO Staff Development and Training	5	25	30	5	20.0%
Advisory and Assistance Services	-	1,450	1,367	-83.00	-5.7%
Other Services	-	230	193	-37.00	-16.1%
Travel and Transportation of Persons	303	446	525	79	17.7%
Communications, Supplies and Equipment	-	190	220	30	15.8%
General Operating Expenses	776	-	-	-	0.0%
Representation Costs	8	9	15	6	66.7%
TOTAL	$2,217	$3,970	$4,000	30	0.8%

Totals may not add due to rounding.

In addition to the NSBO's essential and independent resources and capabilities, external advisory and assistance services are especially critical to support production of NSB reports and supplement the NSB staff's general research and administration services to the Board. These external services provide the Board and its Office with the flexibility to respond independently, accurately and quickly to requests from Congress and the President, and to address issues raised by the Board itself.

Office of Inspector General

OFFICE OF INSPECTOR GENERAL $11,500,000

The Appropriations Act that funds the National Science Foundation provides for a separate appropriation heading for NSF's Office of Inspector General (OIG). Accordingly, the FY 2006 Budget Request identifies the resources needed to support OIG, including amounts for personnel compensation and benefits, contract services, training, travel, supplies, materials, and equipment.

The FY 2006 Budget Request for OIG is $11.5 million, which represents an increase of $1.47 million over the FY 2005 Current Plan of $10.03 million.

Office of Inspector General Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Personnel Compensation & Benefits	$7.30	$7.49	$7.73	$0.24	3.2%
Other Operating Expenses[1]	2.17	2.54	3.77	1.23	48.4%
Total	$9.47	$10.03	$11.50	$1.47	14.7%
Full-Time Equivalent Employment	62	60	61	1	1.7%

Subtotals may not add due to rounding.

[1]Starting in FY 2006, the cost of the annual audit of NSF's financial statements is requested in this appropriation.

Appropriation Language

For necessary expenses of the Office of Inspector General as authorized by the Inspector General Act of 1978, as amended, ~~$10,110,000~~*$11,500,000,* to remain available until September 30, ~~2006~~*2007*. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2005.)*

Office of Inspector General
FY 2006 Summary Statement
(Dollars in Millions)

Fiscal Year	Enacted/ Request	Rescission	Carryover/ Recoveries	Total Resources	Obligations Incurred/Estimated
FY 2004 Appropriation	10.00	-0.06	0.75	10.69	9.47
FY 2005 Current Plan	10.11	-0.08	1.22	11.25	11.25
FY 2006 Request	11.50	-	-	11.50	11.50
$ Change from FY 2005	1.39			0.25	
% Change from FY 2005	13.7%			2.2%	

Totals may not add due to rounding.

Explanation of Carryover

Within the Office of Inspector General appropriation a total of $1.22 million was carried forward into FY 2005 to cover priority audits that are contracted out; fund contracts for financial analysis and other technical support for OIG investigations; provide contract support for information technology and other administrative needs of the office; fund personnel compensation costs; and protect the appropriation against unanticipated variations between obligations and expenditures.

Adjustments to Base

In FY 2006, $1.10 million was moved from the R&RA and EHR appropriation base to the OIG account to cover the cost of the NSF's financial statements audit. The current five-year audit contract expires in FY 2005. While the cost of the new contract will not be known until it has been competed, it is expected to increase by 25-30 percent over current plan estimates.

Financial Statements Audit	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request
R&RA	656,765	710,343	-
EHR	143,948	145,492	-
OIG	-	-	1,100,000
Total	**$800,713**	**$855,835**	**$1,100,000**

Totals may not add due to rounding.

OIG Responsibilities

In February 1989, the National Science Board established OIG pursuant to the Inspector General Act Amendments of 1988. The statute confers on OIG the responsibility and authority to:

- Conduct and supervise audits of NSF programs and operations, including organizations that receive NSF funding.
- Conduct investigations concerning NSF programs and operations, including organizations that receive NSF funding.
- Evaluate allegations of research misconduct, such as fabrication, falsification, or plagiarism, involving individuals who participate in NSF-funded activities.
- Provide leadership, coordination, and policy recommendations for:
  - Promoting economy, efficiency, and effectiveness in the administration of NSF programs and operations, and
  - Preventing and detecting fraud and abuse in NSF programs and operations.
- Issue semiannual reports to the National Science Board and Congress to keep them informed about problems, recommended corrective actions, and progress being made in improving the management and conduct of NSF programs.

As set forth in the OIG Strategic Plan, the primary functions of the Office are audits, reviews, and investigations. To provide the diverse skills, training, and experience necessary to oversee NSF's varied programs, the OIG staff includes scientists, attorneys, certified public accountants, investigators, evaluators, and information technology specialists. The focus of an investigation, audit, or other review may be on a single entity or individual, an organization, a project involving multiple disciplines, or a broad program or functional area.

OIG performs audits of grants, contracts, and cooperative agreements funded by the Foundation's programs. The Office also conducts audits and reviews of both internal agency programs and external organizations that receive NSF funding to ensure that financial, administrative, and programmatic activities are conducted economically, effectively, and in compliance with agency and federal requirements. OIG is also responsible for overseeing the audit of the Foundation's annual financial statements, which are required for all NSF accounts and activities by the Government Management Reform Act of 1994. The Office contracts with a public accounting firm to conduct the financial statements audit, and in the past the cost was allocated proportionately to the accounts audited. Beginning in FY 2006, funds to cover the complete cost of the financial audit are requested in this appropriation. OIG also audits financial, budgetary, and data processing systems used by NSF to develop the financial statements. In addition, the Office performs multi-disciplinary reviews – involving auditors, attorneys, management analysts, investigators, and others as needed – of financial, management, and program operations to identify broader problems and highlight best practices.

OIG investigates possible wrongdoing by organizations and individuals who submit proposals to, receive awards from, conduct business with, or work for the Foundation. The Office also investigates allegations of research misconduct, usually in close coordination with the awardee institutions. After assessing the validity and seriousness of a violation, OIG recommends proportionate action. The Office refers the results to the Department of Justice or other authorities for criminal prosecution or civil litigation, when appropriate. In other cases, OIG refers the matter to the Foundation for administrative resolution; if applicable, the Office also recommends changes in agency policies and procedures to correct problems that have been identified. OIG works closely with institutions on the conduct of their internal investigations and performs outreach activities aimed at preventing and detecting fraud, waste and abuse and at raising the awareness of funded researchers, institutional administrators, and agency employees about the OIG's role and NSF's rules and expectations.

Personnel Compensation and Benefits and General Operating Expenses

(Dollars in Thousands)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Personnel Compensation & Benefits	$7,302	$7,492	$7,728	$236	3.2%
Travel and Transportation of Persons	207	270	290	20	7.4%
Advisory and Assistance Services	1,550	1,888	3,082	1,194	63.2%
Other Services	70	60	60	0	0.0%
Communications, Supplies & Equipment	340	320	340	20	6.3%
	$9,469	$10,030	$11,500	$1,470	14.7%

Totals may not add due to rounding.

The OIG request for FY 2006 assumes a 2.3 percent increase for pay for civilian personnel, but most of the budget increase requested for the OIG will fund the annual audit of NSF's financial statements, which NSF program accounts had previously funded. These audit costs are reflected in the table as part of Advisory and Assistance Services. This audit is conducted by an independent contract auditor under OIG oversight. The contract for the audit will be re-competed in 2005, so its cost in 2006 is uncertain. While recent NSF audits have cost between $600,000 and $810,000, the audit under a new contract is expected to exceed $1.0 million in FY 2006.

The Office's primary effort will continue to focus audit attention in five areas that pose the greatest challenge to the agency: (1) strategic management of NSF resources, including the agency's planning for future workforce needs and the need to strengthen its administrative capabilities (travel funds for monitoring large facilities and other awards, staff recruitment, appropriate use of rotators, office space, etc.); (2) improved financial performance, including the management of large infrastructure projects, a risk-based program for effective post-award monitoring, and appropriate oversight of awards that continue to have cost sharing; (3) expanded electronic government, including improved information security and effective operation of NSF's IT systems; (4) budget and performance integration, including improving the objectivity of the data collected for Government Performance and Results Act reporting, full disclosure of the limitations of more subjective performance reporting (such as the use of "nugget" success stories and Committees of Visitors assessments), and improved cost accounting, especially at the NSF program level; and (5) program-specific challenges in such areas as managing the U.S. Antarctic Program and broadening participation in the agency's merit review process. As NSF's financial exposure grows due to its continuing investment in large facilities and instrumentation and its efforts to make larger awards over longer periods of time, our audit coverage has expanded. Follow-up work in assessing progress in large research equipment projects will also be a priority.

The OIG will maintain its focus on specific issues that emerge concerning the management of NSF programs, procurement and acquisition, information technology, human capital, awardee financial accountability and compliance, and OMB Circular A-133 audits. We have made a strong commitment to improving the quality of audits conducted by CPA firms, and the increase in time and effort required to meet the higher standards is significantly raising the costs of contracted audits. In recent years, these audits have uncovered material issues concerning unallowable indirect costs, unfunded cost-sharing commitments, and records maintained by large school systems that are so inadequate they cannot even be audited. The OIG will phase in assessments of NSF actions resulting from the agency's multiyear business analysis contract and workforce plan, which are scheduled for completion in FY 2005. Finally, we will initiate an audit on international collaborations, which are an integral part of NSF's portfolio, with particular attention to the accountability and audit requirements of international partners.

As criminal, civil and administrative investigative cases have become more complex; we have increased our interaction with NSF, awardee administrators, and the Department of Justice to try to resolve them in the most effective and efficient manner. Today these cases normally require more staff time, specialized knowledge, and analytical skills, as well as more frequent contract support when special financial or other expertise is needed. We have developed and applied a process for identifying grant fraud indicators that may be found through audits and other reviews, enabling OIG to integrate investigative and audit work more effectively and take a more proactive approach. Our Office has also taken a leadership role in establishing a peer review process for investigative activities in Inspector General offices, which will enhance the quality of investigations throughout the IG community. At the requested funding level, the NSF OIG will continue to be the community leader for research misconduct and related investigative initiatives.

In recent years, OIG has made a concerted effort to educate NSF staff and the research communities about avoiding the kinds of problems that lead to investigations, unfavorable audit findings, or administrative corrective actions. The request level will enable us to commit a modest amount of staff time to OIG outreach programs that help NSF staff, awardee institutions, and researchers better understand system and grant management issues and the preventive or corrective measures that may need to be taken. Auditors, investigators, and other staff regularly participate in outreach activities, and as NSF programs increase in complexity and number, OIG has seen a commensurate increase in requests for information from universities and research institutions. The NSF OIG will continue to play a leadership role in convening international conferences and workshops that are well attended by NSF's counterparts in other countries, including their auditing and investigative components, to discuss common concerns.

Facilities

MAJOR MULTI-USER RESEARCH FACILITIES $1,194,250,000

The FY 2006 Request for Facilities totals $1,195.25 million, a $114.97 million increase, or 10.6 percent, over the FY 2005 Current Plan of $1,080.08 million. Operations and maintenance of multi-user facilities and research resources are funded through the Research and Related Activities (R&RA) Account; major construction projects are funded through the Major Research Equipment and Facilities Construction (MREFC) Account.

NSF investments provide state-of-the-art tools for research and education, such as multi-user research facilities, distributed instrumentation networks and arrays, accelerators, telescopes, research vessels, aircraft, and earthquake simulators. In addition, investments in Internet-based and distributed user facilities are increasing as a result of rapid advances in computer, information, and communication technologies. NSF's investments are coordinated with those of other organizations, agencies and countries to ensure complementarity and integration.

NSF Funding for Major Multi-User Research Facilities
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Facilities	594.95	644.03	714.89	70.86	11.0%
Polar Facilities and Logistics	277.07	257.46	300.63	43.17	16.8%
Federally Funded R&D Centers[1]	191.59	178.59	179.53	0.94	0.5%
Total, Major Multi-user Research Facilities	$1,063.61	$1,080.08	$1,195.05	$114.97	10.6%

[1]Excludes the Science and Technology Policy Institute, which is an FFRDC but not a research platform.

To describe the life-cycle of a facility, the Foundation has adopted a set of distinct stages in its Facilities Management and Oversight Guide, found at http://www.nsf.gov/bfa/start.htm[1]. These stages are: 1) Concept/Development – the phase during which the idea of a facility is articulated and project planning and design begins and is completed; 2) Implementation – including construction, upgrade, and/or acquisition, system integration, commissioning, testing, acceptance, transition to operations, and management of these efforts; 3) Operations and Maintenance – including the day-to-day work required to support and conduct research and education activities, to ensure that the facility is operating efficiently and cost-effectively, and to provide small- and intermediate-scale technical enhancements when needed to maintain state-of-the-art research capabilities; and 4) Renewal or Termination – the stage in which decisions regarding continued support of a facility are made. The information learned during the Operations and Maintenance stage and through various reviews of the results of research and education activities and facility management is used to determine whether the facility will be renewed, upgraded, re-competed or terminated. The Facilities Management and Oversight Guide requires the use of Project Advisory Teams (PATs) to advise program officers on business, financial, legal, and other related aspects of projects and project management. The PAT is composed of the Deputy for Large Facility Projects (DLFP) who provides advice and assistance during the implementation phase of the facility life cycle and staff from the Directorates, the Office of the General Counsel, the Office of Legislative and Public

[1]At the December 2004 National Science Board (NSB) meeting, NSF announced that new guidelines for the development, review and approval of major research facilities will be available by about June 2005. The Facilities Management and Oversight Guide is currently being revised as part of this process.

Affairs, and the Office of Budget, Finance and Award Management. The DLFP also provides advice and assistance to Directorates, Divisions and Program staff throughout the life cycle of a facility project.

Major Multi-User Research Facilities Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Facilities	**$594.95**	**$644.03**	**$714.89**	**$70.86**	**11.0%**
Academic Research Fleet	82.50	83.20	83.20	0.00	0.0%
Advanced Modular Incoherent Scatter Radar	12.40	12.50	11.00	-1.50	-12.0%
Cornell Electron Storage Ring	18.00	16.62	14.71	-1.91	-11.5%
Gemini Observatory	13.27	14.81	18.50	3.69	24.9%
HIAPER[1]	12.54	0.00	0.00	0.00	n/a
Incorporated Research Institutes for Seismology	13.00	12.16	13.31	1.15	9.5%
Integrated Ocean Drilling Program	35.10	32.10	30.00	-2.10	-6.5%
Large Hadron Collider	7.00	10.50	13.50	3.00	28.6%
Laser Interferometer Gravitational Wave Observatory	33.00	32.00	32.00	0.00	0.0%
MREFC Facilities[2]	148.90	190.39	267.63	77.24	40.6%
National High Magnetic Field Laboratory	24.50	25.50	25.50	0.00	0.0%
National Nanofabrication Infrastructure Network	13.80	13.90	13.90	0.00	0.0%
National Superconducting Cyclotron Laboratory	15.65	17.50	17.50	0.00	0.0%
Network for Earthquake Engineering Simulation[2]	8.05	19.54	20.52	0.98	5.0%
Shared Cyberinfrastructure Tools	110.66	120.76	114.00	-6.76	-5.6%
Terascale Computing Systems[2]	10.05	0.00	0.00	0.00	n/a
Other Facilities[3]	36.54	42.55	39.62	-2.93	-6.9%
Polar Facilities and Logistics	**$277.07**	**$257.46**	**$300.63**	**$43.17**	**16.8%**
Antarctic Facilities and Operations	151.11	152.55	196.32	43.77	28.7%
Polar Logistics	104.93	104.91	104.31	-0.60	-0.6%
South Pole Station[2]	21.03	0.00	0.00	0.00	n/a
Federally Funded R&D Centers[5]	**$191.59**	**$178.59**	**$179.53**	**$0.94**	**0.5%**
National Astronomy and Ionospheric Center	12.34	12.42	12.50	0.08	0.6%
National Center for Atmospheric Research	82.92	81.22	82.27	1.05	1.3%
National Optical Astronomy Observatory	41.35	37.92	37.36	-0.56	-1.5%
National Radio Astronomy Observatory	54.98	47.03	47.40	0.37	0.8%
Total	**$1,063.61**	**$1,080.08**	**$1,195.05**	**$114.97**	**10.6%**

[1]Implementation funding for HIAPER was provided through the MREFC Account. Operations and Maintenance activities are funded within the R&RA Account through the National Center for Atmospheric Research (NCAR), an FFRDC.

[2]Funding levels for MREFC projects in this table include initial support for operations and maintenance funded through R&RA as well as implementation costs funded through MREFC.

[3]Other Facilities includes support for the Network for Computational Nanotechnology, continued phase out of program and contract activities for the Ocean Drilling Program, and other physics, materials research, ocean sciences, atmospheric sciences, earth sciences and computational sciences facilities.

[5]Does not include the Science and Technology Policy Institute, which is an FFRDC, but not a research platform.

In February 2004, the National Academies released a report on "Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation". This report recommends an open process for selecting new projects to be funded, establishing well-defined criteria and including maximum community input. The results of this final prioritization should be "discussed, explained and documented". NSF concurs with these recommendations and is currently refining the MREFC process to ensure that decisions are clearly documented and explained, and selection criteria clearly articulated.

Performance information related to NSF-funded facilities is available in the Performance Information chapter of this document and in the FY 2004 NSF Performance and Accountability Report (NSF-05-01). A list of Major Research and Equipment Facilities Construction (MREFC) projects can be found in this chapter. For a full discussion of these projects, please refer to the MREFC chapter.

FACILITIES

Academic Research Fleet

Project Description: The Academic Research Fleet consists of 27 vessels in the University-National Oceanographic Laboratory System (UNOLS). These vessels range in size, endurance, and capabilities, providing NSF and other federally-funded scientists with a diverse fleet capable of operating in coastal and open ocean waters to conduct ocean science research. Included is funding for ship operations, shipboard scientific support equipment, oceanographic instrumentation and technical services, ship acquisition and upgrade, and submersible support.

Principal Scientific Goals: The Academic Research Fleet serves as the main platform for the collection of data and testing of hypotheses in oceanography. Through use of these facilities, scientists contribute to advances made in areas such as climate, fisheries, and marine research.

Principal Education Goals: Vessels in the Academic Research Fleet permit shipboard training of future oceanographers. Through cruise participation, graduate and undergraduate students interact with scientists and marine technicians, enabling them to gain first-hand exposure to ocean science field research. Through recent technological innovations, research conducted at sea can be transmitted remotely back to the classroom, broadening the educational impact of the vessels to a wider audience, including K-12 students.

Partnerships and Connections to Industry: The Academic Research Fleet is supported through an interagency partnership, principally with the National Oceanic and Atmospheric Administration (NOAA) and the Office of Naval Research (ONR) via a Memorandum of Understanding (MOU). NSF provides approximately 65 percent of the operating funds for the Fleet, while the remaining operating costs are divided proportionally among the other vessel users. NSF also coordinates with ship-operating and non-operating academic institutions through its connection with UNOLS.

Management and Oversight: NSF provides oversight to the Academic Research Fleet through cooperative agreements with each ship-operating institution and the UNOLS Office, and through standard grants. In addition, NSF oversees the fleet through external review of proposals, site visits, ship inspections, and participation at UNOLS Council and Subcommittee meetings by Program Managers. Several Program Managers within the Division of Ocean Sciences (GEO) are involved in the activities and overall oversight of the academic research fleet.

Management of an individual institution's ship-operating facilities varies with the scale of the operation, but the core responsibility typically resides with the Director of the Institution, the Marine Superintendent (for all aspects of the facility), and the Ship's Captain (for at-sea operations). For larger multi-ship-operating institutions, a chief of marine technicians, schedulers and finance administrators may also be involved in facility management.

Current Project Status: NSF has supported this project for many years. Based on projected science requirements identified in recent reports and workshops, a fleet of vessels to support ocean science research will be needed far into the future. In coordination with the ocean science community, the Federal Oceanographic Facilities Committee (FOFC) is currently revising the report on long-range plans for renewal of the academic fleet. The FY 2006 Request for the Academic Research Fleet totals $83.20 million, level with the FY 2005 Current Plan, which will continue to support the operation, conversion and upgrade of the U.S. Academic Research Fleet. Also included are funds to continue development and construction of a new deep submergence capability to replace the pioneering submersible ALVIN; conversion of a seismic research vessel to replace the aging R/V Maurice Ewing; and, design and development of three Regional Class research vessels. These investments will open significant expanses of the deepest ocean to exploration, enhance coastal research activities and bring greatly enhanced capability to map structures under the sea floor to U.S. researchers.

Funding Profile: All funding for the Academic Research Fleet to date has been provided through the R&RA Account.

Academic Research Fleet Funding Profile

(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001	2.30	56.60	$58.90
FY 2002	2.30	59.60	$61.90
FY 2003	3.00	62.20	$65.20
FY 2004	10.00	72.50	$82.50
FY 2005 Current Plan	11.00	72.20	$83.20
FY 2006 Request	16.30	66.90	$83.20
FY 2007 Estimate	19.50	71.00	$90.50
FY 2008 Estimate	19.80	73.90	$93.70
FY 2009 Estimate	20.80	75.50	$96.30
FY 2010 Estimate	21.47	77.39	$98.85

NOTE: Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Implementation: From time to time, vessels require conversions or upgrades that go beyond the normal maintenance supported by operating costs. Funding decisions for conversions and upgrades are based on strong evidence of scientific need. In recent years, the funding has provided for the conversion or upgrade of ships already in service whose age, configuration, or operating costs have impaired their usefulness. Planning for future years includes the replacement of ships that have reached the end of their useful life and replacing the capability for studies in the deep ocean as the aging ALVIN submersible reaches the end of its useful life. In December 2001, the FOFC of the National Oceanographic Partnership Program (NOPP) prepared a report titled Charting the Future for the National Academic Research Fleet, which defines a federal interagency renewal strategy for the national academic research fleet. The report is currently being revised by the FOFC, however significant changes for renewal of the academic fleet are not anticipated. Major upgrade expenditures indicated in implementation estimates in FY 2006 and out-years are for development of a new deep submergence vehicle, replacement of Regional Class ships and acquisition and reconfiguration of a seismic research vessel, consistent with community, NRC and FOFC reports.

- Operations and Maintenance: This includes funds for operating and maintaining the fleet, shipboard scientific support equipment, oceanographic instrumentation and technical services, and submersible support.

Renewal or Termination: Participation of each ship in the research fleet through a cooperative agreement is governed by the existence of an efficient schedule of scientific research cruises for that ship, assessments of the continued fitness of the ship to conduct research at sea, and the ability of the operating institution to maintain cost effective operations.

Associated Research and Education Activities: NSF-funded researchers utilizing the fleet are supported through NSF's research programs and are subjected to NSF's standard merit review process. The fleet supports approximately 2,500 users per year, which is based on the total number of individual researchers, postdoctoral candidates, graduate and undergraduate students, teachers, K-12 students and observers who have participated in cruises.

Science Support: Because of its collaborative nature and the interagency cooperation, which enables the operation of the academic fleet, NSF only pays for ship time used by NSF researchers.

Advanced Modular Incoherent Scatter Radar

Project Description: The Advanced Modular Incoherent Scatter Radar (AMISR) is a phased array incoherent scatter radar with unique features that allow efficient and cost-effective dismantling, shipping, and re-assembly. The radar comprises three identical antenna faces, each with approximately three times the sensitivity of the incoherent scatter radar currently operating in Sondre Stromfjord, Greenland. Each of the three fixed antenna faces is approximately 35 meters square with 4096 radiating elements located on 128 separate panels. In addition to being relocatable, AMISR will provide the means for unique scientific observations via two significant features that have not been technically feasible in the past and will greatly enhance the way observations and experimental campaigns are conducted. First, the phased-array concept will allow pulse-to-pulse beam steering, thus enabling three-dimensional "imaging" of electron density features in high signal-to-noise environments. Second, an incoherent scatter radar with a solid-state transmitter and no moving parts will permit both extended operating periods and true remote internet operation with virtual "control rooms" at universities world-wide.

A single panel of 32 dipole antennas for the Advanced Modular Incoherent Scatter Radar (AMISR). AMISR consists of three antenna faces, each containing 128 of these panels. *Credit: SRI International*

Principal Scientific Goals: Long-term measurements of atmospheric parameters will us help understand the processes influencing global change, and observations during solar storms will help us understand and predict space weather, the primary goal of the multi-agency National Space Weather Program. There will also be strong synergy between AMISR scientific activities and the Center for Integrated Space Weather

Modeling (CISM), one of NSF's Science and Technology Centers. The AMISR systems at Poker Flat, Alaska, and Resolute Bay, Canada, will enable researchers to investigate fundamental issues of solar-terrestrial science including how the Earth is magnetically and electrically coupled to the Sun; what the structure and dynamics of the magnetosphere, ionosphere, and upper atmosphere are; and how the global energy flowing into the upper atmosphere at the pole flows to the equator. The scientific goals will change in the future as AMISR is deployed at other locations.

Principal Education Goals: The design for the AMISR is at the forefront of current radar, electronics, and signal processing technology. It uses advanced solid-state amplifiers that can be computer-controlled for maximum flexibility and ease of use. It will provide outstanding opportunities for students and young scientists and engineers to be involved with the development of the project and the operation of the instrument. The AMISR will be the first incoherent scatter radar designed for remote usage, allowing students and scientists to plan and configure experiments, and watch in real-time as the data is returned from remote sites. The web-based tools to be developed will make AMISR an excellent means to train the next generation of incoherent scatter radar specialists. The possibilities for new discoveries, combined with the ease of operation, will inspire hundreds of scientists from all over the globe to use the facility.

Partnerships and Connections to Industry: Manufacturing of the 12,000 antenna element units (AEUs) is being done by Sanmina SCI, a global electronics manufacturing firm with headquarters in San Jose, CA. The solid-state power amplifier for each of the units is being manufactured by Comtech PST, a company based in Melville, New York, that specializes in the production of amplifiers for commercial and military uses. The construction of the AMISR support structure and the foundation work at the sites in Alaska and Canada is being performed by VECO Corp., an Alaska-based company that specializes in management, engineering design and construction for the oil and power industries.

Management and Oversight: Overall project management and oversight is the responsibility of the program manager for Upper Atmospheric Facilities within the Division of Atmospheric Sciences. A Project Advisory Team has been appointed, which includes the Deputy for Large Facility Projects and members from the Directorate for Geosciences, the Office of Polar Programs, the Office of Budget Finance and Award Management, and the Office of the General Council. As required in the cooperative agreement for the AMISR construction, SRI has assembled a Technical Advisory Committee to provide technical oversight in the design and development of the AMISR system. SRI has also written a Project Execution Plan that describes the AMISR work breakdown structure, management structure, project milestones, and final test and acceptance plan.

Current Project Status: The cooperative agreement for AMISR construction was approved on August 1, 2003, during the design for manufacturing phase of the project, funded as a separate award for AMISR prototype development. The design of the antennal element units was finalized in 2004. The final design includes features that reduce cost and facility mass production of the units. Full-scale production is expected to begin in early 2005. A prototype system using 8 AMISR panels was deployed at the Jicamarca Radio Observatory in Peru, and initial tests are yielding satisfactory results. An additional 16 panels will be shipped to Gakona, Alaska, for further on-site testing. The Technical Advisory Committee met in December 2004 to review project status.

The AMISR is being developed in three stages. The first stage, which includes design and vendor selection, has been completed. The second stage is the assembly of the first AMISR antenna face at the Poker Flat Research Range in Alaska, a site that is both scientifically interesting and logistically advantageous. In the last stage, the second and third antenna faces will be assembled at the Resolute Bay Observatory in the Canadian Arctic. Future deployments will be determined on the basis of recommendations of a committee from the broader space science research community.

Future milestones for the project are outlined below:

FY 2005 Milestones:
- Initiate full-scale panel and AEU manufacturing
- Poker Flat Activities
  - Complete 128 panels w AEUs
  - Poker Flat (1 face) constructed
  - Poker Flat system test complete and operational
- Resolute Bay Activities:
  - Face 1 and 2 foundation materials, support scaffolding and distribution shelters shipped to Resolute Bay via sealift
  - Face 1 and 2 foundations constructed
  - Face 1 – 128 panels with AEUs shipped via sealift

FY 2006 Milestones:
- Resolute Bay Activities:
  - Complete 128 panels with AEUs
  - Face 1 erected
  - Face 1 system complete and operational
  - Complete 128 panels with AEUs
  - Face 2 – 128 panels w AEUs shipped via sealift

FY 2007 Milestones:
- Resolute Bay Activities:
  - Face 2 constructed
  - AMISR system test complete
- Full operations begin

<u>Funding Profile</u>: The implementation phase of AMISR began late in FY 2003 with an initial allocation of $14.0 million. Additional funding of $12.40 million was provided in FY 2004, as indicated in the table below. Funds allocated in previous fiscal years for prototype development are also shown in the table.

AMISR Funding Profile

(Dollars in Millions)

	Concept/ Development	Implementation	Operations & Maintenance	Total, NSF
FY 2001 & Earlier	3.60			$3.60
FY 2002	3.40			$3.40
FY 2003		14.00		$14.00
FY 2004		12.00	0.40	$12.40
FY 2005 Current Plan		10.00	2.50	$12.50
FY 2006 Request		8.00	3.00	$11.00
FY 2007 Estimate			3.00	$3.00
FY 2008 Estimate			3.00	$3.00
FY 2009 Estimate			3.08	$3.08
FY 2010 Estimate			3.15	$3.15

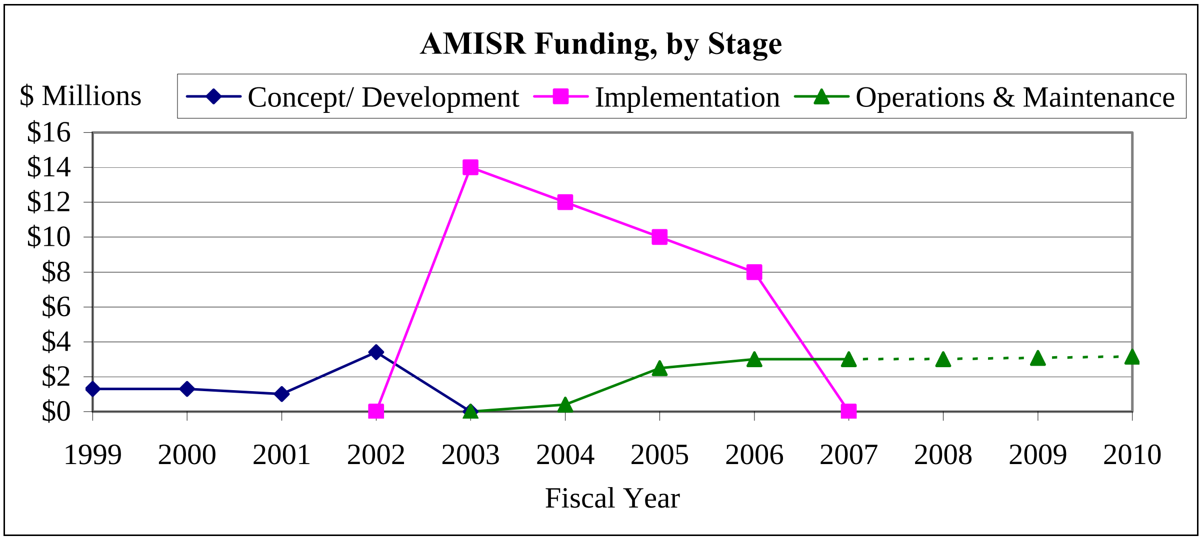
NOTE: A steady state of about $3 million in operations support is expected to occur in or about FY 2008. The expected operational lifespan of this project is 40 years, beginning in FY 2007. Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Concept/Development: Initial R&RA funding for AMISR began in FY 1999 with an award to SRI International to develop the design of the antenna element units. Subsequent funding was provided for building 32 engineering prototype units that were assembled into a panel for testing at the SRI field site near Stanford University and the U.S. Air Force antenna test facility in Ipswich, Massachusetts. The Concept/Development phase concluded with the competitive source selection of Sanmina SCI and two years of design for manufacturing activities involving close interaction between Sanmina and SRI engineers.

- Implementation: The first 4000 antenna element units will be manufactured during the first three months of 2005. Site preparation at Poker Flat is complete. The antenna elements will be assembled onto panels by SRI as they are received from the manufacturer. The assembled panels will be shipped to Alaska early in spring 2005 for integration and testing. This schedule will repeat for the two remaining faces to be deployed at Resolute Bay—the first in 2006 and the second in 2007.

- Operations and Maintenance: SRI is currently preparing a proposal for the initial operation and maintenance of the AMISR systems at Poker Flat and Resolute Bay. Operation and maintenance of the face at Poker Flat will be accomplished in collaboration with personnel at the Geophysical Institute, University of Alaska. Other participating institutions include Stanford University, MIT, and the University of Saskatchewan. Additional instrumentation for the two facilities will be funded through the R&RA grants programs within ATM.



Future Science Support: In addition to the operations support indicated above, AMISR research and education programs will be funded through the Aeronomy, Magnetospheric Physics, and Upper Atmospheric Facilities core programs within the Upper Atmospheric Research Section. The combined annual level of support for this research is estimated to be about $5 million.

Cornell Electron Storage Ring

Project Description: The Cornell Electron Storage Ring (CESR) is a facility that supports research in elementary particle physics as well as research in accelerator physics and superconducting radio frequency (RF) applications. CESR is an electron-positron collider that has provided important knowledge of the properties of the b-quark. Cornell University has modified CESR and the associated particle detector (CLEO) for operation over the energy range 1.5 GeV to 5.6 GeV per beam in order to address high-priority physics questions that relate to the c-quark and possible gluon states that cannot be addressed elsewhere. The transformed collider and detector are named CESR-c and CLEO-c respectively.

The CESR facility is also used by the materials research community at the Cornell High Energy Synchrotron Source (CHESS). CHESS is a high-intensity high-energy X-ray source supported by the NSF. It uses the synchrotron light given off by the charged particles, both electrons and positrons, as they circulate at nearly the speed of light around CESR. As a user facility, CHESS provides state-of-the-art synchrotron radiation facilities for research in physics, chemistry, biology, materials research and environmental sciences.

Principal Scientific Goals: CESR-c and CLEO-c explore a large set of critical weak and strong interaction phenomena, knowledge of which is either lacking or fragmentary. These in turn drive theoretical advances that both extend and enable the full program of physics targeted by many new-generation detectors, such as those at SLAC, Fermilab, and the Large Hadron Collider (LHC), and lay the foundation for strong interaction theory to meet the requirements of future physics beyond the Standard Model.

Principal Education Goals: To support and enhance Ph.D. level graduate education, postdoctoral research experience, research experiences for undergraduates, and research experiences for K-12 science teachers. Engendering excitement in science among young children will be a focus for strengthening K-12 engagements. An important component of that effort will be the participation of CLEO and CESR graduate students in school science classrooms.

Partnerships and Connections to Industry: CESR staff is transferring CESR Superconducting RF (SRF) technology to industry. Two new industrially fabricated SRF cavity systems have been acquired in order to shorten CESR bunch length with higher voltage. Through a license arrangement with Cornell, the ACCEL Corporation has manufactured two superconducting RF sources to power synchrotron light sources. They have been tested and installed in CESR to replace two older, lower gradient modules. Also some of the CHESS users are from industry, including pharmaceutical corporations (Rib-x Pharmaceuticals) and the research arms of Eastman Kodak, Xerox and General Motors. Some medical institutions also make use of CHESS (Dana Farber Cancer Institute, Boston Biomedical Research Institute, and Memorial Sloan-Kettering Institute).

Management and Oversight: CESR-c is managed by the Director of the Laboratory for Elementary Particle Physics (LEPP) at Cornell with help from an Assistant Director and an Associate Director for Accelerator Physics. The CLEO-c experiment is the sole CESR-c experiment in particle physics, and this collaboration consists of users from about 20 U.S. institutions. The CESR-c management interacts with the CLEO-c collaboration through the collaboration spokesperson and executive board as needed, and there are monthly meetings of the collaboration that include CESR-c management.

NSF oversight (PHY/MPS) is provided through annual site visits by NSF staff. Technical review of the award involved panel evaluation of the CESR-c proposal, and a site visit by NSF staff and external reviewers. The oversight process includes annual financial reports and program reports to the NSF and an annual review by a Program Advisory Committee of outside physicists reporting to the Laboratory Director and NSF. A comprehensive review will be held by NSF staff midway through the third year, of a five-year award initiated in FY 2003, with possible assistance from an external panel of experts.

CHESS is supported through the Division of Materials Research of the Directorate for Mathematical and Physical Sciences, the Directorate for Biological Sciences, and by the National Institutes of Health. Those organizations provide management oversight for CHESS through regular site visits. CHESS funding from NSF is $3.90 million in FY 2006.

Current Project Status: CESR reaches its final stages through the five-year Cooperative Agreement initiated in April 2003. Cornell University has modified the CESR colliding beam accelerator and the CLEO particle detector as mentioned above. In addition to the particle physics program, a vigorous program of accelerator science and technology development for accelerator concepts for the future will continue. CESR-c will also provide intense X-ray beams for the program in X-ray science at CHESS. The particle physics program and X-ray science program will now begin to use different accelerator energies, requiring the two programs to operate in different time periods. The FY 2006 Request for CESR totals $14.71 million, a decrease of $1.91 million from FY 2005. It is expected that the CESR-c and CLEO-c projects will cease at the end of the five-year period.

Funding Profile: The FY 2003 – FY 2008 estimated funding for CESR-c and CLEO-c will ensure completion of the elementary particle physics program and provide sufficient time for the particle physics group and the CHESS facility to plan their future activities. All funding for CESR to date has been provided through the R&RA Account.

CESR Funding Profile[1]

(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001		19.49	$19.49
FY 2002		19.49	$19.49
FY 2003		19.49	$19.49
FY 2004		18.00	$18.00
FY 2005 Current Plan		16.62	$16.62
FY 2006 Request		14.71	$14.71
FY 2007 Estimate		15.00	$15.00
FY 2008 Estimate		10.00	$10.00

Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

[1]Includes funding for CESR only. No funding for CHESS is included in this table.

Information pertaining to the data in the table is included below.

- Management and Operations: The facility expects to operate about 5,700 hours per year for CLEO research and for accelerator physics and development. Maintenance is provided through a weekly 8-hour shift and through two or three, 3-week shut-downs for maintenance of the accelerator, superconducting RF, helium refrigerator, vacuum system, beam lines for CHESS, power systems, and other ancillary systems. Approximately 30 percent of the CESR funding is directed toward in-house research (both experimental elementary particle physics and accelerator physics) with the remainder used to operate and maintain the facility. The funding profile above includes minor detector and accelerator changes that are essential to completion of the scientific program before FY 2009.

Associated Research and Education Activities: Cornell continues to be active in outreach:

- Approximately 200 high school physics teachers received tours, lesson plans, and/or presentation materials, along with educational videos on particle physics via outreach events from April 2003 to March 2004;

- Approximately 120 elementary and middle school students and 300 high school students were involved in activities hosted by LEPP. Over 300 people toured the Wilson Laboratory facility during this time frame;

- The Laboratory hosted 19 REU and two RET participants in collaboration with Wayne State University and George Mason University during the summer of 2004; and

- The laboratory trains graduate students in accelerator physics and has supported the development of superconducting radio frequency accelerating cavities.

Science Support: Approximately $3 million is provided annually by NSF in support of separate awards to external users of the CESR/CLEO facility. DOE provides a similar amount in support of awards to individual investigators and groups. In addition, $600,000 is provided in a separate award to Cornell in support of theoretical elementary particle physics research.

About 200 physicists from 22 universities have built and are operating the CLEO detector to study the products of the electron-positron collisions. CESR is a national user facility and the current CLEO-c collaboration includes more than 130 researchers from 25 U.S. and foreign institutions.

The CHESS facility serves a wide spectrum of experimental groups from Universities, National Laboratories and Industry and is used by the materials research community, with typically 600-700 users per year.

Gemini Observatory

Project Description: The Gemini Observatory consists of two 8-meter telescopes, one in the northern hemisphere, in Hawaii, and one in the southern hemisphere, in Chile. The Hawaiian telescope is optimized for infrared observations and is located on Mauna Kea at an altitude of 4,200 meters. The telescope in Chile is located on Cerro Pachon, an outstanding photometric site, at an altitude of 2,700 meters. This siting of the two telescopes assures complete coverage of the sky to complement the observations from space-based observatories, and provides access to the center of our own Galaxy as well as the Magellanic Clouds, our nearest galactic neighbors. Both telescopes are designed to produce superb image quality and both use sophisticated adaptive optics technology to compensate for the blurring effects of the Earth's atmosphere. The Observatory is an international collaboration with the United Kingdom, Canada, Australia, Chile, Argentina and Brazil.

Principal Scientific Goals: Astronomers need to resolve important questions about the age and rate of expansion of the universe, its overall topology, the epoch of galaxy formation, the evolution of galaxies once they are formed, and the formation of stars and planetary systems. The new generation of optical/infrared telescopes with significantly larger aperture (8-meter diameter) than previous instruments provides better sensitivity and spectral and spatial resolution. Technological advances in a number of key areas of telescope construction and design allow these instruments to take advantage of the best performance the atmosphere will allow.

Gemini North dome/enclosure with setting sun (to left) lighting up the bottom half of the telescope through thermal vents (fully open). The observing slit is partially open, revealing the truss and top end of the telescope. *Credit: Neelon Crawford - Polar Fine Arts; courtesy of Gemini Observatory and NSF*

Principal Education Goals: The Gemini telescopes play a central role in the education and training of U.S. astronomy and engineering students. An estimated 20 percent of the projected 400 users per year are students from the partner countries. Gemini is also providing a focus for public outreach and high school student training in all the partner countries, including the development of "sister city" arrangements between Hilo, Hawaii and La Serena, Chile involving students and teachers at high school and elementary school levels. In FY 2004, the Gemini Director was awarded Chile's Gabriela Mistral medal for the Observatory's great contributions to cultural exchange and knowledge of the Universe by the Ministry of Education. This was the first time the medal has been awarded to a non-Chilean.

Partnerships and Connections to Industry: Gemini is an international partnership with the United Kingdom, Canada, Australia, Chile, Argentina, and Brazil. Construction of the telescopes and their instrumentation has involved a large number of industrial concerns in a number of partner and non-partner countries. These have involved firms in large and/or complex optical systems, aerospace industries, electronics and engineering firms, etc. Continued involvement of such industries is part of the instrumentation and facilities renewal activities included in the operating budget of the Gemini Observatory.

Management and Oversight: The project is governed by the Gemini Board, established by the International Gemini Agreement signed by the participating agencies. NSF serves as the Executive Agency for the seven-nation partnership, carrying out the project on their behalf. Programmatic management has been the responsibility of the Staff Associate for Gemini in the Division of Astronomical Sciences (MPS), assisted during construction by an internal Project Advisory Team (PAT) with representation from the Office of the General Counsel, the Office of Legislative and Public Affairs, the Office of Budget, Finance and Award Management, and the Office of International Science and Engineering. During construction, a committee of outside experts regularly reviewed progress and reported to the partnership. With the start of scientific operations, the Gemini Board has established an independent Visiting Committee that will advise on the operation of the Observatory. Gemini is managed by Associated Universities for Research in Astronomy (AURA), Inc., on behalf of the partnership through a cooperative agreement with NSF. AURA conducts its own management reviews through standing oversight committees. The current cooperative agreement expires in FY 2005. Under the terms of the international agreement, the partnership will determine whether to compete the management of the Observatory at that time.

Current Project Status: Construction of both telescopes is complete and science operations are routine at both sites. Commissioning of facility instruments continues at both telescopes. The Chilean partner in Gemini, CONICYT, had a perennial problem paying operations contributions, though they completed the construction payments in full. The astronomical community in Chile feels a far greater need to develop astronomy within the country than a need for more observing time. Gemini South is on Chilean soil and the conditions of exemption from taxes and duties under which Gemini operates in Chile are very advantageous.

CONICYT proposed that the Gemini partners effectively return the equivalent of Chile's construction payment to CONICYT to establish a fund whose proceeds would be used to develop astronomy for Chile. In a "cooperative agreement" CONICYT remains a partner and returns to the partnership the 5 percent observing time on both telescopes that they had been entitled to as a result of paying 5 percent of the capital and operating costs. This proposal has been accepted by the Gemini Board and has been discussed with the National Science Board's Committee on Programs and Plans. Within the partnership there is agreement that the U.S. will assume 52.5 percent of the Chilean share, Australia 30 percent, Canada 15 percent, and Brazil the remaining 2.5 percent. The International Gemini Agreement has been amended to formalize the change.

Funding Profile: The FY 2006 Request totals $18.50 million, an increase of $3.69 million over the FY 2005 Current Plan estimate of $14.81 million. Included in this increase is enhanced operational and visitor support, the start of funding of a new generation of advanced instrumentation, and $1.0 million for partial return of the U.S. share of Chilean capital.

Gemini Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation[1]		Operations & Maintenance[1]		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 1994 & Earlier	12.00		47.00				59.00		$59.00
FY 1995				41.00				41.00	$41.00
FY 1996					3.82		3.82		$3.82
FY 1997					5.32		5.32		$5.32
FY 1998				4.00	5.72		5.72	4.00	$9.72
FY 1999					8.05		8.05		$8.05
FY 2000					8.38		8.38		$8.38
FY 2001					8.66		8.66		$8.66
FY 2002					12.50		12.50		$12.50
FY 2003					13.48		13.48		$13.48
FY 2004					13.27		13.27		$13.27
FY 2005 Current Plan[2]					14.81		14.81		$14.81
FY 2006 Request[2,3]					18.50		18.50		$18.50
FY 2007 Estimate[3]					23.00		23.00		$23.00
FY 2008 Estimate[4]					25.00		25.00		$25.00
Subtotal, R&RA	$12.00		$47.00		$160.51		$219.51		$219.51
Subtotal, MREFC				$45.00				$45.00	$45.00
Total, Each Stage		**$12.00**		**$92.00**		**$160.51**			**$264.51**

[1]Reporting of costs in these categories is as considered and reported by NSF in its response to OIG report 01-2001.

[2] FY 2005 and FY 2006 funding includes the cost of the Chilean capital return, consistent with the U.S. assumption of a portion of the Chilean share.

[3]The current cooperative agreement ends in FY 2005. The figures for FY 2006 and onward reflect the anticipated growth of the operating budget and funds for second generation instrumentation being used by the Observatory and the Gemini Board for planning purposes. The anticipated lifetime of the Observatory is 25 years.

[4]A steady state of about $25 million annually is anticipated for the U.S. share of operations beginning in FY 2008.

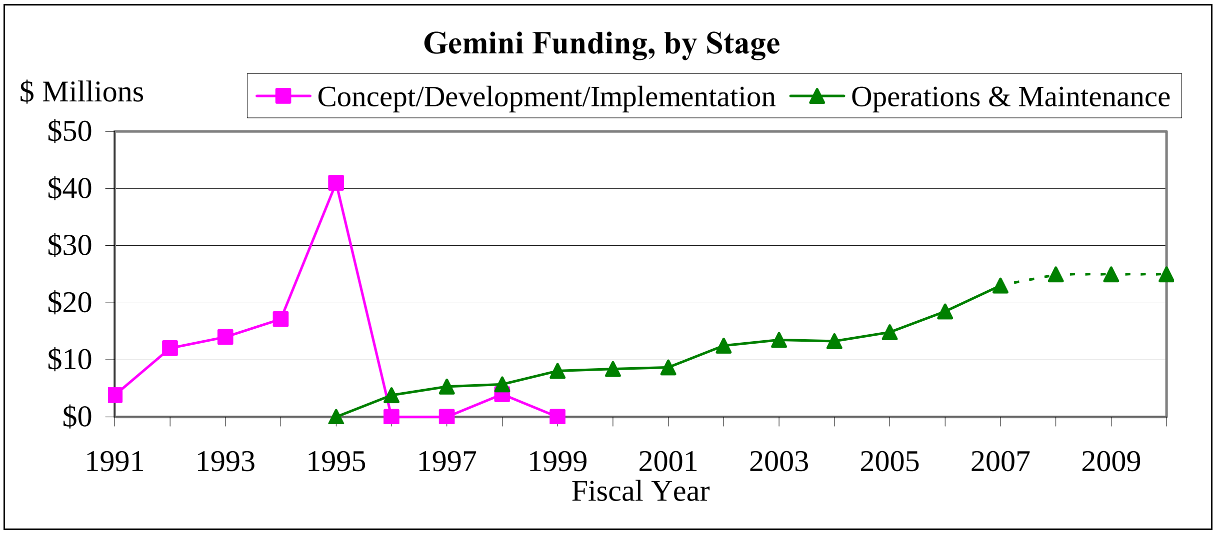
Information pertaining to the data in the table is included below.

- Concept/Development: Funds represent estimated U.S. investments in the development of mirror technologies for a new generation of telescopes, as recommended by the National Academy Report "Astronomy and Astrophysics for the 1980s." Three different mirror technologies were explored. These investments in technology development contributed to the plans for Gemini, as well as to other new telescopes that advance research in astronomy.

- Implementation: Gemini construction was initiated in FY 1991, before establishment of the MREFC Account in FY 1995. The $92 million obligated for Gemini construction is the U.S. share of the total cost ($184 million) for the two telescopes, with the balance provided by international partners.

- Management and Operations: Funding ramped up as the telescopes approached initial operations. Beginning in FY 2002, operations include the U.S. assumption of a portion of the Chilean share of operations costs, as agreed by the international partners. The funds provide additional observing time to the U.S. astronomy community while Chile maintains a share of observing time as host country.

Under this adjustment, NSF supports just over 50 percent of management, operations and maintenance. In FY 2005-2006, costs reflect Chilean capital return, consistent with U.S. assumption of a portion of Chilean share.



Renewal or Termination: The cooperative agreement for the support of Gemini operations is in its 5th year and expires in FY 2005. Under the terms of the international agreement, the partnership will determine whether to compete the management of the Observatory at that time.

Associated Research and Educational Activities: The public information and outreach office at Gemini carries out local outreach to schools, teachers, and the general public. The office also coordinates and serves as a liaison for the outreach efforts of partner countries and provides media services and web-based resources.

Science Support: Along with direct operations and maintenance support for Gemini, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $5 million.

Stephan's Quintet as imaged using the Multi-Object Spectrograph on Gemini North. The interacting members of the cluster are almost 300 million light years away. The galaxy NGC 7320 (top–center) is thought by most astronomers to be in the foreground (about 8-times closer) and is distinguished in this image by multiple red blobs indicating hydrogen clouds where stars are forming. *Credit: Gemini Observatory/Travis Rector, University of Alaska Anchorage*

Incorporated Research Institutes for Seismology

Project Description: IRIS is a consortium of 102 U.S. universities and not-for-profit institutions with research and teaching programs in seismology. IRIS operates a distributed national facility for the development, deployment, and operational support of modern digital seismic instrumentation to serve national goals in basic research in the earth sciences, in earthquake research, and in nuclear test ban monitoring. IRIS is also leading the construction of one aspect of the EarthScope MREFC project. IRIS is organized in four major program elements: (1) The Global Seismographic Network (GSN), which currently consists of a global deployment of 137 permanently installed digital seismic stations; (2) The

Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL), which manages a pool of portable seismometers that are made available to the seismology research community for scheduled regional and local scale studies; (3) The IRIS Data Management System (DMS), which provides the national and international seismic research community with timely access to data from the GSN and PASSCAL; and (4) The IRIS Education and Outreach (E&O) Program, which enables audiences beyond seismologists to access and use seismological data and research for educational purposes, including teacher workshops, student internships, museum exhibits, educational materials, and programs for under-resourced schools.

Principal Scientific Goals: The Earth's interior remains a major scientific frontier holding the key to understanding the origin of the planet. Recent developments in seismic sensor design, and the acquisition, transmission and storage of data have resulted in dramatic improvements in the resolving power of seismic imaging of the interior. Earthquake research, including rapid and accurate location and characterization of the earthquake source, its magnitude and a better understanding of the physical process involved, has also benefited greatly from recent technical advances. The IRIS facility serves the research needs of the national and international seismology community by making available state-of-the-art designs in seismic sensors and data acquisition systems. In addition to its role in providing the observational data essential for basic research in geophysics and earthquake dynamics, IRIS plays a significant role in seismic monitoring of the Comprehensive Test Ban Treaty and in bringing seismology to students and the public through the activities of its Education and Outreach program.

Principal Education Goals: The IRIS Education and Outreach (E&O) Program enables audiences beyond seismologists to access and use seismological data and research for educational purposes. E&O activities include teacher workshops, student field internships, museum exhibits, educational materials, the development of classroom seismic stations, and programs for under-resourced schools. E&O projects serve not only to advance public understanding of geoscience, but also to foster improved understanding of the scientific process and scientific data.

Partnerships: IRIS is heavily involved in partnership activities, many international in nature. Installation and operation of the Global Seismographic Network (GSN) has put IRIS in contact with scientists as well as government and non-government organizations all over the world. Many international IRIS GSN stations are designated as the official stations for nuclear test ban monitoring in their host countries. International teams of scientists organize most PASSCAL projects overseas. The IRIS facilities also are multi-use resources for other government agencies that have responsibilities for development of a nuclear test-ban monitoring capability and for monitoring of global seismicity. For these purposes, agencies in partnership with NSF have provided substantial support to IRIS for accelerated development of the GSN (Department of Defense), shared operation and maintenance of the GSN (U.S. Geological Survey), and accelerated development of the PASSCAL instrument pool (Department of Energy).

Connections to Industry: The use of IRIS PASSCAL instruments for investigations of the shallow crust provides opportunities for collaboration with the petroleum exploration industry. Many students involved in these experiments receive training in techniques that prepare them for careers in the exploration industry. In a broader sense, IRIS continues to closely collaborate with industry in development of seismic instrumentation and software.

Management and Oversight: IRIS is incorporated as a nonprofit consortium representing practically all U.S. university and nonprofit organizations with research and teaching programs in seismology. Each member institution appoints a representative. However, all IRIS program and budget decisions are made by a nine-member Board of Directors. These decisions are made after consultation with the IRIS advisory committees (the four standing committees for each of the four IRIS programs and additional ad hoc working groups appointed for special tasks). The Board of Directors appoints a president of IRIS to a two-year term. The president is responsible for IRIS operations, all of which are managed through the IRIS Corporate Office.

The Division of Earth Sciences, through its Instrumentation & Facilities Program (IF), provides IRIS with general oversight to help assure effective performance and administration. The Program also facilitates coordination of IRIS programs and projects with other NSF-supported facilities and projects and with other Federal agencies and evaluates and reviews the scientific and administrative performance of IRIS.

Current Project Status: The IRIS consortium was founded in 1984 by 26 universities in response to recommendations in a report issued in 1983 by the Committee on Science, Engineering, and Public Policy (COSEPUP) of the National Academies. This report urged that "NSF act as overall coordinator and lead agency for funding a global digital seismic array and that the operation be planned and overseen by a university consortium." During the last twenty years, with support from the Foundation and federal partners, the IRIS consortium has grown to 102 full-member (voting) U.S. universities that operate core research facilities consisting of a Global Seismographic Network (GSN), the Program of Array Seismic Studies of the Continental Lithosphere (PASSCAL), and a Data Management System (DMS). During the last cooperative agreement period, IRIS initiated a new Education and Outreach (E&O) program. The FY 2006 Request for IRIS totals $13.31 million, an increase of $1.15 million over the FY 2005 Current Plan.

Funding Profile: All funding for IRIS to date has been provided through the R&RA Account.

IRIS Funding Profile

(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001	1.90	11.38	$13.28
FY 2002	1.50	11.40	$12.90
FY 2003	3.70	9.50	$13.20
FY 2004	3.10	9.90	$13.00
FY 2005 Current Plan	2.85	9.31	$12.16
FY 2006 Request	3.00	10.31	$13.31
FY 2007 Estimate	3.10	10.50	$13.60
FY 2008 Estimate	3.20	11.00	$14.20
FY 2009 Estimate	3.30	11.50	$14.80
FY 2010 Estimate	3.41	11.79	$15.19

NOTE: Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Implementation: Implementation includes funds for major equipment purchases (data recorders and seismometers) for the PASSCAL Instrument Center in Socorro, NM and the Global Seismographic Network (GSN).

- Operations and Maintenance: This category includes funds to support the IRIS corporate office in Washington, DC, including the Education & Outreach Program (E&O); the PASSCAL Instrument

Center in Socorro, NM; the Data Management System (DMS) in Seattle, WA; and the Global Seismographic Network (GSN). IRIS conducts no "in-house research."

Renewal or Termination: Two reviews have been stipulated in the new NSF cooperative agreement with IRIS: (1) an in-depth study by IRIS of the operation, personnel, and instrument costs, and support of the Global Seismographic Network (GSN), in collaboration with the USGS, representatives of the Federation of Digital Seismic Networks (FDSN), and GSN network operators by July 1, 2003; and (2) an NSF review of IRIS management in coordination with IRIS and its appropriate governance committees, to be completed by July 1, 2004. Both reviews have now been completed. The latter review provided more information for the basis of the decision to either allow the submission of a renewal proposal or to recompete the operation of this facility.

Associated Research and Education Activities: IRIS sponsors an active education and outreach program, which touches a vast number of individuals annually. There are over 2000 individuals on the IRIS mailing list, and over 100 K-12 schools and science centers are using seismographs provided by IRIS. In FY03 350 freshman engineering students designed seismographs under the guidance of IRIS members. The website visitors data in the table below indicate a yearly sum of unique visitors each month, and the K-12 students number assumes each teacher interacts with 80 students per year and continues to teach new students each year. IRIS holds a number of hour-long and 1-day workshops each year for K-12 teachers and college faculty; in FY 2004, 6 such workshops were held. The museum display visitors number is the total number of visitors to the museums that have an IRIS/USGS display.

IRIS Participation

Year	K12 Students taught by IRIS trained teachers	Undergrad summer interns	Graduate students sponsored to attend annual IRIS workshop	K-12 Teachers trained in IRIS workshops	College faculty trained in 1-day workshops	Museum display visitors	Posters distributed	Website visitors
FY 1998	3,400	2	28	43		500,000	2,000	
FY 1999	5,300	6	22	23	35	2,000,000	5,000	
FY 2000	6,900	2	30	20	20	9,000,000	4,000	
FY 2001	12,000	3	33	65	25	9,000,000	3,000	250,000
FY 2002	18,000	6	24	76	16	9,000,000	2,000	300,000
FY 2003	27,000	9	25	117	25	9,000,000	4,000	450,000
FY 2004	35,000	4	20	103	18	16,000,000	8,500	650,000

Science Support: The EAR/Geophysics and Continental Dynamics Programs and the OCE/Marine Geology and Geophysics Program provide most of the funds for NSF-sponsored research, totaling approximately $15 million per year. Funds permit deployment of PASSCAL instruments and use of GSN data stored at the DMS to solve major earth science problems.

Integrated Ocean Drilling Program

Project Description: The Ocean Drilling Program (ODP) terminated in September 2003 with its final drilling programs in the North Atlantic. During the 18-year duration of the ODP, NSF provided 60% of the program's resources and all of the required facilities, with the remaining funding provided by international partners. Phase-out of program and contract activities is planned through FY 2007.

The Integrated Ocean Drilling Program (IODP), begun in FY 2004, is the successor program to the Ocean Drilling Program (ODP), and represents an expanded international partnership of scientists, research institutions, and funding agencies organized to explore the evolution and structure of Earth as recorded in the ocean basins. Ocean drilling is an essential capability in modern geoscience research and education and is used to examine processes ranging from changes in the Earth's climate to the rifting and drifting of continents. Over 600 ocean and earth scientists have completed an internationally coordinated planning effort to examine the scientific objectives for IODP, culminating in the Initial Science Plan Earth, Oceans, and Life. These objectives require a heavy vessel for drilling deep sedimentary and crustal holes, a lighter vessel to provide widely distributed arrays of high-resolution cores to address climate, environmental, and observatory objectives, and occasional use of drilling platforms for the Arctic and nearshore projects, which cannot be undertaken from the two primary IODP vessels.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan has secured funding of at least $500 million and has completed construction of the heavy drillship *Chikyu* (Earth, in Japanese) to address deep drilling objectives in the new program. *Chikyu* was launched in January 2002, will undergo testing through 2006, and will be available for IODP operations in 2007. NSF's planned contribution to this program includes the acquisition, conversion and outfitting of a vessel suitable to achieve the goals of the light vessel requirement using MREFC funds in 2005-2007. An initial period of light drillship operations, from June 2004 to January 2006, uses the ODP drillship *JOIDES Resolution*. The European Consortium for Ocean Research Drilling (ECORD), composed of 15 countries (including Canada), is participating in IODP and providing short-term use of chartered drilling platforms for Arctic and near-shore objectives. The People's Republic of China is an additional IODP participant, and several other potential Asian members may join in the future.

IODP drilling operations provide sediment and rock samples (cores), shipboard and shore-based facilities for the study of these samples, downhole geophysical and geochemical measurements (logging), and opportunities for special experiments to determine in situ conditions beneath the seafloor. The IODP drilling platforms collect geologic samples from the floor of the deep ocean basins primarily through rotary coring and hydraulic piston coring. The logs and samples of the cores are made available to qualified scientists throughout the world for research projects.

Principal Scientific Goals: The IODP scientific program is identified in the Initial Science Plan for the IODP, Earth, Oceans and Life, and includes emphasis on the following research themes:

- The Deep Biosphere and the Sub-seafloor Ocean: Drilling will concentrate on defining the architecture and dynamics of the vast subseafloor plumbing system, where flowing water alters rock, modifies the long-term chemistry of the oceans, lubricates seismically active faults, concentrates economic mineral deposits, and controls the distribution of the deep biosphere.

- The Processes and Effects of Environmental Change: Using a global array of sites, ocean sediment cores will be used to construct a detailed record of the causes, rates and severity of changes in the earth's climate system and their relation to major pulses in biologic evolution.

- Solid Earth Cycles and Geodynamics: Drilling will concentrate on sampling and monitoring regions of the seafloor that currently have the highest rates of energy and mass transfer, and comparing these results to older geologic settings. A crucial initial program of deep drilling will study the seismogenic zone responsible for large destructive earthquakes along active plate boundaries.

Principal Education Goals: Undergraduate and graduate students participate in drilling expeditions, working with some of the world's leading scientists and becoming part of the intellectual fabric essential for future advances in the earth sciences. To reach students that do not participate directly in IODP, investments are made in curriculum enrichment including interactive CD-ROMs, visiting lecture programs, museum displays, and remote classroom broadcasts from the drillship.

Partnerships: MEXT and NSF are equal partners in the IODP and contribute equally to program operation costs. A consortium of 14 European countries and Canada (ECORD) and the People's Republic of China have officially joined IODP. In addition to its financial contribution, the European consortium supplies additional drilling facilities for IODP for short-term operations in shallow water and the Arctic. Several other Asian countries may join in the future.

Connections to Industry: As it did in ODP, NSF is contracting the services of the light drillship from a leading offshore drilling contractor. A commercial contractor provides downhole-logging services. In addition, scientists from industrial research laboratories participate in IODP cruises, are members of the program's scientific and technical advisory committees, and supply data for planning and interpretation of drilling results.

Management and Oversight: NSF and MEXT have signed a Memorandum of Cooperation, which identifies procedures for joint management of a contract to an IODP Central Management Office (CMO). The CMO coordinates and supports scientific planning, drilling platform activity, data and sample distribution, and publication and outreach activities through its management of commingled international science funds, collected and provided by NSF. A non-profit corporation founded by U.S. and Japanese institutions (IODP Management International, Inc.) has been contracted by NSF for the CMO activity. Drillship providers are responsible for platform operational management and costs. NSF provides the light drillship through contract with the U.S. System Integration Contractor (SIC), the JOI Alliance, a consortium of the Joint Oceanographic Institutions, Inc. (JOI), Texas A&M University, and Lamont-Doherty Earth Observatory. MEXT will manage its drillship through the Japan Marine Science and Technology Center (JAMSTEC), while the British Geological Survey manages European drilling contributions.

Scientific advice and guidance for IODP is provided through the scientific advisory structure (SAS). The SAS is responsible for providing scientific advice and guidance for IODP, and consists of the Science Planning and Policy Oversight Committee (SPOCC, the IODP executive authority) and an advisory structure headed by the Science Planning Committee (SPC). The CMO, under the direction of the SPC Chair, is responsible for the coordination of the SAS committees and panels, and for integrating the advice from the panel structure in a manner suitable for providing drilling and operational guidance to the CMO. Membership in the SAS is proportional to IODP financial contribution.

The Division of Ocean Sciences manages the IODP for NSF under the NSF Ocean Drilling Program. NSF's Ocean Drilling Program is placed within the Marine Geosciences Section, with several program officers dedicated to its oversight. One of the program officers serves as the contracting officer's technical representative on the CMO and SIC contracts.

Current Program Status and Future Program Planning: IODP started in FY 2004. A first phase of light drillship drilling activity started in mid-FY 2004 and will continue into early FY 2006. The NSF-supplied light drillship, converted using MREFC funds for IODP needs, will begin drilling in mid FY 2007. The heavy drillship *Chikyu* is expected to begin scientific drilling operations at the beginning of FY 2007. A European-funded drilling expedition to the northern Arctic used several icebreakers, one modified for drilling, in late FY 2004 and early FY 2005.

NSF and MEXT will contribute equally to IODP operations costs, with up to one-third of total costs contributed by the European consortium. NSF is requesting $30.0 million in FY 2006 for operation of the IODP program through the R&RA Account.

Funding Profile: All funding for the operation of the ODP has been provided through the R&RA Account. Implementation funding in FY 2005-2007 is MREFC Account funding that supports the acquisition and outfitting of a drillship for use in the program. For more information on this project, please see the Scientific Ocean Drilling Vessel section of the MREFC Chapter of this document.

Ocean Drilling Funding Profile

(Dollars in Millions)

	Implementation[1]	ODP Operations & Maintenance	IODP Operations & Maintenance	Total, NSF
FY 1997		27.09		$27.09
FY 1998	3.00	26.95		$29.95
FY 1999	3.00	28.13		$31.13
FY 2000		29.50	0.10	$29.60
FY 2001		30.60	0.20	$30.80
FY 2002		31.50	0.30	$31.80
FY 2003		32.00	3.90	$35.90
FY 2004			35.10	$35.10
FY 2005 Current Plan	14.88	5.90	32.10	$52.88
FY 2006 Request	57.92	2.00	30.00	$89.92
FY 2007 Estimate	42.20	1.50	40.00	$83.70
FY 2008 Estimate			60.00	$60.00
FY 2009 Estimate			61.50	$61.50
FY 2010 Estimate			63.04	$63.04

NOTE: Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

[1]Implementation funding in FY 2005-2007 represents the acquisition component of IODP, the Scientific Ocean Drilling Vessel (SODV). The SODV will be funded through the MREFC Account. Please see the MREFC chapter for additional information pertaining to this project.

Information pertaining to the data in the table is included below.

- Implementation: NSF's planned contribution to this program includes the acquisition, conversion and outfitting of a Scientific Ocean Drilling Vessel (SODV) suitable to achieve the goals of the light vessel requirement using MREFC funds in 2005-2007. An initial period of light drillship operations, from June 2004 to January 2006, uses the ODP drillship *JOIDES Resolution*. Further information regarding acquisition of the NSF-supplied light drillship can be found under Scientific Ocean Drilling Vessel in the MREFC chapter.

- Operations and Maintenance: The general contractor for the overall management and operation of the ODP is Joint Oceanographic Institutions, Inc. (JOI), a consortium of major United States oceanographic institutions. Drilling operations and science support services (laboratory equipment, technical support, database maintenance, sample storage and distribution) are managed by Texas A&M University. Lamont-Doherty Earth Observatory of Columbia University manages logging. Support for participation and drilling-related research performed by U.S. scientists is provided by NSF.

Renewal or Termination: IODP international agreements and contracts cover activities through FY 2013. Activities regarding IODP renewal are expected to commence in FY 2011.

Associated Research and Education Activities: A breakdown by year and by category is reflected in the table below. Much of the support for Education and Outreach activities in ODP is through a cooperative agreement with JOI Inc., which has resulted in various educational products and services described here in brief. Three educational CD-ROMs with teaching activities, interviews with scientists, and operational footage have been developed and widely distributed. An educational poster titled, "Blast from the Past," describing the meteorite impact that led to the demise of the dinosaurs was printed, and 64,000 copies have been distributed. A brochure of abstracts (text and figures), highlighting 17 of the Ocean Drilling Program's greatest scientific accomplishments, was published and distributed. JOI also publishes a newsletter three times a year with a distribution of about 2,000. In addition, a display of ODP materials was produced and contributed to the Smithsonian Museum, in Washington DC, where it has been on permanent display since 1997. This display is viewed daily by thousands of museum visitors (numbers are not reflected in the table below).

The services of the program are also listed here in brief. A Distinguished Lecturer Series, through which each year approximately 6 lecturers give a total of about 30 lectures at universities, colleges, and other institutions throughout the country. An Undergraduate Student Trainee Program enables undergraduates to sail on a research vessel as members of the scientific team. Mentors and scientific projects are an integral part of this program. An internship program at JOI Inc. was initiated several years ago as an attempt to introduce recent graduates to the career opportunities of science program management. A longstanding fellowship program provides graduate student fellowship awards to conduct ODP research. Each year, JOI sponsors educational and promotional booths at national and international meetings where products and services are highlighted. The drillship *JOIDES Resolution* has visited U.S. ports approximately 10 times since 1994. At each visit, ship tours are given, and promotional and educational activities have been held at five of these port calls. JOI/ODP sponsors scientific research and planning workshops that commonly involve graduate students. And lastly, many graduate students have sailed on the *JOIDES Resolution*.

ODP Participation

Year	K-12	Undergrad	Graduate	Teachers
FY 1996	620	1,500	1,400	700
FY 1997	2,620	6,210	4,900	1,800
FY 1998	1,300	4,110	3,800	1,300
FY 1999	2,600	5,740	5,900	2,200
FY 2000	17,600	13,680	7,400	4,200
FY 2001	5,600	9,750	9,400	9,700
FY 2002	6,000	8,000	9,500	7,000
FY 2003	6,500	8,500	9,500	7,500
FY 2004	6,500	8,500	9,500	7,500
FY 2005 Estimate	6,500	8,500	9,500	7,500

Science Support: Over 1,600 scientists from forty nations have participated on ODP and IODP cruises since 1985. About 750 of these have been U.S. scientists from over 150 universities, government agencies, and industrial research laboratories, with over 300 of them participating in more than one ODP cruise. Samples and data have been distributed to an additional 800 or more U.S. scientists. These

1,500+ direct U.S. users of ODP materials constitute approximately 10 to 15 percent of the U.S. geoscience community as identified by the American Geological Institute.

NSF provides most of the support for the participation of U.S. scientists in the IODP. The majority of the funding comes from the Division of Ocean Sciences, with additional funding from the Office of Polar Programs related to Antarctic drilling research. Total funding for U.S. participation and analysis of samples and data is expected to reach approximately $30 million annually.

Large Hadron Collider

Project Description: The Large Hadron Collider (LHC) will be the premier facility in the world for research in elementary particle physics. The facility will consist of a superconducting particle accelerator providing two, counter-rotating beams of protons, each beam having an energy up to 7 TeV (1TeV=10^{12} electron volts). The U.S. is involved in the construction of two particle detectors, A Toroidal LHC Apparatus (ATLAS) and the Compact Muon Solenoid (CMS). They are being constructed to characterize the different reaction products produced in the very high-energy proton-proton collisions that will occur in intersection regions where the two beams are brought together.

The LHC is an international project under construction at the CERN laboratory in Geneva, Switzerland. NSF awarded MREFC grants to Northeastern and Columbia Universities under cooperative agreements with subcontracts to over 50 U.S. universities. In FY 2003, the funding of LHC construction by NSF was completed. A total of 34 international funding agencies participate in the ATLAS detector project, and 31 in the CMS detector project. NSF and DOE are providing U.S. support. CERN is responsible for meeting the goals of the international LHC project. The ATLAS and CMS detectors are expected to take data approximately 200 days per year. The remaining time is to be used for maintenance and testing.

The U.S. LHC Research Program, funded through the R&RA account, is now ramping up with awards to Northeastern University and UCLA (for CMS) and Columbia University (for ATLAS). This program consists of Maintenance and Operations, Software and Computing activities and some R&D for future detector upgrades.

The U.S. LHC collaboration has been a leader in the development of Grid-based computing. The Grid will enable the enhanced participation of U.S. universities, and thus the training of students, in both state of the art science and computational techniques, in a project that is centered overseas. The Grid is expected to have broad application throughout the scientific and engineering communities.

Principal Scientific Goals: The LHC will enable a search for the Higgs particle, the existence and properties of which will provide a deeper understanding of the origin of mass of known elementary particles. The LHC will also enable a search for particles predicted by a powerful theoretical framework known as supersymmetry, which will provide clues as to how the four known forces evolved from different aspects of the same 'unified' force in the early universe, and can investigate the possibility that there are extra-dimensions in the structure of the universe.

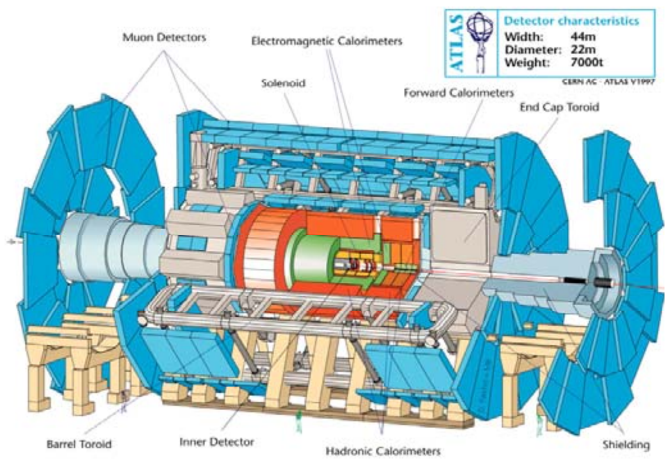
Principal Education Goals: Through the participation of young investigators, graduate students, undergraduates, and minority institutions in this international project, LHC serves the goal of helping to produce a diverse, globally-oriented workforce of scientists and engineers. Further, innovative education and outreach activities, such as the QuarkNet project, allow high school teachers and students to participate in this project (see the URL: http://quarknet.fnal.gov/). Many highly-trained students in high-energy physics move into industrial jobs.

Connections to Industry: Major procurements of components of both warm and superconducting magnets, as well as high-speed electronics, are performed through U.S. industries. Major developments in Grid computing are also valuable outcomes.

Management and Oversight: A program director in the Physics Division of the Directorate for Mathematical and Physical Sciences (MPS) is responsible for day-to-day project oversight. The NSF program director also participates in an internal Project Advisory Team, including staff from the Office of Budget, Finance and Award Management, including the Deputy for Large Facility Projects, the Office of the General Counsel, the Office of Legislative and Public Affairs, and the Office of the Assistant Director for MPS.

U.S. LHC program management is performed through a Joint Oversight Group (JOG), created by the NSF and DOE. The JOG has the responsibility to see that the U.S. LHC Program is effectively managed and executed to meet commitments made under the LHC International Agreement and its Protocols.

Current Project Status: CERN Project Management is making every effort to maintain the LHC extended schedule, which aims for first collisions in 2007, without significant delays. While both experiments may benefit from the extended LHC schedule by having additional time to optimize their installation plans, the U.S. collaborators continue on the original baseline schedule, to avoid any increases in labor and costs. The entire U.S. LHC construction activity is being maintained within the funding cap set forth in the original U.S. funding guidance for the project.



This is a diagram of the particle detector ATLAS (A Toroidal LHC Apparatus). ATLAS and the Compact Moun Solenoid (CMS) represent the U.S. contribution to the construction of the Large Hadron Collider at the CERN laboratory in Geneva, Switzerland. *Credit: LHC project.*

The NSF-supported components of the ATLAS and CMS detectors are scheduled for completion in FY 2005; the final year of appropriated construction funding was in FY 2003. The U.S. ATLAS construction project, as of November, 2004, was 93 percent complete, as measured by Earned Value. The U.S. CMS project is 88 percent complete. Milestones for both projects are being completed in the anticipated years. U.S. cost performance has been excellent, with material contracts typically below estimates, and labor costs tracking close to plan. The U.S. strategy aims for the completion of 95% of the U.S. deliverables by the end of FY 2005, with the remaining items linked to the installation schedule.

Major remaining milestones for the NSF components of LHC are outlined below:

FY 2005 Milestones:

US ATLAS

Complete delivery of Liquid Argon Forward Calorimeter (Section A);
Complete delivery of Silicon Strip Pixels Disk system at CERN;
Complete production and installation of Transition Radiation Tracker (Barrels); and
Complete production of Muon Cathode Strip Chamber Readout.

US CMS

Complete delivery of Electromagnetic (EM) Calorimeter Optical Links;
50 percent of Silicon Tracker Rods completed; and
Complete Muon Trigger Card Production Test

FY 2006 Milestones:

Continue ATLAS and CMS detector installation and testing in underground halls.

FY 2007 Milestone:

First data taking using both ATLAS and CMS detectors.

Funding Profile: Funding for the overall LHC project, including the ATLAS and CMS detectors and the accelerator, is provided through an international partnership involving NSF, the Department of Energy (DOE), and the CERN member states, with CERN member states providing the major portion. Other countries that are not member states are also participating.

The total U.S. contribution to the construction project will be $531 million, with $450 million from the DOE and $81 million from NSF. NSF and DOE will jointly provide a total contribution of $331 million for the detector construction, while DOE will provide the entire U.S. contribution ($200 million) for the accelerator construction. There are two other major detectors being constructed, ALICE and LHC-B, in which the U.S. does not play a role.

LHC Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 1999 & Earlier	5.70		0.15	22.00	0.16		6.01	22.00	$28.01
FY 2000				15.90	0.53		0.53	15.90	$16.43
FY 2001				16.36	2.30		2.30	16.36	$18.66
FY 2002				16.90	1.60		1.60	16.90	$18.50
FY 2003				9.69	5.00		5.00	9.69	$14.69
FY 2004[1]					7.00		7.00		$7.00
FY 2005 Current Plan					10.50		10.50		$10.50
FY 2006 Request					13.50		13.50		$13.50
FY 2007 Estimate					18.00		18.00		$18.00
FY 2008 Estimate					18.00		18.00		$18.00
FY 2009 Estimate					18.00		18.00		$18.00
FY 2010 Estimate					18.00		18.00		$18.00
Subtotal, R&RA	$5.70		$0.15		$112.59		$118.44		
Subtotal, MREFC				$80.85				$80.85	
Total, Each Stage		**$5.70**		**$81.00**		**$112.59**			**$199.29**

NOTE: The estimated operational lifespan of this project is approximately 20 years. Operations and Maintenance Estimates for FY 2007 and beyond are subject to the availability of funds and appropriate program balance and may not reflect actual budget requirements.

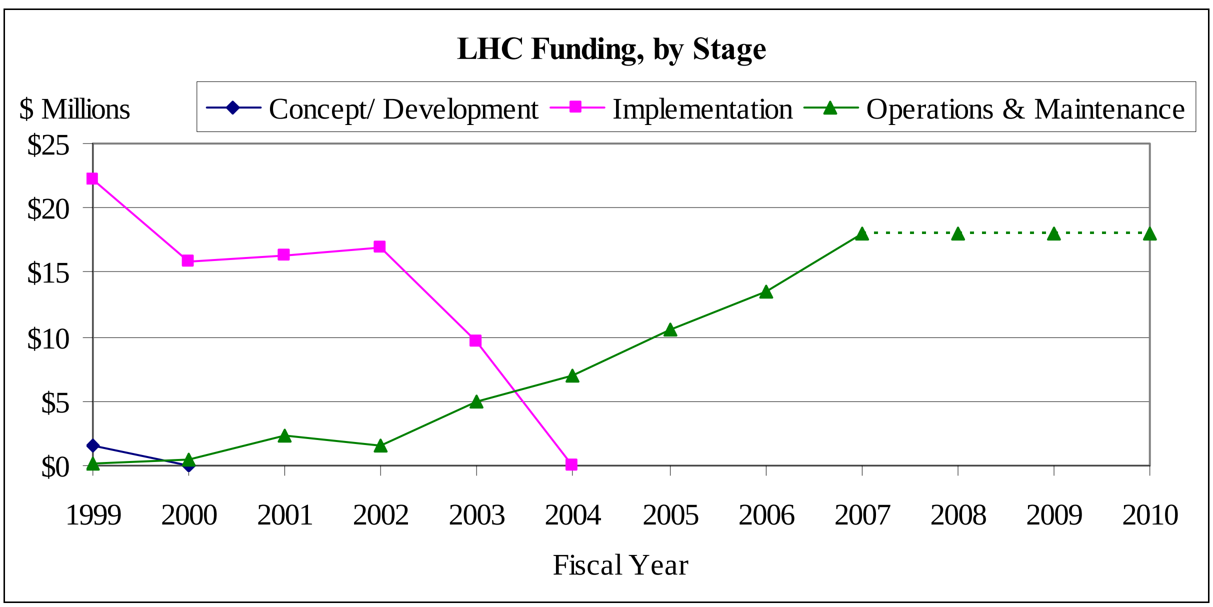
[1]As of FY 2004, start dates for projected NSF funding correspond to accelerated schedules to begin on: 8/1/04, 5/1/05, 2/1/06 and 11/1/06. Thereafter, funding will begin on November 1 of each year.

Information pertaining to the data in the table is provided below.

- Concept/Development: The LHC has been under discussion since FY 1989. NSF funding in FY 1996-99 supported technical design studies.

- Implementation: NSF components of the ATLAS and CMS detectors, constructed with funds provided FY 1999-FY 2003, are anticipated to be completed, tested and ready to install in FY 2005. The overall LHC project is now anticipated for completion at CERN in FY 2007. (In FY 1999, $150,000 in R&RA funds was provided to meet the scheduled award total of $22.15 million. This R&RA action was noted in subsequent NSF MREFC budget justifications to Congress.) Final implementation funding was provided in FY 2003.

- Management & Operations: FY 1999-2008 funding primarily represents investments in university computing infrastructure and software development for remote access, to allow university scientists and students to participate in LHC research as well as other projects. Estimated funding for FY 2005 and beyond reflects the NSF share of operations as the ATLAS and CMS detectors approach and initiate operations. Components of these detectors, by far the largest ever constructed in particle physics, become inaccessible when additional components are installed, and all become inaccessible when data taking begins. To insure satisfactory performance, components must be operated, tested and repaired as soon as installed. Estimated funding during the same period also includes the development of LHC grid software and computing (S&C). Detector operations costs and S&C costs are approximately equal. It is anticipated that over the lifetime of the LHC project, upgrades and new components to address emerging research questions will be considered. Funds for such activities are not included here.



Future Science Support: Along with direct support for operations and maintenance for LHC, NSF will support science and engineering research performed at the facility, through ongoing research and education programs. The annual support for such activities is presently estimated to be about $5.0 million through individual PI awards once the facility reaches full operations. Both ATLAS and CMS have well-developed outreach activities (see Education Goals above).

Laser Interferometer Gravitational Wave Observatory

Project Description: Einstein's theory of general relativity predicts that cataclysmic processes involving super-dense objects in the universe will produce gravitational radiation that will travel to Earth. Detection of these gravitational waves is of great importance, both for fundamental physics and for astrophysics. LIGO, the most sensitive gravitational wave detector ever built, comprises two main facilities, one in Livingston Parish, LA and one in Hanford, WA. At each facility, a large vacuum chamber, with two 4-km arms joined at right angles, houses one or more optical interferometers. The interferometers are used to measure minute changes in the apparent distances between test masses at the ends of the arms caused by a passing gravitational wave. The predicted distortion in space caused by a gravitational wave from a likely type of source is of order one part in 10^{21}, meaning that the expected change in the apparent 4-km length is only of order 4×10^{-18} meters or about 1/1000th of the size of a proton. The 4-km length for LIGO, by far the largest for any optical interferometer, was chosen to make the expected signal as large as possible within the terrestrial constraints. Looking for coincident signals in all the interferometers simultaneously increases the likelihood for gravitational wave detection. The Phase I LIGO currently operating is close to its design specifications. The Advanced LIGO (AdvLIGO) upgrade, designed to reach best possible sensitivity for an earth-based instrument, is requested to begin construction in FY 2008. For more information on AdvLIGO, please see the MREFC Chapter.

Principal Scientific Goals: Of the four known fundamental forces of nature (electromagnetic, weak, strong, and gravitational), the gravitational force is the most enigmatic. It is by far the weakest, yet it holds the universe together, ignites the fusion reaction in stars, and curves space in black holes so severely that light is trapped. And, although the universe is believed to be filled with gravitational waves from a host of cataclysmic cosmic phenomena, we have never detected a gravitational wave and measured its waveform.

The principal scientific goals of LIGO are to detect gravitational waves on Earth for the first time and to develop this capability into a new window on the universe, a window through which we can observe phenomena such as the inspiral and coalescence of neutron stars in binary orbit, black hole collisions, unstable dynamics of newborn neutron stars, supernovae, stochastic background from the early universe, and a host of more exotic or unanticipated processes.

Arial view of LIGO facility in Hanford, WA. The facility, and its companion in Livingston, LA, each houses laser interferometers consisting of mirrors suspended at each of the corners of a gigantic L-shaped vacuum system measuring 4 km on a side. Precision laser beams in the interferometers sense small motions of the mirrors such as those expected to be caused by a gravitational wave. LIGO is about to begin its fourth in a series of long term observations in February 2005 to search for gravitational waves generated by cataclysmic astronomical events. *Credit: www.ligo.caltech.edu*

Principal Education Goals: LIGO is a significant source of highly trained Ph.D. graduates for the country's workforce. With the beginning of LIGO science runs in FY 2002, the number of graduate students is expected to grow. In addition, LIGO has a diverse set of educational activities at its different sites, activities that involve a large number of undergraduates (including those from minority-serving institutions), hands-on activities for K-12 classes, teachers at all levels, and informal education and outreach activities for the public. In FY 2004, LIGO received a large grant to build a Visitor's Center at the Livingston, LA site that will be filled with Exploratorium exhibits and will be the focal point for augmenting teacher education at Southern University and other student-teacher activities state-wide through the Louisiana Systematic Initiative Program.

Connections to Industry: Substantial connections with industry have been required for the state-of-the-art construction and measurements involved in the LIGO projects. Some have led to new products. Areas of involvement include novel vacuum tube fabrication technology, seismic isolation techniques, ultrastable laser development (new product introduced), development of new ultra-fine optics polishing techniques, and optical inspection equipment (new product).

Management and Oversight: LIGO is sponsored by NSF and managed by Caltech under a cooperative agreement. The management plan specifies significant involvement by the user community, represented by the LIGO Scientific Collaboration (LSC), and collaboration with the other major gravitational wave detector activities in Japan, Europe, and Australia. External peer-review committees organized by the NSF help provide oversight through an annual review. NSF oversight is coordinated internally by the LIGO program director in the Division of Physics (MPS), who also participates in the Physics Division Project Advisory Team, comprising staff from the Office of General Counsel, the Office of Legislative and Public Affairs, the Office of Budget, Finance and Award Management, including the Deputy for Large Facility Projects, and the Office of International Science and Engineering.

Current Project Status: All three LIGO interferometers were fully operational by the spring of 2002. Since then, activity has been divided between improving the sensitivity of the interferometers and collecting scientific data. The first science run, S-1, accumulated nearly 100 hours of triple coincidence data in the period from August 23, 2002 to September 9, 2002, with a sensitivity of about a factor of 100 from the design goal. Results from S-1 have been announced at major scientific conferences and reported in three published articles. Work on instrumental refinements between the end of S-1 and the beginning of S-2 in February 2003 produced sensitivities about ten times better than those observed in S-1, i.e., only a factor of about 10 from the design goal. S-2 lasted 59 days (February 14, 2003 – April 14, 2003) with over 300 hours in triple coincidence accumulated. Results from S-2 were presented in 2004 at both the meeting of the American Physical Society in Denver (five talks) and at the International GR-17 Meeting in Dublin (four talks). In S-3 (October 31, 2003 – January 8, 2004), the sensitivity achieved with the best of the three interferometers was only about a factor of 3.5 from the design goal, strengthening expectations that the sensitivity for S-4 that should commence sometime in early 2005 will be at or very near the targeted level. The Hydraulic External Pre-Isolators (HEPI) systems, designed and intended for use with the advanced detectors, have been installed at the Livingston site where they have successfully eliminated interference from excessive seismic noise. The FY 2006 Request for LIGO totals \$32.0 million, the same as the FY 2005 Current Plan. This funding level reflects work to develop improved detectors and full operations of LIGO to run their interferometers at sites at Hanford, WA and Livingston, LA in coincidence with each other and with gravitational wave detectors abroad.

Funding Profile: The history of the LIGO project dates back to early conceptual work in the mid-1970s, moving through pre-construction R&D in the late 1980s to the initiation of LIGO construction in FY 1992. LIGO pre-dates the establishment of the MREFC Account in FY 1995.

LIGO Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand Total
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 2001 & Earlier	47.56		35.90	236.00	49.50		132.96	236.00	$368.96
FY 2002					28.00		28.00		$28.00
FY 2003					33.00		33.00		$33.00
FY 2004					33.00		33.00		$33.00
FY 2005 Current Plan					32.00		32.00		$32.00
FY 2006 Request					32.00		32.00		$32.00
FY 2007 Estimate					33.00		33.00		$33.00
FY 2008 Estimate					33.00		33.00		
FY 2009 Estimate					33.00		33.00		
FY 2010 Estimate					33.00		33.00		$33.00
Subtotal, R&RA	$47.56		$35.90		$339.50		$422.96		
Subtotal, MREFC				$236.00				$236.00	
Total, Each Stage		**$47.56**		**$271.90**		**$339.50**			**$658.96**

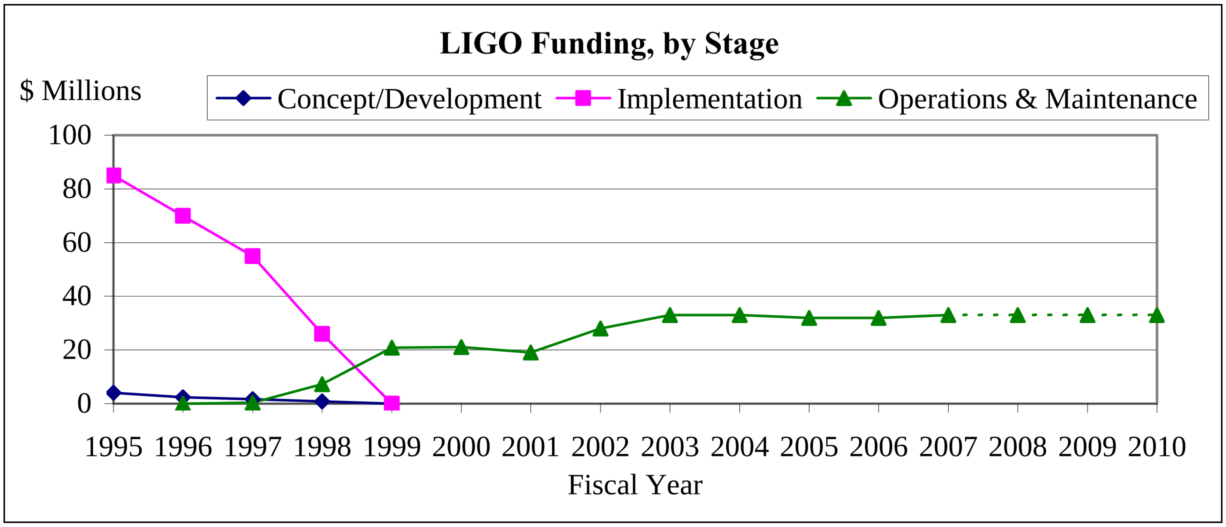
NOTE: The expected operational lifespan of this project is about 20 years. Operations and Maintenance Estimates for FY 2007 and beyond are subject to the availability of funds and appropriate program balance and may not reflect actual budget requirements.

Information pertaining to the data in the table is included below.

- Concept/Development: Funds supported three phases of planning, design and development for LIGO: early conceptual R&D - $11.6 million (FY 1975-87); pre-construction R&D - $16 million (FY 1988-91); and ongoing R&D throughout construction - $20 million (FY 1992-98).

- Implementation: LIGO construction occurred between FY 1992-98, totaling $271.90 million. Prior to the start of the MREFC Account, construction funding was provided through the R&RA Account.

- Management and Operations: LIGO management and operations (M&O) costs began phasing-in in FY 1997. Commissioning costs are included in LIGO operations through FY 2001. M&O funding includes operation for science and engineering runs and R&D for advanced detectors.



Renewal or Termination: The cooperative agreement for the support of LIGO operations expires in FY 2006. NSF expects to renew the agreement at that time pending a satisfactory performance review.

Associated Research and Education Activities: Active outreach programs have been developed at both the Livingston and Hanford sites. Teams at both sites have provided visual displays, hands-on science exhibits, and fun activities for visiting students and members of the public. In the last three years an average of over 2,000 students per year have taken advantage of this opportunity. More formal programs at the sites include participation in the Research Experience for Teachers (RET) Program, a set of "scientist-teacher-student" research projects in support of LIGO, and participation in the SURF/REU programs for college students. In collaboration with RET participants and networks of local educators, both sites have developed Web-based Resources for teachers that includes information on research opportunities for schools and a set of standards-based classroom activities, lessons, and projects related to LIGO science. In FY 2004, NSF initiated a project to build a Visitor's Center at the Livingston, LA site that will be filled with Exploratorium exhibits and that will be the focal point for augmenting teacher education at Southern University and other student-teacher activities state-wide through the Louisiana Systematic Initiative Program. Plans are in progress to hire an outreach coordinator at each site to augment the existing activities.

Science Support: Along with direct operations and maintenance support for LIGO, NSF supports science and engineering research directly related to LIGO activities through ongoing research and education programs. The annual support for such activities is estimated to be about $5 million.

In 1997 LIGO founded the LIGO Scientific Collaboration (LSC) to organize the major international groups doing research that was supportive of LIGO. The LSC now has 44 collaborating institutions with over 440 participating scientists. The role and membership responsibilities of each participating institution are determined by a MOU between the LIGO Laboratory and each institution. The LSC plays a major role in many aspects of the LIGO effort including: R&D for detector improvements, R&D for Advanced LIGO, data analysis and validation of scientific results, and setting priorities for instrumental improvements at the LIGO facilities.

MREFC Facilities

The MREFC Account supports the acquisition, construction and commissioning of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. Projects supported by this account are intended to extend the boundaries of technology and open new avenues for discovery for the science and engineering community. Initial planning and design, and follow on operations and maintenance costs of the facilities are provided through the Research and Related Activities (R&RA) and Education and Human Resources (EHR) Accounts.

NSF believes that the highest priority within the MREFC Account must be the current projects. To that end, highest priority in FY 2006 is to continue to request funding for the Atacama Large Millimeter Array ($49.24 million); EarthScope ($50.62 million); the IceCube Neutrino Observatory ($50.45 million); the Scientific Ocean Drilling Vessel ($57.92 million); and Rare Symmetry Violating Processes ($41.78 million). NSF is requesting no new starts in FY 2006. Two new starts are requested in FY 2007, and one new start is requested in FY 2008. In priority order, these are: Ocean Observatories in FY 2007; the Alaska Region Research Vessel in FY 2007; and Advanced LIGO in FY 2008[2].

For additional information of projects funded through the MREFC Account, please see the MREFC Chapter of this document.

National High Magnetic Field Laboratory

Project Description: The NHMFL develops and operates high magnetic field facilities that scientists use for research in physics, biology, bioengineering, chemistry, geochemistry, biochemistry, materials science, medicine, and engineering. It is the world's largest and highest-powered magnet laboratory, outfitted with a comprehensive assortment of high-performing magnet systems. Many of the unique facilities were designed, developed, and built by the magnet engineering and design team at the NHMFL in collaboration with industry. The facilities are available to all qualified scientists and engineers through a peer-reviewed proposal process.

Principal Scientific Goals: NHMFL scientific goals are to provide the highest magnetic fields, state-of-the-art instrumentation, and support services for scientific research conducted by users from a wide range of disciplines, including all areas of science and engineering.

Principal Education Goals: NHMFL promotes science education and assists in developing the next generation of scientists, engineers, and science education leaders. A variety of programs, opportunities, and mentorship experiences are available for teachers and students at all academic levels – K-12 through post-graduate. The laboratory, with its distinguished faculty and world-class facilities, provides a unique interdisciplinary learning environment and has had a national impact in curriculum development. In FY 2004, its regional K-12 outreach efforts engaged over 6,252 students from Florida and neighboring Georgia in hands-on science activities and tours of the laboratory.

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[2] The National Science Board (NSB) established the priority of all unfunded but NSB-approved projects at the May 2004 NSB meeting, prior to the FY 2005 Omnibus Appropriation. SODV and RSVP received MREFC funds in the Omnibus and are now ongoing projects. NEON received R&RA funding and is also an ongoing project. AdvLIGO received NSB approval for inclusion in a future Budget Request in October 2004 (http://www.nsf.gov/nsb/meetings/2004/1004/major_action_1004_updt.pdf) and is as yet unranked.

Partnerships and Connections to Industry: The Magnet Science and Technology (MS&T) Division of the NHMFL has broad responsibility to develop high magnetic fields and materials for high field magnet wires in response to national needs, such as building advanced magnet systems for the NHMFL sites, working with industry to develop the technology to improve and address new opportunities in magnet-related technologies, and pushing the state-of-the-art beyond what is currently available in high field magnet systems through materials research and magnet technology development. To this purpose, MS&T has established leading capabilities in many aspects of magnet system engineering and assessment. In addition, MS&T cooperates with industry and other international magnet laboratories on a variety of technology projects, including the advancement of conducting materials for magnets, including high quality Cu-Nb micro-composite wires with outstanding characteristics (strength, conductivity, and resistive ratio) now available for the construction of high field coils. These projects cover the range of analysis, design, materials, component development and testing, coil fabrication, cryogenics, system integration and testing.

The newly commissioned 900 MHz wide bore nuclear magnetic resonance magnet: The results achieved so far surpass almost all expectations for this stage of the commissioning phase. *Credit: NHMFL*

The laboratory engages in numerous consortia as one of its mission objectives "to engage in the development of future magnet technology." NHMFL researchers and staff work with both academic and non-academic private partners in diverse areas of magnet technology. In 2003, the laboratory collaborated with 17 private sector companies, 13 national laboratories and federal centers, and 19 international institutions. In addition, the NHMFL has established numerous partnerships and programs to enhance science education and public awareness. The educational and outreach activity reaches nearly 9,000 students, teachers and members of the general public.

Management and Oversight: The NHMFL is operated for the NSF by a consortium of institutions comprised of Florida State University (FSU), the University of Florida (UF), and Los Alamos National Laboratory (LANL) under a cooperative agreement that sets forth the goals and objectives of the NHMFL. NSF established the NHMFL in 1990 and new facilities were dedicated and open to users in October 1994. FSU, as the signatory of the cooperative agreement, has the responsibility for establishing and maintaining appropriate administrative and financial oversight and for ensuring that the operations of the laboratory are of high quality and consistent with the broad objectives of the cooperative agreement.

The principal investigator serves as the director of the NHMFL. Four senior faculty members serve as co-principal investigators. The laboratory is organized into three functional activities: User Programs, Magnet Science and Technology Programs, and Research Programs. In addition, the NHMFL has an Office of Government and Public Relations that oversees corporate outreach activities, including interactions with private industry, federal agencies and institutions, and international organizations. The NHMFL also operates a Center for Integrating Research and Learning (CIRL) that manages educational outreach at all levels. Through the organizational network, the director receives guidance and recommendations from the NHMFL Executive Committee, staff, the participating institutions, and user communities. Two external committees meet regularly to provide the laboratory with critical advice on important user, management, and operational issues. The Users' Committee, elected by the user community, reflects the broad range of users of all of the NHMFL facilities and provides guidance on the development and use of NHMFL facilities and services in support of users. The External Advisory Committee is comprised of representatives from academic, government, and industrial organizations, and from the user community and reports directly to the President of Florida State University. It provides advice and guidance on matters critical to the success of the management of the NHMFL.

From the inception of the NHMFL, NSF administration and oversight was the responsibility of the Executive Officer, Division of Materials Research (MPS), with guidance from an ad hoc working group with representatives from the Division of Chemistry (MPS), the Directorate for Engineering, and the Directorate for Biological Sciences. Site visit reviews are conducted annually. Representatives from other federal agencies including DOE and NIH are invited to participate as observers at the site visit reviews. In July 2002 a new position of Program Director, National Facilities, was established in the NSF Division of Materials Research (DMR). Primary responsibility for NSF administration and oversight of the NHMFL was then assigned to this position, together with similar responsibilities for DMR's other national facilities.

<u>Current Project Status</u>: The NHMFL was established in FY 1990. It is currently moving its primary emphasis from magnet technology and development to a new phase of service to users and research. A 5-year renewal proposal was reviewed in FY 2000. More than 300 groups currently use the NHMFL facilities annually, and the laboratory was described by the NSF external review committee as the leading institution of its kind in the world. The National Science Board (NSB) approved NSF support for the requested 5-year period (January 2001 through December 2005), making support for the final three years of the award contingent on satisfactory progress in the R&D program, management, and leadership of the Nuclear Magnetic Resonance program. A comprehensive NSF site visit review was conducted in May 2002; progress was assessed as satisfactory and the NSB was informed of the outcome of this review in October 2002. A subsequent annual review conducted in October 2003 recommended to continue tracking large, new magnet projects and to continue the process of commissioning the 900 MHz NMR magnet. The NHMFL continued its efforts to strengthen the NMR program. In FY 2004, NSF recommended and the NSB approved a two year extension with level funding moving the expiration date to FY 2007.

The FY 2006 Request for the NHMFL totals $25.50, the same level as the FY 2005 budget, as recommended by the NSB. This budget includes support for the National High Field Mass Spectrometry Facility (NHFMS) supported by the Division of Chemistry of MPS at the level of $1.50 million starting in FY 2005. The National High Field Mass Spectrometry (NHFMS) facility is located at the NHMFL in Tallahassee, Florida. Its purpose is to develop and exploit the unique capabilities of Fourier Transform Ion Cyclotron Resonance (FT-ICR) mass spectrometry. To that end, the NHFMS facility is routinely used to analyze samples that require the ultrahigh resolution and high mass accuracy of FT-ICR. Examples of the ultrahigh resolution provided by this technique include the precise identification of thousands of molecular components in complex biological, pharmaceutical, or petroleum samples.

<u>Funding Profile</u>: All NSF funding for the NHMFL to date has been provided through the R&RA Account.

NHMFL Funding Profile

(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001	6.20	13.80	$20.00
FY 2002	7.97	17.00	$24.97
FY 2003[1]	6.50	17.43	$23.93
FY 2004[1,2]	3.44	21.06	$24.50
FY 2005 Current Plan	3.83	21.67	$25.50
FY 2006 Request	4.00	21.50	$25.50
FY 2007 Estimate	4.00	21.65	$25.65
FY 2008 Estimate	4.00	22.00	$26.00
FY 2009 Estimate	4.00	22.00	$26.00
FY 2010 Estimate	4.00	22.00	$26.00

The data is presented as being either implementation (permanent equipment) or operations and maintenance (non-permanent equipment). Estimates for FY 2007 and beyond are developed for planning purposes and are based on current usage and cost profiles. They will be updated as new information becomes available.

[1]Excludes $183,272 in FY 2003 and $106,000 in FY 2004 for education activities such as the Research Experiences for Teachers Program.

[2]Data for FY 2004 through FY 2009 includes funding for the National High Field Mass Spectrometry Center (not included in FY 2003 at $990,000).

Information pertaining to the data in the table is included below.

- Implementation: The NHMFL supports a wide range of state-of-the-art magnets and instrumentation that are continuously upgraded for the user community. Capacitor driven magnets are the backbone of user programs at the Pulsed Field Facility at Los Alamos. Magnet Science and Technology has aggressively pursued several major magnet projects that are part of the NHMFL core mission: to develop world-class magnet systems for high field research. The Ultra-Wide Bore 900 MHz NMR magnet was successfully brought to field in the NMR building and preliminary solution and solid-state NMR spectra suggest that this will be a very powerful scientific tool for some of the most important items on the Nation's scientific agenda. The results have shown that the system has exceeded all expectations. It will be open to users in the Spring of 2005. There has been significant progress in the DC and pulse user magnet facilities towards field, bore, homogeneity and cooling time upgrades to the standard magnet systems. The Series-Connected Hybrid has been initiated and will provide combined high field and high homogeneity at lower power to the DC facility in a field-homogeneity parameter space never before available in the world, thereby providing copious unique scientific opportunities. Several collaborations were also completed in 2004 including a Sweeper magnet for the National Superconducting Cyclotron Laboratory, undulator magnets for the Advanced Photon Source at Argonne National Laboratories and quench protection of a crystal puller magnet for Duksung Corporation. In addition, the high temperature superconducting magnet and materials group, in collaboration with Oxford Superconducting Technologies, designed and built a high field 5 tesla insert coil and successfully tested it in the 20 tesla wide bore resistive magnet. World records for high field insert coils were established for current density in the high temperature superconducting (HTS) winding at high field, stored energy, peak mechanical stress, diameter in a layer-wound HTS coil, and the total number of turns.

The NHMFL's ICR Program successfully commissioned two FT-ICR mass spectrometers. A 14.5 T system is the highest field FT-ICR mass spectrometer in the world, and will be used to attack a broad range of biological, drug discovery, and petrochemical problems that require ultrahigh resolution and extremely accurate mass. A 7 T FT-ICR mass spectrometer is dedicated to analysis of volatile mixtures (e.g., low boiling fractions of crude oil) and FT-ICR instrumentation development

- Operations and Maintenance: These funds support the operation of the NHMFL, including magnet technology and development, support for user programs, in-house research, routine maintenance, instrumentation and technical services, and education and outreach programs. The increased level of maintenance and operations support that began in FY 2002 enabled the NHMFL to strengthen its programs for user support, equipment and facility maintenance, educational outreach and partnerships, and in-house research, and to meet increased costs for internal facilities and administration including electricity demand charges to operate high-field magnets. Research in the DC general-purpose facility is supported by eight scientists and an engineer whose specialties cover the kinds of measurements needed for most of the science done at the NHMFL and who work directly with users. In addition, the DC facility is supported by eight magnet plant and cryogenic system operators and mechanical, electronic, and computer engineers and technicians.

<u>Renewal or Termination</u>: The cooperative agreement for the support of NHMFL operations was to expire in FY 2005. In FY 2004, the NSB approved a two year extension at level funding, moving the expiration date to FY 2007. NSF plans are to consider support of the NHMFL either by renewal or to hold a recompetition. The decision will be based on the outcome of the recommendation of a blue ribbon panel and the National Academies study on High Magnetic Fields.

<u>Associated Research and Education Activities</u>: The NHMFL base award currently includes approximately $240,000 per year in support of Research Experiences for Undergraduates and a wide variety of pre-college educational outreach and partnership activities with additional funding from the State of Florida. Supplementary NSF funding of approximately $183,000 supports a Research Experiences for Teachers program for FY 2003 through FY 2005.

In FY 2004, educators at the Center for Integrating Research and Learning provided in-class educational experiences for 6,252 students from 34 schools in 9 counties and 3 states. In addition, tours of the NHMFL were provided to 970 members of the general public, with a total of over 8800 students, teachers, and the general public coming in contact with some facet of educational programs. The Center provided professional development opportunities for over 100 teachers through summer institutes, workshops, and conferences.

Participation in NHMFL Education Programs

Year	K-12	Undergrad[1]	Graduate[2]	Teachers[3]
FY 1994	1,200	8	N/A	3
FY 1995	1,515	10	N/A	9
FY 1996	3,990	16	N/A	30
FY 1997	4,075	18	19	255
FY 1998	4,080	18	15	547
FY 1999	7,100[a]	20	16	385
FY 2000	4,266	21	22	1,875[b]
FY 2001	3,959	17	20	1117
FY 2002	3,500	15	22	1319
FY 2003	6,841	21	19	226[c]
FY 2004	6,252	20	12	189

[1]Undergraduates participating in the Summer Minority Program and/or REU

[2]NHMFL-affiliated graduate students earning Ph.D.'s

[a]Statewide implementation of curriculum project in 1999.

[b]Teacher workshops extended to Connecticut and Illinois in 2000.

[c]State of Florida eliminated funding for "Science, Tobacco and You" Program.

In addition to the individuals depicted in the table above, the NHMFL also integrates undergraduate and graduate students and postdoctoral fellows into its ongoing research activities on a regular basis. For example, during 2003, the NHMFL at FSU supported an average of 86 graduate students, 29 postdocs, and 16 undergraduates through awards outside the NSF-NHMFL core funding, e.g., individual investigator grants, state funding, and external sources. The NHMFL is actively preparing and recruiting the next generation of high-field magnet scientists, engineers, and users.

Science Support: Users are supported by NSF, other Federal, state and local agencies, other national agencies, and the private sector. User projects and time are allocated by merit on a competitive basis. NSF does not track the level of user support from non-NSF sources. The laboratory serves more than 2,000 individuals annually.

National Nanofabrication Infrastructure Network

Project Description: The National Nanotechnology Infrastructure Network (NNIN) comprises 13 university sites that form an integrated national network of user facilities supporting research and education in nanoscale science, engineering, and technology. The NNIN provides users across the nation with access, both on-site and remotely, to leading-edge tools, instrumentation, and capabilities for fabrication, synthesis, characterization, design, simulation, and integration. The broad scope of NNIN coverage includes areas of physics, chemistry, materials, mechanical systems, geosciences, biology, life sciences, electronics, optics, molecular synthesis, and molecular scale devices, among others. The NNIN expands significantly beyond the capabilities of the predecessor five-university National Nanofabrication Users Network (NNUN), which concluded after ten years of NSF support at the end of 2003.

Principal Scientific Goals: The NNIN's broad-based national user facilities enable the nation's researchers from academia, small and large industry, and government to pursue new discoveries and applications in diverse domains of nanoscale science and engineering, and help stimulate technological innovation. The network also develops the infrastructure and intellectual and institutional capacity needed to examine and address societal and ethical implications of nanotechnology, including issues of environment, health, and safety.

Principal Educational and Outreach Goals: The NNIN undertakes on a national scale a broad spectrum of innovative activities in education, human resource development, knowledge transfer, and outreach, with special emphasis on non-traditional users and under-represented groups, including women and minorities.

Partnerships and Connections to Industry: The NNIN seeks to leverage its capabilities through connections and collaborations with national and industrial laboratories, and with foreign institutions. Through such partnerships and joint meetings and workshops, the network will share expertise and perspectives, provide specialized training opportunities, coordinate access to unique instrumentation, and transfer newly developed technologies.

Management and Oversight: The NNIN is managed as a cohesive and flexible network partnership through a Network Executive Committee derived from the individual Site Directors, and the Education/Outreach and Society/Ethics Coordinators. The Network Director provides intellectual leadership for the network; is responsible, in cooperation with the Network Executive Committee, for developing strategies, operational plans, and coordination of the activities of the network; and serves as the principal contact on behalf of the network with the NSF. An external Network Advisory Board meets at least annually and provides independent advice and guidance to the Network Director and Executive Committee concerning the network's programs, activities, vision, funding allocations, and new directions. The Advisory Board shares its major recommendations with the NSF. The Site Directors are responsible for local management functions of the individual user facilities, for interfacing with other facilities and with the management team for the overall network, and for connections with the outside communities.

NSF provides oversight to the NNIN under a cooperative agreement. The NNIN is reviewed through annual site reviews held at one of the network sites. In addition, a semi-annual review is held at the NSF attended by the Network Director and Executive Committee members. The program officer for the NNIN activity resides in the Division of Electrical and Communications Systems in the Directorate for Engineering (ENG). The program officer coordinates NNIN oversight with other Division and Directorate members of the NNIN working group. The working group consists of representatives from all NSF Directorates.

Current Project Status: The NNIN began operation under its award on March 1, 2004. The first comprehensive annual review of the NNIN was held following an initial 9 months of operation at the Georgia Tech node in December 2004. In part due to continuity provided by the five sites in the previous NNUN, and to the credit of the NNIN management team, the network already displays many of the attributes promised in the original vision from the proposal: a broad area of accessible micro- and nano-fabrication and characterization resources; a solid base of users with a significant representation from outside the host institutions including industrial and educational users; a strong research portfolio generated by the user community; positive initial performance at new sites with good plans in place to make them fully functioning nodes with solid user bases, including external users; and network-wide plans and efforts underway on educational outreach and societal and ethical implications of nanotechnology.

Funding Profile: The first year of funding in FY 2004 was $13.80 million. The FY 2006 Request is $13.90 million, level with the FY 2005 Current Plan. Primary funding for NNIN is provided by ENG; additional funding is provided by all the Directorates in the Research and Related Activities Account. The Directorate for Education and Human Resources provides support for NNIN in the amount of $200,000.

NNIN Funding Profile

(Dollars in Millions)

	Implementation	Operations & Maintenance[1]	Total, NSF
FY 2004		13.80	$13.80
FY 2005 Current Plan		13.90	$13.90
FY 2006 Request		13.90	$13.90
FY 2007 Estimate		16.10	$16.10
FY 2008 Estimate		18.50	$18.50
FY 2009 Estimate		20.30	$20.30
FY 2010 Estimate		20.81	$20.81

[1]Data in FY 2004-2006 does not include $200,000 provided through the Advanced Technological Education program in the Directorate for Education and Human Resources. Estimates for FY 2007 and beyond are developed strictly for planning purposes and are based on current usage and cost profiles. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Management and Operations: The major portion of NSF funds provides for operation and staffing of the user facilities and associated network activities. They also provide for acquisition and for in-house development of appropriate instrumentation, tools, and processes to serve the user needs. NSF may provide up to a 15 percent annual increase in budget beginning in FY 2007 should there be a need to cover anticipated growth in the user base, with related increased education, training and staffing costs; and enhanced instrumentation. NNIN has provided cumulative user data for its initial reporting year of 2004, which covers the 10-month period from the beginning of operation on March 1, 2004 to December 31, 2004. The cumulative number of users for all 13 NNIN sites is 3,479. This includes 2,914 academic users, 519 industrial users, and 46 government/international users.

<u>Renewal or Termination</u>: The award may be renewed once, without re-competition, for an additional five years, subject to satisfactory review of performance and availability of funds. The maximum duration of the award is for ten years.

<u>Associated Research and Education Activities</u>: The institutions comprising the NNIN have strong underlying internal research programs that provide critical research mass and knowledge base in developing new processes, methodologies, and instrumentation. Planned and ongoing NNIN educational contributions include a hyperlinked open textbook on nanotechnology for undergraduate and graduate students, a science magazine designed to stimulate and challenge 6-10 years olds to explore the physical sciences, a web-based multimedia suite encompassing training and courses for various disciplines in nanoscale science and engineering, and a network-wide research experience for undergraduates (REU) program. In its first year of the REU program, 72 students were accepted, of which 37 percent were female and 14 percent were minority. In FY 2005, the number of REU students will increase to 100.

<u>Science Support</u>: NSF and other agencies independently award research grants to principal investigators who may use the NNIN facilities to carry out some aspects of their research projects.

National Superconducting Cyclotron Laboratory

Project Description: This project supports the operation of the NSCL at Michigan State University (MSU) as a national user facility and also supports the MSU research program. The NSCL is the leading rare isotope research facility in the United States. NSCL scientists and researchers employ a wide range of tools for conducting advanced research in fundamental nuclear science, nuclear astrophysics, and accelerator physics. Important applications of the research conducted at the NSCL benefit society in numerous areas, including new tools for radiation treatments of cancer patients and the assessment of health risks to astronauts. The NSCL began operations of the coupled cyclotron radioactive beam facility in FY 2002, providing users with unique access to beams of unstable nuclei. The NSCL is among the world leaders in heavy ion nuclear physics and nuclear physics with radioactive beams.

The NSCL operates two superconducting cyclotrons. The K500 was the first cyclotron to use superconducting magnets, and the K1200 is the highest-energy continuous beam accelerator in the world. These and other related devices have enabled researchers to learn more about the origins of the elements in the cosmos. Through the newly completed Coupled Cyclotron Facility (CCF), heavy ions are accelerated by the K500 and then injected into the K1200, enabling the production of rare unstable isotopes at much higher intensities.

Principal Scientific Goals: Scientists at the NSCL work at the forefront of rare isotope research. They make and study atomic nuclei that cannot be found on earth and perform experimental research using beams of unstable isotopes to extend our knowledge of new types of nuclei, many of which are important to an understanding of stellar processes. Research activities include a broad program in nuclear astrophysics studies, the studies of nuclei far from stability using radioactive ion beams, and studies of the nuclear equation of state. In addition, research is carried out in accelerator physics.

Principal Education Goals: NSCL supports and enhances Ph.D. level graduate education and post-doctoral research experience. In addition, the site provides research experiences for undergraduate students, as well as training for K-12 teachers.

Partnerships and Connections to Industry: NSCL occasionally enters into license agreements with industry for cyclotron technology or nuclear electronics. A specific license agreement with Accel Corporation exists for compact cyclotrons based on superconducting technology.

Management and Oversight: The NSCL is managed by the Laboratory Director and two Associate Directors: one for Nuclear Science and one for Accelerator Research. During the NSCL upgrade, NSF convened several technical panels to review cost, schedule, technical progress, and management of the project. The NSCL research program is guided by a Program Advisory Committee consisting of external experts as well as an in-house expert, and includes the chairperson of the full NSCL User Group. The procedure for users includes writing and submitting proposals to the NSCL Director and oral presentations. There are two opportunities for proposal submission each year. Approximately 5,000 beam hours for experiments are provided each year. There is generally at least a one-year backlog for experiments. NSF oversight is provided through annual site visits by the cognizant program officer of the Physics Division (MPS) and other staff, accompanied by external experts.

Current Project Status: An experimental program using the recently completed coupled cyclotron facility is now underway. The FY 2006 Request for the NSCL totals $17.50 million, level with the plan of $17.50 million for FY 2005. This will support operations and research at this unique radioactive ion beam facility.

Funding Profile: All funding for NSCL to date has been provided through the R&RA Account.

NSCL Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001	1.00	11.40	$12.40
FY 2002	0.40	14.41	$14.81
FY 2003		15.65	$15.65
FY 2004		15.65	$15.65
FY 2005 Current Plan		17.50	$17.50
FY 2006 Request		17.50	$17.50
FY 2007 Estimate		17.94	$17.94
FY 2008 Estimate		17.94	$17.94
FY 2009 Estimate		17.94	$17.94
FY 2010 Estimate		17.94	$17.94

The current Cooperative Agreement expires in FY 2006. Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Implementation: The facility was recently upgraded to couple two superconducting cyclotrons and to upgrade the fragment separator to produce intense beams of unstable isotopes providing a facility unique in the world. This recent upgrade of the NSCL to the coupled cyclotron facility was accomplished using $12.0 million in incremental funding from the NSF and over $6.0 million from MSU. In addition, $4.0 million was provided to upgrade the cryogenic plant.

- Operations and Maintenance: Funding within this category supports the operation of the facility. Such activities include routine preventive maintenance of the two coupled NSCL cyclotrons, including vacuum systems, RF power systems, beam transport systems, the helium refrigerator used to supply coolant for the superconducting cyclotrons, and miscellaneous subsystems, are carried out each quarter. Approximately 25 percent of the funding is directed toward in-house research (both experimental nuclear science and accelerator research & development) with the remainder used to operate and maintain the facility. The facility serves several hundred active users.

<u>Renewal or Termination</u>: The current cooperative agreement expires at the end of FY 2006. NSF expects to consider a proposal to renew the agreement at that time pending a satisfactory performance review.

<u>Associated Research and Education Activities</u>: The figures shown in the table below are for high school teachers and students participating in the NSCL Physics of Atomic Nuclei (PAN) program. This is a two-week summer program sponsored by MSU with the objective to stimulate an interest in science, particularly in female and minority students.

Participants in the NSCL Physics of Atomic Nuclei (PAN) Program

Year	HS Teachers	HS Students
1995	8	33
1996	8	34
1997	15	30
1998	9	23
1999	13	25
2000	12	21
2001	13	21
2002	12	21
2003	4	15
2004	7	13

Science Support: Theoretical nuclear physics research at the NSCL is separately supported by annual grants totaling approximately $500,000. Additionally, in several recent years Major Research Instrumentation grants have been awarded which have permitted construction of detectors and other equipment important to the operation of the laboratory as a user facility.

George E. Brown Jr. Network for Earthquake Engineering Simulation

Project Description: NEES is a national, networked simulation resource of fifteen geographically distributed, shared use next-generation experimental research equipment sites with teleobservation and teleoperation capabilities. NEES provides national resources to advance earthquake engineering research and education through collaborative and integrated experimentation, computation, theory, databases, and model-based simulation to improve the seismic design and performance of U.S. civil infrastructure systems. Research equipment includes shake tables, geotechnical centrifuges, a tsunami wave basin, large-scale laboratory experimentation systems, and mobile and permanently installed field equipment. NEES equipment is located at academic institutions (or at off-campus field sites) throughout the United States, networked together through a high performance Internet2 cyberinfrastructure system. NEES completed construction on September 30, 2004 and opened for user research and education projects on October 1, 2004. Between FY 2005 and FY 2014, NEES will be operated by the non-profit corporation NEES Consortium, Inc. (NEESinc), located in Davis, California. Through a cooperative agreement with NSF, NEESinc operates the 15 equipment sites; the NEES cyberinfrastructure center; coordinates education, outreach, and training; and develops national and international partnerships.

Principal Scientific Goals: NEES' broad-based national research equipment and cyberinfrastructure will enhance understanding and provide more comprehensive, complete, and accurate models of how civil infrastructure systems respond to earthquake loading (site response, soil-foundation-structure interaction, tsunami effects, and structural and nonstructural response). This will enable the design of new methods, modeling techniques, and technologies for earthquake hazard mitigation.

Principal Education Goals: NEES engages engineering, science, and other students in earthquake engineering discovery through on-site use of experimental facilities, telepresence technology, archival experimental and analytical data, and computational resources with the aim of integrating research and education. NEES has developed an education, outreach and training strategic plan to develop a broad spectrum of education and human resource development activities with special emphasis on non-traditional users and underrepresented groups.

Partnerships and Connections to Industry: Through the Congressionally mandated National Earthquake Hazards Reduction Program (NEHRP), the Federal Emergency Management Agency (FEMA), the National Institute of Standards and Technology (NIST), NSF, and the U.S. Geological Survey (USGS) participate to support research related to earthquake hazard mitigation. Connections to industry include private engineering consultants and engineering firms engaging in NEES research or using data and models developed through NEES. NEES is leveraging and complementing its capabilities through connections and collaborations with large testing facilities at foreign earthquake-related centers, laboratories, and institutions. Through such partnerships and joint meetings and workshops, NEES shares its expertise in testing and cyberinfrastructure, provides specialized training opportunities, and coordinates access to unique testing facilities and the central data repository.

The NEES Tsunami Wave Basin is pictured above. Located at Oregon State University, it is the world's largest shared-use research facility for the study of effects of tsunami inundation on coastal buildings and lifeline infrastructures. A solition (or solitary wave) is being demonstrated in this photo. *Credit: Kelly James, Oregon State*

Management and Oversight: Through a NSF cooperative agreement, NEES Consortium, Inc. (NEESinc) operates the 15 equipment sites and the NEES cyberinfrastructure center; coordinates education, outreach, and training; and develops national and international partnerships. As a non-profit corporation, NEESinc operates under its own governance structure and is overseen by a Board of Directors elected from its membership in accordance with its by-laws. Day-to-day operations of NEESinc is overseen by its headquarters staff that is led by an Executive Director. Each equipment site has a facility director responsible for local day-to-day equipment management, operations, and interface with NEESinc, other NEES equipment sites, users, and the NEES cyberinfrastructure center for network coordination. The NEES cyberinfrastructure center maintains the telepresence, data, collaborative, simulation, and other related services for the entire NEES network.

NSF provides oversight to NEES under a cooperative agreement. NEES is reviewed through annual site visits. The NSF Program Manager for NEES is located in the Civil and Mechanical Systems (CMS) Division in the Directorate for Engineering (ENG). The NSF Deputy for Large Facility Projects provides advice and assistance.

Current Project Status: NEES completed its primary construction activities at the end of FY 2004. About $2.7 million in remaining FY 2004 MREFC funds were used to fund construction of deferred capabilities for NEES during FY 2005. This included four new capabilities for system integration (cyberinfrastructure) and new capabilities at 13 equipment sites. These activities will be completed by September 30, 2005. NEES opened for user research and education projects on October 1, 2004, under the management of NEESinc. Commensurate with opening, the first round of research awards were made by NSF in September/October 2004 to use the NEES facilities. Through a NSF cooperative agreement, NEESinc operates the 15 equipment sites and the NEES cyberinfrastructure center; coordinates education, outreach, and training; and develops national and international partnerships. The NEES tsunami wave basin provides a national resource to calibrate and validate tsunami propagation and inundation modeling tools, model inundation patterns to understand where the threat is most significant, and develop design criteria for coastal community shelters and other critical facilities. Researchers at this facility participated on a post-tsunami rapid-response reconnaissance team with respect to the 26 December 2004 Indian Ocean earthquake.

<u>Funding Profile</u>: NSF received $7.70 million in FY 2000 to initiate construction of NEES. Total MREFC funding for this project was $81.76 million during FY 2000-04, with an additional $1.10 million provided to the project through the Education and Human Resources (EHR) Account.

Appropriated and Requested MREFC Funds for NEES

(Dollars in Millions)

FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	Total
$7.70	$28.14	$24.40	$13.47	$8.05	$81.76

NEES Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation			Operations & Maintenance		Totals			**Grand**
	R&RA	MREFC	R&RA	MREFC	EHR	R&RA	MREFC	R&RA	MREFC	EHR	**Total**
FY 1998 & Earlier	0.26							$0.26			**0.26**
FY 1999											
FY 2000		0.36		7.34					$7.70		**7.70**
FY 2001	0.44	0.03		28.11	1.10			$0.44	$28.14	$1.10	**29.68**
FY 2002				24.40					$24.40		**24.40**
FY 2003				13.47					$13.47		**13.47**
FY 2004				8.05					$8.05		**8.05**
FY 2005 Plan						19.54		$19.54			**19.54**
FY 2006 Request						20.52		$20.52			**20.52**
FY 2007 Estimate						21.27		$21.27			**21.27**
FY 2008 Estimate						22.17		$22.17			**22.17**
FY 2009 Estimate						23.02		$23.02			**23.02**
FY 2010 Estimate						23.60		$23.60			**23.60**
Subtotal, R&RA	$0.70					$130.12		$130.82			
Subtotal, MREFC		$0.39		$81.37					$81.76		
Subtotal, EHR					$1.10					$1.10	
Total, Each Stage		**$1.09**		**$81.37**			**$130.12**				**$213.68**

NOTE: The expected operational lifespan of this project is 10 years, from FY 2005 to FY 2014. NEES operations for FY 2005 – FY 2009 was approved by the National Science Board in May 2004 for up to $106.52 million total; approximately $21.3 million annually. Operations estimates for FY 2007 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available.

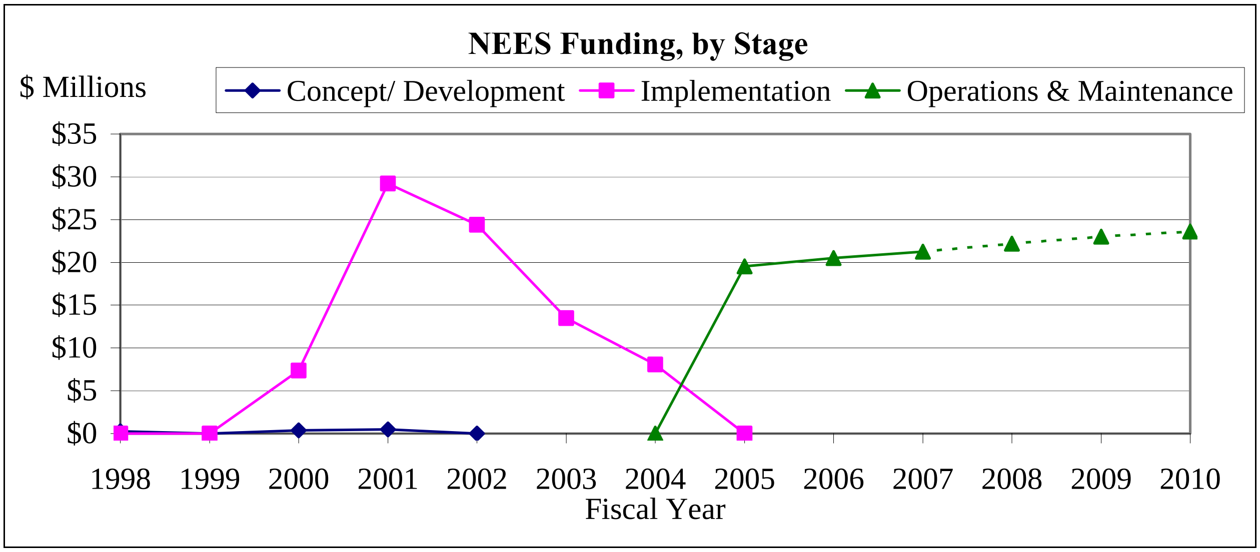
Information pertaining to the data in the table is provided below.

- Concept/Development: R&RA support for planning, design and development included early workshops on experimental needs of the earthquake engineering community and on refinement of ideas for experimental systems in FY 1995 and FY 1998. During this period, the community also developed an action plan at NSF's invitation. Additional R&RA support focused on an international workshop to foster long term working relationships for experimental earthquake engineering research and national workshops and study to develop long-term NEES research concepts and plans (FY 2001). MREFC funds supported planning, design and development specifically for a scoping study of the NEES network system (user and system architecture requirements), including a community workshop for broader input on user requirements prior to the full system integration award being made by NSF.

- Implementation: MREFC funds during this phase support a range of equipment acquisition, as well as system integration and consortium development. To encourage the broadest participation for establishment of geographically distributed NEES equipment sites, the FY 2000 competitive program solicitation for NEES research equipment specifically encouraged participation from EPSCoR states. As a result of the merit review process, one award was made to an institution from an EPSCoR state for which the EPSCoR program provided partial funding through the EHR account in FY 2001.

- Operations and Maintenance: With completion of the construction period in FY 2004, NEES has now entered its 10-year operational period through FY 2014 and is managed by NEES Consortium, Inc. NEES Consortium, Inc., provides the leadership, management, and coordination for all the NEES resources and will establish a broad and integrated partnership that includes participation of the full membership of the earthquake engineering community, both within the U.S. and abroad.

As an Internet-based resource, access to the NEES network is 24/7 to anyone with Internet capabilities. The NEES experimental facilities are expected to be fully utilized annually as shared use research sites coordinated by NEES Consortium, Inc., and for research by personnel at the host institutions. NEES experimental resources and data are expected to be used annually by approximately 1000 U.S. researchers and students.



Future Science Support: Along with direct operations and maintenance support for NEES, NSF provides support for research performed at NEES equipment sites through ongoing research and education programs. The NEES cyberinfrastructure also provides a platform for the earthquake engineering community as well as other communities to develop new tools for shared cyberinfrastructure. In addition, NSF has initiated grand challenge, small group, and individual investigator research projects that will utilize a number of NEES experimental sites, data, and computational resources to comprehensively address major research questions in earthquake engineering and seismic hazard mitigation. The annual support for such activities is estimated to be about $9.0 million annually.

Shared Cyberinfrastructure Tools

Project Description: In FY 2006, NSF will continue to provide support for shared cyberinfrastructure tools. Activities included in shared cyberinfrastructure tools enable the national community to access high-end computing, communications, networking, data storage, and information analysis resources, and complement other shared cyberinfrastructure investments made by the agency. Funding supports the provision of services that provide for the effective use of cyberinfrastructure resources by researchers and educators nationwide. NSF's coordinated investments in this area are facilitating development of technology and policy platforms that will provide for interoperability across science and engineering fields and across organizational, regional and national boundaries. Shared cyberinfrastructure tools build on the successes of the prior Partnerships for Advanced Computational Infrastructure (PACI), and incorporate the agency's ongoing investments in the Extensible Terascale Facility (ETF).

Principal Scientific Goals: Information technology has had widespread impact on science and engineering – simulation and modeling are now as important to discovery as theory and experimentation, advances in sensor technology and the availability of affordable mass data storage devices are making possible the collection, creation and federation of large complex datasets, and pervasive networking technology is enriching collaborations and providing broad access to a multitude of scientific resources. NSF continues to capitalize on the science and engineering opportunities provided by advances in information technology through support of a shared cyberinfrastructure that enriches discovery, learning and innovation in all science and engineering domains. Shared cyberinfrastructure tools activities support and/or integrate a diverse set of advanced computing engines, data archives and digital libraries, observing and sensor systems, and other research and education instrumentation that are critical to the work of the nation's science and engineering researchers and educators.

Principal Education Goals: NSF seeks to ensure that the broadest range of individuals, institutions and stakeholder communities are participating in the design, development, deployment and/or use of shared cyberinfrastructure tools. In FY 2006, the agency will support new efforts to prepare current and future generations of scientists and engineers to use, develop and support cyberinfrastructure as described in the CISE sub-chapter.

Partnerships and Connections to Industry: Cyberinfrastructure is by definition a partnership activity and involves a large number of academic, industry and government partner organizations, both foreign and domestic. NSF-supported shared cyberinfrastructure partners have enjoyed industrial strategic partnerships with Fortune 500 Companies, including Allstate Insurance Company; the Boeing Company; Caterpillar Inc.; Eastman Kodak Company; J. P. Morgan; Kellogg Company; Motorola, Inc.; Sears; Shell Oil Company; Arena Pharmaceuticals; BAE Systems; Brocade; Ceres, Inc; Computer Science Corp.; Pfizer; JVC; Lockheed Martin; and ESRI. They also have had strategic technology partnerships with a number of companies including ANSYS, Inc., Compaq (now Hewlett Packard), Cray Inc., IBM, Informix Corp., Intel, Microsoft Corp., Oracle, Qwest, SGI, Storage Tek, and Sun Microsystems.

Management and Oversight: NSF awards for support of shared cyberinfrastructure tools are made through cooperative agreements and grants. Investments in national supercomputing resources are being made through cooperative agreements with the National Center for Supercomputing Applications (NCSA), the San Diego Supercomputing Center (SDSC), the Pittsburgh Supercomputing Center (PSC), the Texas Advanced Computing Center (TACC) and other partner institutions in the Extensible Terascale

Facility. With upgrades in supercomputing capacity completed during FY 2004 and ongoing in FY 2005, NSF will double the computing cycles made available to the national science and engineering community. The National Resource Allocation Committee (NRAC) meets semi-annually to review and make recommendations on large supercomputing resource requests. In recognition of the expanding definition of cyberinfrastructure, during FY 2005 the NRAC process is being modified to include allocation of other shared cyberinfrastructure resources, with compute cycles no longer likely to be the only resources allocated. Cooperative agreement awardees submit annual reports and plans that are reviewed by committees of experts external to NSF. Committee recommendations are acted upon by the cognizant NSF program officer and reviewed by the Division Director. A Cyberinfrastructure User Advisory Committee (CUAC) is currently being established to provide input to NSF's shared cyberinfrastructure partners on the needs of the broad user community.

Current Status: The FY 2006 Request for shared cyberinfrastructure tools totals $114 million, out of a total of $176 million allocated to all shared cyberinfrastructure. Other activities reported as shared cyberinfrastructure but not included as "shared cyberinfrastructure tools" include workforce development activities and research to inform the development of information integration tools to manage scientific data.

Funding Profile: All funds for the operations and maintenance of shared cyberinfrastructure tools are being provided through the R&RA Account in CISE/SCI. In the past, NSF's main investments in shared cyberinfrastructure tools were made through the Partnerships for Advanced Computational Infrastructure (PACI), as described below.

Shared Cyberinfrastructure Funding Profile[1,2]

(Dollars in Millions)

	Implementation	Management, Operations & Maintenance	Total, NSF
FY 1998	21.30	38.80	$60.10
FY 1999	23.90	45.60	$69.50
FY 2000	27.20	42.80	$70.00
FY 2001	21.90	51.40	$73.30
FY 2002	25.90	49.37	$75.27
FY 2003	25.00	48.24	$73.24
FY 2004	30.50	80.16	$110.66
FY 2005 Current Plan	12.14	108.62	$120.76
FY 2006 Request	19.00	95.00	$114.00

[1]Funding for FY 1998 through FY 2004 represents fuding provided through the Partnerships for Advanced Computational Infrastructure (PACI) program.

[2]Funds provided in FY 2000-FY 2004 through the MREFC Account for Terascale Computing Systems are not included.

Information pertaining to the data in the table is provided below.

- Implementation: Concept planning for PACI was done in the 1995 to 1997 time frame. The PACI activity evolved between 1997 and 2003, in part due to continuing advances in IT and the national community's needs for access to advanced IT resources. Contributions made by PACI helped inform development of the shared cyberinfrastructure tools activity. The 2003 report of the NSF Advisory

Committee for Cyberinfrastructure is also informing the agency's plans for shared cyberinfrastructure tools. Implementation in the context of shared cyberinfrastructure tools includes acquisition and deployment of cyberinfrastructure hardware, such as high-end computing systems. In FY 2006, funds available will provide for selective cyberinfrastructure enhancements identified through an ongoing process being developed within NSF to identify agency-wide priorities.

- Management, Operations and Maintenance: The Management, Operations and Maintenance data describes support for IT professionals, the development and support of software tools, and the provision of networking infrastructure to ensure that effective cyberinfrastructure services are available to the national user community.

Renewal or Termination: With the conclusion of PACI, revised cooperative agreements with NCSA and SDSC have been developed to ensure the continuing provision of high-end computing resources and related services to the national community. These cooperative agreements extend through the end of FY 2007. Complementing the resources and services provided by NCSA and SDSC, in FY 2005 and beyond the Extensible Terascale Facility will provide cyberinfrastructure services to advance science and engineering research and education. The management and operations of the Extensible Terascale Facility will be funded in cooperative agreements extending through FY 2009. During FY 2005 and FY 2006, NSF will work with the national science and engineering community and its shared cyberinfrastructure partners in the development of a plan that will guide the agency's future implementation investments.

Associated Education Activities: To take advantage of the power of cyberinfrastructure and its potential to transform science and engineering research and education, NSF will expand the CI-TEAM program established in FY 2005 to prepare current and future generations of scientists and engineers to effectively leverage cyberinfrastructure to further their research and education agendas. The CI-TEAM activity builds upon the successes of PACI-EOT activities.

Science Support: Leading-edge shared cyberinfrastructure resources serve many areas of scientific and engineering research supported by the NSF. Annual support for research and education projects that take advantage of shared cyberinfrastructure tools is modestly estimated to be $200 million.

NSF's investments in the development and provision of shared cyberinfrastructure services and tools are made in partnership with a number of organizations around the nation, reflecting the pervasive impact of information technology and the growing capabilities and expertise now resident in a larger number of organizations. As such, the agency's investments in shared cyberinfrastructure tools are no longer best characterized as "facilities" investments. Consequently, in FY 2007 and beyond NSF will report its investments in shared cyberinfrastructure tools as Infrastructure and Instrumentation.

Terascale Computing Systems

Project Description: The NSF Terascale Computing Systems project funded the construction of the Extensible Terascale Facility (ETF). ETF, also commonly known as the Teragrid, provides the broad-based academic science and engineering community with access to scalable, balanced, terascale computing resources, including two 10+ teraflops supercomputing systems (one at the National Center for Supercomputing Applications and one scheduled to come on line in the spring of 2005 at the Pittsburgh Supercomputing Center) and over 35 teraflops across the ETF. Users also have access to at least 500 terabytes of storage at a single site (at the San Diego Supercomputing Center) and nearly 1 petabyte across the ETF. Using ETF, researchers and educators are able to conduct analyses at unprecedented scale, to merge multiple data resources seamlessly, and to advance discovery at the frontiers of science and engineering.

Principal Scientific Goals: To provide state-of-the-art cyberinfrastructure capabilities that position the nation's researchers and educators to address a broad range of state-of-the-art problems, including those commonly referred to as "grand challenge" problems, across all science and engineering fields. ETF's distributed architecture permits the seamless integration of large, managed scientific data archives; high-performance computational resources available within ETF can be used to mine, analyze, visualize, and perform related simulations on these data.

Principal Education Goals: To provide current and future generations of scientists and engineers with access to unique, state-of-the-art cyberinfrastructure that promises to advance discovery, learning and innovation across all fields.

Partnerships and Connections to Industry: Several companies have served as partners in the construction of ETF. Primary industrial partners include Cray, Force 10, Hewlett Packard, IBM, Intel, Juniper, Oracle, Qwest, and SUN Microsystems.

Management and Oversight: Management and oversight of this project is provided by a Program Director in the Shared Cyberinfrastructure (SCI) Division of the Directorate for Computer and Information Science and Engineering (CISE). An NSF Project Advisory Team (PAT) consisting of representatives from several NSF Directorates and Offices has also provided oversight. The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. During the construction phase, an external Technical Advisory Panel made periodic site visits to the ETF partner institutions to review construction progress and provide technical advice to the Program Director. The Technical Advisory Panel participated in resolution of major technical, managerial, or scheduling concerns; provided technical guidance/advice, especially with regard to the integration and coordination with other SCI-funded program activities; and reviewed and, where required, approved technical reports and information to be delivered by the awardees. The NSF Project Advisory Team will continue to assist the Program Director with management and oversight of ETF.

With the October 1, 2004 initiation of the operations phase of ETF, a new ETF management structure is being put in place. It consists of a single integrative activity, termed the Teragrid Grid Infrastructure Group (GIG), and nine coordinated resource provider (RP) activities, one at each of the nine participating sites. The GIG is designed with a single Project Director, supported by four technical Area Directors, a Program Manager and Science Coordinator, and an Executive Steering Committee. Each RP participates in a TeraGrid-wide Resource Provider Forum and participates in TeraGrid-wide operational structures of the GIG in areas such as coordinated operations, allocations, and security. All ten awardees, both the GIG and the nine RPs, report directly to a single NSF Program Director. A Cyberinfrastructure User Advisory Committee (CUAC) is currently being established to provide input to ETF and NSF's other shared cyberinfrastructure partners on the needs of the broad user community.

Current Project Status: The ETF construction phase was completed on September 30, 2004; ETF resources began allocated usage as part of "early operations" in October 2004. Allocations for ETF were included, for example, in the National Resource Allocation Committee's September 2004 allocations. The full operations phase for ETF is scheduled to begin in the spring of 2005.

Funding Profile: ETF was created through a coordinated series of investments as follows:

- In FY 2000, the Pittsburgh Supercomputing Center (PSC) built a Terascale Computing System (TCS) with peak performance of 6 teraflops.
- The Distributed Terascale Facility (DTF) was initiated in FY 2001 by a partnership including the National Center for Supercomputing Applications, the San Diego Supercomputer Center, Argonne

National Laboratory and the California Institute of Technology. Based on multiple Linux clusters, DTF linked its sites through a high-performance "DTF backplane".

- In FY 2002 NSF provided funding to enhance the TCS and DTF and initiated the creation of the ETF by extending the "DTF backplane" to TCS and by placing extensible hubs in Chicago and Los Angeles that permitted further expansion of this new distributed facility.
- In FY 2003 NSF made awards to extend the ETF to four additional sites - Indiana University, Purdue University, Oak Ridge National Laboratory, and the Texas Advanced Computing Center at the University of Texas at Austin. Via high-speed network connections, the Spallation Neutron Source at ORNL and other unique computational and data resources in Indiana and Texas were integrated into ETF for use by the nation's research and education community.
- In FY 2004, PSC received an award to acquire a 10 teraflops Cray Red Storm capability system that has the potential to be scalable to 150 teraflops. This acquisition constituted the final award funded from the MREFC account, Terascale Computing Systems.

Appropriated MREFC Funds for Terascale Computing Systems

(Dollars in Millions)

FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	Total
$36.00	$44.90	$35.00	$9.94	$10.05	$135.89

ETF entered its operations phase on schedule in October 2004. A summary of the funding profile from FY 2000 through FY 2004 is provided below.

Terascale Computing Systems Funding Profile

(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance[3]		Totals		**Grand**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	**Total**
FY 1998	0.06						$0.06		**0.06**
FY 1999									
FY 2000				36.00				$36.00	**36.00**
FY 2001				44.90	2.37		$2.37	$44.90	**47.27**
FY 2002[1]					7.06		$7.06		**7.06**
FY 2003				44.94	11.17		$11.17	$44.94	**56.11**
FY 2004[2]				10.05				$10.05	**10.05**
Subtotal, R&RA	$0.06				$20.60		$20.66		
Subtotal, MREFC				$135.89				$135.89	
Total, Each Stage		**$0.06**		**$135.89**		**$20.60**			**$156.55**

[1]FY 2002 MREFC funding for Terascale was carried over into FY 2003 due to the NSB meeting schedule.

[2]FY 2004 funding includes implementation funds totaling $110,000 carried over from FY 2003.

For further information on shared cyberinfrastructure facilities and tools, please refer to the Shared Cyberinfrastructure section of this chapter.

Information pertaining to the data in the table is provided below.

- Concept/Development: Planning for the Terascale Computing Systems MREFC project began in 1998, with a series of three workshops held at NSF to assess the need within the academic research community for computational resources with multi-teraflop capability.

- Implementation: TCS was funded at Pittsburgh Supercomputing Center in FY 2000. It was fully operational in the first quarter of 2002. Funding for DTF was provided to the San Diego Supercomputing Center and the National Center for Supercomputing Applications in FY 2001. Construction of DTF continued through FY 2003. Funds in FY 2002 were used to enhance and augment TCS and DTF, fully integrate TCS and DTF into a single grid-enabled facility, and enable the DTF to extend beyond the five initial sites. ETF was thereby created. Funds in FY 2003 supported connections to four additional ETF sites. Funds in FY 2004 were used to acquire a prototype 10 teraflops capability system at the Pittsburgh Supercomputing Center.

- Management and Operations: The ETF facility incurred operations costs of approximately $10 million in FY 2004. Management and operations costs in FY 2005 and FY 2006 are estimated to be $30 million, as ETF enters its full management and operations phase. Estimates for FY 2007 and beyond are developed for planning purposes and are based on current cost profiles.

Future Science Support: NSF will support science and engineering research and education enabled by ETF through ongoing research and education programs. Annual support for research and education using the ETF is estimated to be about $200 million.

Other Facilities

Other Facilities support, $39.62 million in FY 2006, includes continued support for the Network for Computational Nanotechnology (NCN), which focuses on modeling and simulation of chemical, biological and pharmaceutical systems, and the continued phase-out of program and contract activities for the Ocean Drilling Program. Other items within this category include facilities for computational sciences, physics, materials research, ocean sciences, atmospheric sciences, and earth sciences.

POLAR FACILITIES AND LOGISTICS[3]

Antarctic Facilities and Operations

Project Description: Antarctic Facilities and Operations provide the basic infrastructure and transportation support for all U.S. research conducted in Antarctica, including that funded by U.S. mission agencies, for year-round work at three U.S. stations, two research ships, and a variety of remote field camps. All life support is provided by NSF, including facilities infrastructure, communications, and utilities (water and power), and health and safety infrastructure.

Principal Scientific Goals: Antarctic Facilities and Operations provides science support in Antarctica, ranging from astrophysics to microbiology and climatology; provides environmental stewardship, and maintains U.S. presence in Antarctica in accord with U.S. policy.

[3] The South Pole Station Modernization project included initial support for operations and maintenance funded through the R&RA Account as well as construction, acquisition and commissioning costs funded through the MREFC Account. A complete discussion of this project may be found in the MREFC chapter.

Principal Education Goals: By maintaining and operating the three U.S. stations in Antarctica, Antarctic Facilities and Operations support all scientific work performed by U.S. scientists in Antarctica. Specific science and education goals are managed by the science programs.

Partnerships and Connections to Industry: There are approximately 385 separate subcontractors for supplies and technical services. The U.S. Antarctic Program prime support contractor is Raytheon Polar Services Company (RPSC).

Management and Oversight: The Office of Polar Programs (OPP) has the overall management responsibility for Antarctic Facilities and Operations. The performance of the support contractor is evaluated every year by an Award Fee Board, with representatives from OPP and the Budget, Finance and Award Management. In addition, performance is reviewed by Committees of Visitors and the OPP Advisory Committee.

Antarctic Facilities and Operations also includes management of South Pole Station Modernization, an activity funded out of the Major Research Equipment and Facilities Construction (MREFC) Account from FY 1998. The new station will provide the infrastructure required for imaginative new science on the drawing board.

Current Project Status: All three Antarctic stations are currently operating as normal.

Funding Profile: All funding for Antarctic Facilities and Operations has been provided through the R&RA Account. Support for South Pole Station Modernization, the South Pole Safety and Environment, and the Polar Aircraft Upgrades projects are found in the MREFC Section.

Antarctic Facilities and Operations Funding Profile

(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001		117.96	117.96
FY 2002		126.15	126.15
FY 2003		143.93	143.93
FY 2004		151.11	151.11
FY 2005 Current Plan		152.55	152.55
FY 2006 Request		196.32	196.32
FY 2007 Estimate		202.20	202.20
FY 2008 Estimate		208.30	208.30
FY 2009 Estimate		214.50	214.50
FY 2010 Estimate		220.90	220.90

NOTE: Estimates for FY 2007 and beyond are developed strictly for planning purposes and are based on current cost profiles. They will be updated as new information becomes available. Beginning in FY 2006, Antarctic facilities and operations support includes $48 million for NSF to assume the responsibility, from the U.S. Coast Guard, for funding the costs of icebreakers needed for the support of scientific research in polar regions.

Information pertaining to the data in the table is included below.

- Operations and Maintenance: The Office of Polar Programs (OPP) contracts with a prime support contractor for science support, and operations and maintenance of the Antarctic stations and related infrastructure in New Zealand and Chile, as well as leasing of research vessels and fixed-wing aircraft used in support of research. The contractor is selected through a competitive bidding process. Other agencies and contractors also provide technical support in areas of expertise such as engineering, construction and communications.

Renewal or Termination: Not applicable to the facilities themselves. The current Antarctic support contract was recompeted and awarded in FY 2000. After a five-month phase-in period the contractor assumed responsibility for operations in March 2000. The contract's ten year performance period is segregated into a five-year initial period and a five-year optional period. NSF is presently considering whether to exercise its option to extend the performance period.

Associated Research and Education Activities: The Antarctic infrastructure makes science in Antarctica possible - ranging from astrophysics to microbiology and climatology - and maintains U.S. presence in Antarctica in accord with U.S. policy. Research is funded through the Antarctic Research Grants Program at NSF and through other federal agencies funding research in Antarctica.

Science Support: OPP's prime support contractor provides science support, as well as operations and maintenance of the facilities.

Polar Logistics

Arctic research support and logistics is driven by and responsive to the science supported in U.S. Arctic Research programs. Funding for logistics is provided directly to grantees or to key organizations that provide or manage Arctic research support and logistics. Major components include: access to U.S. Coast Guard and other icebreakers, University-National Oceanographic Laboratory vessels and coastal boats, and support on the U.S. Coast Guard Cutter Healy; access to fixed and rotary-wing airlift support; upgrades at Toolik Field Station, University of Alaska, Fairbanks' field station for ecological research on Alaska's North Slope; safety training for field researchers and funding for field safety experts, global satellite telephones for emergency response, and improved logistics coordination; development of a network of strategically placed U.S. Long-Term Observatories linked to similar efforts in Europe and Canada; and installation of a modern local area network in Barrow/Naval Arctic Research Laboratory with improved access to the Internet.

U.S. Antarctic Logistical Support is provided by U.S. Department of Defense (DoD) components. Major elements include: Military personnel of the 109th Airlift Wing (AW) of the New York Air National Guard; 109th AW LC-130 flight activity and aircraft maintenance; transportation and training of personnel in connection with the U.S. Antarctic Program; logistics facilities of the Air Force Detachment 13 in Christchurch, New Zealand and the 109th Airlift Wing in Scotia, New York; air traffic control, weather forecasting, and electronic equipment maintenance; charter of Air Mobility Command Airlift and Military Sealift Command ships for the re-supply of McMurdo Station; fuel purchased from the Defense Logistics Agency; and use of Department of Defense satellites for communications.

NSF is requesting $104.31 million for Polar Logistics, a decrease of $600,000 from the FY 2005 Current Plan of $104.91 million. Arctic Logistics support decreases to $36.79 million, but will provide continuing support for research projects throughout the Arctic including Alaska, Canada, the Arctic Ocean, Greenland, Scandinavia and Russia; support for Toolik Field Station, University of Alaska, Fairbanks' field station for ecological research on Alaska's North Slope; and continuing support for a cooperative agreement with the Barrow Arctic Science Consortium. Support provided by DoD for the U.S. Antarctic Logistics program is level in FY 2005, at $67.52 million.

Polar Icebreaking

With the FY 2006 Budget Request, NSF will assume the responsibility, from the U.S. Coast Guard, for funding the costs of icebreakers that support scientific research in polar regions.

FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS

National Astronomy and Ionospheric Center

Project Description: The NAIC is a visitor-oriented national research center, supported by NSF and focusing on radio and radar astronomy and atmospheric sciences. Its principal observing facility is the world's largest radio/radar telescope, a 305m-diameter spheroid constructed within a karst depression in western Puerto Rico near the town of Arecibo. The facility itself is called the Arecibo Observatory. The NAIC is operated by Cornell University for NSF under a cooperative agreement. NAIC provides telescope users with a wide range of research and observing instrumentation. The center has a permanent staff of scientists, engineers, and technicians who are available to help visiting investigators with their observation programs.

Principal Scientific Goals: The NAIC was founded to advance the study of basic research in Radio Astronomy, Solar System Radar Astronomy, and Ionospheric Physics.

Principal Education Goals: NAIC's primary education goal is to support and enhance the education of graduate and undergraduate student researchers. Arecibo was one of NSF's first sites for the Research Experiences for Undergraduates (REU) program. At Arecibo, graduate students receive training through use of the facility for Ph.D. research. NAIC also sponsors a major outreach program in Puerto Rico via a modern Visitor's Center, a new Learning Center, and summer workshops for K-12 teachers. In addition NAIC holds, in collaboration with NRAO, a summer school on single-dish radio astronomy techniques. This is a continuing bi-yearly school alternating between NRAO sites and Arecibo.

Partnerships and Connections to Industry: NAIC currently has partnerships with NASA, NRAO, Penn State and other Universities, and the Angel Ramos Foundation of Puerto Rico (a private organization).

Management and Oversight: NAIC is one of four National Centers in astronomy supported by the Astronomical Sciences Division (AST) in the Directorate for Mathematics and Physical Sciences (MPS). Management is via a cooperative agreement with Cornell University. This agreement requires that an annual progress report and program plan be submitted to and approved by NSF. Bi-weekly teleconferences are maintained between the NSF program manager and the NAIC Director. The program manager visits the Observatory several times per year. Arecibo Visiting Committee meetings (commissioned by Cornell) are attended by the NSF program manager, and committee reports are made available to NSF. Yearly status reports and long-range plans are presented by NAIC/Cornell representatives in visits to NSF. Management reviews by external review panels for NSF are held typically three years into a 5-year cooperative agreement.

Current Project Status: A solicitation for the management of NAIC was issued in November 2003. Two proposals were received, and a panel meeting was held June 14-16, 2004. The results of the competition have not yet been announced. The cooperative agreement with Cornell to manage NAIC has been extended through March 2005, pending results of the competition. The FY 2006 Request for NAIC totals \$10.60 million, an increase of \$80,000 over the FY 2005 budget of \$10.52 million.

Funding Profile: All funding for NAIC to date has been provided through the R&RA Account.

NAIC Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001	1.10	9.00	$10.10
FY 2002		11.00	$11.00
FY 2003		12.63	$12.63
FY 2004		12.34	$12.34
FY 2005 Current Plan		12.42	$12.42
FY 2006 Request		12.50	$12.50
FY 2007 Estimate		12.50	$12.50
FY 2008 Estimate		12.50	$12.50
FY 2009 Estimate		12.50	$12.50
FY 2010 Estimate		12.50	$12.50

The current Cooperative Agreement was to expire in FY 2004; it has been extended to March 2005 pending results of a competition. Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Implementation: All construction and commissioning occurred before this reporting period. Construction of the Arecibo Observatory by the Air Force was completed in 1963. NSF took over funding for operations in 1970. The primary NSF-funded upgrade during the period reported was installation of a Gregorian feed system to enhance telescope efficiency and increase useable bandwidth.

- Operations and Maintenance: In-house research accounts for about 6 percent of the total operations budget of NAIC. Most of this research concerns traditional radio-astronomical observations (interstellar gas, galaxies, pulsars) and radar astronomy of solar system objects (asteroids, planetary surfaces and moons). This research furthers the scientific mission of the facility and maintains a scientifically competent staff. The planetary radar program, which has been funded by NASA since 1974, is in a period of transition. NASA has decided to ramp down and then terminate its support by the end of FY 2005.

Renewal or Termination: The cooperative agreement with Cornell to manage NAIC was to expire in September 2004; it was extended to March 2005, pending results of the competition for management of NAIC.

Associated Research and Education Activities: Teacher training is conducted in intensive workshops, held in the past at the Visitor's Center, and as of 2002 in the new Learning Center (both built with funding from the Angel Ramos Foundation of Puerto Rico). Arecibo attracts roughly 120,000 visitors per year, with many K-12 school groups visiting from across the island. Many graduate students use NAIC for dissertation research and Research Experiences for Undergraduates (REU) students also use the telescope as part of their summer research experience. Support for REU is at the level of roughly $50,000 per year.

Science Support: In addition to MPS funding, the Atmospheric Sciences Division in the Directorate for Geoscience expects to provide $1.70 million in FY 2005 and $1.70 million in FY 2006 for ionospheric research and staff support. NSF does not provide individual investigator awards targeted specifically for use of NAIC. Many users are supported through NSF or NASA grants which pursue scientific programs that require use of NAIC.

National Center for Atmospheric Research

Project Description: National Center for Atmospheric Research (NCAR) is a federally funded research and development center (FFRDC) serving a broad research community, including atmospheric scientists as well as researchers in complementary areas of the environmental and geosciences. Facilities available to university, NCAR, and other researchers include a world-class supercomputing facility providing services well suited for the development, validation and execution of large computational models in the atmospheric, oceanic and related sciences. NCAR is also responsible for the curation, archiving and manipulation of large data sets, NCAR's aviation infrastructure provides research aircraft, which can be equipped with sensors to measure dynamic physical and chemical states of atmospheric phenomena at local, regional and global scales. In addition, airborne and portable ground-based radar systems are available for atmospheric research as are other surface sensing systems. NCAR operates the several facilities of the High Altitude Observatory (HAO) that are dedicated to the study of the sun, solar phenomena, space weather, and the responses of the upper atmosphere to the sun's output. As a NSF sponsored facility NCAR is committed to the dissemination of newly discovered knowledge in all the above areas.

Principal Scientific Goals: As an internationally recognized center of excellence, NCAR scientific research programs include the following areas: large-scale atmospheric and ocean dynamics that contribute to an understanding of the past and present climate processes and global climate change, including interactions with other of the Earth's environmental systems; global and regional atmospheric chemistry including atmospheric connections to geochemical and biogeochemical cycles; the variable nature of the Sun and the physics of the corona and their interaction with the earth's magnetic field; the physics of clouds, thunderstorms, precipitation formation, and the interactions and effects on larger-scale weather; and the examination of human society's impact on and response to global environmental change. In addition, NCAR provides fellowships, internships, workshops and colloquia for a complete range of visiting scientists to conduct research and interact with NCAR scientists.

Principal Education Goals: NCAR disseminates knowledge of the geosciences to the general public, K-12 schools, teachers and students, to undergraduate, and graduate institutions, to postdoctoral and career scientists and researchers, as well as to policy and decisions makers. One way this is achieved is via educational tours and exhibits reaching tens of thousands of people every year. Professional training courses, innovative and award-winning science education websites as well as the directed activities of the Office of Education and Outreach are further examples of how NSF's goal of integrating research and education is attained through NCAR activities.

Partnerships: Research collaborations among NCAR staff and university colleagues are integral to its success as an institution, and as a focus and meeting point for the broader atmospheric and related sciences community. NCAR fosters and strongly supports these interactions through many approaches devised and refined over the course of 43 years. Notable recent examples include the community models, extensive collaboration with university partners (e.g. 748 peer-reviewed papers in FY 2004 that were co-authored by NCAR and university-based scientists), and extensive collaboration with non-academic scientists nationally and internationally.

Connections to Industry: NCAR works to develop new collaborations and partnerships with the private sector through directed research and technology transfer. These activities span improved capabilities for detecting, warning and forecasting mesoscale weather phenomena of economic and social importance to the private and public sectors to longer term economic consideration of climate change issues.

Management and Oversight: NCAR is managed by the University Corporation for Atmospheric Research (UCAR), a university-governed and university-serving organization comprised of over 68 Ph.D. granting academic institutions, with NCAR as its major engine of basic and applied research. UCAR works in partnership with NSF, the university community, and its other research sponsors such as NASA, NOAA, DOE, EPA, and the FAA whenever such research collaboration enhances NCAR's basic NSF-supported research goals or facilities missions. NSF's Division of Atmospheric Sciences (GEO) along with the Division of Grants and Agreements (DGA), provide oversight of this facility via a cooperative agreement with the managing institution, UCAR.

Current Project Status: With the completion of a strategic plan "NCAR as Integrator," in FY 2001, NCAR embarked on a plan to implement 27 strategic initiatives that collectively have a wide range in scientific scope. Examples include the water cycle across scales, biogeosciences, data assimilation, and undergraduate leadership workshops. In addition, NCAR is managing the acquisition of the Major Research Equipment and Facilities Construction (MREFC) project High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER), has contracted with Gulfstream, Inc. and Lockheed-Martin to procure a modified G-V aircraft that will begin scientific operations in FY 2005. (Further information on the capabilities of HIAPER follow the NCAR section).

Funding Profile: All funds for NCAR during this time frame have been provided through the R&RA Account.

NCAR Funding Profile

(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001	7.53	70.50	$78.03
FY 2002	3.75	73.84	$77.59
FY 2003	4.50	76.30	$80.80
FY 2004	4.61	78.31	$82.92
FY 2005 Current Plan	4.73	76.49	$81.22
FY 2006 Request	4.85	77.42	$82.27
FY 2007 Estimate	4.97	78.56	$83.53
FY 2008 Estimate	4.30	81.73	$86.03
FY 2009 Estimate	4.44	81.73	$86.17
FY 2010 Estimate	4.58	81.73	$86.31

NOTE: MPS contributions for statistics and modeling are included. Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Implementation: In FY 1999-2003, a project to refurbish the Mesa Lab building located in Boulder, CO, was funded and project tasks undertaken. The refurbishment included long-sought for upgrades of various facets of NCAR's Mesa Lab facilities such as handicap accessibility, wiring systems, structural and utilities upgrades.

- Operations and Maintenance: This funding supports the operation of the NCAR facilities, including supercomputers, instrumented research aircraft and associated flight costs, and ground-based portable observing systems. Routine maintenance costs of the aircraft and facilities are also covered under this category. In addition, approximately half of the management, operations and maintenance amount is used to support science conducted by NCAR scientists.

Renewal or Termination: The management of NCAR will be competed before the end of the current cooperative agreement, September 30, 2008. In addition, a mid-award review of both science activities as well as management effectiveness will be performed. Future funding levels beyond FY 2005 will be dependent on the outcome of those reviews and on the continuous oversight provided by NSF. Proposals for the next funding award, beyond FY 2008, will be subject to NSF's standard merit review procedures, and will be reviewed by both individual expert reviewers as well as a focus panel composed of preeminent researchers and managers.

Associated Research and Education Activities: NCAR employs a large number of scientists who pursue research objectives individually and in groups. In addition, numerous external researchers use NCAR facilities to further their research objectives. NCAR has recently created an expanded and updated visitor area where various hands-on displays for K-12 when schoolchildren or citizens come to visit the Mesa Laboratory. Lectures and demonstrations are also provided for visiting students and teachers. Teachers listed in the table below are those K-12 instructors coming to attend a workshop or bring students to learn about atmospheric sciences. Undergraduate and graduate students are those who arrive at NCAR for a temporary stay to do specific research that usually lasts three months to a year or two at most.

Direct Impact of NCAR's Participation in Education Activities

Year	K-12	Undergrad	Graduate	Teachers
FY 1994	3,799	*23*	*66*	108
FY 1995	8,477	*23*	*66*	100
FY 1996	5,926	*25*	*65*	47
FY 1997	7,067	*25*	*67*	32
FY 1998	7,063	*26*	*68*	264
FY 1999	9,569	*24*	*69*	90
FY 2000	9,894	*24*	*69*	92
FY 2001	8,995	23	63	101
FY 2002	9,424	*67*	*57*	865[a]
FY 2003	7,295[a,b]	*85*	*109*	815[a]
FY 2004	8,505	*81*	*125*	1,381

NOTE: All numbers in italics are estimates.

[a] The increased number of teachers in FY 2002 includes participants at a series of workshops.

[b] The decreased number in FY 2003 reflects partial closure of Mesa Lab facilities tours during refurbishment.

Science Support: NSF-supported researchers with grants totaling approximately $25 million per year used the aircraft and observational facilities operated by NCAR in FY 2004. This support comes from programs within the Atmospheric Sciences Division for proposals submitted for use of the NCAR aircraft during field campaigns. Additional use of NCAR observational facilities by other NSF funded activities such as oceanography and polar programs, along with NSF wide Priority Areas such as Biocomplexity in the Environment also contribute to this support. NSF-supported researchers with grants totaling approximately $30 million per year used the computational resources of NCAR for a wide range of modeling, simulation and data assimilation tasks. Many principal investigators additionally request computing time at the NCAR facility to accomplish analyses required to evaluate results from their completed field and observational work.

High-performance Instrumented Airborne Platform for Environmental Research (HIAPER)

Project Description: This project is the acquisition, modification and instrumentation of a high altitude research aircraft capable of conducting science at or near the tropopause (~50,000 ft) with an extensive scientific payload and a flight range in excess of 6,000 nautical miles. The aircraft will fly approximately 400-500-research flight hours each year, with extensive mission specific outfitting preceding each research campaign. The remaining time will be devoted to aircraft maintenance and technology refreshment of the platform infrastructure. HIAPER will be a national facility, available to the university community as well as to NSF's federal partners such as the National Oceanographic and Atmospheric Administration, the National Aeronautics and Space Administration, the Office of Naval Research and the Department of Energy under existing interagency agreements. HIAPER will be based at NCAR's Research Aviation Facility, Jefferson County Airport, Broomfield, Colorado. Deployments of the aircraft will occur worldwide.

HIAPER is pictured above, on its rollout from the paint hangar at Gulfstream. *Credit: NCAR*

The HIAPER project will conclude this year, and the aircraft will transition to progressive science missions to test and evaluate the platform in the summer; full operations are anticipated by the conclusion of FY 2005. Once the aircraft has been formally accepted, it will no longer be reported separately, but as part of the activities of the aircraft's operator, NCAR.

Principal Scientific Goals: HIAPER will be a research platform with altitude, range, and endurance capabilities that will enable investigators to perform critical earth system science research. With a maximum altitude for the aircraft of 51,000 feet, the ability to carry significant payloads to such high altitudes will enable scientists to conduct important atmospheric studies in and near the tropopause. The modified aircraft will be capable of covering a range of 6,000 nautical miles in a single flight, which will allow for such varied missions as research flights covering the borders of the continental U.S., the world's large ocean basins, and even studies of the South Pole environment conducted from South America or New Zealand. The platform will serve the entire geosciences community: atmosphere, cryosphere, biosphere, and hydrosphere.

Principal Education Goals: To engage science and non-science students and the broader public in atmospheric and geosciences discovery through the use of technology to create a HIAPER "tele-presence" in real or retrospective time with the aim of integrating research and education.

Partnerships and Connections to Industry: The airframe has been acquired from Gulfstream Corporation, with selected airframe modifications provided by Lockheed-Martin Corporation. Additional support was received from Aeromet Corporation. There was also significant participation from smaller private firms in research instrumentation development.

Management and Oversight: At NSF a Program Officer in the Atmospheric Sciences (ATM) Division in the Directorate for Geosciences (GEO) oversees the HIAPER project. The NSF Program Officer receives advice and oversight support from a NSF Project Advisory Team (PAT), which consists of representatives from GEO, the Office of General Counsel, the Office of Budget, Finance and Award Management (BFA), the Directorate for Mathematical and Physical Sciences (MPS), and the Office of Polar Programs. The NSF Deputy for Large Facility Projects is a member of the PAT and provides advice and assistance. At NCAR a Project Director manages the day to day activities of HIAPER, and a separate HIAPER Advisory Committee (HAC), consisting of representatives of the university research community, national laboratories, the University Corporation for Atmospheric Research (UCAR), NCAR and NSF provides advice and recommendations to the NCAR Director, to whom the HIAPER Project Director reports.

Current Project Status: In late December 2001 UCAR and Gulfstream Aircraft Corporation (GAC), a subsidiary of General Dynamics, signed a contract for the acquisition of a Gulfstream V. The green airframe was delivered to Lockheed-Martin in June 2002 for extensive airframe structural modifications to meet science requirements. By October 2004 all the structural modifications were completed and the aircraft was ferried back to Savannah (Gulfstream) for painting and final infrastructure installations. The painting was completed in December and HIAPER exited the paint hangar on 21 December 2004 with its final paint scheme. Installation of interior infrastructure is in progress; UCAR accepts the aircraft on behalf of NSF on 17 February 2005 and the aircraft ferries to NCAR on 18 February 2005. Once at NCAR the Research Aviation Facility will complete the scientific infrastructure and also work with the instrument developers on instrument integration issues as they arise.

Milestones for the project are outlined below:

FY 2005 Milestones:
- Receipt/acceptance of modified aircraft by UCAR
- Research Infrastructure and Data Systems Installed
- Preparation for Deployments and initial progressive science mission flights

FY 2006 Milestone:
- First Deployment

Funding Profile: Funds were appropriated by the Congress beginning in FY 2000. The total estimated construction cost for the project is $81.50 million.

Appropriated MREFC Funds for HIAPER
(Dollars in Millions)

FY 2000	FY 2001	FY 2002	FY 2003	Total
$8.50	$12.47	$35.00	$25.53	$81.50

HIAPER Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand Total
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1997 & Earlier									
FY 1998	0.30						0.30		$0.30
FY 1999	0.40						0.40		$0.40
FY 2000		0.50		8.00				8.50	$8.50
FY 2001		0.40		12.07				12.47	$12.47
FY 2002				35.00				35.00	$35.00
FY 2003				12.99				12.99	$12.99
FY 2004				12.54				12.54	$12.54
FY 2005 Current Plan					2.00		2.00		$2.00
FY 2006 Request					5.00		5.00		$5.00
Subtotal, R&RA	$0.70				$7.00		$7.70		
Subtotal, MREFC		$0.90		$80.60				$81.50	
Total, Each Stage		**$1.60**		**$80.60**		**$7.00**			**$89.20**

NOTE: The expected operational lifespan is 25 years, pending the full integration of scientific instrumentation. A steady state of about $5.0 million in operations support will occur in FY 2006.

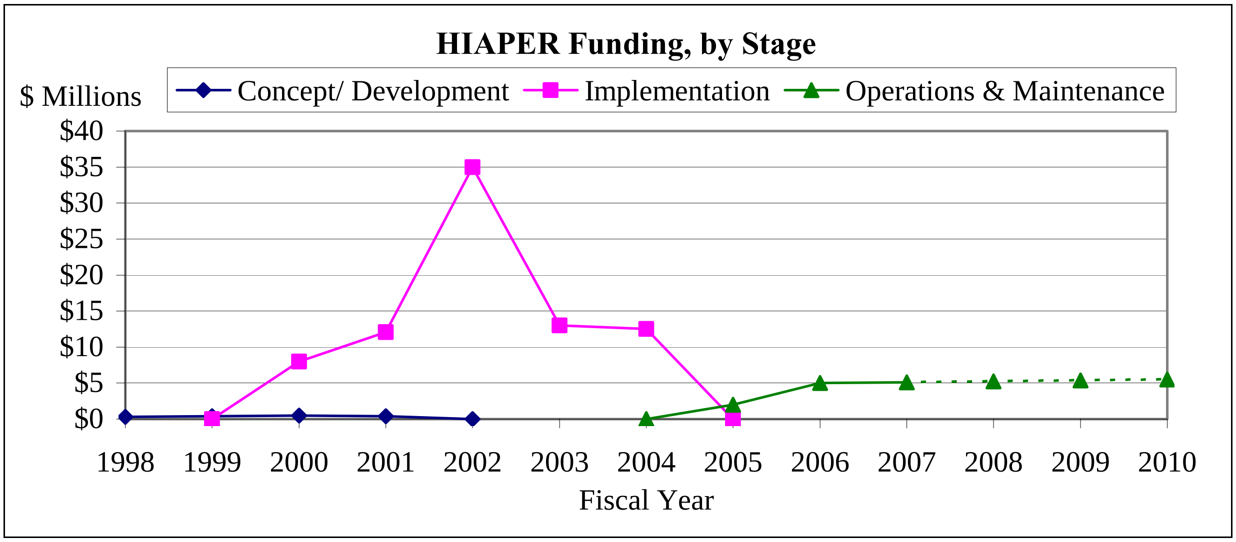
Information pertaining to the data in the table is provided below.

- Concept/Development: Initial R&RA funding of approximately $700,000 provided support for workshops to identify the highest priority performance characteristics and platform requirements, and for other workshops, reviews and best practices consultations with federal and nonfederal experts. MREFC funds obligated during this phase of the project include support for the preparation of the Request for Proposals. After the proposal was received at UCAR, an evaluation and selection team was formed to determine if the proposal met the requirements in the RFP.

- Implementation: The total construction cost for the project is $81.50 million. The full-appropriated amounts for FY 2000-02 were required in order to acquire and modify the airframe. Funding was provided to Gulfstream to secure a production slot, and the remainder of the funds was held until the contract was negotiated, approved by NSF and signed by UCAR and GAC. Subsequent funding enabled project completion.

- Operations and Maintenance: The aircraft will be maintained and operated by the Research Aviation Facility at NCAR. The intent is to operate the aircraft as a fully certified (FAA Airworthiness Certification) platform rather than a public use aircraft. Additional follow-on instrumentation will be developed during the operational phase of HIAPER, funded by the R&RA grants program within

ATM, or other activities within NSF or its federal partners. HIAPER, in contrast to many research facilities, will accommodate instrumentation from other agencies, international partners as well as new instruments that are developed over the 25-year operational time period. Instruments for HIAPER typically will be modular and able fly on a variety of platforms, not exclusively HIAPER.



Future Science Support: Along with direct operations and maintenance support for HIAPER, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $10 to $12 million, once the facility reaches full operations.

National Optical Astronomy Observatory

Project Description: The National Optical Astronomy Observatory was established in 1982 by uniting the operations of the Kitt Peak National Observatory in Arizona and the Cerro Tololo Inter-American Observatory in Chile. NOAO is a federally funded research and development center (FFRDC) for research in ground-based nighttime optical and infrared astronomy. NOAO also represents the U.S. astronomical community in the International Gemini Observatory. The National Solar Observatory (NSO), once administratively part of NOAO but now with an independent management structure, makes available to qualified scientists the world's largest collection of optical and infrared solar telescopes and auxiliary instrumentation for observation of the solar photosphere, chromosphere, and corona. The NSO operates facilities in Sunspot, New Mexico and Tucson, Arizona as well as a coordinated worldwide network of six telescopes (GONG) specifically designed to study solar oscillations. As national facilities, NOAO and NSO telescopes are open to all astronomers regardless of institutional affiliation on the basis of peer-reviewed observing proposals.

Principal Scientific Goals: NOAO supports basic research in astronomy and solar physics by providing the best ground-based astronomical telescopes to the nation's astronomers, promoting public understanding and support of science, and advancing all aspects of U.S. ground-based astronomical research.

Principal Education Goals: NOAO promotes and enhances the education of undergraduate and graduate student researchers and outreach training and curriculum development for K-12 teachers. Approximately 15 percent of all NOAO and NSO users are graduate students. Some recent examples of outreach activities include: Project ASTRO, which matches astronomers with 4th to 9th grade teachers and community educators in the Tucson and Sunspot areas who want to enrich their astronomy and science teaching; and the use of Astronomy in the Teacher Leaders in Research-Based Science Education (TLRBSE), a summer workshop for middle and high school teachers.

Partnerships and Connections to Industry: Thirty-one U.S. Member Institutions and five International Affiliate Members comprise the Member Institutions of the Association of Universities for Research in Astronomy (AURA), Inc., the management organization for NOAO. Other partners include the USAF Office of Scientific Research, NASA, and industrial vendors. Development of new telescopes, instrumentation, and sensor techniques is done in partnership with relevant industry, through subawards to various large and small aerospace, optical fabrication, and IT companies.

Management and Oversight: Management is through a cooperative agreement with AURA. Separate Directors for NOAO and NSO report to the President of AURA. Oversight is through detailed annual program plans and long range plans for NOAO and NSO, plus quarterly and annual reports. NSF conducts periodic reviews of AURA management by external committees. Ongoing oversight and evaluation is by an assigned NSF program director in the Astronomy Division (AST) in the Directorate for Mathematical and Physical Sciences (MPS) and by a standing external committee for NOAO.

Current Project Status: Cooperative agreements for continuing management and operations are for terms of five years; a new agreement was competed and awarded to AURA October 1, 2002. A management review will be carried out this year, three years into the current cooperative agreement. The FY 2006 Request for NOAO totals $37.36 million, a decrease of $560,000 from the FY 2005 Current Plan budget of $37.92 million. NOAO funding includes $35.0 million for NOAO and NSO telescopes (an increase of $280,000 over their FY 2005 base), plus $2.0 million for the Telescope System Instrumentation Program (TSIP) and $360,000 for the Adaptive Optics Development Program (AODP) that are administered for the community through NOAO. TSIP, funded level with the FY 2005 Current Plan, is a program to unify the privately held and the national optical and infrared observatory facilities by funding instrument development and construction at the private observatories in return for observing time on those facilities which is in turn allocated to the astronomical community at large on the basis of peer-reviewed observing proposals. AODP, reduced from its FY 2005 level by $840,000, is funded at a level sufficient to cover existing commitments only. NSO is nearing the completion of the design and development phase for the Advanced Technology Solar Telescope and a proposal for its construction was submitted in late calendar year 2003 and is currently under review. NOAO is actively participating in the development of both the Giant Segmented Mirror Telescope and the Large Synoptic Survey Telescope, both of which are high priority recommendations of the Decadal Survey conducted by the NRC's Astronomy and Astrophysics Survey Committee.

Funding Profile: All funding for NOAO to date has been provided through the R&RA Account.

NOAO Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001		31.20	$31.20
FY 2002[1]		36.82	$36.82
FY 2003[1]		39.64	$39.64
FY 2004[1]		41.35	$41.35
FY 2005 Current Plan		37.92	$37.92
FY 2006 Request		37.36	$37.36
FY 2007 Estimate		39.00	$39.00
FY 2008 Estimate		39.00	$39.00
FY 2009 Estimate		39.00	$39.00
FY 2010 Estimate		39.00	$39.00

The current Cooperative Agreement expires in FY 2006. Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

[1]In FY 2002-4, data include $4.0 million for Telescope System Instrumentation Program (TSIP). Support for TSIP dropped to $2.0 million in FY 2005-6. AODP funds are included at a level of $3 million in FY 2003 and FY 2004, $1.20 million in FY 2005 and $360,000 in FY 2006.

Information pertaining to the data in the table is included below.

- Implementation: All construction and commissioning of major telescopes occurred before this reporting period. Recent upgrades have been made in the National Solar Observatory facilities, with the completion and commissioning of the Synoptic Optical Long-term Investigations of the Sun (SOLIS) telescope in 2003.

- Operations and Maintenance: The management and operations budget primarily maintains and utilizes existing facilities and develops new instrumentation for existing telescopes in support of research by the national astronomical community. Basic research by in-house scientific staff accounts for approximately 9 percent of the total budget.

Renewal or Termination: The current cooperative agreement expires in FY 2006. A management review will be carried out this year, three years into the current cooperative agreement, on the basis of which NSF will decide whether to renew or recompete the program. Funding amounts for FY 2007 and beyond will be determined through negotiation based on proposals received at this time.

Associated Research and Educational Activities: Teacher training includes participation of more than 350 teachers in Project ASTRO; intensive (multi-week) training of about 25 teachers per year through Teacher Learning through Research Based Science Education; and Research Experience for Teachers. K-12 numbers are not tracked but it is estimated that school groups make up about 10 percent of the roughly 85,000 visitors per year to public visitor centers at NOAO and NSO. Instructional materials are developed in collaboration with the Lawrence Hall of Science Great Explorations in Science and Math (GEMS) program. The "Hands on Optics" program, aimed at middle school students, is being developed by NOAO in collaboration with the Optical Society of America and the International Society for Optical Engineering. NOAO hosts the "Astronomy Education Review," a refereed, on-line journal (http://aer.noao.edu) that disseminates information about astronomy and space science education. Observational facilities are also used by approximately 200 graduate students each year and by undergraduate students participating in the REU program, university-sponsored research, and the Practicas de Investigacion de Astronomia program (Chile).

Science Support: In addition to the funds listed above, approximately $500,000 per year is provided in total from the NSF Division of Elementary, Secondary and Informal Education (EHR), the NSF Division of Atmospheric Sciences (GEO), the Program for Education and Special Programs in the Astronomy Division (REU and teacher enhancement) (MPS), and the Office of International Science and Engineering (REU). For all NOAO and NSO telescopes, a peer-review telescope allocation committee provides merit-based telescope time but no financial support. NSF does not provide awards targeted specifically for use of NOAO. Most users are supported through NSF or NASA grants to pursue scientific programs that require use of NOAO.

National Radio Astronomy Observatory

Project Description: The National Radio Astronomy Observatory (NRAO) is a federally funded research and development center (FFRDC) that provides state-of-the-art radio telescope facilities for use by the scientific community. NRAO conceives, designs, builds, operates and maintains radio telescopes used by scientists from around the world to study virtually all types of astronomical objects known, from planets and comets in our own Solar System to quasars and galaxies billions of light-years away. NRAO operates major radio telescopes at Green Bank, West Virginia, at Socorro, New Mexico, and at ten telescope array sites spanning the U.S. from the Virgin Islands to Hawaii. NRAO's headquarters are in Charlottesville, Virginia. These federally funded, ground-based observing facilities for radio astronomy are available to any qualified astronomer, regardless of affiliation or nationality, on the basis of scientific peer-reviewed proposals.

Principal Scientific Goals: NRAO supports and advances basic research in the astronomical sciences, including understanding: the geometry and the matter content of the universe; the formation of galaxies, stars and planets; and the nature of black holes.

Principal Education Goals: NRAO supports and enhances the education of undergraduate and graduate student researchers and outreach training for K-12 teachers. The primary education goal is to support the development of a scientifically and technically literate society through a comprehensive outreach program in which information about radio astronomy is made available to the public through the world-wide web and news media. NRAO sites support visitor/education centers; and educational programs are developed in partnership with other institutions. NRAO also supports undergraduate, graduate and post-doctoral students in radio-astronomy scientific research, the design, construction, test and implementation of innovative scientific instruments and telescopes for radio-astronomy and of software tools for the scientific data analysis and for the interpretation of radio-astronomical data.

Partnerships and Connections to Industry: To make the observations needed to sustain radio astronomy research, 2,000 scientists from over 150 institutions around the world partner with NRAO. Numerous other U.S. universities, NASA, foreign scientific and technical institutes and industrial vendors are also partners. The development of new telescopes, instrumentation, and sensor techniques is completed in partnership with relevant industry, through competitive subawards to various large and small aerospace companies, radio antenna manufacturing firms, and specialized electronics and computer software companies.

Management and Oversight: Management is through a cooperative agreement with Associated Universities Incorporated (AUI). The NRAO director reports to the President of AUI. Oversight is through detailed annual program plans and long range plans for NRAO, plus monthly, quarterly, and annual reports. NSF conducts periodic reviews of AUI management by external committees. Ongoing oversight and evaluation is by an assigned NSF program director in the Astronomy Division (AST) in the Directorate for Mathematical and Physical Sciences (MPS) and by a standing external committee for NRAO.

Current Project Status: Cooperative agreements for continuing management and operations are for terms of five years. The present Cooperative Agreement was extended through March 31, 2006, by action of the National Science Board. The recommended funding level for the cooperative agreement beyond March 31, 2006, will be addressed subsequent to community recommendations on the scope and balance of the Division of Astronomical Sciences' total program, expected to be provided during the second quarter of 2005. The VLA is undergoing an upgrade of its electronics and communications systems. The upgrade, carried out within the funds appropriated to NRAO, will significantly enhance the capabilities of the VLA as currently configured, and also provides the base for a possible major upgrade, generally described as the Expanded Very Large Array (EVLA). The NRAO is also engaged in construction of the international Atacama Large Millimeter Array (ALMA), a millimeter/submillimeter interferometer, which was approved as a Major Research Equipment and Facilities Construction project by the National Science Board in winter 2001. NRAO is the U.S. implementing organization of the ALMA project. The FY 2006 Request for NRAO totals \$47.40 million, an increase of \$370,000 from the FY 2005 Current Plan of \$47.03 million.

Funding Profile: All funding for NRAO to date, excluding construction funding for ALMA, which is managed by NRAO, has been provided through the R&RA Account.

NRAO Funding Profile

(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 2001	5.00	47.10	\$52.10
FY 2002	5.00	35.43	\$40.43
FY 2003	5.00	40.33	\$45.33
FY 2004	9.34	45.64	\$54.98
FY 2005 Current Plan	6.34	40.69	\$47.03
FY 2006 Request	5.00	42.40	\$47.40
FY 2007 Estimate	5.00	41.50	\$46.50
FY 2008 Estimate	4.32	41.50	\$45.82
FY 2009 Estimate	4.32	41.50	\$45.82
FY 2010 Estimate	4.32	41.50	\$45.82

The current Cooperative Agreement expires in FY 2006. Operations estimates for FY 2007 and beyond have been developed based on current cost profiles and are not intended to reflect actual budget requirements. They will be updated as new information becomes available.

Information pertaining to the data in the table is included below.

- Implementation: All construction and commissioning of NRAO telescopes occurred before this reporting period. The Observatory is now engaged in an upgrade to the 25-year-old Very Large Array (VLA) radio telescope located in Soccoro, NM, an upgrade that will enhance the capabilities of the current VLA as well as provide basic underpinnings for a possible future project known as the Expanded Very Large Array (EVLA).

- Operations and Maintenance: Funding for management, operations and maintenance primarily maintains and utilizes existing facilities and develops new instrumentation for existing telescopes in support of research by the national astronomical community. Basic research by in-house staff is less than 5 percent of the total budget.

- ALMA operations: The funding profile for the ALMA activity includes early operations funding beginning in FY 2005 at $1 million. These additional funds are not explicitly included in the table above, but are expected to be part of the NRAO operating expenditures beginning in FY 2005. Further information on the ALMA project can be found in the MREFC chapter.

Renewal or Termination: The current cooperative agreement expires in FY 2006. A renewal proposal from AUI for operations of NRAO will form the basis of a new 5-year cooperative agreement and funding amounts for FY 2007 and beyond will be determined through negotiation at that time.

Associated Research and Education Activities: NRAO conducts an active educational and public outreach program. The observatories host a combined total of approximately 50,000 visitors each year to the Green Bank and Very Large Array facilities, including school field trips for K-12 students. The Green Bank observatory recently completed the construction of a bunkhouse to house student groups on overnight trips. Observatory professional scientific and engineering staff also visit classrooms regularly to provide special instruction in the astronomical and radio sciences. Observational facilities are used by graduate students carrying out dissertation research and those on work experience programs and by undergraduate students participating in the REU program.

Science Support: In addition to the funding listed above, approximately $500,000 per year is provided in total from the NSF Division of Elementary, Secondary and Information Education in EHR and the Program for Education and Special Programs in the Astronomy Division. A peer-review telescope allocation committee provides merit-based telescope time but no financial support. NSF does not provide individual investigator awards targeted specifically for use of NRAO. Many users are supported through NSF or NASA grants to pursue scientific programs that require use of NRAO.

NSF-Wide Investments

Cyberinfrastructure

CYBERINFRASTRUCTURE

Cyberinfrastructure Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biological Sciences	70.00	77.00	84.00	7.00	9.1%
Computer and Information Science and Engineering	141.13	168.60	181.56	12.96	7.7%
Engineering	45.00	52.00	52.00	0.00	0.0%
Geosciences	67.50	71.35	77.35	6.00	8.4%
Mathematical and Physical Sciences	21.20	37.40	51.20	13.80	36.9%
Social, Behavioral and Economic Sciences	20.40	20.39	20.54	0.15	0.7%
Office of International Science and Engineering	1.40	1.00	1.00	0.00	0.0%
Office of Polar Programs	25.00	25.00	26.50	1.50	6.0%
Subtotal, Research and Related Activities	391.63	452.74	494.15	41.41	9.1%
Education and Human Resources	18.00	20.40	15.00	-5.40	-26.5%
Total, Cyberinfrastructure Funding	$409.62	$473.14	$509.15	$36.01	7.6%

Totals may not add due to rounding.

The emergence of **cyberinfrastructure** – an infrastructure that harnesses the power and ubiquity of information technology – reflects some basic facts of life today: the Internet has become far more than an e-mail carrier; our workplaces, homes, cars and pockets are full of ever-shrinking computing devices; and data pile up far faster than anyone can make sense of it all. In fact, as described in the representative examples below, advances in information technologies are fueling the emergence of powerful NSF-supported research and education tools that enable discovery, learning and innovation across a range of science and engineering disciplines:

- Environmental scientists and engineers are drawing upon cyberinfrastructure to investigate the complexity of our environment, from the molecular to the planetary scale. This multidisciplinary work requires the collection and analysis of large volumes of data, it requires experiments with computer models that in many cases depend upon the world's most advanced supercomputers, and it relies upon the collaboration of scientists and engineers from a wide range of disciplines.
- Earthquake engineers are accessing shake tables, reaction wall facilities, geotechnical centrifuges, tsunami wave tanks and mobile field equipment that are integrated through a common cyberinfrastructure framework, allowing them to perform tele-observation and tele-operation of experiments; to publish to and make use of curated data repositories; to access computational resources and open-source analytical tools; and to use collaborative tools for experiment planning, execution, analysis, and publication.
- Plant biologists are using cyberinfrastructure tools developed to extract implicit genome information to reveal the structure and function of plant genes at levels from the molecular to the organismal. The new knowledge and insights gained from plant genomics will lead to new discoveries and conceptual advances in our understanding of the biology of plants, as well as to the broader impact of this new knowledge in applications relating to agriculture, natural resources, the environment, health, and plant-based industries.
- Computer scientists and engineers are conducting research on next-generation systems architectures that will enable future generations of cyberinfrastructure. Research advances will enable the

development of cyberinfrastructure systems that, for example, monitor and collect information on such diverse subjects as plankton colonies, endangered species, soil and air contaminants, medical patients, and buildings, bridges and other man-made structures. Across a wide range of applications, cyberinfrastructure systems promise to reveal previously unobservable scientific phenomena.

NSF's current focus on the development of a *comprehensive* cyberinfrastructure, which integrates advanced computing engines, federated data archives and digital libraries, observing and sensor systems, and other research and education instrumentation into a common framework, builds on the agency's long history of leadership in this area. Our cyberinfrastructure investments are guided by three principles.

- *Science and engineering opportunities must drive cyberinfrastructure investments*. A rich mix of cyberinfrastructure projects supports communities who have been traditional users of extant cyberinfrastructure as well as those communities who are only now beginning to identify emerging cyberinfrastructure opportunities.
- *Development of intellectual capital to develop, sustain and effectively utilize cyberinfrastructure is critical.* Coordinated NSF action encourages the participation of a broad range of individuals, institutions, and stakeholder communities in cyberinfrastructure design, development, deployment and use. Multidisciplinary teams of computer scientists and engineers and domain scientists and engineers are key to the development of and sustained support for cyberinfrastructure.
- *Unwavering attention to interoperability and sustainability will provide economies of scale and scope and will guard against the balkanization of science.* Coordinated action and integrative planning and management approaches underscore the importance of interoperability across science and engineering fields and across organizational, cultural, regional, and national boundaries. Effective collaboration and development of a common vision enables a wide range of science and engineering research and education opportunities while ensuring that advances made in one domain rapidly migrate to others.

NSF's FY 2006 investments in cyberinfrastucture will continue to promote science and engineering advances enabled by cyberinfrastructure, and will foster the integration of a range of state-of-the-art heterogeneous research and education tools. The agency's FY 2006 investments include the following:

- Informed by the recent report of the High-End Computing Revitalization Task Force, funding for research on High-End Computing (HEC) architectures will be increased, and will leverage interagency coordination and collaboration activities.
- An agency-wide programmatic activity, CI-TEAM, aimed at preparing current and future generations of scientists and engineers to effectively use cyberinfrastructure will be strengthened.
- Continuing support will be provided for Protein Data Bank (PDB), the international repository and primary source for information about the structure of biological macromolecules, a key research resource and central component to our understanding of living systems.
- Support for the National Radio Astronomy Observatory and the National Optical Astronomy Observatory will include enhanced efforts to make available long-term data archives for astronomical research and education.
- Substantial investments will be made in major social and behavioral science data collections, and will address issues such as confidentiality protections and means for securing worldwide, user-friendly access.
- Continuing investments will be made in the National STEM Digital Library (NSDL) to support a national resource of high-quality Internet-based STEM educational content and services to support learners at all levels, and in the Digital Library for Earth Science Education (DLESE), a community effort involving educators, students, and scientists working together to improve the quality, quantity, and efficiency of teaching and learning about the Earth system at all levels.

- Projects that provide the nation's multidisciplinary computational science and engineering community with access to high-end computing and other cyberinfrastructure resources will be supported.
- Development of next-generation data management systems and tools will improve support of domain specific data types, such as sequences, pathways, and time series data.

Over time, NSF investments will contribute to the development of a powerful, stable, persistent, and widely accessible cyberinfrastructure to enable the work of science and engineering researchers and educators across the nation and around the world.

Biocomplexity in the Environmen

BIOCOMPLEXITY IN THE ENVIRONMENT

The world is facing significant scientific and societal challenges, including the prospect of rapid environmental and climate change, the threat of biological warfare, and the complicated question of long-term environmental security. The integrity of local, regional and global ecosystems is inextricably linked to human well-being, and environmental and human health often intertwine. While exploration of complex environmental systems poses significant research challenges, it is a necessary element of local, national, and global security and critical to the development of new scientific and technological capabilities that will significantly advance our ability to anticipate environmental conditions and thus improve environmental decision-making. Thus, both scientific and practical needs for clear, quantitative understanding of the world motivate continued focus on the investigation of complex environmental systems.

The *Biocomplexity in the Environment* (BE) priority area is designed to give NSF the capability to respond to the demand for new approaches to investigating complex environmental systems in which the dynamic behavior of biota is linked to the physical and chemical processes of the environment. Investigations must be highly interdisciplinary, consider non-human biota and/or humans explicitly, and examine challenging systems that have high potential for exhibiting nonlinear or highly coupled behavior. Advanced computational and mathematical modeling strategies are intrinsic to this research. The term "biocomplexity" is used to stress the requirement that research questions must address the dynamic web of interrelationships that arise when living things at all levels – from their molecular structures to genes to organisms to ecosystems to urban centers – interact with their environment. This priority area will result in more complete and synthetic understanding of natural processes, of human behaviors and decisions in the natural world, and ways to use new technology effectively to sustain life on earth.

In future years, as part of the planned phasing down of the priority area, NSF will refer to this research portfolio as Complexity in Environmental Systems (CES).

Biocomplexity in the Environment Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biological Sciences	39.86	39.86	30.43	-9.43	-23.7%
Computer and Information Science and Engineering	8.01	8.00	3.00	-5.00	-62.5%
Engineering	6.00	6.00	6.00	0.00	0.0%
Geosciences	37.22	37.22	37.22	0.00	0.0%
Mathematical and Physical Sciences	4.70	4.03	3.36	-0.67	-16.6%
Social, Behavioral and Economic Sciences	6.27	2.00	2.00	0.00	0.0%
Office of International Science and Engineering	0.50	0.50	0.25	-0.25	-50.0%
Office of Polar Programs	1.55	1.55	1.55	0.00	0.0%
Subtotal, Research and Related Activities	104.11	99.16	83.81	-15.35	-15.5%
Education and Human Resources	0.00	0.00	0.00	0.00	NA
Total, Biocomplexity in the Environment	$104.11	$99.16	$83.81	-$15.35	-15.5%

Long-term Goals: NSF will continue to emphasize research and education on the role of *Biocomplexity in the Environment*. This priority area is part of investments and accomplishments within NSF's FY 2006 environmental investment portfolio of approximately $892 million. The intellectual goals of the effort are to:

- Synthesize environmental knowledge across disciplines, subsystems, time and space;
- Discover new methods, models, theories, and conceptual and computational strategies for understanding complex environmental systems;
- Develop new tools and innovative applications of new and existing technologies for cross-disciplinary environmental research;
- Integrate human and societal and ecological factors into investigations of the physical environment and environmental engineering;
- Improve science-based forecasting capabilities and enhance research on decision-making and human environmental behaviors; and
- Advance a broad range of infrastructure to support interdisciplinary environmental activities: collaboratory networks, information systems, research platforms, international partnerships, and education activities that enhance and diversify the future environmental workforce.

Long-term Funding for Biocomplexity in the Environment
(Dollars in Millions)

FY 2000	FY 2001	FY 2002	FY 2003	FY 2004 Actual	FY 2005 Plan	FY 2006 Request	FY 2007
$50.00	$54.88	$58.10	$70.12	$104.11	$99.16	$83.81	$83.81

Estimates for 2007 and beyond do not reflect policy decisions and are presented for planning purposes only.

FY 2006 Topical Areas: In FY 2006, NSF plans to invest $83.81 million in the interdisciplinary Biocomplexity in the Environment activities described below. Five primary areas will be supported. The first three stress the interactions of humans and biota with the chemical and physical environment. The latter two areas contribute enhanced fundamental understanding of the role of microorganisms in the environment.

- **Earth Systems, Cycles, and Pathways: Biogeochemical, chemical and physical pathways linking the atmosphere, ocean and solid Earth** – This involves the interrelation of biological, geochemical, geological, and physical processes at all temporal and spatial scales, with particular emphasis on understanding linkages between biologically important chemical and physical cycles (for example, the cycles of carbon, oxygen, nitrogen, phosphorus, sulfur and essential minerals) and the influence of human and other biotic factors on those cycles. This includes research on biotic mediation of the distribution, transformation and transport of significant biogeochemical constituents, such as carbon, among terrestrial, atmospheric, and ocean and seafloor environments. Also included is research on the complex processes, both abiotic and biotic, that affect water cycle variability, time-dependence in the distribution of freshwater resources, and feedbacks between the water cycle and other physical, geochemical and biological processes, for example, climate processes, the carbon cycle, or terrestrial ecosystems.

A panda at the China Research and Conservation Center for the Giant Panda in the Wolong Nature Reserve in Sinchuan Province in southern China.

- **Dynamics of Coupled Natural and Human Systems** – This involves quantitative, interdisciplinary analyses of relevant human and natural system processes and the complex interactions among human systems and natural systems at diverse scales. Example areas of study include land use, the role of institutions in decision-making, and social valuation of biodiversity.

- **Materials Use: Science, Engineering and Society** – This involves studies directed toward reducing adverse human impact on the total, interactive system of resource use; the design and synthesis of new materials with environmentally benign impacts on complex environmental systems; as well as maximizing the efficient use of individual materials throughout their life cycles.

- **Microbial Genome Sequencing** – This involves use of high throughput sequencing of microorganisms of fundamental biological interest, importance to agriculture, forestry, food and water quality, or value in understanding potential agents of bioterrorism. Genome sequence information will provide the basis for understanding the physiology, pathology, and ecology of these organisms. This knowledge can be applied to detection and economic uses of organisms and to understanding microbial adaptation to extreme environments. Emphasis will also be placed on sequencing microbes of interest because of their associations with other organisms—plants, animals, or other microbes. This is an interagency activity in partnership with the U.S. Department of Agriculture.

- **Ecology of Infectious Diseases** – This involves development of predictive models and discovery of principles for relationships between environmental factors and transmission of infectious agents. Potential benefits include the development of disease transmission models, understanding of unintended health effects of environmental change, and improved prediction of disease outbreaks, emergence, and re-emergence. Examples of environmental factors include habitat transformation, biological invasion, biodiversity loss, and contamination. This activity involves an interagency partnership with the National Institutes of Health.

In addition to these primary areas, additional multidisciplinary research and education activities that use a synthetic approach to understanding complex environmental systems will be supported. These include:

- Environmental Genomics – the integrated use of genomic and information technology approaches to gain novel insights into environmental questions and problems.
- Integration Activities for Sensor Networks and Observing Systems – development of data management tools and partnerships to improve data coordination and access, as well as addressing computational challenges in ecosystem dynamics.
- Molecular Scale Studies – development of benign materials and elucidation of molecular scale environmental processes.
- Educational Activities – projects that integrate education and research on complex environmental systems that promote workforce development, including increased participation of underrepresented minorities, and the professional development of science teachers.
- International Partnerships – collaborations with research partners in other countries that expand the scope of research activities on complex environmental systems and broaden the experience of U.S. students.

PERFORMANCE ASSESSMENT RATING TOOL

PART Assessment of Biocomplexity in the Environment. A PART assessment of the Biocomplexity in the Environment (BE) program was completed to inform the FY 2006 budget decision-making process. Overall, BE earned an "effective" PART rating.

Annual Efficiency Goal: Percent of award decisions made available to applicants within six months of proposal receipt or deadline date, while maintaining a credible and efficient competitive merit review system, as evaluated by external experts. Timely availability of proposal decisions allows the research community to more effectively plan activities. Considering the increasing complexity and numbers of proposals coming into NSF, the goal of keeping decision time for 70 percent of proposals down to six months is ambitious.

Biocomplexity in the Environment Purpose and Design: The Biocomplexity in the Environment (BE) priority area is a multidisciplinary effort with the purpose of synthesizing knowledge across disciplines; improving science-based forecasting for complex environmental systems; and advancing a broad range of methods, tools, and infrastructure to support interdisciplinary activities. BE specifically responds to the demand for new, interdisciplinary approaches for investigating the interactivity of the environment and both human and non-human biota, and program activities address the need for new training, organizations and funding to bring together multidisciplinary research teams as identified by the National Research Council.

NSF's activities through its investments in BE address unique interdisciplinary research questions and needs for multidisciplinary research teams that are not under the purview of mission-oriented federal, state or local agencies. NSF partners with other agencies to avoid duplication (e.g., the Microbial Genome Sequencing activity is administered jointly with USDA and other agencies, the Ecology of Infectious Diseases activity is with NIH, and research activities at the William R. Wiley Environmental Molecular Sciences Laboratory with DOE).

Strategic Planning: Specific long-term performance measures for NSF's investments in Biocomplexity in the Environment are drawn from the objectives set forth in the NSF Strategic Plan FY 2003-2008, and they encompass NSF's commitment to promoting interdisciplinary research to enhance scientific understanding of complex environmental systems and processes for the benefit of society.

The Advisory Committee for Environmental Research and Education (AC/ERE) reviews and oversees the BE program. The AC/ERE meets semi-annually to evaluate program activities and progress and make recommendations that direct program planning and effect program improvements. The AC/ERE also authors reports and occasional papers to provide program guidance.

For NSF's investments in Biocomplexity in the Environment (BE), the Committee of Visitors (COV) process provides a valuable mechanism for identifying and addressing planning-related issues. Through the COV, NSF receives feedback on the activity's goals and overall effectiveness. Steps to address weaknesses are identified, when applicable. In the FY 2004 COV review of the BE program, one of the recommendations was to expand social science methodology to include rigorous qualitative research methods. The 2005 solicitation for BE will be revised to reflect this recommendation. The BE program has successfully emphasized NSF's broader impacts criterion, as acknowledged by the National Research Council as "one of the few programs to require that applicants explicitly include an education or outreach component."

BE Management: Performance information is collected from NSF grant recipients via interim, annual and final project reports. Site visits to larger projects are also used to collect performance information.

Committee of Visitors (COV) reviews and recommendations are utilized to improve program performance. Process-related or quantitative goals such as dwell time are monitored via the agency's Enterprise Information System (EIS). All of these assessments impact management practices.

BE Results/Accountability: NSF relies on external evaluation to determine whether it is achieving its long-term objectives. Input is derived from the Committees of Visitors (COVs), Principal Investigator annual and final project reports, and summaries of substantial outcomes ("nuggets") from funded research. The Advisory Committee for GRPA Performance Assessment has determined that the accomplishments under the Ideas goal have demonstrated "significant achievement" toward annual and long-term performance.

Human and Social Dynamics

HUMAN AND SOCIAL DYNAMICS

The Human and Social Dynamics (HSD) priority area supports multidisciplinary approaches to understanding the complex dynamics within and among human and social systems and their environments, at scales ranging from cellular to global and from nanoseconds to millennia. HSD aims to increase our collective ability to anticipate the complex consequences of change; to better understand the dynamics of human and social behavior, including that of the human mind; to better understand the cognitive and social structures that create and define change; and to help people and organizations better manage profound or rapid change.

Almost every major challenge this country faces, ranging from climate change, to terrorism, to the need for an educated workforce, has, at its core, important human and social dynamics. New technologies, such as high-speed computers and functional magnetic resonance imaging machines, and new methods for collecting and analyzing data underlie a dramatic increase in the contributions that the social, behavioral, and economic sciences can make to the understanding of processes that shape human and social action. HSD builds upon unprecedented opportunities for fruitful synergies across the social and behavioral sciences and other fields of sciences and engineering. Together all the NSF directorates can push the frontiers of knowledge, where discovery and innovation are likely.

The title *Human and Social Dynamics* captures the priority area's crucial defining elements:

- HSD focuses on human beings, with special attention to individual behavior and cognition.
- HSD focuses on groups, organizations, societies, and institutions, as they influence and are affected by changes in social and physical environments.
- HSD focuses on understanding systems that are constantly changing and being changed. The interactions and feedbacks in dynamic systems are not captured by standard linear models and transcend traditional disciplinary boundaries.

Human and Social Dynamics Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change Over FY 2005 Amount	Percent
Biological Sciences	0.50	0.50	0.50	0.00	0.0%
Computer and Information Science and Engineering	3.00	3.00	3.00	0.00	0.0%
Engineering	2.00	2.00	2.00	0.00	0.0%
Geosciences	1.35	1.35	1.35	0.00	0.0%
Mathematical and Physical Sciences	0.53	0.50	0.50	0.00	0.0%
Social, Behavioral and Economic Sciences	21.56	30.90	31.40	0.50	1.6%
Office of International Science and Engineering	0.15	0.00	0.50	0.50	0.0%
Office of Polar Programs	0.00	0.00	0.20	0.20	0.0%
Subtotal, R&RA	$29.08	$38.25	$39.45	$1.20	1.6%
Education and Human Resources	0.99	0.00	0.00	0.00	0.0%
Total, Human and Social Dynamics	$30.07	$38.25	$39.45	$1.20	1.6%

Totals may not add due to rounding.

This focus on the dynamic aspects of human and social behavior promises to bring about important advances in what is known about human action and development as well as organizational, cultural, societal, and technological adaptation and change. The HSD priority area encourages widespread interdisciplinarity. Team research and international collaborations are explicitly encouraged, and proposals that link researchers from SBE science disciplines with those from other science disciplines are specifically invited.

This priority area began in FY 2003 within the Social, Behavioral, and Economic Sciences Directorate (SBE). In FY 2004, HSD expanded to reach across all NSF science disciplines, education, and engineering. The response to the FY 2004 announcement was enthusiastic, with over 800 proposals submitted. Fully half of the primary investigators on these proposals were from disciplines outside the SBE sciences, including 17 percent from the Directorate for Computer and Information Science and Engineering and 14 percent from the Directorate for Engineering.

Long-term Goals. In response to the large number of meritorious FY 2004 submissions, NSF issued a solicitation in FY 2005 encouraging proposals for funding with FY 2005 and FY 2006 appropriations.SS NSF is emphasizing interdisciplinary research related to human and social dynamics that will:

- Improve decision making through research that focuses on the cognitive and social processes of risk construction, communication, and evaluation; the role of biases in individual and organizational hypothesis development and testing; the construction of decision support systems, particularly in response to risks posed by extreme events; and other areas ripe for breakthroughs.
- Explore the causes and consequences of large-scale social transformations, including globalization, democratization, and scientific and technological change, and of agents of change in important social institutions and subsystems, such as political, economic, environmental, and educational systems.
- Advance understanding of human behavior and performance at individual, social, and population levels, by exploring the interplay of neurological, sensory-motor, psychological, informational, and social and organizational systems that produce coordinated efforts within and between individuals.
- Encourage researchers to "think big" about integrated research questions, through grants of a size and duration that allow substantial coordination across researchers, disciplines, and project areas.
- Stimulate significant advances in data resources and new problem definitions and framings within which novel research techniques can be tested and put into practice.
- Support enhancements to methods and tools, including geospatial and cybertools; sensors and new modes of connectivity; modeling, including network analysis and non-linear dynamics; technologies for dataset organization and analysis; and multi-user collaborative environments.
- Support HSD Small Grants for Exploratory Research.

Long-term Funding for Human and Social Dynamics

(Dollars in Millions)

FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	FY 2007	FY 2008
$30.07	$38.25	$39.45	$40.24	$41.04

Estimates for 2007 and beyond do not reflect policy decisions and are presented for planning purposes only.

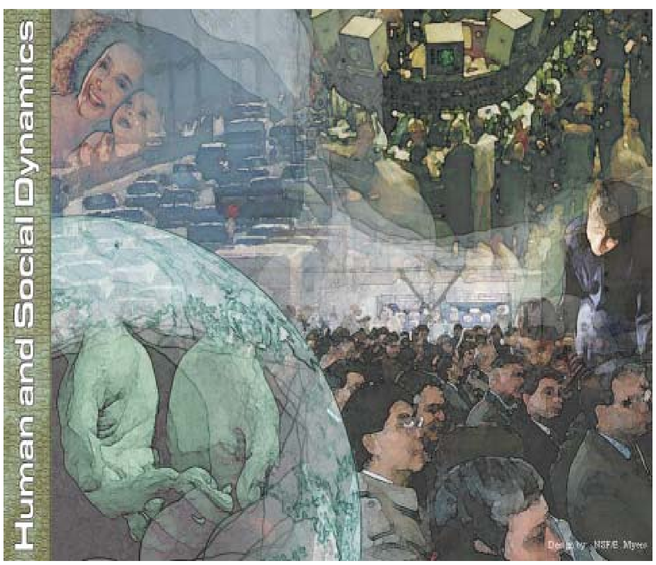
FY 2006 Research Focus. In FY 2006, NSF plans to invest $39.45 million in interdisciplinary research on *Human and Social Dynamics*. Team efforts and international collaborations will be encouraged and a mixed portfolio will be funded, including major research projects and exploratory projects aimed at education and development of novel tools. As part of a five-year investment supporting the Climate Change Research Initiative, $5.0 million will be devoted to decision making under uncertainty as it relates to climate change, in the form of continuing support for funded Centers.

Change remains the focus of the FY 2005 – FY 2006 competition with attention to the dynamics of changing human and social systems, from the internal workings of the human mind to the interplay of global social and cultural systems. The HSD competition supports research at various scales, including individual, group, and organizational behavior as structured phenomena that develop over time. This focus continues with the substantive themes of the first round of HSD competition: agents of change; dynamics of human behavior; and decision making, risk, and uncertainty.

Dynamics of Human Behavior. A wide range of intertwined sciences contributes to this research, which explores processes that are cognitive, linguistic, developmental, organizational, cultural, and biological. Relevant research includes development of human communication, cognitive requisites for effective human-machine interfaces, and robustness of organizational forms to unexpected, exogenous challenges. Such research can model ways to improve human interaction in settings ranging from research laboratories to elementary classrooms.

Decision Making, Risk, and Uncertainty. Research on decision making, risk, and uncertainty enables a better understanding of matters such as the cognitive neuroscience of risk assessment, hypothesis construction and testing in the face of biases, distributed versus centralized decision making, the construction of effective decision support systems, and risks posed by extreme events, such as natural disasters and terrorist attacks. Development of test beds can examine vulnerability and resilience, and extrapolate and predict future losses and loss mitigation possibilities.

Agents of Change. HSD research will also delve into the dynamics and consequences of large-scale social transformations, such as the interactions of science and technology with globalization and democratization, and more focused systemic changes, such as the interactions of political, economic, environmental, and educational systems with agents of change. One goal is to gain a better understanding of how social systems and their constituent parts react to a variety of drivers, ranging from war and ideology to the Internet and home computers.



In conjunction with these areas, HSD also supports advances in the tools, education, and resources needed to achieve breakthroughs. These are likely to include cybertools such as sensors and modes of connectivity; advances in modeling, including agent-based modeling, network analysis, and non-linear dynamics; improved methods to organize and analyze complex datasets; and projects to build such infrastructure as instrumentation, laboratory networks, and data resources. Developments in spatial social science uses geo-spatial tools to integrate locational information with other social data to shed light on effects of neighborhood on crime, diffusion of innovations, and growth of virtual, regional, and global networks.

Educational efforts will aim at promoting interdisciplinary approaches, instructing user communities in the use of promising tools and models, and communicating the fruits of the HSD priority area to students at all levels.

Mathematical Sciences

MATHEMATICAL SCIENCES

Today's discoveries in science, engineering and technology are intertwined with advances across the mathematical sciences. New mathematical tools disentangle the complex processes that drive the climate system; mathematics illuminates the interaction of magnetic fields and fluid flows in the hot plasmas within stars; and mathematical modeling plays a key role in research on microscale, nanoscale, and optical devices. Innovative optimization methods form the core of computational algorithms that provide decision-making tools for Internet-based business information systems.

The fundamental mathematical sciences – embracing mathematics and statistics – are essential not only for the progress of research across disciplines, they are also critical to training a mathematically literate workforce for the future. Technology-based industries that help fuel the growth of the U.S. economy and increasing dependence on computer control systems, electronic data management, and business forecasting models, demand a workforce with effective mathematical and statistical skills, well-versed in science and engineering.

It is vital for mathematicians and statisticians to collaborate with engineers and scientists to extend the frontiers of discovery where science and mathematics meet, both in research and in educating a new generation for careers in academia, industry, and government. For the United States to remain competitive among other nations with strong traditions in mathematical sciences education, we must attract more young Americans to careers in the mathematical sciences. These efforts are essential for the continued health of the nation's science and engineering enterprise.

The role of mathematics has expanded in science and society, but the resources devoted to three key areas – fundamental mathematical and statistical research, interdisciplinary collaboration between the mathematical sciences and other disciplines, and mathematics education – have not kept pace with the needs, thus limiting the nation's scientific, technical, and commercial enterprises. To strengthen the mathematical foundations of science and society, the NSF will continue to support the priority area, focused in the mathematical sciences, encompassing interdisciplinary efforts in all areas of science, engineering, and education supported by the Foundation.

Mathematical Sciences Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biological Sciences	2.18	2.21	2.21	0.00	0.0%
Computer and Information Science and Engineering	2.18	2.29	2.29	0.00	0.0%
Engineering	2.91	2.91	2.91	0.00	0.0%
Geosciences	7.07	7.07	7.07	0.00	0.0%
Mathematical and Physical Sciences	70.23	70.23	70.23	0.00	0.0%
Social, Behavioral and Economic Sciences	1.82	1.50	1.50	0.00	0.0%
Office of Polar Programs	0.18	0.20	0.20	0.00	0.0%
Subtotal, Research and Related Activities	86.56	86.41	86.41	0.00	0.0%
Education and Human Resources	5.00	2.72	2.22	-0.50	-18.4%
Total, Mathematical Sciences	$91.56	$89.13	$88.63	-$0.50	-0.6%

Totals may not add due to rounding.

Long-term Goals: The goal of this priority area is to advance frontiers in three interlinked areas: (1) fundamental mathematical and statistical sciences; (2) interdisciplinary research involving the mathematical sciences with science and engineering, and focused on selected themes; and (3) critical investments in mathematical sciences education. The investment plan (FY 2002 – FY 2007) will allow efforts in research and education to take root and begin a long-term transformation in the way mathematics, science, and education interact. The long-term goals of the investments in the priority area that were articulated during its initial stages and continue as important goals are to:

- Foster significant advances in fundamental mathematics and statistics together with important benefits for the mathematical and other sciences and engineering;
- Foster interdisciplinary research partnerships that integrate the mathematical sciences with other science and engineering disciplines and recognize mathematicians and statisticians as full partners;
- Integrate the most appropriate, state of the art, statistical principles and mathematical tools and concepts into all NSF sponsored research;
- Train a new generation of researchers in interdisciplinary approaches to future science and engineering challenges;
- Increase the numbers and diversity of U.S. students trained in the mathematical and statistical sciences to meet the increasing demands of scientific research, engineering, and technology in academic institutions, industry, and government laboratories; and
- Develop a framework to significantly advance the image and understanding of mathematics in the general population.

Long-term funding for the Mathematical Sciences

(Dollars in Millions)

FY 2002 Actual	FY 2003 Actual	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	FY 2007 Estimate
$30.00	$60.42	$91.56	$89.13	$88.63	$88.63

Estimates for 2007 and beyond do not reflect policy decisions and are presented for planning purposes only.

FY 2006 Areas of Emphasis: NSF plans to invest $88.63 million in the Mathematical Sciences activities described below.

- **Fundamental Mathematical and Statistical Sciences:** Fundamental research areas include themes such as dynamical systems and partial differential equations, geometry and topology, stochasticity, number theory, algebraic and quantum structures, the mathematics of computation, statistics, and multi-scale and multi-resolution analysis. To enhance research in these areas, the NSF will provide improved support for mathematical sciences through research groups and individual investigator grants, as well as through institute and undergraduate, graduate, and postdoctoral training activities.

- **Advancing Interdisciplinary Science and Engineering:** The concepts and structures developed by fundamental mathematics often provide just the right framework for the formulation and study of applications in other disciplines. Mathematics and statistics have yielded new analytical, statistical, computational, and experimental tools to tackle a broad range of scientific and technological challenges long considered intractable. This success has fueled a demand for increased support for collaborative research in which teams containing both mathematical scientists and researchers from other science and engineering disciplines work together: (a) to develop new mathematical approaches to concrete scientific or engineering problems for which adequate mathematical tools do not yet exist as well as (b) to apply these sophisticated techniques to significant problems in science and engineering. Such interdisciplinary collaborations will also nurture a new breed of researchers, broadly trained in both mathematics and science or engineering disciplines, needed to tackle the increasingly complex multidisciplinary research topics that confront society. Three broad, interdisciplinary research themes are being emphasized in the mathematical sciences priority area:

- **Mathematical and statistical challenges posed by large data sets** – Much of modern science and engineering involves working with enormous data sets. Major challenges include: the identification and recovery of meaningful relationships between data; the identification and validation of the structure of large data sets, which require novel mathematical and statistical methods; and improvement of theories of control and decision-making based on large, complex data streams. These challenges arise in such diverse arenas as: large genomic databases; the explosion of data gathered from earth monitoring systems (satellite observations, seismic networks, and global observation systems); situations in which privacy and missing data are major concerns; the massive data streams generated by automated physical science instruments, which must be compressed, stored and accessed for analysis; and data produced by modern engineering systems that place networked sensors and actuators on scalable networks to support dynamic interactions.

- **Managing and modeling uncertainty** – Predictions and forecasts of phenomena – bracketed by measures of uncertainty – are critical for making better decisions, whether in public policy or in research. Improved methods for assessing uncertainty will increase the utility of models across the sciences and engineering and result in better predictions of phenomena. Improving the ability to forecast extreme or singular events will improve safety and reliability in such systems as power grids, the Internet, and air traffic control. Advancing techniques to assess uncertainty has applications ranging from forecasting the spread of an invasive species, to predicting genetic change and evaluating the likelihood of complex climate change scenarios. In the social sciences, methods for assessing uncertainty will improve the utility of forecasts of phenomena such as market behavior.

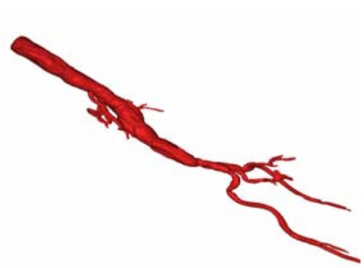
- **Modeling complex nonlinear systems** – Advances in mathematics are necessary for a fundamental understanding of the mechanisms underlying interacting complex systems and systems far from equilibrium. They are essential to the further development of modern physical theories of the structure of the universe at the smallest and largest scales. Across the sciences, there is a great need to analyze and predict emergent complex properties and understand multi-scale phenomena, from social behaviors to brain function, and from communication networks to multi-scale business information systems to complex, engineered systems. The development of new mathematical and statistical ideas and tools for understanding complex systems in the environment will be a particular area of interest, building on efforts that began in FY 2004 and FY 2005 and will continue as an emphasis in FY 2006.

  To enhance research in these areas of science and engineering which depend on cross-cutting themes in the mathematical sciences, NSF will support opportunities encompassing interdisciplinary research groups, interdisciplinary centers, interdisciplinary cross-training programs, and partnership activities with other federal agencies. Training activities will cover interdisciplinary professional development at many levels and those that link highly innovative training activities with research.

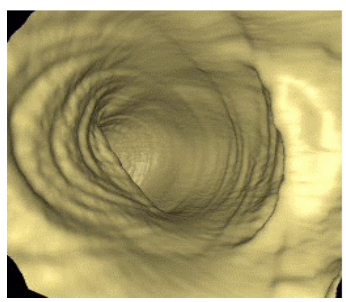
- **Advancing Mathematical Sciences Education:** This effort will support innovative educational activities, centered on the research priorities highlighted above. Activities which foster closer connections between research and education will include: curriculum development both in the mathematical sciences and in incorporating sophisticated mathematics into other disciplines, introducing new ideas across the K-16 spectrum; and research on how mathematics is learned, particularly in light of new learning technologies and emerging mathematical fields. Investments include support for undergraduate and graduate education and postdoctoral training coupled with curriculum reform. Mentoring at key transition points in the careers of mathematical scientists will be emphasized. An area of focus that will continue in FY 2006 is to enhance undergraduate research experiences at the interface between the mathematical and biological sciences.

Recent Research Highlight

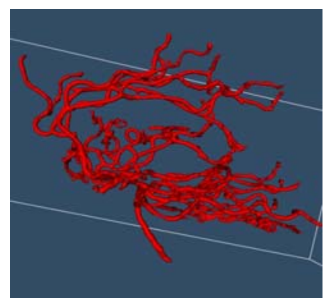
Automatic Segmentation and Virtual Endoscopy. A group at the University of California, Berkeley has developed computational algorithms to perform virtual endoscopy, allowing non-invasive examination of arterial and vascular structures, virtual colonoscopies, and guidance for surgical navigation and procedures. Starting with various types of scans, the goal of their algorithms is to provide a complete reconstruction of the internal structures, complete with examination of pathways, interconnectedness, and identification of abnormal pathologies and regions. Why is this research important? In part, the answer lies in the delicate nature of some of the structures. Probes and invasive testing to map out structures of aortas, colons, and vasculatures carry an intrinsic risk: these procedures can themselves cause tearing, blockages, and induce more serious problems. Advance knowledge about the unknown terrain provides insight about accessibility and areas requiring detailed examination. The algorithms developed by the group are accurate, robust, and reliable in practical computation and are now in use in a variety of medical imaging software. The results of a mathematical/numerical technique, based on a combination of Fast Marching Methods and Level Set Methods, to automatically find, segment and reconstruct, and then measure complex anatomical structures, are shown in the images below. These images show aortic reconstruction, a virtual colonoscopy, and the Circle of Willis, which is a ring of arteries at the base of the brain.



Aortic Reconstruction



Colon Segmentation and Trajectory



Circle of Willis Reconstruction

Credits: R. Malladi, T. Deschamps, and J.A. Sethian (University of California, Berkeley)

Nanoscale Science and Engineering

NANOSCALE SCIENCE AND ENGINEERING

Nanoscale Science and Engineering (NS&E) is the NSF priority area contributing to the multiagency National Nanotechnology Initiative (NNI). NS&E at NSF encompasses the systematic understanding, organization, manipulation and control of matter at the atomic, molecular and supramolecular levels. Novel materials, devices, and systems – with their building blocks on the scale of nanometers – open up new directions in science, engineering and technology with potentially profound implications for society. With the capacity to manipulate matter at this scale, science, engineering and technology are realizing revolutionary advances, in areas such as individualized pharmaceuticals, new drug delivery systems, more resilient materials and fabrics, catalysts for industry and order-of-magnitude faster computer chips.

Nanoscale Science and Engineering Funding
NSF Priority Area
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biological Sciences	5.31	5.85	3.85	-2.00	-34.2%
Computer and Information Science & Engineering	17.56	18.48	5.00	-13.48	-72.9%
Engineering	108.88	127.77	127.77	0.00	0.0%
Geosciences	7.94	7.94	6.14	-1.80	-22.7%
Mathematical and Physical Sciences	111.48	131.62	95.82	-35.80	-27.2%
Social, Behavioral and Economic Sciences	2.59	1.56	1.56	0.00	0.0%
Office of International Science and Engineering	0.00	0.26	0.00	-0.26	-100.0%
Subtotal, Research and Related Activities	253.76	293.48	240.14	-53.34	-18.2%
Education and Human Resources	2.29	3.07	2.90	-0.17	-5.5%
Total, Nanoscale Science and Engineering	$256.05	$296.55	$243.04	-$53.51	-18.0%

Nanoscale science and engineering research promises a better understanding of nature, a new world of products beyond what it is now possible, high efficiency in manufacturing, sustainable development, better healthcare and improved human performance. The NNI began in FY 2001 (http://www.nano.gov). NSF's role in NNI emphasizes long-term, fundamental research aimed at discovering novel phenomena, processes, materials, and tools; supporting new interdisciplinary centers and networks of excellence; supporting research infrastructure, including shared user facilities; and addressing research and educational activities on the societal implications of advances in nanoscience and nanotechnology.

NSF has been a pioneer among federal agencies in fostering the development of nanoscale science, engineering and technology. It supports fundamental knowledge creation across all disciplinary principles at the nanoscale. In FY 2005, NSF has a budget for NS&E of $296.55 million for research in a wide range of research and education activities in nanoscale science and engineering. In FY 2006, funding for NS&E declines as new NNI activities transition from NS&E to NSF core research, consistent with the planned phase-out if the NS&E Priority Area. NSF's investment of $243.04 for NS&E will emphasize research aimed at discovering novel phenomena, processes, and tools and strengthening critical fields such as nanobiotechnology, nanomanufacturing, nanoelectronics, and catalysis at the nanoscale; modeling and simulation, supporting interdisciplinary centers and networks of excellence (including the National Nanotechnology Infrastructure Network and the Network for Computational Nanotechnology, both with over 6500 users in FY 2006); a workforce to exploit opportunities presented by these new capabilities; and addressing activities with relevance to environment, health, education and other societal implications.

Support will encompass single investigator research, interdisciplinary research and education teams, national science and engineering centers, exploratory research and education projects, and education and training. The overarching ideas are reaching systematic control of phenomena at the nanoscale, exploitation of new phenomena and functions that do not extrapolate outside of the nanoscale domain, and use of the implications of such capabilities in areas of national interest. A dedicated theme for nanotechnology in the SBIR/STTR programs established in FY 2000 continues.

Long-term objectives include building a foundation of fundamental research for understanding and applying novel principles and phenomena for nanoscale manufacturing and other areas of relevance; ensuring that U.S. institutions will have access to a full range of nano-facilities; enabling access to nanotechnology education for the public through informal education, and for students in U.S. middle schools, secondary schools, colleges and universities; and catalyzing the creation of new commercial markets that depend on three-dimensional nanostructures. These goals will enable development of revolutionary technologies that contribute to improved human health, agricultural advancements, material and energy conservation, and sustainability in the environment.

Long-term Funding for NS&E at NSF

(Dollars in Millions)

FY 2001	FY 2002	FY 2003	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	FY 2007[1]
$149.68	$192.28	$221.25	$256.05	$296.55	$243.04	$233.04

Estimates for 2007 and beyond do not reflect policy decisions and are presented for planning purposes only.

[1] FY 2007 will be the final year for the NS&E priority area.

Program Changes in FY 2006

Investments will be dedicated to research and education on:

- Active nanostructures, systems of nanosystems and molecular nanosystems. Research on nanoscale devices and system architecture, and their respective fabrication, will be emphasized;
- New tools for understanding and controlling assembling of materials and their emerging properties at the nanoscale;
- Converging science, engineering and technology from the nanoscale, and in particular at the nano-biology interface and nano-information interface;
- Long-term societal implications of nanotechnology in society, and public interaction;
- Earlier educational programs and teaching materials, including for K-12;
- Expand partnerships of academic researchers with industry, medical facilities and states through two programs, “Grand Opportunities for Academic Liaison with Industry” and “Partnerships for Innovation.”

National Nanotechnology Initiative Funding
Federal Multiagency Initiative
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biological Sciences	5.31	47.00	49.00	2.00	4.3%
Computer and Information Science & Engineering	17.56	18.48	12.00	-6.48	-35.1%
Engineering	108.88	127.77	127.77	0.00	0.0%
Geosciences	7.94	7.94	9.00	1.06	13.4%
Mathematical and Physical Sciences	111.48	132.14	141.54	9.40	7.1%
Social, Behavioral and Economic Sciences	2.59	1.56	1.56	0.00	0.0%
Office of International Science and Engineering	0.00	0.26	0.00	-0.26	-100.0%
Subtotal, Research and Related Activities	253.76	335.15	340.87	5.72	1.7%
Education and Human Resources	2.29	3.07	2.90	-0.17	-5.5%
Total, National Nanotechnology Initiative	$256.05	$338.22	$343.77	$5.55	1.6%

FY 2006 will likely see accelerated transition from scientific discoveries to technological innovation, as well as maintaining the pace of discoveries over the next year. Funding priority will be given to: (1) understanding and controlling the assembly of nanoscale materials, (2) research enabling the nanoscale as the most efficient manufacturing domain including fabrication of nanostructured materials and catalysts, (3) nanobiotechnology and nanobiomedicine, (4) innovative nanotechnology solutions to biological-chemical-radiological-explosive detection and protection, (5) understanding and potential application of quantum effects and other nanoscale phenomena, (6) nanoelectronics beyond complementary metal-oxide superconductors (CMOS) and nanophotonics, (7) development of new instrumentation and standards, and in particular for imaging, characterization and manipulation of materials and systems in three dimensions at the nanoscale, (8) education and training of a new generation for future industries, including high school, undergraduate, graduate and informal education through the Nanoscale Science and Engineering Education program solicitation. Three new networks expected to be selected through the FY 2005 solicitation, will become operational in FY 2006: the Center for Hierarchical Nanomanufacturing, the Center for Nanotechnology in Society, and the Center for Nanoscale Informal Education. These networks, together with the existing ones (NNIN, NCN and Nanoscale Center for Learning and Teaching) will establish a research and education platform for nanotechnology at the national level, including open and remote access based on merit review and clearing house opportunities at the national level.

FY 2006 NNI Funding. NSF's contributes to the goals and seven program component areas (PCAs) outlined in the NNI Strategic Plan:

1) Fundamental nanoscale phenomena and processes. The FY 2006 Request includes $95.0 million for fundamental research and education, with special emphasis on:

- *Novel phenomena, quantum control and basic engineering processes* – to discover and understand phenomena and design processes specific at the nanoscale, including new phenomena in materials, mechanics, chemistry, biology, electronics and optics. Potential applications include quantum computing and new devices and processes for advanced communications and information technologies.
- *Biosystems at the nanoscale* – to support study of biologically-based or -inspired systems that exhibit novel properties and potential applications. Potential applications include improved drug delivery, biocompatible nanostructured materials for implantation, exploiting of functions of cellular

organelles, devices for research in genomics, proteomics and cell biology, and nanoscale sensory systems, such as miniature sensors for early detection of cancer.

- *Converging science and engineering at the nanoscale* – The convergence of nanotechnology with information technology, modern biology and social sciences will reinvigorate discoveries and innovation in almost all areas of the economy. This theme includes investments in (a) Nano-biology interface and improving human performance, and (b) Nano-information interface research.
- *Multi-scale, multi-phenomena theory, modeling and simulation at the nanoscale* - to support theory, modeling, large-scale computer simulation and new design tools and infrastructure in order to understand, control and accelerate development in new nanoscale regimes and systems.

2) Nanomaterials. The FY 2006 Request includes $75.0 million for discovery of novel nanoscale and nanostructured materials and at gaining a comprehensive understanding of the properties of nanomaterials (ranging across length scales, and including interface interactions). Another focus will be on design and synthesis, in a controlled manner, of nanostructured materials with targeted properties. Research on the discovery, understanding and control of materials at the nanoscale will be critical to the development and success of innovative technologies including communications, energy, healthcare and manufacturing.

3) Nanoscale devices and systems. The FY 2006 Request includes $54.0 million for R&D that applies the principles of nanoscale science and engineering to create novel, or to improve existing, devices and systems. This includes the incorporation of nanoscale or nanostructured materials to achieve improved performance or new functionality, and developing new concepts to understand interactions among nanoscale devices in complex systems, including the physical, chemical, and biological interactions between nanostructures and device components. Interdisciplinary teams will investigate methods for design of systems composed of nanodevices.

Silicon nanotechnology and beyond CMOS is an area of focus. Research will explore ultimate limits to scaling of features and alternative physical principles for devices employed in sensing, storage, communication, and computation. The research activity in this area will help develop innovative technologies, including replacing electron charge as information carrier and bottom-up device assembly technologies at the atomic and molecular levels.

4) Instrumentation research for nanotechnology. The FY 2006 Request includes $11.80 million for R&D pertaining to create new tools needed to advance nanotechnology research and commercialization, including next-generation instrumentation for characterization, measurement, synthesis, and design of materials, structures, devices, and systems.

5) Nanomanufacturing. The FY 2006 Request includes $24.47 million to support new concepts for high rate synthesis and processing of nanostructures, nanostructured catalysts, fabrication methods for devices, and assembling them into nanosystems and then into larger scale structures of relevance in industry and in the medical field. R&D aimed at enabling scaled-up, reliable, cost effective manufacturing of nanoscale materials, structures, devices, and systems. It includes R&D and integration of ultra-miniaturized top-down processes, increasingly complex bottom-up or self-assembly processes, and developing novel concepts for high-rate synthesis and processing of nanostructures and nanosystems.

6) Major research facilities and instrumentation acquisition. The FY 2006 Request includes $24.0 million for establishment of user facilities, acquisition of major instrumentation, and other activities that develop, support, or enhance the scientific infrastructure for the conduct of nanoscale science, engineering, and technology research and development. It also supports ongoing operations of the National Nanotechnology Infrastructure Network and Network for Computational Nanotechnology. The investment will support facilities for 15 ongoing Nanoscale Science and Engineering Centers.

7) Societal Dimensions. The FY 2006 Request includes $59.50 million for various research and other activities that address the broad implications of nanotechnology for society, including benefits and risks, such as:

- Research directed at environmental, health, and safety impacts of nanotechnology development and basic research supporting risk assessment of such impacts ($24.0 million)
- Education-related activities, such as development of materials for schools, curriculum development for nanoscience and engineering, development of new teaching tools, undergraduate programs, technical training, and public outreach ($28.0 million) without including the educational component of student assistantships and fellowships in research awards
- Research directed at identifying and quantifying the broad implications of nanotechnology for society, including social, economic, workforce, educational, ethical, and legal implications ($7.50 million). The application of nanoscale technologies will stimulate far-reaching changes in the design, production and use of many goods and services. The implications of nanotechnology for society will be analyzed from social, behavioral, legal, ethical and economic perspectives. Factors that stimulate scientific discovery at the nanoscale will be investigated, effective approaches to ensure the safe and responsible development of nanotechnology will be explored and developed, and the potential for converging technologies to improve human performance will be addressed.

Coordination with Other Agencies

The NSF program is coordinated among 22 departments and agencies members through the National Science and Technology Council's subcommittee on Nanoscale Science, Engineering and Technology (NSET). NSET is chaired by an NSF staff member. Examples of specific coordination efforts are: Nanomanufacturing with DOD and NIST; Environmental issues with EPA and NIOSH; NSECs, NNIN and NCN centers and network with DOD, NASA and DOE; in modeling and simulation and nanoelectronics with DOD and NASA.

In the longer term, the capabilities of nanotechnology for systematic control and manufacture at the nanoscale are envisioned to evolve in four overlapping generations. Each generation of products is marked here by creation of first commercial prototypes through systematic control of the respective phenomena and the development of appropriate manufacturing processes, each requiring specific research emphasis: passive nanostructures, active nanostructures, three-dimensional nanosystems, and heterogeneous molecular nanosystems.

NSF Centers

NATIONAL SCIENCE FOUNDATION CENTERS

By bringing together people, ideas and tools on scales large enough to effect significant progress in disciplinary and cross-disciplinary fields, Centers play a key role in advancing science and engineering in the U.S., particularly through their encouragement of interdisciplinary research and the integration of research and education.

Centers Funding
(Dollars in Millions)

	Program Initiation (year)	FY 2004 Number of Centers	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Centers for Analysis and Synthesis	1995	1	3.15	7.07	6.82	-0.25	-3.5%
Chemistry Centers	1998	32	17.44	13.01	14.81	1.80	13.8%
Earthquake Engineering Research Centers	1988	3	5.99	6.00	6.00	0.00	0.0%
Engineering Research Centers	1985	19	65.60	61.57	61.80	0.23	0.4%
Long-Term Ecological Research Program	1980	26	21.27	22.78	22.78	0.00	0.0%
Materials Centers	1994	35	57.20	57.00	58.00	1.00	1.8%
Mathematical Sciences Research Institutes	1982	6	15.05	17.15	17.15	0.00	0.0%
Nanoscale Science and Engineering Centers	2001	14	31.19	34.29	35.12	0.83	2.4%
Physics Frontiers Centers	2001	10	14.27	18.72	19.52	0.80	4.3%
Plant Genome Virtual Centers	1998	25	36.00	36.00	36.00	0.00	0.0%
Science and Technology Centers	1987	11	43.98	48.90	50.99	2.09	4.3%
Science of Learning Centers	2003	3	37.56	19.84	23.00	3.16	15.9%
SBE Centers	n/a	11	14.16	8.50	6.50	-2.00	-23.5%
Total, Centers		196	$362.85	$350.83	$358.49	$7.66	2.2%

Totals may not add due to rounding.

Centers for Analysis and Synthesis

- **Center for Ecological Analysis and Synthesis:** The National Center for Ecological Analysis and Synthesis (NCEAS) at the University of California at Santa Barbara promotes integrative studies of complex ecological questions and serves as a locus for the synthesis of large data sets. The goals of the center are to advance the state of ecological knowledge through the search for universal patterns and principles and to organize and synthesize ecological information so that it will be useful to researchers, policy makers and resource managers addressing important environmental issues. The Center supports in-house working groups, post-doctoral associates, and sabbatical visits by senior scientists, all on a competitive basis. A Science Advisory Board serves to screen proposals on an annual basis. NSF's support for NCEAS in FY 2006 is $3.82 million.

- **Center for the Synthesis of Biological Evolution:** Initial funding of $3.60 million in FY 2005 supported the establishment of the Center for the Synthesis of Biological Evolution. The Center provides mechanisms to foster synthetic, collaborative, cross-disciplinary studies in evolutionary biology. It plays a pivotal role in the further unification of the biological sciences as it draws together knowledge from disparate biological fields and increases our general understanding of biological design and function. Finally, the Center has a critical role in organizing and synthesizing evolutionary knowledge that is useful to policy makers, government agencies, educators and society.

The FY 2006 funding level is $3.0 million. The established center will continue to develop new tools and cross-disciplinary standards for management of biological information and meta-information, support data analysis capabilities with broad utility across the biological science, host workshops bringing together scientists from a variety of disciplines to begin to integrate various approaches to the field, and to begin to host and curate databases important to evolutionary synthesis.

Chemistry Centers

Chemistry Centers include Chemical Bonding Centers (CBCs), Environmental Molecular Science Institutes (EMSIs) and Collaborative Research in Chemistry (CRCs). These programs provide diverse ways for groups of researchers in the chemical sciences to work collaboratively on challenging problems of fundamental and strategic importance. These include the molecular basis of life processes, the molecular origins of life, activation of strong bonds as a means to decrease energy requirements in chemical processing and synthesis, the rational design of materials for electronics, catalysts, atmospheric aerosols, and small molecular clusters with unique properties.

Several chemistry awardees are using powerful new tools and the synergy of interdisciplinary approaches to gain a better understanding of water. Both commonplace and exotic, water interacts with itself and other materials in complex ways that impact the chemical reactions occurring in the atmosphere, on the earth and within our bodies. Researchers supported by Chemistry Centers are using synchrotron x-ray diffraction, ultrafast laser spectroscopy, infrared spectroscopy, mass spectrometry, quantum chemistry calculations, molecular dynamics simulations and other cutting-edge tools to understand the structure and reactivity of water at surfaces and in condensed phases.

In FY 2006, NSF will provide $14.81 million, an increase of $1.80 million (13.8 percent) over the FY 2005 Current Plan of $13.01 million, to support 3 new centers, making the total 35 centers.

Earthquake Engineering Research Centers

Three Earthquake Engineering Research Centers (EERCs) focus on reducing earthquake losses, integrating research and education, and developing partnerships with industry and the public agencies responsible for earthquake hazard mitigation at the local, state and federal levels. The EERCs link geological information about the nature of earthquake hazards in different regions of the country with geotechnical and structural engineering knowledge to provide state-of-the-art structural design methodologies. They provide the knowledge and technology base for industry and public agencies to build and retrofit buildings, bridges, and other infrastructure to better withstand the impacts of earthquakes. Because these centers involve partnerships among social scientists and engineers, they are developing a new generation of decision tools to improve public service agencies' planning for earthquake hazard mitigation and their responses during earthquake emergencies.

EERCs are major contributors in the field both in the U.S. and internationally. An additional $10 million from universities, three states, government, and industry were leveraged with $5.99 million in NSF support during FY 2004. There were 65 academic institutions and 155 non-academic organizations participating in the research and education programs of the EERCs. The EERCs involved 476 university-level faculty and students in research and curriculum development and 225 K-12 students in research and education. The EERCs produced 1 new course. In FY 2006, NSF will provide a total of $6.0 million to the EERCs, equal to FY 2005.

Engineering Research Centers

The Engineering Research Centers (ERC) program stands as a landmark in federal support for university research and education in partnership with industry. These centers provide an environment where academe and industry can focus together on advances in the complex engineered systems that transform industrial processing systems and product lines most important for the Nation's future. ERCs bring diverse engineering and scientific disciplines together to address fundamental research issues at the interface between the discovery-driven culture of science and the innovation-driven culture of engineering. They provide the intellectual foundation for industry collaboration with faculty and students to resolve generic, long-range challenges, producing the knowledge needed to ensure steady advances in technology, speed their transition to the marketplace, and train graduates who are effective in applying them in industry.

ERCs are also devoted to the integration of research and education by creating team environments for learning and research and producing curricula and course materials for bioengineering, multimedia information systems, manufacturing, electronic packaging, and particle science and technology, among others. In addition, all ERCs have active programs to stimulate interest in engineering with pre-college students and their teachers and several have sites at local museums to educate the general public about engineering and technology.

An additional $72 million in support from industry, other federal agencies, universities, and four states leveraged NSF support of $65.60 million in FY 2004. There were 373 academic institutions and 206 non-academic organizations participating in the research and education programs of the ERCs. In addition, there were 316 memberships with industry, an additional 51 affiliated and 81 contributing firms from the U.S. and abroad. The full set of ERCs involved 3,557 university-level faculty and students in research and curriculum development, 209 K-12 teachers, and 613 K-12 students in research and education. The ERCs produced 35 new courses, 98 course modules, and 6 certificate and degree programs. There were 28 patents issued and 60 licenses issued to ERC Intellectual Property. In FY 2006, NSF funding for ERCs totals $61.80 million, an increase of $230,000 over the FY 2005 Current Plan. This funding will support 13 ERCs across a broad range of technologies in bioengineering, micro and opto electronics, information technology, design and manufacturing plus four new centers.

Long Term Ecological Research Program

The Long Term Ecological Research (LTER) program is an NSF-wide Centers program that supports long-term analysis of ecological phenomena, both natural and human influenced; comparisons of observations across diverse ecosystems; integration of information from multiple sites and multidisciplinary projects through cross-site syntheses; and provision of large, secure, ecologically diverse sites with well-developed support capabilities. Extensive computer networking, facilitated by the LTER Network Office, enables regional, national and international communication and synthesis. In FY 2006 NSF will support 26 LTER sites that are representative of major ecosystems, including two sites in Antarctica. A significant recent development in 2004-2005 was the expansion of the network through the addition of 2 new near-coastal marine sites, one off the coast of southern California and the second a coral reef site in the South Pacific. The LTER program will conclude its first two-year strategic planning process in FY 2006, focusing on network-wide science and synthesis, interdisciplinary science across LTER sites, and the integration of research and education. NSF provided assistance in 2004 to the international LTER program (ILTER) for enabling it to become a more autonomous international organization. Over 30 countries are now ILTER members, enabling worldwide research collaborations between the U.S. sites and sites abroad. NSF's FY 2006 core support for the LTER program will total $22.78 million.

Materials Centers

Materials Centers include Materials Research Science and Engineering Centers (MRSECs) and International Materials Institutes (IMIs). MRSECs support interdisciplinary materials research addressing fundamental problems of intellectual and strategic importance. They support shared experimental facilities, they place strong emphasis on the integration of research and education at all levels, and they provide support to stimulate emerging areas of materials research. The MRSECs feature cutting-edge materials research in areas such as polymers, biomimetic and biomolecular materials, magnetic and ferroelectric materials, nanoscale materials, electronic and photonic materials, structural materials, and organic systems and colloids. During FY 2005 approximately half of the existing MRSECs compete with new proposals for new six-year awards effective in September 2005.

The Materials Centers program also includes the International Materials Institutes (IMIs). IMIs are five-year awards (renewable through open competition) that support and stimulate cooperative activities in various areas of materials research and education between U.S. investigators and their colleagues worldwide. The first three IMIs were established in FY 2003, and three more were established in FY 2004.

The MRSECs have strong links to industry and other sectors. MRSECs and IMIs also involve research and educational partnerships among academic institutions in the U.S. as well as international partnerships.

NSF's FY 2006 support for the Materials Centers totals $58.0 million, an increase of $1.0 million (1.8 percent) over the FY 2005 Current Plan. Leveraged support from non-NSF sources for these centers was over $62 million in FY 2004.

Mathematical Sciences Research Institutes

The Institutes provide a national resource for in-depth research in the mathematical sciences and for multidisciplinary research between mathematical scientists and other scientists and engineers from academia, industry, and government laboratories. Significant postdoctoral experiences are nurtured through mentoring with world-class mathematical scientists and through opportunities with partner universities, industries, and government laboratories. In FY 2006, NSF will provide $17.15 million, level with the FY 2005 Current Plan.

Nanoscale Science and Engineering Centers

As part of the multi-agency National Nanotechnology Initiative, NSF funded six centers in FY 2001; two centers focused on manufacturing at the nanoscale were established in FY 2003; six centers in FY 2004, and an additional two centers are planned for FY 2005. Research at the nanoscale aims to advance the development of the ultra-small technology that will transform electronics, materials, medicine, environmental science and many other fields. Each center has a long-term vision for research, and together they will provide coherence and a long-term outlook to U.S. nanotechnology research and education. Support will be provided for education and outreach programs from the graduate to the K-12 level, designed to develop a highly skilled workforce, advance pre-college training, and advance the public understanding of nanoscale science and engineering. The centers have strong partnerships with industry, national laboratories and international centers of excellence. In FY 2006, NSF will provide continuing support to fourteen centers at $35.12 million, an increase of $830,000 (2.4 percent) over the FY 2005 Current Plan of $34.29 million.

Physics Frontiers Centers

The Physics Frontiers Centers program was initiated in FY 2001. These centers provide critical resources and necessary infrastructure to exceptionally promising new areas of physics. They serve as focal points to help catalyze new fields, with the resources and infrastructure to enable development of the new tools and techniques needed, and to facilitate exploration of new directions in a way that is not practical in individual investigator awards. Areas such as atom lasers, quantum information science, computational physics, biological physics, and astrophysics are particularly promising for such an investment. Interdisciplinary research is a key element of this program, and each center is expected to have a significant outreach and infrastructure component. In FY 2006, NSF will provide a total of $19.52 million for support of ten centers, an increase of $800,000 above the FY 2005 Current Plan.

Plant Genome Virtual Centers

The Plant Genome Research subactivity supported twenty-five Plant Genome Virtual Centers in FY 2004. These are multi-institutional networks where coordinated, multi-disciplinary teams pursue comprehensive, interdisciplinary research on the structure, organization and function of plant genomes relevant to economically important plants or plant processes.

Of the 25 centers supported in FY 2004, 20 were continuations or renewals of virtual centers created in previous years; 5 were newly established centers. The 25 centers involve 155 scientists as key personnel with a large number of postdoctoral fellows, graduate students, undergraduate students, technical personnel, and others involved. Key participants are located at 55 institutions in 28 states. International collaborators in 3 projects from 7 different countries are involved in a number of areas of research including the potato, wheat, and model legume projects. NSF support for Plant Genome Virtual Centers in FY 2005 and FY 2006 totals $36.0 million each year.

Science and Technology Centers

NSF's Science and Technology Centers (STC) Integrative Partnerships Program supports innovation in the integrated conduct of research, education, and knowledge transfer in fields of basic science, mathematics, and engineering. STCs foster partnerships that build a new collaborative culture among researchers and educators at all levels in academia, industry, government laboratories, and other public and private organizations. The Centers provide opportunities to explore challenging and complex research problems that often require interdisciplinary expertise and high-risk approaches, access to state-of-the-art instrumentation and facilities, and a commitment of high levels of support for sustained periods of time. It is estimated that STC funding from sources other than NSF totaled approximately $38 million in FY 2004.

STCs have an impressive record of research accomplishments, research training, contributions to K-12 education, and timely transfer of knowledge and technology from the laboratory to industry and other sectors. Traditional barriers among disciplines and among university, governmental, and industrial laboratories have been reduced, creating a new mode of leadership and management in research and education. STCs have engaged the nation's intellectual talent, robustly drawn from its full human diversity, in the conduct of research and education activities; enabled the training of undergraduate students, graduate students, and postdoctoral fellows; involved scores of industrial researchers in basic research; and spawned new companies, products, and jobs.

STCs also create partnerships and programs that transfer knowledge in service to society with respect to new research areas, promising new instrumentation, and potential new technologies. NSF's FY 2006 Request for the STC program is $50.99 million. Of this, $42.09 million resides in directorate budgets for continuing support of 11 established STCs. An additional two STCs, established in FY 2005, are funded ($8.0 million) within the Integrative Activities budget line, which also includes $900,000 for ongoing administrative support for all 13 STCs.

Science of Learning Centers

NSF's investment builds on the Foundation's support for multidisciplinary research that advances fundamental knowledge about the science of learning. Science of Learning Centers (SLC) are built around a unifying research focus and incorporate a diverse, multidisciplinary environment involving appropriate partnerships with academia, industry, international partners, all levels of education, and other public and private entities.

The $3.16 million increase brings FY 2006 funding for the SLCs to $23.0 million. In FY 2006, NSF continues the third of five initial years of support for four Centers awarded in the program's first competition and provides startup support for a second cohort of up to four SLCs. This funding level is designed to support a diverse portfolio of research projects, providing leadership across a broad range of science and engineering approaches to the science of learning research.

SBE Centers

- **Children's Research Initiative Centers:** The Children's Research Initiative (CRI) supports a variety of research activities, including small research centers, individual investigator awards, collaborative proposals, and workshops. Together, the research centers represent a new thrust in the field of integrative developmental science; individually, they support leading-edge research about children and media, developmental science, and the integration and dissemination of developmental science to inform both research and policy. Centers established from FY 2001 through FY 2003 are located at the University of North Carolina-Chapel Hill, Cornell University, New York University, and the University of Michigan. A fifth center is a collaboration among four universities: Georgetown University, Northwestern University, University of Texas-Austin, and University of California-Los Angeles. No additional centers were established in FY 2005. In FY 2006, NSF will provide $1.50 million to support three CRI centers.

- **Climate Change Research Initiative Centers:** In FY 2004, there was support for five centers focusing on Decision Making Under Uncertainty related to climate variability and change as part of the government-wide Climate Change Research Initiative (CCRI):
  - Arizona State University's Decision Center for a Desert City uses Phoenix as a laboratory to study adaptation strategies, with particular attention to water management in an arid climate.
  - Carnegie Mellon University's Climate Decision Making Center focuses on how to deal with unavoidable uncertainties, including cost and policy decision implications.
  - Columbia University's Center for the Study of Individual and Group Decision Making Under Climate Uncertainty (DMUU) focuses on integrating psychological insights with those from other social sciences to develop tools to help people better understand the impacts of climate change and their response options.
  - The University of Colorado-Boulder's Science Policy Assessment and Research on Climate (SPARC) team examines decision makers' expectations about what science can deliver, whether policy makers can use available information, and what future information might be useful to them.
  - The Rand Corporation research team conducts fundamental research on different characterizations of uncertainty and develops quantitative tools to deal with robust decision making.

  In FY 2006, NSF will continue to support the five CCRI Centers for a total of $5.0 million.

FY 2004 Estimates for Selected Centers
(Dollars in Millions)

	Number of Participating Institutions[1]	Number of Partners[2]	Total NSF Support	Total Leveraged Support[3]	Number of Participants[4]
Chemistry Centers	60	18	$17	$2	650
Earthquake Engineering Research Centers	65	155	$6	$10	1,130
Engineering Research Centers and Groups	373	433	$66	$72	7,810
Long-Term Ecological Research Program	184	125	$21	$73	2,500
Materials Centers	99	347	$57	$62	5,150
Physics Frontiers Centers	16	14	$14	$2	478
Plant Genome Virtual Centers	55	7	$36	$6	2,160
Science and Technology Centers	86	326	$44	$38	1,915

[1]Number of Participating Institutions: all academic institutions that participate in activities at the centers.

[2]Number of Partners: the total number of non-academic participants, including industry, states, and other federal agencies at the centers.

[3]Total Leveraged Support: funding for centers from sources other than NSF.

[4]Number of Participants: the total number of people who utilize center facilities, not just persons directly supported by NSF.

Centers Supported by NSF in FY 2004

Center	Institution	State
Center for Ecological Analysis and Synthesis	U of California-Santa Barbara	CA
Chemistry Centers		
Actinides and Heavy Metals in the Environment - The Formation, Stability, and Impact of Nano- and Micro-Particles	U of Notre Dame	IN
Activation and Transformation of Strong Bonds	U of Washington	WA
Alternative Chemistries for Barrier Materials in Cu Metallization	U of Florida	FL
An Integrated Approach to Understanding the Air-Water Interface in Atmospherically Relevant Systems	U of California-Irvine	CA
Atom and Group Transfer Reactions: A Combined Synthetic, Structural, Theoretical, Kinetic, and Solution Calorimetry Investigation	Mass Institute of Tech	MA
Catalytic Manipulation of Amide-Based Molecules and Materials	U of Wisconsin-Madison	WI
Chemical and Microbial Interactions at Environmental Interfaces	Stanford U	CA
Chemical Design of Materials	U of California-Santa Barbara	CA
Darwinian Chemical Systems	Mass. General Hospital	MA
Environmental Redox-Mediated Dehalogenation Chemistry	Johns Hopkins U	MD
Environmental Chemical Analysis	Penn State U	PA
Environmental Molecular Science	SUNY-Stony Brook	NY
Exploiting Self-Assembly in Biological and Synthetic Macromolecules to Create Novel Hybrid Materials	U of Pittsburgh	PA
Fundamental Studies of Nonparticle Formation in Air Pollution	Worcester Polytechnic Inst	MA
Gas Hydrates: From Fundamental Theory to Hydrogen Transport	U of California-Irvine	CA
Institute for Environmental Bioinorganic Chemistry	Princeton U	NJ
Laboratory for Molecular Sciences	California Institute of Tech	CA
Lanthanide Binding Tags:New Chemical Tools for Proteomics	Mass Institute of Tech	MA
Molecular Environmental Chemistry of Mn Oxide Biomineralization	U of California-San Diego	CA
Molecular Isotopic Tools for Environmental Research	Woods Hole	MA
Molecular Level Analysis of Macromolecule-Surface Interactions in Bacterial Adhesion	Penn State U	PA
Molecular Structure and Microstructure of Primary $PM_{2.5}$ Derived from Stationary and Mobile Fossil Fuel Sources	U of Kentucky	KY
Micro Imaging for Sensory and Materials Applications	Mass Institute of Tech	MA
Moderate Resolution Protein Structures by Chemical Cross-Linking and Mass Spectrometry	U of Calif-San Francisco	CA
Multi-dimensional Molecular Metals, Crystal Design, and Superconductivity	Cornell U	NY
Multiply-bound Polymer Chains: Novel Chemistry for Improved Interfacial Properties	U of Tennessee	TN
Next Generation Aromatics	U of Georgia	GA
Ordering Processes in Water, Aqueous Solutions, and Water-Biomolecule Solutions	Arizona State	AZ
Role of Environmental Molecular Interfaces on the Chemical and Biological Reactivity of Pollutants	Ohio State U	OH
Synthesis and Characterization of Fluorescent Porphyrinoid Bioconjugates for Imaging and Bioanalyses	Louisiana State Univ	LA
Synthesis and Characterization of New Molecular Clusters of Tetrels	U of California-Davis	CA
Toward Synthetic Biology: the replication of synthetic polymers	Emory U	GA

Earthquake Engineering Research Centers		
Mid-America Earthquake Center	U Illinois-Champaign-Urbana	IL
Multidisciplinary Center for Earthquake Engineering Research	State U of NY-Buffalo	NY
Pacific Earthquake Engineering Research Center	U of California-Berkeley	CA
Engineering Research Centers		
Advanced Engineering Fibers and Films	Clemson U	SC
Bioengineering Educational Technology	Vanderbilt U	TN
Biomimetic Microelectronic Systems	U of Southern California	CA
Biotechnology Process Engineering	Mass Institute of Tech	MA
Collaborative Adaptive Sensing of the Atmosphere	U of Mass, Amherst	MA
Computer-Integrated Surgical Systems and Technologies	Johns Hopkins U	MD
Engineered Biomaterials	U of Washington	WA
Engineering of Living Tissue	Georgia Institute of Tech	GA
Environmentally Beneficial Catalysis	U of Kansas	KS
Environmentally Benign Semiconductor Manufacturing	U of Arizona	AZ
Extreme Ultraviolet Science and Technology	Colorado State U	CO
Integrated Media Systems	U of Southern California	CA
Low Cost Electronic Packaging	Georgia Institute of Tech	GA
Neuromorphic Systems Engineering	California Institute of Tech	CA
Particle Science & Technology	U of Florida	FL
Power Electronic Systems	Virginia Tech U	VA
Reconfigurable Machining Systems	U of Michigan	MI
Subsurface Sensing and Imaging Systems	Northeastern U	MA
Wireless Integrated MicroSystems	U of Michigan	MI
Long Term Ecological Research Sites		
Arctic Tundra: Toolik Field Station	Marine Biological Lab	MA
Bonanza Creek Experimental Forest	U of Alaska	AK
California Current Ecosystem	U of Calif - San Diego	CA
Cedar Creek Natural History Area	U of Minnesota	MN
Central Arizona-Phoenix Urban LTER	Arizona State U	AZ
Coweeta Hydrologic Laboratory	U of Georgia	GA
Florida Coastal Everglades	Florida International U	FL
Georgia Coastal Ecosystems	U of Georgia	GA
H.J. Andrews Experimental Forest	Oregon State U	OR
Harvard Forest	Harvard U	MA
Hubbard Brook Experimental Forest	Syracuse U	NY
Jornada Experimental Range	Duke U	NC
Kellogg Biological Station	Michigan State U	MI
Konza Prairie Research Natural Area	Kansas State U	KA
Luquillo Experimental Forest	U of Puerto Rico-Rio Piedros	PR
McMurdo Dry Valleys, Antarctica	Desert Research Institute	NV
Metropolitan Baltimore Urban LTER	Institute of Ecosystem Studies	MD
Moorea Coral Reef Ecosystem	U of Calif - Santa Barbara	CA
Niwot Ridge-Green Lakes Valley	U of Colorado	CO
North Temperate Lakes	U of Wisconsin	WI
Palmer Station, Antarctica	U of California	CA
Plum Island Sound	Woods Hole	MA
Santa Barbara Coastal LTER	U of California-Santa Barbara	CA
Sevilleta National Wildlife Refuge	U of New Mexico	NM
Shortgrass Steppe	Colorado State U	CO
Virginia Coast Reserve	U of Virginia	VA
Materials Centers		
Advanced Carbon Materials Center	U of Kentucky	KY

Center for Complex Materials	Princeton U	NJ
Center for Materials for Information Science	U of Alabama	AL
Center for Materials Research	Cornell U	NY
Center for Materials Science and Engineering	Mass Institute of Tech	MA
Center for Micro- and Nanomechanics of Materials	Brown U	RI
Center for Nanoscopic Materials Design	U of Virginia	VA
Center for Nanomagnetic Structures	U of Nebraska	NE
Center for Nanoscale Science	Pennsylvania State U	PA
Center for Nanostructured Materials	U of Wisconsin	WI
Center on Nanostructured Materials	Johns Hopkins U	MD
Center for Oxide Thin Films, Probes and Surfaces	U of Maryland	MD
Center for Polymer Science and Engineering	U of Massachusetts	MA
Center for Polymers at Engineered Interfaces	SUNY-Stony Brook/CUNY/ Polytech U	NY
Center for Polymer Interfaces and Macromolecular Assemblies	Stanford U/ UC-Davis/IBM	CA
Center for Response-Driven Polymeric Films	U of Southern Mississippi	MS
Center for Science and Engineering of Materials	California Institute of Tech	CA
Center for Semiconductor Physics in Nanostructures	U of Oklahoma/ U of Arkansas	OK,AR
Center for Sensor Materials	Michigan State U	MI
Center for Thermal Spray Research	SUNY-Stoney Brook	NY
Ferroelectric Liquid Crystals Materials Research Center	U of Colorado-Boulder	CO
International Institute on Complex Adaptive Matter	U of California / Los Alamos NL	CA/NM
International Materials Institute: Advanced Neutron Scattering Network for Education and Research	U of Tenn/Oak Ridge Nat Lab	TN
International Materials Institute: Center for Materials Science	U of Calif - Santa Barbara	CA
International Materials Institute: Materials Informatics and Combinatorial Materials Science	Rensselaer Poly/U Maryland/ Florida Inter	NY/MD/ FL
International Materials Institute: New Functionality in Glasses	Lehigh / Penn State	PA
Laboratory for Research on the Structure of Matter	U of Pennsylvania	PA
Materials Research Center	U of Chicago	IL
Materials Research Center	Harvard U	MA
Materials Research Center	Northwestern U	IL
Materials Research Science and Engineering Center	U of California-Santa Barbara	CA
Materials Research Science and Engineering Center	U of Minnesota	MN
Materials Research Science and Engineering Center	Carnegie Mellon U	PA
Materials Research Science and Engineering Center	Columbia U	NY
US/Africa Materials Institute	Princeton U	NJ
Mathematical Sciences Research Institutes		
American Institute of Mathematics	Palo Alto	CA
Institute for Mathematics and Its Applications	U of Minnesota	MN
Institute for Pure and Applied Mathematics	U of California-Los Angeles	CA
Mathematical Biosciences Institute	Ohio State U	OH
Mathematical Sciences Research Institute	U of California-Berkeley	CA
Statistical and Applied Mathematical Sciences Institute	Duke U	NC
Nanoscale Science and Engineering Centers		
Affordable Nanoengineering of Polymer Biomedical Devices (CANPBD)	Ohio State U	OH
High Rate Nanomanufacturing	Northeastern, U New Hampshire, U Mass, Lowell	MA
Integrated Nanomechanical Systems	Berkley, Cal Tech, Stanford, UC Merced	CA
Molecular Function at the Nano/Bio Interface	U of Pennsylvania	PA
Integrated Nanopatterning and Detection Technologies	Northwestern U	IL

Probing the Nanoscale	Stanford U, IBM	CA
Nanoscale Systems in Information Technologies	Cornell U	NY
Science of Nanoscale Systems and their Device Applications	Harvard U	MA
Templated Synthesis and Assembly at the Nanoscale	U of Wisconsin-Madison	WI
Electronic Transport in Molecular Nanostructures	Columbia U	NY
Nanoscience in Biological and Environmental Engineering	Rice U	TX
Directed Assembly of Nanostructures	Rensselaer Polytechnic Inst	NY
Center for Integrated and Scalable Nanomanufacturing	U of Calif-Los Angeles	CA
Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems	U Illinois-Champaign-Urbana	IL
Physics Frontiers Centers		
Center for Cosmological Physics	U of Chicago	IL
Center for Gravitational-Wave Phenomenology	Pennsylvania State U	PA
Frontiers of Optical, Coherent Ultrafast Science	U of Michigan	MI
Joint Institute for Laboratory Astrophysics	U of Colorado	CO
Joint Institute for Nuclear Astrophysics	Notre Dame U	IN
Kavli Institute for Theoretical Physics	U California - Santa Barbara	CA
Magnetic Self-Organization in Laboratory and Astrophysical Plasmas	U of Wisconsin - Madison	WI
Center for the Study of the Origin and Structure of Matter	Hampton U	VA
Center for Theoretical Biological Physics	U of California-San Diego	CA
Ultracold Atoms	Harvard U, MIT	MA
Plant Genome Virtual Centers		
A Protein Interaction Database for Rice Protein Kinases	U of Nebraska-Lincoln	NE
A Rice Oligononucleotide Array	U of California-Davis	CA
Comparative and Functional Genomics of Tomato	Cornell U	NY
Comparative Evolutionary Genomics of Cotton	Iowa State U	IA
Deep Transcriptional Profiling of Rice Using Signature Sequencing	U of Delaware	DE
Dissecting Phytophthora Resistance in Soybean using Expression Profiling and Analysis of Quantitative Train Loci	VA Polytechnic Inst & St U	VA
Finishing the Rice Genome	Cold Spring Harbor Lab	NY
Functional Analyses of Genes Involved in Maize Leaf Initiation	U of Georgia	GA
Functional Genomics of Hemicellulose Biosynthesis	Michigan State U	MI
Functional Genomics of Maize Centromeres	U of Georgia	GA
Gene Inventory and Function of the Model Legume	U of California-Davis	CA
Grass Genome Biodiversity	U of Georgia	GA
Identification and Characterization of Plant Cell Wall Mutants	Purdue U	IN
Vitis vinifera: Abiotic Stress and Wine Quality	U of Nevada-Reno	NV
Microarray Resources for Maize Research	U of Arizona	AZ
Molecular and Functional Diversity in the Maize Genome	U of Wisconsin-Madison	WI
Oryza Map Alignment Project	U of Arizona	AZ
Sequencing the Gene Space of a Model Legume	U of Minnesota	MN
The Floral Genome Project	Penn State U	PA
The Plant Ontology Consortium	Cold Spring Harbor Lab	NY
Potato Functional Genomics: Analysis of Growth, Development, Metabolism and Responses to Stress	U of California-Berkeley	CA
Center for Plant Evolutionary Genomics	New York U	NY
Center for Analysis of Rice Genome Transcription	Yale U	CT
Evolutionary Genomics of the Compositeae	Indiana U	IN
Global Analysis of Functional Units in Plant Chromosomes	NC State U	NC
Science and Technology Centers		
Adaptive Optics	U of California-Santa Cruz	CA
Advanced Materials for Water Purification	U of Illinois	IL
Behavioral Neuroscience	Georgia State U	GA

Biophotonics Science and Technology	U of California-Davis	CA
Earth Surface Dynamics	U of Minnesota	MN
Embedded Networked Sensing	U of California-Los Angeles	CA
Environmentally Responsible Solvents and Processes	U of North Carolina	NC
Integrated Space Weather Modeling	Boston U	MA
Materials and Devices for Information Technology Research	U of Washington	WA
Nanobiotechnology	Cornell U	NY
Sustainability of Semi-Arid Hydrology and Riparian Areas	U of Arizona	AZ
Science of Learning Centers		
The LIFE Center - Learning in Formal and Informal Environments	U of Washington	WA
CELEST - A Center for Learning in Education, Science and Technology	Boston U	MA
Pittsburgh Science of Learning Center - Studying Robust Learning with Learning Experiments in Real Classrooms	Carnegie Melon U	PA
SBE Centers		
Children's Research Centers		
Children's Digital Media Center	Georgetown U	DC
North Carolina Child Development Research Collaborative	U of North Carolina	NC
Cornell Center for Research on Children	Cornell U	NY
Center for Research on Culture, Development and Education	New York U	NY
Center for the Analysis of Pathways from Childhood to Adulthood	U of Michigan	MI
Climate Change Research Initiative Centers		
Decision Center for a Desert City	Arizona State U	AZ
Climate Decision Making Center	Carnegie Mellon U	PA
Center for the Study of Individual and Group Decision Making Under Climate Uncertainty	Columbia U	NY
Science Policy Assessment and Research on Climate Team	U of Colorado-Boulder	CO
The Rand Corporation Research Team	Rand Corporation	CA
National Consortium for Violence Research	Carnegie Mellon U	PA

NSF Selected Cross-Cutting Programs

SELECTED CROSS-CUTTING PROGRAMS

NSF Cross-cutting programs include interdisciplinary programs, programs that are supported by multiple Directorates, and programs jointly supported by NSF and other Federal agencies. Examples of major Cross-cutting activities include the following:

- ADVANCE: A budget of $19.80 million for ADVANCE in FY 2006 will fund Partnerships for Adaptation, Implementation, and Dissemination Awards to support the analysis, adaptation, dissemination and use of existing innovative materials and practices that have been demonstrated to be effective in increasing representation and participation of women in academic science and engineering careers. These awards seek to broaden the impact of institutional transformation efforts, and to expand the network of institutions and individuals who are equipped with knowledge about the institutional factors underlying the underrepresentation of women in academic science and engineering. In addition, support for ongoing awards for institutional transformation will be continued.

- Faculty Early Career Development (CAREER): FY 2006 funding for CAREER awards total $133.79 million, an increase of $2.40 million above the FY 2005 Current Plan of $131.39 million. CAREER awards support exceptionally promising college and university junior faculty who are committed to the integration of research and education and who are most likely to become the academic leaders of the 21st Century. This increase will support approximately five new awards.

- Graduate Fellowships and Traineeships: The FY 2006 budget provides $215.69 million, an increase of $300,000 over FY 2005, for NSF's three flagship graduate fellowship and traineeship programs. This funding will support an estimated 4,600 graduate students across NSF.

    - $96.63 million for the Graduate Research Fellowship (GRF) program to support graduate students in all STEM fields. FY 2006 funding will support approximately 2,280 fellows.
    - $69.07 million for the Integrative Graduate Education and Research Traineeship (IGERT) program to support comprehensive Ph.D. programs that are innovative models for interdisciplinary education and research, and that prepare students for academic and non-academic careers. FY 2006 funding will support approximately 1,385 IGERT trainees.
    - $49.99 million for the Graduate Teaching Fellowships in K-12 Education (GK-12) program to strengthen partnerships between higher education institutions and local school districts by providing universities the opportunity to become engaged with a program that features outreach to K-12 schools in a manner that benefits both their teachers and students. FY 2006 funding will support approximately 935 graduate fellows.

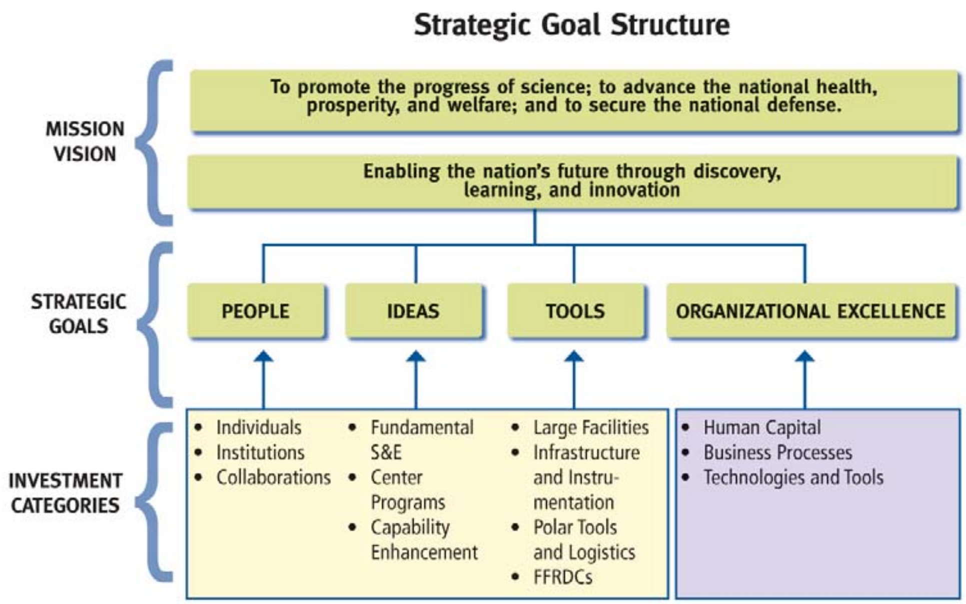
- Research Experiences for Undergraduates (REU): The FY 2006 Request for NSF's REU program totals $53.69 million, an increase of $2.57 million above the FY 2005 Current Plan of $51.12 million. The REU program supports active research participation by undergraduate students in any of the areas of research funded by the National Science Foundation. REU Sites involve students in research who might not otherwise have the opportunity, particularly those from institutions where research programs are limited. A significant fraction of the student participants come from outside the host institutions.

- Research Experiences for Teachers: (RET): The FY 2006 Request for NSF's RET program totals $8.45 million, an increase of $2.0 million above the FY 2005 Current Plan of $6.45 million. Funding will provide additional pre-service and in-service K-12 teachers with discovery-based learning experiences.

Performance Information

PERFORMANCE INFORMATION

This chapter provides supporting information on the performance activities used in developing NSF's FY 2006 Request. The NSF Strategic Plan for FY 2003-2008 established the overall framework for evaluating NSF's performance (as shown in the figure below).



The evaluations conducted under this framework focus on the strategic goals and the investment categories.

- For NSF's four strategic goals – People, Ideas, Tools, and Organizational Excellence – the Advisory Committee for GPRA Performance Assessment (AC/GPA) reviews key indicators for each goal to determine if NSF has demonstrated significant achievement. For the Organizational Excellence goal, the AC/GPA receives input from NSF's Advisory Committee for Business and Operations in making its determination.

- The investment categories constitute the operational component of NSF's strategic framework, and as such they are evaluated using the PART, the Program Assessment Rating Tool developed by the Office of Management and Budget. For the FY 2006 Budget Request, three investment categories were reviewed using the PART: Institutions; Collaborations; and Polar Tools, Facilities, and Logistics. In addition, the Biocomplexity in the Environment Priority Area was also assessed using the PART. All were rated "effective" (the highest rating) under the PART. (The NSF PART schedule is included at the end of this chapter.)

The following sections review the most recent evaluations of each strategic goal and the associated PART activities for FY 2006. More detailed information on NSF's performance is available in the FY 2004 Performance and Accountability Report (NSF-05-01).

People

FY 2006 Annual Performance Goal for People: NSF will demonstrate significant achievement for the majority of the following performance indicators related to the People outcome goal:

- Promote greater diversity in the science and engineering workforce through increased participation of underrepresented groups in NSF activities.
- Support programs that attract and prepare U.S. students to be highly qualified members of the global S&E workforce, including providing opportunities for international study, collaborations and partnerships.
- Promote public understanding and appreciation of science, technology, engineering, and mathematics, and build bridges between formal and informal science education.
- Support innovative research on learning, teaching and education that provides a scientific basis for improving science, technology, engineering and mathematics education at all levels.
- 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.

Baseline / Prior Year Results: This goal is a continuation of the FY 2005 Strategic Goal based on the NSF Strategic Plan FY 2003 through FY 2008. FY 2001 was the first year that NSF had an annual performance goal with associated indicators for People. Each fiscal year's performance indicators may differ from those of prior years, but in all cases they serve as measures of progress toward achievement of NSF's strategic outcome goal. NSF was successful in achieving the annual performance goal associated with the People strategic outcome in FY 2001 through FY 2004. Evaluation of achievement includes input from the external Advisory Committee for GPRA Performance Assessment.

Means and Strategies for Success:

- Support, through merit-based grants and cooperative agreements, the most promising and capable individuals and groups throughout the U.S.
- Pay particular attention to development of people beginning careers in science and engineering.
- Use all aspects of NSF activity to embed diversity in the science and engineering workforce.
- Maintain existing partnerships and explore opportunities for developing new partnerships that focus on broadening participation. These include making presentations at national and regional meetings involving minority-serving organizations and at formal meetings of NSF programs (e.g., EPSCoR and LSAMP).
- Focus on (a) preparation and professional development of teachers of mathematics and science, and (b) alignment of standards, rigorous curricula and assessments.
- Support the production of well-trained researchers and educators by providing a variety of NSF activities (e.g., programs with industry; NSF centers) to afford interactive research and education opportunities for students, post-doctoral scientists and faculty at all career stages.
- Support approaches that integrate research and learning activities, encourage the partnering of the K-12 and higher education communities and develop intellectual capital.
- Encourage attendance at international meetings, faculty/student exchange opportunities, and research utilizing international facilities and field/logistics centers in order to further engage the NSF community in international activities.
- Promote increased linkages between formal programs and informal activities such as those involving museum and science center exhibits, public fora, or the Internet to communicate with the public.

Resources Required: This goal can be achieved with NSF's requested FY 2006 staff and budgetary resources.

FY 2006 Annual Performance Goal – Graduate Students: Number of graduate students funded through fellowships or traineeships from Graduate Research Fellowships (GRF), Integrative Graduate Education and Research Traineeships (IGERT), or Graduate Teaching Fellowships (GK-12). This goal is revised to include GK-12. Although GK-12 involves partnerships between universities and K-12 schools, the primary purpose of the program is to expand the skills and applications of STEM graduate students. Therefore, the re-worded goal will now include the three primary Division of Graduate Education programs: GRF, IGERT and GK-12.

Number of Graduate Students Funded Through GRF, IGERT and GK-12					
	FY 2002	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal				4,600	4,600
Result	3,623	4,046	4,628	&	&

& = Data not yet available

FY 2006 Annual Performance Goal – Broadening Participation of Organizations: Percentage of proposals received from academic institutions not in the top 100 of NSF funding recipients for the Institutions and Collaborations investment categories. This goal corresponds to NSF's goals to broaden the participation by proposing institutions.

Percent of proposals received from academic institutions not in the top 100 of NSF funding recipients.						
Investment Category	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
	Baseline	Baseline	Baseline	Baseline	Target	Target
Institutions	73%	66%	70%	68%	72%	73%
Collaborations	63%	62%	61%	61%	62%	63%

Program Assessment Rating Tool (PART) Evaluation: PART evaluations on the Institutions and Collaborations investment categories were completed to inform the FY 2006 budget decision-making process. Overall, the PART assessments found Institutions and Collaborations to be "effective" programs and that additional attention should continue to be focused on achieving performance and efficiency targets.

Ideas

FY 2006 Annual Performance Goal for Ideas: NSF will demonstrate significant achievement for the majority of the following performance indicators related to the Ideas outcome goal:

- Enable people who work at the forefront of discovery to make important and significant contributions to science and engineering knowledge;
- Encourage collaborative research and education efforts – across organizations, disciplines, sectors and international boundaries;
- Foster connections between discoveries and their use in the service of society;
- Increase opportunities for individuals from underrepresented groups and institutions to conduct high quality, competitive research and education activities;
- Provide leadership in identifying and developing new research and education opportunities within and across science and engineering fields; and
- Accelerate progress in selected science and engineering areas of high priority by creating new integrative and cross-disciplinary knowledge and tools, and by providing people with new skills and perspectives.

Means and Strategies for Success:

NSF utilizes the following means and strategies to achieve the strategic outcome goal of Ideas and its associated long-term investment categories and annual performance goals:

- Support the most promising ideas through merit-based grants and cooperative agreements to individual researchers and groups, in partnership with colleges, universities, and other institutions – public, private, state, local, and federal – throughout the U.S.;
- Encourage partnerships and cooperative research efforts – among disciplines, in different sectors, and across international boundaries;
- Take informed risks in emerging research areas where consensus on appropriate directions (e.g., theory, methodology, or knowledge) is just beginning to form;
- Partner with a diverse range of investigators (e.g., new, minority) and institutions (e.g., research universities, community colleges, EPSCoR states, minority-serving institutions);
- Identify and support major cross-disciplinary priority areas where U.S. and NSF leadership are important;
- Identify and provide support for new and emerging opportunities;
- Develop and support a high-quality, balanced award portfolio that considers disciplines and fields, interdisciplinary research areas, and emerging opportunities; and
- Utilize the NSF core strategies of integrating research and education, promoting partnerships, and developing intellectual capital.

Baseline / Prior Year Results: This goal is a continuation of the FY 2005 Strategic Goal based on the NSF Strategic Plan FY 2003 through FY 2008. FY 2001 was the first year that NSF had an annual performance goal with associated indicators for Ideas. Each fiscal year's performance indicators may differ from those of prior years, but in all cases they serve as measures of progress toward achievement of NSF's strategic outcome goal. NSF was successful in achieving the annual performance goal associated with the Ideas strategic outcome in FY 2001 through FY 2004. Evaluation of achievement includes input from the external Advisory Committee for GPRA Performance Assessment.

Resources Required: This goal can be achieved with NSF's requested FY 2006 staff and budgetary resources.

Revised FY 2005 Annual Performance Goals – Award Size: The FY 2005 goals for award size and award duration will not continue in FY 2006 as NSF focuses on improving success rates for proposals. The 2005 target for average annualized award size will decrease from $142,000 to the FY 2004 level of $140,000.

Average Annualized Award Size for Research Grants						
	FY 2000	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**
Goal		$110,000	$113,000	$135,000	$139,000	$140,000
Result	$106,000	$114,000	$116,000	$136,000	$140,000	&

& = Data not yet available

Program Assessment Rating Tool (PART) Evaluation: A PART on the Biocomplexity in the Environment priority area was completed to inform the FY 2006 budget decision-making process. Overall, the PART assessments found this program to be "effective" and that additional attention should continue to be focused on achieving performance and efficiency targets.

Tools

FY 2006 Annual Performance Goal for Tools: NSF will demonstrate significant achievement for the majority of the following performance indicators related to the Tools outcome goal:

- Expand opportunities for U.S. researchers, educators, and students at all levels to access state-of-the-art S&E facilities, tools, databases, and other infrastructure.
- Provide leadership in the development, construction, and operation of major, next-generation facilities and other large research and education platforms.
- Develop and deploy an advanced cyberinfrastructure to enable all fields of science and engineering to fully utilize state-of-the-art computation.
- Provide for the collection and analysis of the scientific and technical resources of the U.S. and other nations to inform policy formulation and resource allocation.
- Support research that advances instrument technology and leads to the development of next-generation research and education tools.

Means and Strategies for Success:

NSF utilizes the following means and strategies to achieve the strategic outcome goal of Tools and its associated long-term investment goals and annual performance goals.

- Support, through merit-based grants and cooperative agreements of sufficient size and duration, the most promising projects proposed by individual researchers and groups throughout the U.S.;
- Partner with other federal agencies, states, private organizations, national laboratories, or other nations to develop infrastructure by capitalizing on and leveraging the human and financial resources of each group;
- Operate an internal NSF capital planning process that encourages the development of innovative capabilities and meets the infrastructure needs of the U.S. community served by NSF;
- Develop and implement improvements for selecting, managing and overseeing large facility projects;
- Ensure that the breadth of infrastructure needs of the scientific community are examined regularly through workshops, panels, advisory groups, or other mechanisms;
- Provide broad support to the information technology community and others involved in innovative applications of cutting-edge IT tools for science and engineering;
- Upgrade the computation and computing infrastructure for all fields of science and engineering;
- Provide information on the status of the domestic / foreign science and engineering enterprise to inform science policy and priority setting;
- Develop and support a high-quality, balanced portfolio that invests in disciplines and fields, interdisciplinary research areas, and emerging opportunities; and
- Utilize the NSF core strategies of integrating research and education, promoting partnerships, and developing intellectual capital.

Baseline / Prior Year Results: This goal is a continuation of the FY 2005 Strategic Goal based on the NSF Strategic Plan FY 2003 through FY 2008. FY 2001 was the first year that NSF had an annual performance goal with associated indicators for Tools. Each fiscal year's performance indicators may differ from those of prior years, but in all cases they serve as measures of progress toward achievement of NSF's strategic outcome goal. NSF was successful in achieving the annual performance goal associated with the Tools strategic outcome in FY 2001 through FY 2004. Evaluation of achievement includes input from the external Advisory Committee for GPRA Performance Assessment.

Resources Required: This goal can be achieved with NSF's requested FY 2006 staff and budgetary resources.

FY 2006 Annual Performance Goal within Facilities – Facility Construction: For ninety percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan. This goal applies to all ongoing projects and those to be completed in FY 2006 that have a total project cost of at least $5.0 million.

PERCENT OF CONSTRUCTION ACQUISITION AND UPGRADE PROJECTS WITH NEGATIVE COST AND SCHEDULE VARIANCES OF LESS THAN 10% OF THE APPROVED PROJECT PLAN.						
	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal	90%	90%	90%	90%	90%	90%
Result	84%	48%	88%	100%	&	&

& = Data not yet available

FY 2006 Annual Performance Goal within Facilities – Facility Operations: For ninety percent of operational facilities, keep scheduled operating time lost to less than 10 percent. This goal applies to all NSF-supported facilities that received greater than $8 million in annual operations and maintenance support. Results for the Facility Operations goal are shown below.

Comparison with scheduled operating time.							
	FY 2000	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal	Keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time.	For 90 percent 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 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, keep scheduled operating time lost to less than 10 percent.	For 90 percent of operational facilities, keep scheduled operating time lost to less than 10 percent.	For 90 percent of operational facilities, keep scheduled operating time lost to less than 10 percent.	For 90 percent of operational facilities, keep scheduled operating time lost to less than 10 percent.
Result	22 of 26 (85%) facilities met goal. Not achieved.	25 of 29 (86%) facilities met goal. Not achieved.	26 of 31 (84%) facilities met goal. Not achieved.	26 of 30 (87%) facilities met goal. Not achieved.	26 of 29 (89.7%) facilities met goal. Not achieved.	& &	& &

Program Assessment Rating Tool (PART) Evaluation: A PART on the Polar Tools, Logistics and Facilities investment category were completed to inform the FY 2006 budget decision-making process. Overall, the PART assessments found Polar Tools, Logistics and Facilities to be an "effective" program with recommendations to perform a targeted review through a Committee of Visitors (completed), continue to improve performance targets and monitoring, and further promote the use of Earned Value Management in facilities construction. NSF has developed goals for this investment category using the Facilities Construction goal, incorporating Earned Value Management, and Facilities Operations.

Therefore, starting in FY 2004, Polar Tools, Logistics and Facilities construction and operations are tracked separately from these other facilities.

Organizational Excellence

FY 2006 Strategic Goal for Organizational Excellence: NSF will demonstrate significant achievement for all of the following performance indicators related to the Organizational Excellence outcome goal:

- Operate a credible, efficient merit review system.
- Utilize and sustain broad access to new and emerging technologies for business application.
- Develop a diverse, capable, motivated staff that operates with efficiency and integrity.
- 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.

Comparison to FY 2005 Goal: This goal is a continuation of the FY 2005 Strategic Goal developed based on the NSF Strategic Plan FY 2003 through FY 2008. NSF achieved the goal in FY 2004. Evaluation of achievement included input from two groups of external experts: the Advisory Committee for GPRA Performance Assessment and the Advisory Committee for Business and Operations.

Means and Strategies for Success:

The means and strategies NSF uses to successfully achieve Organizational Excellence include:

- Support for the NSF Academy. Enabling the future of NSF by inspiring a culture of learning, the NSF Academy is committed to ensuring the highest level of achievement for all NSF staff by providing continuous learning opportunities through a variety of educational venues in support of the agency's mission. The Academy is expanding in the areas of e-business courses, knowledge management, new employee orientation and career development activities.
- External input through the Business and Operations Advisory Committee. The committee includes leading officials in research administration, education management, information technology, and public administration. The Committee is charged with providing advice on issues related to NSF's business practices and operations, including innovative approaches to the achievement of NSF's strategic goals.
- Evaluation through the Advisory Committee for GPRA Performance Assessment. NSF determined that a more efficient and effective process for the assessment of agency performance with respect to strategic goals was to charge a single external committee of experts with review of all Foundation accomplishments. The Committee comprises about 25 independent external experts representing academia, industry, and government.
- Findings and recommendations from the NSF Business Analysis. The Business Analysis is central to NSF's overall framework for long-term investments in OE. The analysis focuses on how NSF can best respond to such challenges as managing a portfolio that is growing in both size and complexity and becoming a fully integrated organization capable of working both within and across boundaries – be they disciplinary, sectoral, institutional, or international. The analysis also addresses key underlying issues raised in the President's Management Agenda and government-wide issues identified by the Government Accountability Office.
- Continued implementation of the new Strategic Human Capital Initiatives. These initiatives include recruitment, outreach, and accountability.
- Employment of next-generation technology. NSF is continuing to re-engineer internal processes – such as through the eJacket system – to implement technology-enabled solutions for the future.

- Improved monitoring and oversight through increased funding for travel. These capabilities include additional management and oversight activities, such as site visits to major facilities, as well as increased outreach, participation in science and engineering workshops, and staff training.

Resources Required: This goal can be achieved with NSF's requested FY 2006 staff and budgetary resources.

FY 2006 Annual Performance Goals – Time to Decision: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline or target date, or receipt date, whichever is later.

Percent of proposals NSF-wide processed within 6 mos of deadline/target date, or receipt date, whichever is later							
FY:	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Goal	70%	70%	70%	70%	70%	70%	70%
Result	54%	62%	74%	77%	77%	&	&

In the FY 2006 PARTs, NSF adopted goals consistent with the NSF-wide Time to Decision goal. These PART goals include a quality component that is based on a review by the Advisory Committee for GPRA Performance Assessment regarding the continued credibility and effectiveness of NSF's merit review system:

> *For FY 2006, NSF will make at least 70% of award decisions available to applicants within six months of proposal receipt or deadline/target date while maintaining a credible and efficient competitive merit review system, as evaluated by external experts for the following investment categories and priority areas: Individuals, Institutions, Collaborations, Nanotechnology and Biocomplexity in the Environment.*

Percent of proposals processed within 6 mos of deadline/target date, or receipt date, while maintaining a credible and efficient competitive merit review system, as evaluated by external experts			
Investment Category	**FY 2004**	**FY 2005**	**FY 2006**
	Baseline	Target	Target
Individuals	74%	70%	70%
Institutions	83%	70%	70%
Collaborations	82%	70%	70%
Nanotechnology	46%	70%	70%
Biocomplexity	61%	70%	70%

Means and Strategies for Success (Time to Decision):

- Proposal pressure continues to build making this goal increasingly challenging. The number of proposal solicitations and the frequency of deadlines for these solicitations are under review.
- "Real-time" management reports that pinpoint pending proposals in danger of exceeding the six-month processing goal are distributed monthly to NSF senior management.

- Performance on prompt handling of proposals has been added to the performance evaluation criteria for some of the Foundation's Program Officers.
- Managers and staff throughout the Foundation are being recognized for efforts to improve timely processing of proposals and thereby reduce the time to decision.
- NSF staff continue to work towards shortening time to decision by making more effective use of electronic mechanisms in conducting reviews, working cooperatively to eliminate overloads and bottlenecks, and carefully tracking each stages of the proposal processing process.

Resources Required (Time to Decision): These goals can be achieved with NSF's requested FY 2006 staff and budgetary resources.

Schedule for PART Activities

	People	Ideas	Tools	Priority Areas
FY 2005	Individuals		Facilities	Nanoscale S&E Info. Tech. Research
FY 2006	Institutions Collaborations		Polar	Biocomplexity Env.
FY 2007		Fundamental S&E	FFRDCs	
FY 2008		Centers Capability Enhancements	Infrastructure & Instrumentation	Math. Sciences Human, Social Dyn.

NSF has now completed PARTs for five investment categories and three priority areas. PARTs for the remaining five investment categories and two priority areas will be completed during the development of the FY 2007 and FY 2008 budgets, as shown in the schedule above. Detailed PART results are available at http://www.whitehouse.gov/omb/budget/.

Technical Information

FY 2006 Appropriations Language

FY 2006 Appropriations Language

National Science Foundation

RESEARCH AND RELATED ACTIVITIES

For necessary expenses in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), and the Act to establish a National Medal of Science (42 U.S.C. 1880-1881); services as authorized by 5 U.S.C. 3109; maintenance and operation of aircraft and purchase of flight services for research support; acquisition of aircraft; $4,333,500,000 to remain available until September 30, 2007, of which not to exceed $425,000,000 shall remain available until expended for Polar research and operations support, and for reimbursement to other Federal agencies for operational and science support and logistical and other related activities for the United States Antarctic program: *Provided*, That from amounts specified for Polar research and operations support, the National Science Foundation shall reimburse the Coast Guard for such sums as mutually determined to be necessary for Coast Guard operations and maintenance of the U.S. polar icebreaking fleet: *Provided* further, That receipts for scientific support services and materials furnished by the National Research Centers and other National Science Foundation supported research facilities may be credited to this appropriation.

EDUCATION AND HUMAN RESOURCES

For necessary expenses in carrying out science and engineering education and human resources programs and activities pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services as authorized by 5 U.S.C. 3109, and rental of conference rooms in the District of Columbia, $737,000,000, to remain available until September 30, 2007.

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

For necessary expenses for the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets pursuant to the National Science Foundation Act of 1950, as amended, including authorized travel, $250,010,000, to remain available until expended.

SALARIES AND EXPENSES

For salaries and expenses necessary in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); services authorized by 5 U.S.C. 3109; hire of passenger motor vehicles; not to exceed $9,000 for official reception and representation expenses; uniforms or allowances therefor, as authorized by 5 U.S.C. 5901-5902; rental of conference rooms in the District of Columbia; and reimbursement of the General Services Administration for security guard services; $269,000,000: *Provided*, That contracts may be entered into under "Salaries and expenses" in fiscal year 2006 for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year.

OFFICE OF INSPECTOR GENERAL

For necessary expenses of the Office of Inspector General as authorized by the Inspector General Act of 1978, as amended, $11,500,000, to remain available until September 30, 2007.

OFFICE OF THE NATIONAL SCIENCE BOARD

For necessary expenses (including payment of salaries, authorized travel, hire of passenger motor vehicles, the rental of conference rooms in the District of Columbia, and the employment of experts and consultants under section 3109 of title 5, United States Code) involved in carrying out section 4 of the National Science Foundation Act of 1950 (42 U.S.C 1863) and Public Law 86-209 (42 U.S.C. 1880 et seq.), $4,000,000: *Provided*, That not more than $9,000 shall be available for official reception and representation expenses.

Summary of FY 2006 Budget by Appropriation and Activity

SUMMARY OF FY 2006 BUDGET BY APPROPRIATION AND ACTIVITY

(DOLLARS IN MILLIONS)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	CHANGE FY 2006 Req/FY 2005 Current Plan Amount	Percent
RESEARCH AND RELATED ACTIVITIES					
Biological Sciences	$587.05	$576.61	$581.79	$5.18	0.9%
Computer and Information Science and Engineering	605.35	613.72	620.56	6.84	1.1%
Engineering	565.57	561.30	580.68	19.38	3.5%
Geosciences	713.41	694.16	709.10	14.94	2.2%
Mathematical and Physical Sciences	1,091.59	1,069.86	1,086.23	16.37	1.5%
Social, Behavioral and Economic Sciences	184.30	196.90	198.79	1.89	1.0%
Office of International Science and Engineering[1]	40.83	33.73	34.51	0.78	2.3%
U.S. Polar Research Programs	274.18	276.84	319.41	42.57	15.4%
U.S. Antarctic Logistical Support Activities	67.54	67.52	67.52	0.00	0.0%
Integrative Activities	163.52	129.91	134.90	4.99	3.8%
Subtotal R&RA	$4,293.34	$4,220.55	$4,333.49	$112.94	2.7%
Unobligated Balance Available Start of Year	-28.42				
Unobligated Balance Available End of Year	6.55				
Recoveries of Prior Year Obligations	-9.09				
Adjustments to Prior Year Accounts	-0.01				
Unobligated Balance Lapsing	-0.01				
Reduction Pursuant to P.L. 108-199	25.23				
Subtotal R&RA	$4,287.59	$4,220.55	$4,333.49	$112.94	2.7%
Transferred from other funds	-10.99				
Appropriation Total	$4,276.60	$4,220.55	$4,333.49	$112.94	2.7%
EDUCATION AND HUMAN RESOURCES					
Math and Science Partnership	$138.71	$79.36	$60.00	-$19.36	-24.4%
EPSCoR	94.24	93.68	94.00	0.32	0.3%
Elementary, Secondary and Informal Science Education	206.39	181.95	140.80	-41.15	-22.6%
Undergraduate Education	162.91	153.67	135.00	-18.67	-12.1%
Graduate Education	155.35	154.70	155.00	0.30	0.2%
Human Resource Development	120.09	118.54	118.40	-0.14	-0.1%
Research, Evaluation and Communication	66.41	59.52	33.80	-25.72	-43.2%
Subtotal EHR	$944.10	$841.42	$737.00	-$104.42	-12.4%
Unobligated Balance Available Start of Year	-5.00				
Unobligated Balance Available End of Year	1.41				
Recoveries of Prior Year Obligations	-1.53				
Adjustments to Prior Year Accounts	0.00				
Unobligated Balance Lapsing	0.00				
Reduction Pursuant to P.L. 108-199	5.57				
Appropriation Total[2]	$944.55	$841.42	$737.00	-$104.42	-12.4%

[1] OISE FY 2004 Actual includes $10.99 million provided to NSF by the U.S. Department of State for an award to the U.S. Civilian Research and Development Foundation.

[2] Excludes $57.28 million in FY 2004 and an estimated $100.0 million in FY 2005 and FY 2006 from H-1B Nonimmigrant Petitioner Fees.

SUMMARY OF FY 2006 BUDGET BY APPROPRIATION AND ACTIVITY

(DOLLARS IN MILLIONS)

	FY 2004	FY 2005	FY 2006	CHANGE FY 2006 Req/FY 2005 Current Plan	
	Actual	Current Plan	Request	Amount	Percent
MAJOR RESEARCH EQUIPMENT & FACILITIES CONSTRUCTION	$183.96	$173.65	$250.01	$76.36	44.0%
Unobligated Balance Available Start of Year	-66.11				
Unobligated Balance Available End of Year	37.12				
Recoveries of Prior Year Obligations	0.00				
Adjustments to Prior Year Accounts	0.01				
Reduction Pursuant to P.L. 108-199	0.92				
Appropriation Total	$155.90	$173.65	$250.01	$76.36	44.0%
SALARIES AND EXPENSES [3]	$218.92	$223.20	$269.00	$45.80	20.5%
Unobligated Balance Available Start of Year	0				
Unobligated Balance Available End of Year	0				
Adjustments to Prior Year Accounts	0				
Unobligated Balance Lapsing	0.05				
Reduction Pursuant to P.L. 108-199	1.30				
Subtotal, S&E	$220.26	$223.20	$269.00	$45.80	20.5%
Transferred from other funds	-$0.26				
Appropriation Total	$220.00	$223.20	$269.00	$45.80	20.5%
NATIONAL SCIENCE BOARD	$2.22	$3.97	$4.00	$0.03	0.8%
Unobligated Balanced Available Start of Year	0.00				
Unobligated Balanced Available End of Year	0.00				
Recoveries of Prior Year Obligations	0.00				
Adjustments to Prior Year Accounts	0.00				
Unobligated Balance Lapsing	1.66				
Reduction Pursuant to P.L. 108-199	0.02				
Appropriation Total	$3.90	$3.97	$4.00	$0.03	0.8%
OFFICE OF INSPECTOR GENERAL	$9.47	$10.03	$11.50	$1.47	14.7%
Unobligated Balanced Available Start of Year	-0.65				
Unobligated Balanced Available End of Year	1.22				
Recoveries of Prior Year Obligations	-0.12				
Adjustments to Prior Year Accounts	-0.01				
Unobligated Balance Lapsing	0.03				
Reduction Pursuant to P.L. 108-199	0.06				
Appropriation Total	$10.00	$10.03	$11.50	$1.47	14.7%
TOTAL, NATIONAL SCIENCE FOUNDATION	$5,610.95	$5,472.82	$5,605.00	$132.18	2.4%

Totals may not add due to rounding.

[3] The FY 2004 Actual includes a transfer of $260,500 from the Department of State for processing an award to the U.S. Civilian Research and Development Foundation.

NSF Funding by Program

NSF FUNDING BY PROGRAM

(Dollars in Millions)

PROGRAM	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change Over FY 2005 Amount	Change Over FY 2005 Percent
BIOLOGICAL SCIENCES					
MOLECULAR AND CELLULAR BIOSCIENCES	$121.42	$118.16	$109.75	-$8.41	-7.1%
INTEGRATIVE ORGANISMAL BIOLOGY	107.29	103.50	101.76	-1.74	-1.7%
ENVIRONMENTAL BIOLOGY	107.94	106.04	107.18	1.14	1.1%
BIOLOGICAL INFRASTRUCTURE	80.68	80.62	82.93	2.31	2.9%
Research Resources	*49.10*	*49.32*	*51.32*	*2.00*	*4.1%*
Human Resources	*31.58*	*31.30*	*31.61*	*0.31*	*1.0%*
EMERGING FRONTIERS	80.24	74.05	85.93	11.88	16.0%
PLANT GENOME RESEARCH	89.47	94.24	94.24	0.00	0.0%
Total, BIO	$587.05	$576.61	$581.79	$5.18	0.9%
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING					
COMPUTING & COMMUNICATION FOUNDATIONS	79.59	91.41	102.53	11.12	12.2%
COMPUTER & NETWORK SYSTEMS	$115.40	$132.39	$142.96	$10.57	8.0%
INFORMATION & INTELLIGENT SYSTEMS	80.02	92.54	104.67	12.13	13.1%
SHARED CYBERINFRASTRUCTURE	112.29	123.60	124.96	1.36	1.1%
INFORMATION TECHNOLOGY RESEARCH	218.07	173.78	145.44	-28.34	-16.3%
Total, CISE	$605.35	$613.72	$620.56	$6.84	1.1%
ENGINEERING					
BIOENGINEERING AND ENVIRONMENTAL SYSTEMS	$51.00	$48.22	$50.68	$2.46	5.1%
CHEMICAL AND TRANSPORT SYSTEMS	69.21	65.79	68.99	3.20	4.9%
CIVIL AND MECHANICAL SYSTEMS	67.22	81.98	84.21	2.23	2.7%
DESIGN AND MANUFACTURING INNOVATION	65.92	63.85	67.41	3.56	5.6%
ELECTRICAL AND COMMUNICATIONS SYSTEMS	74.61	71.64	74.35	2.71	3.8%
ENGINEERING EDUCATION AND CENTERS	134.03	127.06	129.71	2.65	2.1%
OFFICE OF INDUSTRIAL INNOVATION	103.58	102.76	105.33	2.57	2.5%
Total, ENG	$565.57	$561.30	$580.68	$19.38	3.5%

NSF FUNDING BY PROGRAM

(Dollars in Millions)

PROGRAM	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change Over FY 2005 Amount	Change Over FY 2005 Percent
GEOSCIENCES					
ATMOSPHERIC SCIENCES	$238.40	$233.43	$239.79	$6.36	2.7%
Atmospheric Sciences Research Support	*156.65*	*153.38*	*158.69*	*5.31*	*3.5%*
National Center for Atmospheric Research	*81.75*	*80.05*	*81.10*	*1.05*	*1.3%*
EARTH SCIENCES	152.03	148.96	154.07	5.11	3.4%
Earth Sciences Project Support	*119.75*	*115.19*	*119.73*	*4.54*	*3.9%*
Instrumentation and Facilities	*32.28*	*33.77*	*34.34*	*0.57*	*1.7%*
OCEAN SCIENCES	322.98	311.77	315.24	3.47	1.1%
Ocean Section	*120.35*	*115.98*	*117.28*	*1.30*	*1.1%*
Integrative Programs Section	*118.40*	*113.70*	*114.97*	*1.27*	*1.1%*
Marine Geosciences Section	*84.23*	*82.09*	*82.99*	*0.90*	*1.1%*
Total, GEO	$713.41	$694.16	$709.10	$14.94	2.2%
MATHEMATICAL AND PHYSICAL SCIENCES					
ASTRONOMICAL SCIENCES	$196.63	$195.10	$198.64	$3.54	1.8%
CHEMISTRY	185.12	179.45	181.37	1.92	1.1%
MATERIALS RESEARCH	250.65	240.50	245.70	5.20	2.2%
MATHEMATICAL SCIENCES	200.35	200.38	200.38	0.00	0.0%
PHYSICS	227.77	224.94	230.14	5.20	2.3%
MULTIDISCIPLINARY ACTIVITIES	31.07	29.49	30.00	0.51	1.7%
Total, MPS	$1,091.59	$1,069.86	$1,086.23	$16.37	1.5%
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES					
SOCIAL AND ECONOMIC SCIENCES	$86.43	$91.99	$92.80	$0.81	0.9%
BEHAVIORAL AND COGNITIVE SCIENCES	71.49	78.97	79.84	0.87	1.1%
SCIENCE RESOURCES STATISTICS	26.37	25.94	26.15	0.21	0.8%
Total, SBE	$184.30	$196.90	$198.79	$1.89	1.0%

NSF FUNDING BY PROGRAM

(Dollars in Millions)

PROGRAM	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change Over FY 2005 Amount	Change Over FY 2005 Percent
OFFICE OF INTERNATIONAL SCIENCE AND ENGINEERING[1]	$40.83	$33.73	$34.51	$0.78	2.3%
UNITED STATES POLAR RESEARCH PROGRAMS	$274.18	$276.84	$319.41	$42.57	15.4%
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES	$67.54	$67.52	$67.52	$0.00	N/A
INTEGRATIVE ACTIVITIES	$163.52	$129.91	$134.90	$4.99	3.8%
Total, RESEARCH AND RELATED ACTIVITIES	$4,293.34	$4,220.55	$4,333.49	$112.94	2.7%
EDUCATION AND HUMAN RESOURCES					
MATH & SCIENCE PARTNERSHIP	$138.71	$79.36	$60.00	-$19.36	-24.4%
EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCoR)	94.24	93.68	94.00	0.32	0.3%
ELEMENTARY, SECONDARY AND INFORMAL SCIENCE EDUCATION	206.39	181.95	140.80	-41.15	-22.6%
Instructional and Assessment Materials Development	*29.32*	*28.52*	*19.00*	*-9.52*	*-33.4%*
Teacher & Student Development	*114.94*	*90.37*	*58.80*	*-31.57*	*-34.9%*
Informal Science Education	*62.13*	*63.06*	*63.00*	*-0.06*	*-0.1%*
UNDERGRADUATE EDUCATION	162.91	153.67	135.00	-18.67	-12.1%
Curriculum, Laboratory and Instructional Development	*94.16*	*94.41*	*80.00*	*-14.41*	*-15.3%*
Workforce Development	*68.75*	*59.26*	*55.00*	*-4.26*	*-7.2%*
GRADUATE EDUCATION	155.35	154.70	155.00	0.30	0.2%
HUMAN RESOURCE DEVELOPMENT	120.09	118.54	118.40	-0.14	-0.1%
Undergraduate/ Graduate Student Support	*67.64*	*70.37*	*70.40*	*0.03*	*0.0%*
Research & Education Infrastructure	*37.54*	*33.15*	*33.50*	*0.35*	*1.1%*
Opportunities for Women and Persons with Disabilities	*14.91*	*15.02*	*14.50*	*-0.52*	*-3.5%*
RESEARCH, EVALUATION AND COMMUNICATION	66.41	59.52	33.80	-25.72	-43.2%
Research	*54.31*	*50.20*	*29.30*	*-20.90*	*-41.6%*
Evaluation	*12.10*	*9.32*	*4.50*	*-4.82*	*-51.7%*
Total, EHR[2]	$944.10	$841.42	$737.00	-$104.42	-12.4%

NSF FUNDING BY PROGRAM

(Dollars in Millions)

PROGRAM	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change Over FY 2005 Amount	Change Over FY 2005 Percent
MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION	$183.96	$173.65	$250.01	$76.36	44.0%
SALARIES AND EXPENSES[3]	218.92	223.20	269.00	45.80	20.5%
NATIONAL SCIENCE BOARD	2.22	3.97	4.00	0.03	0.8%
OFFICE OF INSPECTOR GENERAL	9.47	10.03	11.50	1.47	14.7%
NATIONAL SCIENCE FOUNDATION	$5,652.01	$5,472.82	$5,605.00	$132.18	2.4%

Totals may not add due to rounding.

[1] OISE FY 2004 Actual includes $10.99 million provided to NSF by the U.S. Department of State for an award to the U.S. Civilian Research and Development Foundation.

[2] Excludes $57.28 million in FY 2004 and an estimated $100.0 million in FY 2005 and FY 2006 from H-1B Nonimmigrant Petitioner Fees.

[3] The FY 2004 Actual inlcudes a transfer of $260,500 from the U.S. Department of State for processing an award to the U.S. Civilian Research and Development Foundation.

NSF by Object Classification

OBJECT CLASSIFICATION

NSF Consolidated Budget by Object Classification
Obligations, in millions of dollars
(Includes All Appropriation Headings) [1]

Object Class Code	Standard Title	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request
11.1	Full-time permanent	105	113	121
11.3	Other than fulltime permanent	9	9	10
11.5	Other personnel compensation	6	6	6
11.8	Special personal service payment	2	2	2
	Total personnel compensation	122	130	139
12.1	Civilian personnel benefits	27	29	30
21.0	Travel and transportation of persons	16	21	23
23.1	Rental payments to GSA	19	20	22
23.3	Communications, utilities, and miscellaneous charges	2	1	1
25.1	Advisory and assistance services	65	66	71
25.2	Other services	10	11	12
25.3	Purchases of goods and services from Government accounts	15	15	15
25.4	Operation and maintenance of facilities	196	196	196
25.5	Research and development contracts	23	23	23
25.6	Medical Care	0	1	1
25.7	Operation and maintenance of facilities	24	18	36
26.0	Supplies and materials	3	3	3
31.0	Equipment	8	8	17
41.0	Grants, subsidies, and contributions	5,122	4,931	5,016
	Total, Direct obligations [2]	$5,652	$5,473	$5,605

Totals may not add due to rounding.
[1]Excludes obligations for the Donations Account.
[2]Excludes H-1B Nonimmigrant Petitioner obligations.

NSF Reimbursable Activity

REIMBURSABLE ACTIVITY

Reimbursements for the Research and Related Activities Appropriation and the Education and Human Resources Appropriation are realized from other federal agencies that have entered into interagency agreements with the Foundation. NSF enters into agreements (including Memoranda of Understanding) with other U.S. government agencies, as authorized by the NSF Act, 42 U.S.C. 1870 (c) and the Economy Act: 31 U.S.C. 1535, under which NSF assumes some responsibility for activities supported by these agencies. These activities can include jointly funded projects and programs, support of research operations and logistics, and access to NSF supported research facilities.

REIMBURSEMENTS BY AGENCY

(Dollars in Millions)

DEPARTMENT/AGENCY	FY 2004 Actual
DEFENSE	
Air Force	6.2
Army	6.9
Other DOD (DARPA, NSA & Intelligence Agency)	15.6
Navy	2.2
Subtotal, DOD	$30.9
Army Corp of Engineers	5.4
CIA	9.0
Commerce (Other than NOAA)	6.7
Education	1.1
Energy	9.2
EPA	0.5
Health & Human Services	16.6
Homeland Security	6.4
Library of Congress	0.8
NASA	14.9
National Archives	2.7
State	0.5
OTHER (less than $500,000)	2.3
TOTAL REIMBURSEMENTS	**$107.0**

Totals may not add due to rounding.

Since the 1980s, the number of interagency agreements NSF handles has increased dramatically. This increase is indicative of the growth in the breadth and complexity of the Foundation's programmatic activity. Consistent with applicable legislation and GAO decisions, agreements include reimbursement for costs that are incurred in the management and administration of these awards.

In FY 2004 the largest portion of NSF's reimbursable activity came from joint activities with the Department of Defense, (28.9 percent) the Department of Health and Human Services (15.5 percent) and the National Aeronautics and Space Administration (13.9 percent). Reimbursable activities with the Department of Defense were primarily for support of the Air Force's Advanced Electro-Optical System (AEOS) and Army's 4 Dimensional Weather System (4DWX). Reimbursable activities with the Department of Health and Human Services are for non-medical biological research such as the human frontiers science program and the protein data bank.

NSF Personnel Summary

PERSONNEL SUMMARY

	FY 2004 Actual
Full-Time Equivalent Employment (FTE)	1,274
Average GS Grade	10.85
Average Salary	$90,490

DETAIL OF PERMANENT APPOINTMENTS

	FY 2004 Actual
ES-5	79
AD	316
GS/GM-15	73
GS/GM-14	90
GS/GM-13	110
GS-12	91
GS-11	54
GS-10	11
GS-9	75
GS-8	64
GS-7	127
GS-6	15
GS-5	4
GS-4	0
Subtotal	714
Total Permanent Appointments	1,109
FTE	1,274

Explanation of NSF Carryover for FY 2005

EXPLANATION OF CARRYOVER FOR FY 2005

The National Science Foundation's total unobligated balance of $46.32 million from the FY 2004 Appropriation consists of amounts displayed below.

- Within the Research and Related Activities (R&RA) appropriation $6.56 million was carried forward into FY 2005. The Office of Polar Programs (OPP) portion totals $5.60 million and includes $2.74 million for Antarctic Logistics Support, $270,000 for the Operations Support Program and $2.20 million in unobligated recoveries. The Office of Integrative Activities (OIA) carried forward $425,955 for the Science and Technology Centers (STC) site visits. The Office of International Science and Engineering (OISE) carried forward $287,000 for the start-up costs for the NSF/China Office. The remaining amounts are from several awards in various programs that were not ready for obligation in FY 2004.

- Within the Education and Human Resources (EHR) appropriation $1.41 million was carried forward into FY 2005. This includes $1.0 million for the Louis Stokes Alliances for Minority Participation (LSAMP), $214,807 for Graduate Fellowships and $140,000 for the Presidential Awards for Excellence in Science, Mathematics, and Engineering Mentoring Program (PAESMEM). The remaining amounts are from several awards in various programs that were not ready for obligation in FY 2004.

- Within the Major Research Equipment and Facilities Construction (MREFC) appropriation $37.13 million was carried forward into FY 2005. This includes $37.13 million for the Office of Polar Programs (OPP) activity (i.e., $29.87 million for the South Pole Station Modernization, $115,000 for Polar Support Aircraft upgrades, and $34,418 for the South Pole Safety project, and $7.11 million for IceCube).

- Within the Office of Inspector General appropriation a total of $1.22 million was carried forward into FY 2005 to cover priority audits that are contracted out; fund contracts for financial analysis and other technical support for OIG investigations; provide contract support for information technology and other administrative needs of the office; fund personnel compensation costs; and protect the appropriation against unanticipated variations between obligations and expenditures.

Distribution of FY 2004 Carryover into FY 2005

(Dollars in Millions)

	FY 2005 Current Plan	FY 2005 Carryover from FY 2004	Adjusted Total FY 2005 Estimate
Research and Related Activities	4,220.55	6.56	4,227.11
Education and Human Resources[1]	841.42	1.41	842.83
Major Research Equipment and Facilities Construction	173.65	37.13	210.78
Salaries and Expenses	223.20	-	223.20
National Science Board	3.97	-	3.97
Office of Inspector General	10.03	1.22	11.25
Total	$5,472.82	$46.32	$5,519.14

Totals may not add due to rounding.

[1]Carryover excludes H-1B Nonimmigrant Petitioner Fees.

Full Budgetary Costing

NATIONAL SCIENCE FOUNDATION
FY 2006 CONGRESSIONAL REQUEST
FULL BUDGETARY COSTING

The tables below show two methods for allocating the full budgetary cost of the NSF FY 2006 Request. The first shows the full budgetary costs allocated to each of NSF's operating directorates. The second shows these costs allocated to three of NSF's strategic outcome goals: People, Ideas, and Tools. Organizational Excellence, NSF's fourth strategic goal encompasses the indirect costs to be allocated under full budgetary costing. These allocations represent initial steps, using readily available information, in NSF's plans to achieve the integration of budget, cost, and performance, consistent with the President's Management Agenda.

What is Full Budgetary Cost? OMB Circular A-11 defines "full-cost" as the sum of all budget resources used by an agency to achieve program outputs and outcomes. These include both *direct* program costs and *indirect* costs, which generally include administrative costs and other activities that are not directly attributable to a single program or activity. For two of NSF's appropriations, Research and Related Activities (R&RA) and Education and Human Resources (EHR), all funds are directly attributable to directorates and outcome goals. For NSF's other four appropriations, Major Research Equipment and Facilities Construction (MREFC), Salaries and Expenses (S&E), National Science Board (NSB), and the Office of Inspector General (OIG), the funds are distributed using the methodologies described below.

Allocation by Directorate

The current budget structure contains program activities within R&RA and EHR that equate to directorates. Therefore, R&RA and EHR funding is already aligned by directorate. MREFC funds projects are managed by a particular NSF directorate. Therefore, each MREFC project can be directly associated with a particular directorate. In addition, each managing directorate is responsible for the initial planning, design and follow-on operations and maintenance costs that are funded through R&RA. The MREFC program funds were assigned to the managing directorate responsible for oversight of a particular project. (Table 1)

All budget items funded through the S&E, NSB, and OIG appropriations accounts are defined as Organizational Excellence (OE) and are allocated to directorates. More than half of the S&E account can be precisely associated with an individual directorate. These S&E Direct budget items consist of distributed funding for travel, training, equipment, supplies, incentive awards and premium pay. Also, space rental and personnel compensation and benefits (PC&B) of employees in a particular directorate are attributed to that directorate in the financial accounting system.

Once S&E Direct budget items that are directly associated with a particular directorate have been assigned, then budget items associated with the Office of Information and Resource Management (IRM), Office of Budget, Finance and Award Management (BFA), the staff offices in the Office of the Director (OD), NSB, and OIG are allocated. These S&E Indirect budget items are allocated to a particular directorate based on its proportion of the total FY 2006 Request. The FY 2006 NSB and OIG budgetary costs are assigned using the same methodology as the S&E Indirect costs total. (Table 1)

Allocations by Strategic Outcome Goal

The full budgetary costing by People, Ideas, and Tools (PIT) was derived by using the same methodology as stated above, except the Direct S&E budget items, Indirect S&E budget items, and total NSB and OIG funding were assigned using the PIT percentages for each directorate. (Table 2)

FY 2006 FULL BUDGETARY COSTING
Table 1: Allocation of Major Research Equipment and Facilities Construction (MREFC), Salaries and Expenses (S&E), National Science Board (NSB), and the Office of Inspector General (OIG)
(Dollars in Thousands)

	BIO	CISE	ENG	GEO	MPS	SBE	OISE	OPP	IA	R&RA Total	EHR	TOTAL
FY 2006 CONGRESSIONAL REQUEST	**581,790**	**620,560**	**580,680**	**709,100**	**1,086,230**	**198,790**	**34,510**	**386,930**	**134,900**	**4,333,490**	**737,000**	**5,070,490**
MREFC												
ALMA Construction					49,240					**49,240**	-	**49,240**
EarthScope				50,620						**50,620**	-	**50,620**
HIAPER										**-**	-	**-**
IceCube Neutrino Observatory								50,450		**50,450**	-	**50,450**
NEES										**-**	-	**-**
NEON										**-**	-	**-**
RSVP					41,780					**41,780**	-	**41,780**
Scientific Ocean Drilling				57,920						**57,920**	-	**57,920**
South Pole Station										**-**	-	**-**
Terascale Computing Systems										**-**	-	**-**
MREFC Subtotals	**-**	**-**	**-**	**108,540**	**91,020**	**-**	**-**	**50,450**	**-**	**250,010**	**-**	**250,010**
Total Directorate FY 2006 Request including MREFC	**581,790**	**620,560**	**580,680**	**817,640**	**1,177,250**	**198,790**	**34,510**	**437,380**	**134,900**	**4,583,500**	**737,000**	**5,320,500**
Direct S&E												
Space Rental Direct	1,375	1,048	1,527	1,184	1,329	1,030	416	506	-	8,415	1,790	10,204
PC&B Direct	14,356	9,376	16,875	14,894	20,002	18,631	3,478	6,964	-	104,576	19,424	124,000
Distributed S&E Direct	1,355	1,602	1,449	1,296	1,731	738	368	683	-	9,222	1,121	10,343
Direct S&E Subtotals	**17,086**	**12,026**	**19,851**	**17,374**	**23,062**	**20,399**	**4,262**	**8,153**	**-**	**122,213**	**22,335**	**144,547**
Indirect S&E Cost Allocation	14,665	15,643	14,637	17,897	27,381	5,016	882	9,753	-	105,874	18,578	124,453
S&E Direct & Indirect Subtotals	**31,751**	**27,669**	**34,488**	**35,271**	**50,443**	**25,415**	**5,144**	**17,906**	**-**	**228,087**	**40,913**	**269,000**
NSB Allocation	**471**	**503**	**470**	**575**	**880**	**161**	**28**	**313**		**3,401**	**597**	**4,000**
OIG Allocation	**1,355**	**1,445**	**1,353**	**1,654**	**2,530**	**464**	**82**	**901**	**-**	**9,784**	**1,717**	**11,500**
NSF TOTAL	**615,367**	**650,177**	**616,991**	**855,140**	**1,231,103**	**224,830**	**39,764**	**456,500**	**134,900**	**4,824,772**	**780,227**	**5,605,000**

FY 2006 FULL BUDGETARY COSTING
Table 2: Allocation by People, Ideas, and Tools
(Dollars in Thousands)

Total Directorate FY 2006	**BIO**	**CISE**	**ENG**	**GEO**	**MPS**	**SBE**	**OISE**	**OPP**	**IA**	**R&RA**	**EHR**	**TOTAL**
People	66,765	80,046	93,777	34,530	122,931	12,702	9,892	7,723	9,500	437,866	611,632	**1,049,499**
Ideas	424,520	426,765	487,385	415,787	732,158	165,678	29,872	81,579	31,900	2,795,644	152,467	**2,948,111**
Tools	124,082	143,366	35,829	404,823	376,014	46,450	-	367,198	93,500	1,591,262	16,128	**1,607,390**
FULL BUDGETARY COST	**615,367**	**650,177**	**616,991**	**855,140**	**1,231,103**	**224,830**	**39,764**	**456,500**	**134,900**	**4,824,772**	**780,227**	**5,605,000**

Subtotals may not add due to rounding.

Changes Between FY 2005 Request and FY 2005 Current Plan

CHANGES BETWEEN FY 2005 REQUEST AND FY 2005 CURRENT PLAN

The FY 2005 Current Plan for the National Science Foundation is $5,472.82 million, or 4.7 percent less than requested. This represents a decrease of $179.19 million, from the FY 2004 Actual of $5,652.01 million. Funding levels for the FY 2005 Current Plan include the 0.80 percent rescission.

Changes Between FY 2005 Request and FY 2005 Current Plan

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Request	FY 2005 Current Plan	Change between FY 2005 Current Plan & FY 2005 Request Amount	Percent
Research & Related Activities	4,293.34	4,452.31	4,220.55	-231.76	-5.2%
Education & Human Resources[1]	944.10	771.36	841.42	70.06	9.1%
Major Research Equipment	183.96	213.27	173.65	-39.62	-18.6%
Salaries & Expenses	218.92	294.00	223.20	-70.80	-24.1%
National Science Board	2.22	3.95	3.97	0.02	N/A
Office of Inspector General	9.47	10.11	10.03	-0.08	-0.8%
Total, NSF	$5,652.01	$5,745.00	$5,472.82	-$272.18	-4.7%

Totals may not add due to rounding.

[1] MSP was included in R&RA for the FY 2005 Request at $80.0 million, but was funded out of EHR in the FY 2005 Current Plan.

The FY 2005 Current Plan for the **Research and Related Activities** (R&RA) Appropriation is $4,220.55 million, a decrease of 5.2 percent from the FY 2005 Request.

The FY 2005 Current Plan within the Directorate for Biological Sciences includes $94.24 million for plant genome research, and $5.95 million for continued planning and design activities for the National Ecological Observatory Network (NEON), as recommended by the National Academies report. Funding for NEON was requested in the MREFC Account, but is provided in the R&RA Account.

Within the Directorate for Computer and Information Science and Engineering (CISE), all divisions are funded at the FY 2005 Request level, corresponding to an increase of approximately 14 percent for core information technology (IT) programs. The Information Technology Research Subactivity is reduced by $4.33 million from the FY 2005 Request. Within this account, funds previously invested in IT research broadly defined are targeted to specific IT research and education emphases, including an additional $10.0 million increase for new cybersecurity awards that respond to the Cybersecurity Research and Development Act, and a $3.0 million increase for cyberinfrastructure research.

The FY 2005 Current Plan within the Directorate for Engineering includes $127.77 million for the Nanoscale Science and Engineering priority area; $19.54 within the Division of Civil and Mechanical Systems to initiate operations for the George E. Brown, Jr., Network for Earthquake Engineering Simulation (NEES), and $102.76 million for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs.

The FY 2005 Current Plan within the Directorate for Mathematical and Physical Sciences will provide $2.50 million for design and development of the Giant Segmented Mirror Telescope; and $2.30 million for continued design and development for the Rare Symmetry Violating Processes (RSVP) project. The MPS Current Plan also includes a $132.14 million contribution to the National Nanotechnology Initiative.

Of appropriated funding for Social, Behavioral and Economic Sciences, $30.90 million will target the expansion of the Human and Social Dynamics (HSD) priority area. Total NSF funding for HSD is $38.25 million in FY 2005.

Of funds provided for Integrative Activities at the FY 2005 level, $89.28 million will be provided for Major Research Instrumentation. Two new Science and Technology Centers will be initiated at $6.0 million.

The Directorate for **Education and Human Resources** (EHR) will be funded at $841.42 million, an increase of 9.1 percent over the FY 2005 Request. Within the FY 2005 Request, funding for the Math and Science Partnership was included in the Integrative Activities line within Research and Related Activities. Congress appropriated the funds within the EHR Account. MSP funding is reflected in the EHR Account in the FY 2004 Actual and the FY 2005 Current Plan. If the FY 2005 Request for EHR is changed to match Congressional action it would include the funds for MSP (for a revised EHR total of $851.36 million) and would show the change to the Current Plan is a negative $9.94 million, which is an overall reduction of EHR of 1.2 percent.

Of the amount appropriated for Elementary, Secondary and Informal Education, $63.06 million has been provided for the Informal Science Education program. Within the level of funding for Undergraduate Education, $45.14 million will be provided for the Advanced Technological Education program, $25.28 million for the STEM Talent Expansion Program, and $7.89 million for the Noyce Scholarship Program.

Within the funding level for Human Resource Development $35.02 million will be provided for the Louis Stokes Alliances for Minority Participation, $25.22 million for the Historically Black Colleges and Universities Undergraduate program (HBCU-UP), $14.79 million for the Alliance for Graduate Education and Professoriate, and $15.87 million for the Centers of Research Excellence in Science and Technology (CREST) program.

The **Major Research Equipment and Facilities Construction** (MREFC) Account is funded at $173.65 million, a decrease of 18.6 percent from the FY 2005 Request. Within MREFC, $49.30 million will be provided for construction of the Atacama Large Millimeter Array (ALMA) radio telescope, $46.97 million for EarthScope, $47.62 million for the IceCube Neutrino Detection project, $14.88 million for the Scientific Ocean Drilling Vessel, and $14.88 million for the Rare Symmetry Violating Processes (RSVP) project. Additionally, NSF will continue to refine the National Ecological Observatory Network (NEON) plan from funds provided under Research and Related Activities.

The **Salaries and Expenses** (S&E) appropriation totals $223.20 million. These funds provide for the operation, management, and direction of all Foundation programs and activities, and include necessary funds to develop and coordinate NSF programs.

The **National Science Board** (NSB) will be funded at $3.97 million.

The **Office of Inspector General** (OIG) will be funded at $10.03 million.

Quantitative Data Tables

NATIONAL SCIENCE FOUNDATION
Research and Development Special Analysis

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
Support of R&D	(Dollars in Thousands)		
Conduct of Research and Development			
Basic Research	$3,505,051	$3,415,893	$3,464,304
Applied Research	265,618	279,062	276,308
Development	0	0	0
Subtotal, Conduct of R&D	3,770,669	3,694,955	3,740,612
R&D Facilities			
Land, Building and Fixed Equipment	13,273	16,310	17,179
Major Equipment	382,085	346,038	412,174
Subtotal, R&D Facilities & Major Equipment	395,358	362,348	429,353
Total, Support of R&D	4,166,027	4,057,303	4,169,965
Non-Investment Activities	544,719	567,247	664,062
Education and Training	941,263	848,270	770,973
TOTAL	$5,652,009	$5,472,820	$5,605,000

Totals may not add due to rounding.

RESEARCH AND RELATED ACTIVITIES
Research and Development Special Analysis

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
Support of R&D		(Dollars in Thousands)	
Conduct of Research and Development			
Basic Research	$3,378,569	$3,295,893	$3,364,304
Applied Research	240,691	259,062	261,308
Development	0	0	0
Subtotal, Conduct of R&D	3,619,260	3,554,955	3,625,612
R&D Facilities			
Land, Building and Fixed Equipment	13,273	16,310	17,179
Major Equipment	197,309	172,388	162,164
Subtotal, R&D Facilities & Major Equipment	210,582	188,698	179,343
Total, Support of R&D	3,829,842	3,743,653	3,804,955
Non-Investment Activities	303,356	322,047	371,562
Education and Training	160,139	154,850	156,973
TOTAL	$4,293,337	$4,220,550	$4,333,490

Totals may not add due to rounding.

EDUCATION AND HUMAN RESOURCES
Research and Development Special Analysis

	FY 2004 Actual	FY 2005 Estimate	FY 2005 Estimate
Support of R&D	(Dollars in Thousands)		
Conduct of Research and Development			
Basic Research	$126,482	$120,000	$100,000
Applied Research	24,927	20,000	15,000
Development	0	0	0
Subtotal, Conduct of R&D	151,409	140,000	115,000
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	812	0	0
Subtotal, R&D Facilities & Major Equipment	812	0	0
Total, Support of R&D	152,221	140,000	115,000
Non-Investment Activities	10,760	8,000	8,000
Education and Training	781,124	693,420	614,000
TOTAL	$944,105	$841,420	$737,000

Totals may not add due to rounding.

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION
Research and Development Special Analysis

	FY 2004 Actual	FY 2005 Estimate	FY 2005 Estimate
Support of R&D		(Dollars in Thousands)	
Conduct of Research and Development			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	183,964	173,650	250,010
Subtotal, R&D Facilities & Major Equipment	183,964	173,650	250,010
Total, Support of R&D	183,964	173,650	250,010
Non-Investment Activities	0	0	0
Education and Training	0	0	0
TOTAL	$183,964	$173,650	$250,010

Totals may not add due to rounding.

SALARIES AND EXPENSES
Research and Development Special Analysis

	FY 2004 Actual	FY 2005 Estimate	FY 2005 Estimate
Support of R&D	(Dollars in Thousands)		
Conduct of Research and Development			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities	218,916	223,200	269,000
Education and Training	0	0	0
TOTAL	$218,916	$223,200	$269,000

Totals may not add due to rounding.

OFFICE OF INSPECTOR GENERAL
Research and Development Special Analysis

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
Support of R&D		(Dollars in Thousands)	
Conduct of Research and Development			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities	9,469	10,030	11,500
Education and Training	0	0	0
TOTAL	$9,469	$10,030	$11,500

Totals may not add due to rounding.

NATIONAL SCIENCE BOARD
Research and Development Special Analysis

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Estimate
Support of R&D		(Dollars in Thousands)	
Conduct of Research and Development			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities	2,218	3,970	4,000
Education and Training	0	0	0
TOTAL	$2,218	$3,970	$4,000

Totals may not add due to rounding.