National Science Foundation

Summary of the FY 2003 Budget Request to Congress

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National Science Foundation
Budget Overview
FY 2003

The National Science Foundation requests $5.036 billion for FY 2003, $239.9 million or 5.0 percent over FY 2002. The priorities established in this Budget Request take into account both growing needs and expanding opportunities for high-impact investments to strengthen U.S. world leadership in science, engineering and technology. They aim to keep the nation's science and engineering enterprise healthy, dynamic, and relevant.

NSF Funding by Appropriation
(Millions of Dollars)

	FY 2002 Current Plan	FY 2003 Request	Percent Change
Research and Related Activities	3,598.64	3,783.21	5.1%
Education and Human Resources [1]	875.00	908.08	3.8%
Major Research Equipment & Facilties Construction	138.80	126.28	-9.0%
Salaries and Expenses	176.40	210.16	19.1%
Office of Inspector General	7.04	8.06	14.5%
Total, NSF [2]	$4,795.88	$5,035.79	5.0%

Totals may not add due to rounding.

[1] Does not include estimates of $90 million in FY 2002 and $92.5 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees.
[2] The figures shown for Salaries and Expenses (S&E) and the Office of Inspector General (OIG) include pension and health costs as proposed by the Administration's Cost Integration Legislation, requiring agencies to pay their full share of accrued costs of retirement beginning in FY 2003. Net of these additional amounts, the adjusted totals for FY 2003 are $202.95 million for S&E, $7.70 million for OIG, and $5,028.21 million for the NSF total. The FY 2002 figures also include the accrual amounts.

Productivity growth in the 1990s – powered by new knowledge and driven by technological innovation – makes the economic benefits of a comprehensive fundamental research and education enterprise abundantly clear. New products, processes and entire new industries depend upon rapid advances in research. In the highly competitive global economy, continued progress in science and engineering is the principal path to continuing U.S. leadership.

The events of September 11th and subsequent anthrax attacks demonstrate that a nation strong in science and technology can respond rapidly and effectively to crises and changing national circumstances. Fundamental research across the full spectrum of science and engineering disciplines, together with the highly skilled workforce that makes research and innovation possible, provides the knowledge capital for the nation to draw upon in times of exceptional need. A growing stock of knowledge focused on the frontiers of research increases the options available for response. A talented and highly skilled science and engineering workforce accelerates the development of new technologies to meet unexpected needs.

Shoebox-sized robots – developed with NSF funding – were key additions to the search and rescue efforts at the World Trade Center following September 11. They were able to reach areas of the collapsed structures that were inaccessible to rescue workers and dogs.

Photo Credit: University of South Florida

The capacity to advance economic prosperity, ensure homeland security, and raise the quality of life for all citizens depends critically on the nation's science and engineering talent. Technology is now prevalent throughout society, in our daily lives and in the workplace. As the pace of technological change has accelerated, more sophisticated skills are needed in nearly every profession and across all levels of education. NSF investments reflect a commitment to the integration of education and research that addresses these challenges. Although NSF accounts for under 4 percent of federal research and development spending, it supports roughly 50 percent of the non-medical fundamental research at our colleges and universities. These funds support the work of over 200,000 scientists, engineers, teachers and students every year.

People, Ideas, and Tools: NSF Strategic Goals

NSF aims to increase the productivity of the nation's research and education enterprise through priority investments linked directly to three strategic goals, expressed simply as People, Ideas, and Tools. These goals reflect outcomes at the heart of the research enterprise: a world-class science and engineering workforce; the generation of new knowledge across the frontiers of science and engineering; and the tools to get the job done efficiently and effectively.

NSF Budget by Strategic Goal
(Millions of Dollars)

	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate
People [1]	894.29	993.50	1,086.70
Ideas	2,296.87	2,431.07	2,559.44
Tools	1,054.99	1,144.62	1,121.50
Administration and Management [2]	213.72	226.68	268.14
Total, NSF	$4,459.87	$4,795.88	$5,035.79

Totals may not add due to rounding.

[1] Does not include $78.5 million in FY 2001, and estimates of $90 million in FY 2002 and $92.5 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees.

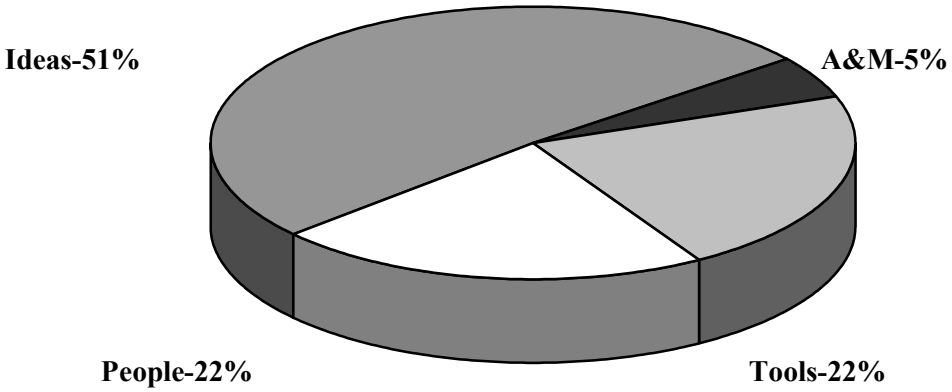
[2] The figures shown for Administration and Management (A&M) include pension and health costs as proposed by the Administration's Cost Integration Legislation, requiring agencies to pay their full share of accrued cost of retirement beginning in FY 2003. Net of these additional amounts, the adjusted totals for FY 2003 are $260.57 million for A&M, and $5,028.21 million for the NSF total. The FY 2002 figures also include the accrual amounts.

NSF facilitates significant discoveries at the frontiers of knowledge by quickly recognizing and flexibly responding to changing and emerging research areas and educational needs. Continuous dialogue with the community of researchers assures a wide variety of high quality investigations that lead to new knowledge. This uniquely effective, collaborative mode of operation is even more critical today to ensure the optimal use of limited funds as the pace of scientific discovery increases.

People produce the Ideas that are the currency of the new knowledge-based economy. The need for more sophisticated Tools has paralleled recent advances in science and engineering, creating a growing demand for access to them. NSF's overall strategy is to invest in state-of-the-art tools that add unique value to research and are accessible and widely shared among researchers across the nation.

The FY 2003 Budget Request provides $1.1 billion for programs specifically addressing the NSF strategic goal of People; $2.6 billion for Ideas; and $1.1 billion for Tools. The request also includes a $268.1 million investment in Administration and Management, which responds to priorities outlined in the *President's Management Agenda*.

FY 2003 Budget Request of $5.04 Billion



Highlights and Priorities

Investing in Top Talent

A highly skilled, diverse science and engineering workforce is a principal driver of growth in our knowledge-based economy. Since NSF's inception in 1950, 23 former NSF graduate fellows have gone on to receive the Nobel Prize.

The FY 2003 Budget Request provides approximately $37 million to increase annual stipends and the number of students in the Graduate Research Fellowships, Graduate Teaching Fellowships in K-12 Education, and Integrative Graduate Education and Research Traineeships (IGERT) programs. Stipends will rise from $21,500 to $25,000 for academic year 2003-2004, continuing the program of gradual increases initiated in FY 2001.

Attracting more of the nation's most promising students into graduate level science and engineering is NSF's highest priority. However, several factors are discouraging students from pursuing advanced degrees, including:

- Average starting salaries for students holding a Bachelor's degree in science or engineering are nearly twice the level of current stipends for graduate students.
- Debt incurred by U.S. undergraduates has more than doubled in the 1990s.

The low level of stipends, combined with the increasing burden of debt, acts as a deterrent, limiting the number of students choosing to pursue advanced studies. These problems are particularly prevalent among minority students, who are far more likely to borrow for undergraduate study.

Previous increases in stipends have already produced results. Applications to the NSF Graduate Research Fellowship program, which had decreased by nearly 40 percent during the 1990s, are increasing once again as stipend levels have risen from $15,000 in 1999 to $21,500 for academic year 2002-2003.

Furthermore, the need to encourage the best students – at all educational levels – to pursue studies in science, technology, engineering and mathematics extends well beyond graduate education. Two NSF programs target undergraduate students. The Noyce Scholarships ($4.0 million) will address the shortage of highly trained K-12 teachers by funding talented mathematics, science and engineering students who wish to pursue teaching careers in elementary or secondary schools. The Science, Technology, Engineering and Mathematics Talent Expansion Program ($2.0 million), established in FY 2002, provides grants to colleges and universities to implement programs designed to increase the number of undergraduate math and science majors.

Math and Science Partnership (MSP)

The FY 2003 Budget Request proposes $200.0 million for the second year of the Math and Science Partnership program, part of a five-year investment of about $1.0 billion.

America's future prosperity and security can be assured only if all of the nation's children have the opportunity to develop their talents and realize their full potential. High levels of achievement in math and science at the preK-12 levels are increasingly necessary for success in the complex, high technology workplace of the 21st Century.

The MSP brings states and local school districts together with the science, engineering, mathematics and education departments of institutions of higher education to strengthen preK-12 math and science education. Recent successes with systemic reform efforts in urban and rural schools demonstrate that significant improvements in student achievement can be sustained through the application of evidence-based approaches to math and science education.

The Math and Science Partnership program will build on these efforts through experimental approaches to the improvement of teacher preparation and professional development, and through building the capacity of schools to provide a challenging curriculum for every student. The partnership also aims to increase the number, quality and diversity of preK-12 math and science teachers. By integrating participants into a national network of educational researchers and teachers, the program will improve the national capacity to analyze, evaluate and apply promising approaches to math and science education.

Climate Change Research Initiative

As part of the Administration's new multi-agency Climate Change Research Initiative, NSF will implement a $15.0 million program of research to advance understanding in highly focused areas of climate science in FY 2003. The initiative aims to reduce uncertainty in critical areas of climate change and provide timely information to facilitate policy decisions.

NSF's investments will support investigations in four areas:

- Advancing our understanding of the carbon cycle;
- Improving our ability to manage the risks associated with climate change and to make sound decisions, despite uncertainty;
- Developing sensors to measure carbon dioxide and methane; and
- Measuring and understanding the impact of black carbon.

The initiative will include the development of improved sensors and diagnostic systems for observing, modeling, and analyzing carbon dioxide, methane, and other greenhouse gases in the atmosphere, the oceans, and terrestrial environments, including soils. As part of this effort, better data on black carbon particles, a significant source of aerosols in the atmosphere, will be collected and integrated into climate models to gain a better understanding of the magnitude of their effect on climate.

These studies will also incorporate a vigorous modeling and data synthesis effort to improve and refine climate change models. Research on risk communication and management, together with the development of information bases and improved tools to support decisions, will enhance national capacity to make informed policy decisions on climate change. Through workshops and consultation with the community, NSF will develop consensus on promising research directions in these areas, and establish 3 to 4 interdisciplinary risk management research centers. These focused investigations will complement NSF's ongoing programs in climate change science.

Recent studies in Antarctica's Dry Valleys found a unique, distinct cooling trend over the last 35 years. Conversely, warming has been documented on other parts of the continent, notably the Antarctic Peninsula. All of this information has proven vital to studies of the global climate.

Photo credit: Peter Doran/National Science Foundation

Priority Areas

NSF Funding by Priority Area
(Dollars in Millions)

Priority Area	FY 2002 Current Plan	FY 2003 Request	Percent Change
Biocomplexity in the Environment	58.10	79.20	36.3%
Information Technology Research	277.52	285.83	3.0%
Nanoscale Science and Engineering	198.71	221.25	11.3%
Learning for the 21st Century Workforce	144.82	184.69	27.5%
Mathematical Sciences	30.00	60.09	100.3%
Social, Behavioral and Economic Sciences	0.00	10.00	NA
Total, Priority Areas	$709.15	$841.06	18.6%

Totals may not add due to rounding.

NSF investments are focused on the frontiers of knowledge, where discovery and innovation are likely to produce significant progress. In addition to a balanced portfolio of investments that maintain the vitality

of core disciplines, NSF identifies and supports emerging opportunities that hold exceptional promise to advance knowledge. Investments in each of these priority areas support a broad range of promising research directions and platforms in developing areas of science and engineering. NSF's objective is to provide the sustained level of investment necessary to move research forward rapidly, while training the cadre of scientists and engineers who maintain research momentum and transfer research results to industry.

NSF's FY 2003 Budget Request includes a new Mathematical Sciences priority area, provides seed funding for a new priority area in the Social, Behavioral and Economics Sciences, and sustains funding for four established priority areas: Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, and Learning for the 21st Century Workforce.

Mathematical Sciences ($60 million): Mathematics is both a powerful tool for insight and a common language for science and engineering. Underlying recent progress in genomics, information technologies, and climate science are powerful new mathematical and statistical tools and applications. These tools enable scientists and engineers to tackle a broad range of scientific and technological challenges long considered intractable.

In addition to fundamental research in the mathematical and statistical sciences, the Mathematical Sciences priority area will support the integration of mathematics and statistics research and education across the full range of science and engineering disciplines. Investigations will focus on the challenges posed by large data sets such as those generated by research on genomes, and by today's sophisticated sensors and satellite observation systems, including seismic and global oceanic and atmospheric observational networks. Other studies will produce improved methods for assessing uncertainty, and enhance our ability to forecast extreme or singular events, improving the safety and reliability of such systems as power grids, the Internet and air traffic control.

The development of new mathematical tools is also needed to analyze and predict emergent complex behavior in interacting systems, from social behaviors to brain function, and from communication networks to multi-scale business information systems.

Social, Behavioral and Economic Sciences ($10 million): The FY 2003 Budget Request provides seed funding for a new priority area in the Social, Behavioral and Economic Sciences that explores the complex interactions among society, its institutions, and technology. This priority area aims to enable our society to take greater advantage of technology and to anticipate and prepare for its consequences. Deeper understanding of these dynamics can inform a wide range of 21st Century phenomena, from innovation to globalization, from the risks and benefits of new technologies to adaptation to rapid change, with a special emphasis on global change research.

Recent advances in information technologies and quantitative and experimental methods have paved the way for major advances in these fields. One research area will explore human information and language processing, cognition, learning and decision-making to provide advances that could drive new technologies to enhance these basic human capabilities. Other studies will extend recent research in game theory and experimental methods that has produced a better understanding of market performance and has led to the improvement of electromagnetic spectra auctions. A special emphasis will be on decision-making under uncertainty as part of the President's Climate Change Research Initiative.

Biocomplexity in the Environment ($79 million): This priority area focuses on the complex interdependencies of natural and human systems in the environment at scales ranging from microscopic to global. The use of advanced scientific and technological capabilities – including genomics, computational and information technologies, and real time sensing techniques – is beginning to yield a

wealth of data about the environment and promises to significantly improve our ability to forecast outcomes of multiple interactions and thus expand the knowledge base relied on by decision makers. Because of the growing urgency of environmental questions for national security and quality of life, development of superior ways to study, explore, and model complex environmental processes is increasingly important.

Two new emphasis areas this year are microbial genome sequencing and ecology of infectious diseases. Research in both of these areas will contribute knowledge needed to develop strategies to assess and manage the risks of infectious diseases, invasive species, modified organisms, and biological weapons. Research on the dynamic links and feedbacks among biophysical and socioeconomic systems and on the links between geophysical cycles, humans and other biotic factors will continue. Other interdisciplinary investigations will hasten development and application of powerful new molecular, bioinformatic and computational methods and technologies. Attention in this priority area will also be given to understanding the processes, systems, and social structures that optimize the use of materials throughout their life cycles, from natural resource to consumer use and reuse. The FY 2003 Budget Request in this area builds on past investments in core disciplines and in biocomplexity, that is, the remarkable and dynamic web of interrelationships that arise when living things at all levels interact with their environment

Information Technology Research ($286 million): Information technology has become pervasive in our public and private lives through basic scientific and engineering advances. Yet only a small portion of its potential to transform commerce, learning and government has been tapped.

NSF's Information Technology Research (ITR) priority area, entering its fourth year in FY 2003, will exploit and deepen fundamental research at the interface between fields and disciplines. From the investigation, development, and strengthening of large-scale networks to the creation of new integrative software and advanced architectures for high-end computing, ITR will support a wide-range of research to expand the benefits of IT across the national economy and society.

Studies will continue to explore new applications to advance research across all fields. Other research will focus on providing a sound basis for assured construction and certification of safe, trusted computing systems in interconnected environments – needed both to support business applications and to provide security for cyberinfrastructure. An emphasis on the interactions between humans and computers will advance understanding of the educational impacts and uses of IT, and of issues in IT literacy and IT workforce development, including a focus on barriers and impediments to IT careers among women, minorities, and other underrepresented groups. Research will address fundamental questions about the efficacy of IT in education, examine theories and models of learning, and integrate cutting-edge IT research into curricula and classrooms. ITR will also support the creation of digital library collections and the development of advanced technologies for managing and working with digital information.

Nanoscale Science and Engineering ($221 million): Nanoscale science and engineering -- the systematic organization, manipulation and control of matter at atomic, molecular and supramolecular levels -- promises revolutionary advances in pharmaceuticals, more efficient manufacturing, higher performance materials, faster computers and networks, a cleaner environment with sustainable development, and improved defense. NSF plans to support a wide range of fundamental research and educational activities in this priority area, including approximately fifteen nanotechnology research and education centers, which focus on electronics, biology, optoelectronics, advanced materials and engineering.

In its third year, this priority area will emphasize long-term, fundamental research aimed at discovering novel phenomena, processes and tools. One research area will focus on the study of biologically based

systems, with potential applications in drug delivery, materials for implants, and nanoscale sensor systems, such as early cancer detection devices. Another will explore nanoscale physical and chemical processes related to trapping and release of nutrients and contaminants in the natural environment, with potential benefits for clean energy and pollution control.

Other investigations will contribute to the creation of new materials and functional nanoscale structures, with applications in quantum computing and advanced communications and information technologies. Support for innovative educational models will ensure a cadre of scientists and engineers well versed in this emerging field, and research on the implications of nanotechnology for society will contribute to its responsible development and application.

Learning for the 21st Century Workforce ($185 million): Continuing U.S. leadership in the global economy is increasingly dependent on a highly skilled and diverse science, technology, engineering and mathematics workforce. Citizens will need greater understanding in all these fields to meet the requirements of the high technology workplace, reap the benefits of a growing economy, and participate effectively in public policy decisions. This priority area aims to improve our understanding of learning processes through research and to enhance the synergy of understanding and practice through applications and explorations in learning environments and workforce development contexts.

The centerpiece of the FY 2003 investment in this priority area is the new Science of Learning Centers activity. This program creates multidisciplinary, multi-institutional centers to expand our understanding of learning through research on the learning process, the context of learning and learning technologies. The centers will serve as national resources, and will play a critical role in the demonstration of effective workforce preparation strategies. NSF expects to support three to four centers and provide seed funding for a number of projects that could eventually develop into centers.

Other activities in this priority area will explore the potential of information technology to enhance learning, and create activities to strengthen the links between formal and informal education and across educational levels. Investment in Centers for Learning and Teaching will provide lifelong learning opportunities for the instructional workforce in contexts supported by information technology tools and by research on learning, science and mathematics.

Core Investments

NSF ensures the vitality of "core" research and education activities across all disciplines and educational levels by supporting the best ideas in science, engineering, mathematics and technology. One of NSF's enduring strengths is its reliance on merit-based competitive processes to identify the most promising research directions. Each year NSF can fund only about one-third of the proposals submitted for consideration, but many more are highly rated in the peer review process. Investments in core research and education advance the frontiers of knowledge on a broad front, providing the knowledge needed to make progress in established fields, as well as fuel new research areas and contribute to emerging interdisciplinary fields.

A major focus for NSF core funding in FY 2003 will be an increase in average annual grant size to $125,000. In constant dollars, the average size of NSF grants has been falling for many years. An increase is needed to improve the efficiency and effectiveness of the science and engineering community. Implementing this increase in grant size may have an effect on the number of grants awarded, but will lead to greater research productivity. Over the longer term, NSF intends to address the need to increase the duration of grants as well. The average duration is currently 2.9 years, too short to achieve results in many promising areas of research. Improving both grant size and duration are important long-term priorities for NSF.

NSF is in the process of conducting two surveys to obtain the views of the U.S. research community on award size and duration issues. The surveys will be conducted with principal investigators receiving NSF grants in FY 2001 as well as representatives from the principal investigators' respective institutions. The results from the surveys will help NSF improve the efficiency of the proposal and award process and will be used in the formulation of the FY 2004 budget.

Major Research Equipment and Facilities Construction

The Major Research Equipment and Facilities Construction (MREFC) Account will fund two new projects in FY 2003:

- **EarthScope**: The Budget Request provides funding of $35.0 million for EarthScope, an earthquake detection and research network, to investigate the structure and evolution of the North American continent and the physical processes controlling earthquake and volcanic eruptions. EarthScope will use state-of-the-art technology to gather data that will be used to assess and mitigate national risks associated with earthquakes, volcanic eruptions, and landslides.

- **NEON**: Funding of $12.0 million for FY 2003 will be provided to establish two prototype sites of the National Ecological Observatory Network (NEON). NEON will develop and deploy cutting-edge data collection and monitoring tools, and will construct integrated models of ecosystem function and dynamics. Sites will share data and resources through high-speed Internet connections. When fully implemented, NEON will provide the capability to integrate ecological data and deepen understanding of complex ecosystem dynamics at the local, regional, and national levels. Data gathered, monitored, analyzed and modeled will establish a baseline against which to detect abrupt changes or long-term trends, such as climate change, and enhance our ability to predict their effects. In this way, NEON could act as an early detection system for a wide array of biological and chemical threats, from invasive species to chemical and biological warfare agents.

In addition to the two new projects already described, the MREFC Account for FY 2003 will fund five continuing projects:

- ALMA, Phase II: ($30.0 million);

- Large Hadron Collider ($9.7 million);

- Network for Earthquake Engineering Simulation ($13.6 million);

- South Pole Station Modernization ($6.0 million); and

- Terascale Computing Systems ($20.0 million).

In January 2002, the National Science Foundation (NSF) joined its international partners in dedicating Gemini South, the second of the two Gemini telescopes to become operational.

Photo Credit: Gemini Observatory

Additional FY 2003 Highlights

EPSCoR: Funding for the Experimental Program to Stimulate Competitive Research (EPSCoR) will total approximately $105.0 million in FY 2003. This includes $75.0 million provided through the Education and Human Resources Appropriation, and approximately $30.0 million provided through NSF's Research and Related Activities Account. EPSCoR builds the capacity of educational institutions to compete more effectively for research funds, and enables researchers from these institutions to participate more fully in NSF research activities.

Partnerships for Innovation: Funding for the Partnerships for Innovation (PFI) program is provided in FY 2003 at a level of $5.0 million for a total investment of $34.5 million since the inception of the program in FY 2000. The PFI program builds innovation capacity by linking new knowledge and knowledge-rich workforce to economic growth and other societal benefits through the partnership endeavors of a diverse range of colleges and universities, private sector firms, local, state, and federal government entities and other organizations.

Plant Genome Research Program: The FY 2003 budget provides $75.0 million to support ongoing research on the genomics of plants of major economic importance. Working in virtual centers (centers without walls), multi-investigator teams will focus on functional genomics, large-scale sequencing, and developing tools and resources for plant genomics studies. To increase the participation of new investigators in plant genome research, a program of Young Investigator Awards in Plant Genome Research will be established.

Increasing Management Efficiency/Administration and Management: The FY 2003 request includes a $268.1 million investment in NSF's Administration and Management (A&M) portfolio, a $41.5 million (18 percent) increase. This includes funding for 67 additional full-time equivalent positions (FTE) – the first increase in more than a decade, as well as significant new investments in leading-edge information technology systems, to advance NSF's leadership in e-government.

This request reflects findings from the first stages of a comprehensive, strategic assessment of NSF's A&M responsibilities. This framework for this assessment is based on the five government-wide, mutually-reinforcing goals stated in the *President's Management Agenda*:

- Strategic Management of Human Capital
- Budget and Performance Integration
- Competitive Sourcing
- Expanded e-Government
- Improved Financial Management.

Over its 50-plus year history, NSF's commitment to excellence in supporting research and education has consistently been matched by its high standards and commitment to innovation in administration and management. Continuing this tradition of excellent stewardship requires a level of investment that reflects NSF's increasing responsibilities, the growing complexity of its workload, and new requirements for both IT and physical security.

Transfers from Other Agencies

In FY 2003, three programs are proposed to be transferred to the NSF from other agencies:

- Environmental Education formerly at the Environmental Protection Agency ($9.0 million). This will establish a comprehensive program that will fund a broad suite of environmental science education activities at the preK-12 level, in informal education venues, and at the undergraduate level.

- National Sea Grant program formerly at the National Oceanic and Atmospheric Administration ($57 million). The National Sea Grant program was originally developed at NSF in the 1960s. NSF will re-establish and operate it as a competitive, merit-based research, education, and outreach program focused on development of marine resources.

- Hydrology of Toxic Substances formerly at the United States Geological Survey ($10 million). NSF will establish new activities focused on the science of water quality at the interface of natural and human systems. Based on the USGS Toxics program, this new effort in water quality will be reoriented to focus on the fundamental processes affecting water quality.

For each of these programs, NSF will work in partnership with the relevant agencies to sustain each program's major objectives while incorporating NSF's experience with merit-based, competitive processes.

Summary of NSF Accounts

Research and Related Activities

The Research and Related Activities (R&RA) Account supports activities that enable the U.S. to provide leadership and promote progress across the expanding frontiers of scientific and engineering research and education. These activities support areas of inquiry critical to long-term U.S. economic strength, security, and quality of life. Research activities spur new knowledge, ideas, tools and approaches that open doors to understanding and solving problems and offer increased opportunities for economic growth. Moreover, as students work alongside senior staff performing research activities, there is a natural integration of research and education as students acquire the skills necessary to perform world-class research and become members of the next generation's workforce of scientists and engineers. NSF investments in R&RA reflect the Foundation's three strategic goals: People, Ideas and Tools.

The FY 2003 Request for R&RA totals $3.78 billion, a $184.57 million, or 5.1 percent, increase over FY 2002. In FY 2003, support is provided for research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment; Information Technology Research; Nanoscale Science and Engineering; Learning for the 21st Century Workforce; Mathematical Sciences; and Social, Behavioral and Economic Sciences. NSF will also emphasize increasing the average annualized award size. Within R&RA:

- The **Biological Sciences** (BIO) Activity provides support for research to advance understanding of the underlying principles and mechanisms governing life. Research ranges from the study of the structure and dynamics of biological molecules, such as proteins and nucleic acids, through cells, organs and organisms, to studies of populations and ecosystems. It encompasses both internal and external processes of organisms, and includes temporal frameworks ranging from measurements in real-time through individual life spans, to the full scope of evolutionary time. The biological sciences are undergoing a profound transformation. Recent advances in genomics, informatics, computer science, mathematics, physics, chemistry, engineering, and the Earth and social sciences have spawned the 21st Century Biology, which is multidimensional, multidisciplinary, data driven and education-oriented. The FY 2003 Request for BIO totals $525.62 million, a $17.21 million, or 3.4 percent, increase over FY 2002. BIO will continue to support fundamental academic research on biodiversity, environmental biology, and plant biology, including providing leadership for the Multinational Coordinated *Arabidopsis* Genome Project.

- The **Computer and Information Science and Engineering** (CISE) Activity supports research on the theory and foundations of computing, system software and computer system design, human-computer interaction, as well as prototyping, testing and development of cutting-edge computing and communications systems to address complex research problems. CISE also provides the advanced computing and networking capabilities needed by academic researchers for cutting-edge research in all science and engineering fields. The FY 2003 request for CISE totals $526.94 million, a $12.06

million, or 2.3 percent, increase over FY 2002. This includes $190.67 million as part of NSF's Information Technology Research priority area.

- The **Engineering** (ENG) Activity seeks to enhance the quality of life and national prosperity by investing in research and education activities that spur new technological innovations and create new products and services and more productive enterprises. ENG also makes critical investments in facilities, networks, and people to assure diversity and quality in the nation's infrastructure for engineering education and research. The FY 2003 Request for ENG totals $487.98 million, a $15.66 million, or 3.3 percent, increase over FY 2002. ENG will support research in areas including information technology, nanotechnology, biotechnology, and microelectronics. Funds are included to meet the mandated level for the Foundation-wide Small Business Innovation Research (SBIR) program.

- The **Geosciences** (GEO) Activity supports research in the atmospheric, Earth, and ocean sciences. Basic research in the geosciences advances our scientific knowledge of the Earth and advances our ability to predict natural phenomena of economic and human significance, such as climate change, earthquakes, weather, fish-stock fluctuations, and disruptive events in the solar-terrestrial environment. The FY 2003 Request of $691.07 million, an $81.6 million, or 13.4 percent, increase over FY 2002, will support the operation and enhancement of national user facilities as well as fundamental research across the geosciences, including emphases on the U.S. Weather Research Program and National Space Weather Program; the U.S. Global Change Research Program; the Biocomplexity in the Environment priority area, and research on the key physical, chemical and geologic cycles within the Earth System. Approximately $74.0 million of the increase is attributable to programs proposed to be transferred from other agencies: EPA, NOAA, and USGS.

- The **Mathematical and Physical Sciences** (MPS) Activity supports research and education in astronomical sciences, chemistry, materials research, mathematical sciences and physics. Major equipment and instrumentation such as telescopes, particle accelerators, synchrontron light sources and neutron facilities are provided to support the needs of individual investigators. The FY 2003 Request of $941.57 million, a $21.12 million, or 2.3 percent increase over FY 2002, will support fundamental research, state-of-the-art instrumentation, facilities, groups and centers, and the education and training of the future workforce, including bringing scientific discovery to the public. Support will also be provided for the Mathematical Sciences priority area. Progress in science and engineering is fundamentally linked with advances across the mathematical sciences; investments in the Mathematical Sciences priority area focuses on interdisciplinary efforts between mathematics and all areas of science, engineering and science education.

- The **Social, Behavioral and Economic Sciences** (SBE) Activity supports research to build fundamental scientific knowledge about human behavior, interaction, and social and economic systems, organizations and institutions. SBE also facilitates NSF's international activities by promoting partnerships between U.S. and foreign researchers, enhancing access to critical research conducted outside the U.S. and increasing knowledge of mutually beneficial research opportunities abroad. To improve understanding of the science and engineering enterprise, SBE supports science resources studies which are the nation's primary source of data on the science and engineering enterprise. In FY 2003, SBE's Request of $195.61 million, a 15.9 percent increase from FY 2002, includes funding for initiation of a new SBE Priority Area. This investment aims to lift the social, behavioral and economic sciences to a new dimension by supporting basic research that is primed for major advances because of new research tools or new data. Support will also be provided for research on the processes through which technology and society advance through continual

interactions. As part of the Climate Change Research Initiative, support will be provided for research on decision-making under uncertainty.

- **Polar Programs**, which includes the U.S. Polar Research Programs and U.S. Antarctic Logistical Support Activities, supports multidisciplinary research in Arctic and Antarctic regions. These geographic frontiers – premier natural laboratories – are the areas predicted to be first affected by global change. They are vital to understanding past, present, and future responses of Earth systems to natural and man-made changes. Polar Programs support provides unique research opportunities ranging from studies of the Earth, ice and oceans to research in atmospheric sciences and astronomy. In FY 2003, Polar Programs is proposed at $303.81 million, a $6.0 million, or 2.0 percent increase over FY 2002. FY 2003 priorities include support for interdisciplinary studies of Arctic environmental changes; preliminary investigation of Antarctic subglacial lakes; and polar genomics. Support is also provided to sustain the science facilities and operations that make Arctic and Antarctic research possible, with FY 2003 emphases including expanded access to Arctic oceans using the U.S. Coast Guard Cutter *Healy* and improvements in Antarctic communications capabilities and bandwidth.

- **Integrative Activities** (IA) supports emerging cross-disciplinary research and education efforts and major research instrumentation, and provides support for the Science and Technology Policy Institute (STPI). The FY 2003 Request of $110.61 million for IA, a $4.10 million, or 3.8 percent, increase over FY 2002, includes $54.0 million for Major Research Instrumentation, $26.61 million in support of Science and Technology Centers, $20.0 million for Science of Learning Centers, $5.0 million for Partnerships for Innovation, $4.0 million for STPI, and $1.0 million for Disaster Response Research Teams.

Education and Human Resources

The FY 2003 Request for Education and Human Resources (EHR) is $908.08 million, a $33.08 million, or 3.8 percent, increase over FY 2002. In addition, $92.5 million is projected in FY 2003 from H-1B Nonimmigrant Petitioner Receipts for scholarships and K-12 education activities. In FY 2003, NSF's highest priorities in the Education and Human Resources (EHR) Activity are increases in funding for the Math and Science Partnership (MSP), graduate student support, and the Centers for Learning and Teaching (CLT). MSP addresses critical concerns of the Administration and the Congress that math and science learning and teaching must be improved for all preK-12 students in the U.S. Graduate stipends are no longer considered to be attractive by many students because they are viewed as inadequate to compensate for the cost of education and mounting student debt, and to offset opportunities for higher salaries offered by employers to STEM baccalaureate degree holders. CLT is designed to meet major national needs to strengthen the human infrastructure for science, technology and math education, to increase the number of well-qualified K-16 educators, and to provide research opportunities in science and math education and education reform.

Major Research Equipment and Facilities Construction

The FY 2003 Request for Major Research Equipment and Facilities Construction (MREFC) is $126.28 million, a decrease of $12.52 million, or 9.0 percent from FY 2002. 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. Early planning, research and development costs, and operations, management and maintenance costs of the facilities are provided through R&RA.

In FY 2003, funding for seven projects is requested through the MREFC Account. Five projects initiated in FY 2002 and prior years include: construction of the Atacama Large Millimeter Array (ALMA), the Large Hadron Collider (LHC), the Network for Earthquake Engineering Simulation (NEES), the South Pole Station Modernization Project (SPSM), and Terascale Computing Systems. Two new projects are proposed: EarthScope and the National Ecological Observatory Network (NEON) Phase I.

Salaries and Expenses

The FY 2003 Request for Salaries and Expenses (S&E) is $210.16 million, a $33.76 million, or 19.1 percent, increase over FY 2002. The Salaries and Expenses Appropriation provides funds for staff salaries and benefits, and general operating expenses necessary to manage and administer the NSF. The requested level supports 1,217 full-time equivalents (FTE), an increase of 67 FTE, and will support a focused set of investments that foster NSF's continuing commitment to customer service.

Office of Inspector General

The Office of Inspector General (OIG) was established to promote economy, efficiency, and effectiveness in administering the Foundation's programs; to detect and prevent fraud, waste, or abuse within NSF or by individuals that request or receive NSF funding; and to identify and resolve cases of misconduct in science. The FY 2003 Request for OIG is $8.06 million, a $1.02 million, or 14.5 percent, increase over FY 2002. The requested level supports 53 FTE.

NSF Investments and Strategic Goals

The National Science Foundation's FY 2003 funding request supports the agency's investment in *People*, *Ideas*, and *Tools* – the Foundation's three strategic outcome goals. These goals flow from NSF's statutory mission – "to promote the progress of science..." and form the basis for the many activities of the Foundation. NSF's investments in *People, Ideas*, and *Tools* work in concert to promote progress in all aspects of science and engineering research and education, and are underpinned by investments in administration and management.

- *People* - Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers and well-prepared citizens."
- *Ideas* - Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."
- *Tools* - Providing "broadly accessible, state-of-the-art and shared research and education tools."

NSF Budget by Strategic Goal
(Millions of Dollars)

	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate
People	894	994	1,087
Ideas	2,297	2,431	2,559
Tools	1,055	1,145	1,122
Administration and Management[1]	214	227	268
Total, NSF[2]	$4,460	$4,796	$5,036

Totals may not add due to rounding.

[1]The figures shown for Administration and Management (A&M) include pension and health costs as proposed by the Administration's Cost Integration Legislation, requiring agencies to pay their full share of accrued cost of retirement beginning in FY 2003. Net of these additional amounts, the adjusted totals for FY 2003 are $261 million for A&M, and $5,028 million for the NSF total. The FY 2002 figures also include the accrual amounts.

[2]Does not include $78.5 million in FY 2001, and estimates of $90 million in FY 2002 and $92.5 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees.

The strategic plan identifies NSF's management of the investment process as a critical factor in achieving the agency's goals. NSF strategies for meeting new challenges and carrying out agency goals and mission, include:

- Continued funding to sustain an efficient and enabled research and education community;
- Investments in Priority Areas;
- Adequate funding of the Major Research Equipment and Facilities Construction account; and
- Maintaining a capable and well-trained science and engineering workforce.

Detailed discussions of NSF's investment in *People*, *Ideas*, *Tools*, and Administration and Management follows this section.

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Core Research and Education Activities

NSF investments in core research and education activities are targeted to disciplinary and multidisciplinary programs to support the best new ideas generated from the academic community. These funds support single investigator and small group grants and also provide primary support for junior faculty and students. They are extremely important in invigorating the research and education community since they promote emergence of new ideas and fields, especially where the defining borders of disciplines are blurring and new technologies are emerging. Investments in the core activities ensure the vitality of scientific and engineering fields in interdisciplinary research and discovery. If the nation is to continue to have access to the best science and engineering talent, it needs to maintain the health, security, and vitality of its citizens. Only the National Science Foundation has the vital role of providing this balance for U.S. science and engineering.

Investments in Selected Priority Areas

In addition to investments in core research and education, NSF funding for selected priority areas provides key, agency-wide opportunities for pursuing the strategic outcome goals. Through these priority areas, NSF identifies and accelerates progress in areas of emerging opportunity that hold exceptional promise for advancing knowledge and addressing national interests. Each requires appropriate attention to developing people with new skills and new perspectives; new approaches to knowledge generation across the frontiers of science and engineering; and creating the tools that enable rapid advances.

The FY 2003 Budget Request emphasizes investments in six interdependent priority areas – Biocomplexity in the Environment; Information Technology Research; Nanoscale Science and Engineering; Learning for the 21st Century Workforce; Mathematical Sciences; and Social, Behavioral and Economic Sciences. In addition, NSF continues to give high priority to the Math and Science Partnership begun in FY 2002 as part of the President's education plan, *No Child Left Behind*. Within the priority areas, there is a rich mix of activity that integrates areas of fundamental research with elements of practice in related fields. This synergy characterizes the interdependence of the priority areas as, for example, concepts and techniques from the mathematical sciences influence the development of our understanding of biocomplexity or nanoscale science and engineering and vice versa.

NSF Priority Area Investments
(Millions of Dollars)

Priority Area	FY 2001 Actual	FY 2002 Current Plan	FY 2003 Request	Change Amount	Change Percent
Biocomplexity in the Environment	54.88	58.10	79.20	21.10	36.3%
Information Technology Research	216.27	277.52	285.83	8.31	3.0%
Nanoscale Science and Engineering	149.68	198.71	221.25	22.54	11.3%
Learning for the 21st Century Workforce	143.33	144.82	184.69	39.87	27.5%
Mathematical Sciences	0.00	30.00	60.09	30.09	100.3%
Social, Behavioral and Economic Sciences	0.00	0.00	10.00	10.00	N/A
Total, Priority Areas	$564.16	$709.15	$841.06	$131.91	18.6%

Totals may not add due to rounding.

❑ 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 and chemical 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 as well as environmental and human health. Fundamental study of complex environmental systems is therefore a key 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.

The *Biocomplexity in the Environment* (BE) priority area is designed to respond to the demand for new approaches to investigating the interactivity of biota and the environment. It will result in more complete 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. 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 strategies and technologies must be developed and utilized. The term "biocomplexity" is used to stress the requirement that research questions must explicitly address the dynamic web of interrelationships that arise when living things at all levels – from molecular structures to genes to organisms to ecosystems to urban centers – interact with their environment.

Proposed funding for the Biocomplexity in the Environment priority area is as follows:

(Millions of Dollars)

	FY 2002 Current Plan	FY 2003 Request	Change Amount	Change Percent
Biological Sciences	16.90	35.86	18.96	112.2%
Computer and Information Science and Engineering	6.10	7.36	1.26	20.7%
Engineering	3.69	6.00	2.31	62.6%
Geosciences	23.00	22.22	-0.78	-3.4%
Mathematical and Physical Sciences	5.35	4.70	-0.65	-12.1%
Social, Behavioral and Economic Sciences	1.65	1.65	0.00	0.0%
Office of Polar Programs	1.41	1.41	0.00	0.0%
Total, Biocomplexity in the Environment	$58.10	$79.20	$21.10	36.3%

Totals may not add due to rounding.

Long-term Goals: For the next three years, NSF will 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 2003 environmental investment portfolio of approximately $930 million. The intellectual goals of the effort are to:

- Synthesize environmental knowledge across disciplines, subsystems, time and space;
- Discover new methods, 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, 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 the Biocomplexity in the Environment priority area is as follows:

(Millions of Dollars)

FY 2000 Actual	FY 2001 Actual	FY 2002 Current Plan	FY 2003 Request	FY 2004	FY 2005
50.00	54.88	58.10	79.20	87.76	92.24

FY 2003 Areas of Emphasis: In FY 2003, NSF plans to invest $79.20 million in the interdisciplinary Biocomplexity in the Environment activities described below. The first two areas listed have been added this year to specifically address the long-term need for increased biosecurity.

- **Microbial Genome Sequencing** – a systematic effort to determine the genetic composition and gene function of microbes in order to build a knowledge base to identify and characterize species and to understand the dynamics of microbial communities, particularly in response to environmental changes. Sequencing of microbes with specific relevance to bioterrorism will be included.

- **Ecology of Infectious Disease** – development of predictive models and discovery of principles for relationships between environmental factors and transmission of infectious agents. Research focuses on ecological determinants of transmission by vectors or abiotic agents, the population dynamics of species, and transmission to humans or other hosts. Anthropogenic environmental factors include habitat destruction or fragmentation, biological invasion, agricultural practices, environmental pollution, climate change, and bioterrorism.

- **Dynamics of Coupled Natural and Human Systems** – quantitative, interdisciplinary analyses of relevant human and natural system processes and the complex interactions among human and natural systems at diverse scales, with special emphasis given to studies of natural capital; landscapes and land use; and uncertainty, resilience, and vulnerability.

- **Coupled Biogeochemical Cycles** – the interrelation of biological, geochemical, geological, and physical processes at all temporal and spatial scales, with particular emphasis on understanding linkages between chemical and physical cycles (for example, the carbon, oxygen, nitrogen, phosphorus and sulfur cycles), and the influence of human and other biotic factors on those cycles.

- **Genome-Enabled Environmental Sciences and Engineering** – the integrated use of genomic and information technology approaches to gain novel insights into environmental questions and problems.

- **Instrumentation Development for Environmental Activities** – the development of instrumentation and software that takes advantage of microelectronics, photonics, telemetry, robotics, sensing systems, modeling, data mining, and analysis techniques to bring recent laboratory instrumentation advances to bear on the full spectrum of environmental biocomplexity questions.

- **Materials Use: Science, Engineering and Society** – 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 biocomplex systems, as well as maximizing the efficient use of individual materials throughout their life cycles.

In addition to these primary areas, other multidisciplinary research and education activities will be supported:

- Molecular scale studies of environmental processes and technologies – interdisciplinary teams to investigate biogeochemical processes and alternative manufacturing processes at the level of molecular reactions and interfaces.
- Water cycle – research on complex, planetary-scale hydrologic processes, including investigation of how those processes interact with weather and climate to alter landscapes, coastal ecosystems, terrestrial vegetation, and aquifers.
- Social and behavioral processes – emphasis on predictive capabilities and response to extreme and unpredictable events, including the study of adaptation to environmental change in the Arctic.
- "Tree of Life" – exploration of genealogical relationships of the 1.7 million extant species at a genetic level with emphasis on providing information on the identity and characteristics of the majority of species on Earth to a wide range of users in medicine, biotechnology, agriculture, and industry.
- Educational activities – a range of projects associated with biocomplexity studies that include informal science activities, development of instructional material, and efforts in scientific literacy and communication.

- International partnerships – collaborations that include research partners in other countries in order to broaden the experience of U.S. students and expand the scope of biocomplexity research activities.

❑ Information Technology Research

Enabled by basic scientific and engineering advances, Information Technology (IT) has become pervasive in our public and private lives and is transforming science, commerce, learning, and government. NSF's portfolio will continue to emphasize fundamental research in IT and in all the areas that IT impacts. In FY 2000, the NSF Information Technology Research (ITR) program stressed fundamental research; in the second year, additional applications in science and engineering were added; and in the third year, the program expanded to research in multidisciplinary areas, focusing on fundamental research at the interfaces between fields and disciplines. In FY 2003, ITR will exploit and deepen the research initiated to this point; it will support research to create and utilize cutting-edge cyberinfrastructure; and it will create new opportunities for novel research and technology development.

Proposed funding for the Information Technology Research priority area is as follows:

(Millions of Dollars)

	FY 2002 Current Plan	FY 2003 Request	Change Amount	Change Percent
Biological Sciences	6.08	6.80	0.72	11.8%
Computer and Information Science and Engineering	173.51	190.67	17.16	9.9%
Engineering	10.23	11.17	0.94	9.2%
Geosciences	12.16	13.21	1.05	8.6%
Mathematical and Physical Sciences	33.06	35.52	2.46	7.4%
Social, Behavioral and Economic Sciences	4.26	4.65	0.39	9.2%
Office of Polar Programs	1.22	1.33	0.11	9.0%
Subtotal, Research and Related Activities	240.52	263.35	22.83	9.5%
Education and Human Resources	2.00	2.48	0.48	24.0%
Subtotal, R&RA and Education and Human Resources	242.52	265.83	23.31	9.6%
Major Research Equipment and Facilities Construction	35.00	20.00	-15.00	-42.9%
Total, Information Technology Research	$277.52	$285.83	$8.31	3.0%

Totals may not add due to rounding.

Long-term Goals: By expanding basic research in interdisciplinary areas and addressing large problems, NSF will amplify the benefits of IT in all areas of science and engineering, and spur progress across the national economy and society. The Information Technology Research program over the next two years will continue to target the following areas: large-scale networking; high-end computing; high-end computation and infrastructure; high-confidence software and systems; human computer interaction and information management; software design and productivity; and social, economic, and workforce implications of IT plus IT workforce development.

Long-term funding for the Information Technology Research priority area is as follows:

(Millions of Dollars)				
FY 2000 Actual	FY 2001 Actual	FY 2002 Current Plan	FY 2003 Request	FY 2004
126.00	216.27	277.52	285.83	291.21

FY 2003 Areas of Emphasis: Investments will emphasize the following research:

- **Large-Scale Networking –** Research in large-scale networking will explore strategic Internet technologies such as network-centric middleware, network monitoring, and problem detection and resolution. It will establish principles and tools (design, security, scaling, simulation, and recovery) for active and intelligent networks that can adjust when wireless devices move from place to place. Optical networking issues form another area for investigation. It is anticipated that the research will enable new classes of applications in areas such as distributed, data-intensive computing; collaboration protocols; computational steering of scientific simulations; distance visualization; operation of remote instruments; and large-scale, distributed systems.

- **High-End Computing –** Research investments in high-end computing will focus on such advanced computing concepts as new architectures, software component technologies, and algorithms that are specifically targeted at scientific and engineering applications. New materials and methods will be examined that may lead to creation of new designs for processors in computing devices (e.g., quantum phase data storage and retrieval; nanoscale device and system architectures; and biological substrate computing, using organic molecules). Research will also center on the creation of efficient systems software technologies, including operating systems, programming languages, compilers, memory hierarchies, input/output, and performance tools for high-performance systems.

- **High-End Computation and Infrastructure –** Research investments in high-end computation and infrastructure will support collaborative research and information sharing on high-end applications across the sciences; and support electronic collaboratories in which scientists in any field and any location can work together in real time through distributed networked applications. Additionally, investment in this priority area will advance research in computation-intensive systems and data-driven applications, including robotics, human augmentation, image processing, simulation, animation, and telepresence; and create computation and visualization technologies and tools to enable researchers to see, feel, interact with, and analyze computed and measured data from a variety of scientific and engineering disciplines. The program will also provide continued support for Terascale Computing Systems in order to strengthen the high performance computational capability needed for computational science research and applications.

- **High-Confidence Software and Systems** – Research investments in high-confidence software and systems will provide a sound theoretical, scientific, and technological basis for assured construction and certification of safe, trusted computing systems in interconnected environments. It will provide the necessary understanding to build system engineering tools that incorporate risk-based assurance appropriate to specific application domains; lead to discovery of scientific principles for the construction of high-confidence systems that are predictable and robust, including adaptive systems that are "self-healing;" and enable exploration of the theoretical and engineering foundations for real-time distributed and embedded systems, including hybrid discrete and continuous systems.

- **Human Computer Interaction and Information Management** – Research investments in the field of human computer interaction and information management will be pursued through innovative information technology applications in educational and work environments. These applications will

lead to enhanced human abilities, such as augmenting human memory, attention span, sensory perception, and comprehension. Research will focus on development of multimodal technologies, tools, and devices that may enable all individuals to live full and independent lives, whatever their ages or physical capacities. Language technologies, such as machine translation, speech-driven computer interactions, pattern recognition, and automated transcription will be investigated. Investments will focus on the development of digital library collections, including study of how to determine, collect, and preserve what is of value in the world's enormous new digital output, as well as how and what to digitize from humanity's pre-digital knowledge stores. Research will be performed in architectures, tools, and technologies for organizing, annotating, searching, mining, preserving, and utilizing distributed, heterogeneous multimedia archives. In addition, advanced technologies for managing and working with digital information, from visualization, data fusion, and analysis capabilities to remote collaboration and metadata notation schemes will be developed.

- **Software Design and Productivity –** Research investments in software design and productivity will focus on development of mathematical, computer science, and engineering models to test fundamental new directions for cost-efficient development of very high-quality software in the emerging world of interconnectivity among heterogeneous devices, from embedded processors to mobile devices to massive systems of systems. It will address the theoretical foundations of software design while including substantial experimental evaluations, and attack the challenges of scalability pressures and the inherent heterogeneity of components. Improvements will be made through evaluation and testing of the practical applicability of new methods and techniques on realistic large-scale application platforms.

- **Social, Economic and Workforce Implications of IT and IT Workforce Development –** Research investments in this category will support issues in IT literacy and workforce development, including a focus on barriers and impediments to information technology careers among women, minorities, and other underrepresented groups. Innovative information technology applications will be developed for work-related learning and broader access to IT by expanding the high-performance infrastructure to encompass all educational communities and students. The fundamental questions about the efficacy of IT in education, including the examination of theories and models of learning, and development of high-quality IT applications for learning environments will be addressed.

❑ Nanoscale Science and Engineering

Nanoscale science and engineering (NSE) encompasses the systematic organization, manipulation and control of matter at atomic, molecular and supramolecular levels. Novel materials, devices, and systems – with their building blocks on the scale of nanometers – shift and expand possibilities in science, engineering, and technology. A nanometer (one-billionth of a meter) is to an inch what an inch is to 400 miles. With the capacity to manipulate matter at this scale, a revolution has begun in science, engineering, and technology including individualized pharmaceuticals, new drug delivery systems, more resilient materials and fabrics, and order of magnitude faster computer chips.

Nanoscale science and engineering has the promise of enabling a better understanding of nature, a new world of products beyond what is now possible, high efficiency in manufacturing, sustainable development, better healthcare, and improved human performance.

Proposed funding for the Nanoscale Science and Engineering priority area is as follows:

(Millions of Dollars)

	FY 2002 Current Plan	FY 2003 Request	Change Amount	Change Percent
Biological Sciences	2.33	2.98	0.65	27.9%
Computer and Information Science and Engineering	10.20	11.14	0.94	9.2%
Engineering	86.30	94.35	8.05	9.3%
Geosciences	6.80	7.53	0.73	10.7%
Mathematical and Physical Sciences	93.08	103.92	10.84	11.6%
Social, Behavorial and Economic Sciences	0.00	1.11	1.11	N/A
Subtotal, Research and Related Activities	198.71	221.03	22.32	11.2%
Education and Human Resources	0.00	0.22	0.22	N/A
Total, Nanoscale Science and Engineering	$198.71	$221.25	$22.54	11.3%

Totals may not add due to rounding.

The National Nanotechnology Initiative (NNI) is a government-wide effort that began in FY 2001 (http://www.nano.gov). NSF is emphasizing long-term, fundamental research aimed at discovering novel phenomena, processes, and tools; addressing NNI Grand Challenges; supporting new interdisciplinary centers and networks of excellence including shared user facilities; supporting research infrastructure; 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. In FY 2002, NSF is investing $198.71 million in a wide range of research and education activities, including approximately 15 nanotechnology research and education centers, which focus on areas such as electronics, biology, optoelectronics, advanced materials and engineering.

This investment will be expanded in FY 2003 by 11.3 percent to develop and strengthen critical fields and to establish the science and engineering infrastructure and workforce needed to exploit the opportunities presented by these new capabilities. Besides single investigator research, support will be focused on interdisciplinary research and education teams, national science and engineering centers, exploratory research and education projects, and education and training.

Long-term Goals include building a foundation of fundamental research for understanding and applying novel principles and phenomena for nanoscale manufacturing and other NNI Grand Challenges; ensuring that U.S. institutions will have access to a full range of nano-facilities; enabling access to nanotechnology education for students in U.S. colleges and universities; and catalyzing the creation of new commercial markets that depend on three-dimensional nanostructures. These goals will make possible development of revolutionary technologies that contribute to improvements in health, advance agriculture, conserve materials and energy, and sustain the environment.

Long-term funding for the Nanoscale Science and Engineering priority area is as follows:

(Millions of Dollars)

FY 2001 Actual	FY 2002 Current Plan	FY 2003 Request	FY 2004	FY 2005
149.68	198.71	221.25	251.25	266.25

FY 2003 Areas of Emphasis: NSF's planned investment for Nanoscale Science and Engineering in FY 2003 is $221.25 million. The Foundation's five programmatic focus areas are:

- **Fundamental Research and Education –** The FY 2003 request includes an estimated $141.0 million for fundamental research and education, with special emphasis on:
  - *Biosystems at the Nanoscale* – Approximately $21 million 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.
  - *Nanoscale Structures, Novel Phenomena and Quantum Control* – Approximately $53 million to discover and understand phenomena specific at the nanoscale, create new materials and functional nanoscale structures and exploit their novel properties. Potential applications include quantum computing and new devices and processes for advanced communications and information technologies.
  - *Device and System Architecture* – Approximately $28 million to develop 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.
  - *Nanoscale Processes in the Environment* – Approximately $10 million to support studies on nanoscale physical and chemical processes related to the trapping and release of nutrients and contaminants in the natural environment. Potential benefits include artificial photosynthesis for clean energy and pollution control, and nanoscale environmental sensors and other instrumentation.
  - *Multi-scale, Multi-phenomena Theory, Modeling and Simulation at the Nanoscale* – Approximately $21 million 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.
  - *Manufacturing processes at the nanoscale* - Approximately $8 million to support new concepts for high rate synthesis and processing of nanostructures, fabrication methods for devices, and assembling them into nanosystems and then into larger scale structures of relevance to industry and medical fields.

- **Grand Challenges –** Approximately $10.7 million will fund interdisciplinary activities to focus on major long-term challenges: nanostructured materials 'by design,' nanoscale electronics, optoelectronics and magnetics, nanoscale-based manufacturing, catalysts, chemical manufacturing, environment and healthcare.

- **Centers and Networks of Excellence –** Approximately $37.9 million will support six research and education centers established in FY 2001, and a multidisciplinary, multi-sectoral network for modeling and simulation at the nanoscale. Support includes the nanofabrication user facilities that come online in FY 2002.

- **Research Infrastructure –** Approximately $21.7 million will support instrumentation and facilities for improved measurements, processing and manipulation at nanoscale, and equipment and software for modeling and simulation. University-industry-national laboratory and international collaborations will be encouraged, particularly for expensive instrumentation and facilities.

- **Societal and Educational Implications of Science and Technology Advances –** Approximately $9.9 million will support student assistantships, fellowships and traineeships, curriculum

development on nanoscience and engineering and development of new teaching tools. The implications of nanotechnology on society will be analyzed from social, behavioral, legal, ethical, and economic perspectives. Factors that stimulate scientific discovery at the nanoscale, ensure the responsible development of nanotechnology, and utilize converging technologies to improve human performance will be investigated. The development and use of nanoscale technologies is likely to change the design, production and use of many goods and services, ranging from vaccines to computers to automobile tires.

❑ Learning for the 21st Century Workforce

Continued U.S. leadership in the global economy is dependent on the availability of a diverse science, technology, engineering, and mathematics (STEM) workforce. U.S. citizens as a whole will also need greater STEM literacy in order to participate in an informed manner in important public policy discussions and to utilize scientific and quantitative skills in their daily lives. The teachers who will develop our scientific and engineering workforce and prepare our young people for responsible citizenship form an important part of the larger workforce. Moreover, as technological advances radically change workplace environments, the workforce at large will require new skills (i.e., higher degrees of problem solving ability, quantitative computer and communications literacy, and increased competencies in STEM). The Learning for the 21st Century Workforce priority area focuses on generating the base of knowledge that will support effective research-based pedagogies that will address these higher order skills and prepare and support the STEM workforce of the future.

In order to use new learning concepts to meet emerging workforce needs, NSF has adopted a strategy that includes two overarching goals: (1) improve our understanding of learning processes through an aggressive research program; and (2) transfer that understanding into learning environments and apply it to workforce development. Successful pursuit of these goals will generate the knowledge, people and tools needed to develop a modern workforce that is second to none in its ability to use, adapt and create STEM concepts in the workplace. It will also develop a science, technology, engineering, and mathematics workforce that leads the world and fully reflects the strength of the nation's diversity.

Proposed funding for Learning for the 21st Century Workforce priority area is as follows:

(Millions of Dollars)

	FY 2002 Current Plan	FY 2003 Request	Change Amount	Change Percent
Biological Sciences	1.70	1.93	0.23	13.5%
Computer and Information Science and Engineering	1.15	1.20	0.05	4.3%
Engineering	3.40	4.87	1.47	43.2%
Geosciences	3.90	4.23	0.33	8.5%
Mathematical and Physical Sciences	5.00	5.97	0.97	19.4%
Social, Behavioral and Economic Sciences	5.40	5.46	0.06	1.1%
Office of Polar Programs	1.10	1.12	0.02	1.8%
Integrative Activities	0.00	20.00	20.00	N/A
Subtotal, Research and Related Activities	21.65	44.78	23.13	106.8%
Education and Human Resources	123.17	139.91	16.74	13.6%
Total, Learning for the 21st Century Workforce	$144.82	$184.69	$39.87	27.5%

Totals may not add due to rounding.

Long-term Goals: Over a five-year period, NSF will explore several connected aspects of learning in order to:

- Expand our understanding of learning in young people and adults, and take advantage of opportunities provided by state-of-the-art information and learning technologies to explore new models of workforce preparation and development.
- Support the transformation of today's workforce into one that is prepared to learn throughout life.
- Develop exemplary practices for broadening participation in STEM career fields to better reflect the diversity of the nation.
- Include opportunities in formal and informal STEM education to experience the realities of the national and global workplace and to better prepare those entering the workforce.
- Prepare the next generation of leaders and develop a citizenry that understands the processes of creating new knowledge and the value of incorporating new knowledge into their working practice.

Long-term funding for the Learning for the 21st Century Workforce priority area is as follows:

(Millions of Dollars)

FY 2001 Actual	FY 2002 Current Plan	FY 2003 Request	FY 2004	FY 2005
143.33	144.82	184.69	191.97	197.00

FY 2003 Areas of Emphasis: The Learning for the 21st Century Workforce priority area combines a concentration in certain core programs in the Education and Human Resources (EHR) Account with research and education efforts sponsored by the Research and Related Activities Account. NSF core programs include the Interagency Education Research Initiative (IERI), the Research on Learning and Education (ROLE) program, Centers for Learning and Teaching (CLT), and others. These programs will be expanded by an NSF-wide integrative activity, the new Science of Learning Centers that forms the centerpiece of the Learning for the 21st Century Workforce priority area in FY 2003.

- **Science of Learning Centers** – multidisciplinary, multi-institutional centers to expand our understanding of learning through research on the learning process, the context of learning and learning technologies leading to enhanced understanding of how people think and learn. SLCs will serve as national "learning" resources, and will play a critical role in the demonstration of effective workforce preparation strategies. NSF expects to fund this program at $20.0 million in FY 2003, providing funds for three or four centers and a number of catalyst projects. Catalyst projects include planning grants to support seed projects which could become SLCs at a later date. At this level, the SLC investment will support a diverse portfolio of projects, providing leadership across a broad range of science and engineering approaches, including research that will speak to and learn from educational reform, workforce development, and the linkage of educational strategies to economic development, and add generally to the knowledge base in cognition.

  SLCs will be organized around a unifying research focus and an effective implementation strategy that will achieve all three of the SLC principal goals: (1) advancing the understanding of learning, through research on the learning process, the context of learning, and/or learning technologies; (2) strengthening the connections between science of learning research and educational and workforce development, in a manner that mutually advances both; and (3) building effective collaborative research communities with sufficient resources and organizational capacity to respond to new educational and workforce challenges, and capitalize on new research opportunities and discoveries.

- **Learning research** – investments in multidisciplinary research incorporating fields such as design of learning environments, human-computer interactions, cognitive psychology, cognitive neuroscience, computational linguistics, child development, sociology and complex educational systems. Investments include IERI, ROLE, and other research activity related to child learning and cognitive development. The FY 2003 request for research is $67.75 million.

- **Learning tools** – research, development, and testing of information technology-based tools that facilitate learning across many levels of formal and informal education and for both individuals and groups. New communication and information technologies show promise to enhance the delivery of education and offer the possibility of providing truly learner-centered, independent learning environments over an entire lifetime and at any convenient place and time. Continuing investments include the National Science, Technology, Engineering and Mathematics Education Digital Library (NSDL), a prototype information technology-based tool designed to increase the quality, quantity, and comprehensiveness of Internet education resources. The FY 2003 request is $27.50 million.

- **Creating connections** – activities that link formal and informal STEM education and create connections across levels of formal education and workforce development. Investments in this core element recognize that learning happens continuously and in many ways. They provide mechanisms to bridge gaps caused by the organization of learning environments into discrete systems of formal and informal education, and into discrete educational layers. Investments include the Graduate Teaching Fellowships in K-12 Education (GK-12) program, which is budgeted at $41.44 million in FY 2003.

- **Centers for Learning and Teaching (CLT)** – activities that link K-12 and higher education to provide lifelong learning opportunities for the instructional workforce in contexts supported by information technology tools and by research on learning, science and mathematics. CLTs will address the need to increase the quality of research on learning and teaching, to develop the next generation of science and mathematics education specialists, and to strengthen the competencies of the preK-16 instructional workforce. The request for Centers for Learning and Teaching program is $28.0 million in FY 2003.

The Math and Science Partnership discussed below also reflects many of the goals of Learning for the 21st Century Workforce. The partnerships developed with various localities will ensure that all students have the opportunity to perform to high standards by using effective, research-based approaches, improving teacher quality, and insisting on accountability for student performance.

❑ 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 micro-, nano-, 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, which 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 that is 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 academe, industry, and government. For the United States to remain competitive among other nations with strong traditions in mathematical sciences education, more young Americans must be attracted 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, NSF will focus on the mathematical sciences, encompassing interdisciplinary efforts in all areas of science, engineering and education supported by the Foundation.

In FY 2002, NSF provided $30.0 million in funding support as a focused investment in interdisciplinary research in mathematics within the Mathematics and Physical Sciences Activity; Mathematical Sciences becomes a Foundation-wide priority area in FY 2003, building on this initial investment.

Proposed funding for the Mathematical Sciences priority area is as follows:

(Millions of Dollars)

	FY 2002 Current Plan	FY 2003 Request	Change Amount	Change Percent
Biological Sciences	0.00	0.91	0.91	N/A
Computer and Information Science and Engineering	0.00	2.29	2.29	N/A
Engineering	0.00	0.91	0.91	N/A
Geosciences	0.00	4.57	4.57	N/A
Mathematical and Physical Sciences	30.00	47.39	17.39	58.0%
Social, Behavioral and Economic Sciences	0.00	1.10	1.10	N/A
Office of Polar Programs	0.00	0.18	0.18	N/A
Subtotal, Research and Related Activities	$30.00	$57.35	$27.35	91.2%
Education and Human Resources	$0.00	$2.74	2.74	N/A
Total, Mathematical Sciences	$30.00	$60.09	$30.09	100.3%

Totals may not add due to rounding.

Long-term Goals: From FY 2003 through FY 2007, the mathematical sciences priority area will advance frontiers in three interlinked areas: (1) fundamental mathematical and statistical sciences; (2) interdisciplinary research involving the mathematical sciences with science and engineering through focused, selected themes; and (3) critical investments in mathematical sciences education. A five-year investment plan will allow efforts in research and education to take root and begin a transformation in the way mathematics, science, and education interact. The long-term goals of the investments in the priority area are to:

- Foster significant advances in fundamental mathematics and statistics with important benefits for the mathematical and other sciences and engineering;
- Promote the synergy of fundamental mathematical sciences research with its use in other fields of fundamental research and applications;
- Enhance the use of state-of-the-art mathematical and statistical tools across NSF research fields while exploring those fields for seeds of new mathematical and statistical directions;
- Ensure award size and duration for researchers in the mathematical sciences that enable them to bring new ideas to fruition and to promote interdisciplinary collaborations;
- Train a new generation of researchers in interdisciplinary approaches to future science and engineering challenges with mathematical and statistical elements;
- 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 priority area is as follows:

(Millions of Dollars)

FY 2002 Current Plan	FY 2003 Request	FY 2004	FY 2005	FY 2006	FY 2007
30.00	60.09	72.10	86.50	99.50	109.50

FY 2003 Areas of Emphasis: In FY 2003, NSF plans to invest $60.09 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, Bayesian estimation, and multi-scale and multi-resolution analysis. To enhance research in these areas, the NSF will provide increased support for mathematical sciences through focused research groups and individual investigator grants, as well as through institutional 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 phenomena 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 both interest in the further development of new mathematical and statistical ideas and techniques and demand for research teams capable of recognizing the potential and for using these sophisticated techniques in addressing science and engineering problems. A new breed of researchers, broadly trained in both mathematics and science or engineering disciplines and capable of translating mathematical concepts and techniques across disciplines, is needed to tackle the increasingly complex multidisciplinary research topics that confront society. Three broad research themes have been identified for initial emphasis 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 data streams, with new statistical techniques to assess complicated data sets. These challenges arise in such diverse arenas as: large genetic databases; the explosion of data gathered from satellite observation systems, seismic networks, and global oceanic and atmospheric observational networks; 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 systems such as power grids, the Internet, and air traffic control. Advancing techniques to assess uncertainty has applications ranging from helping to forecast the spread of an invasive species, to predicting genetic change and evaluating the likelihood of complex climate change scenarios. For example, in the social sciences, methods for assessing uncertainty will improve the utility of forecasts of market behavior.

- *Modeling complex nonlinear systems* – Advances in mathematics are necessary for a fundamental understanding of the mechanisms underlying interacting complex systems and will be 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, from social behaviors to brain function, and from communication networks to multi-scale business information systems.

To enhance research in these areas of science and engineering which depend on cross-cutting themes in the mathematical sciences, NSF support will encompass interdisciplinary focused 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 will include: teacher preparation and professional development; curriculum development both in the mathematical sciences and in incorporating sophisticated mathematics into other disciplines, introducing new technologies and materials 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.

❑ Social, Behavioral and Economic Sciences

The theme of the Social, Behavioral and Economic Sciences (SBE) priority area is to research how technology and society advance through continual interactions. The social system – society and its political, economic, legal, education, health care, and other institutions – influences how scientific discovery happens and what technologies are developed. Concurrently, technological development causes change in the social system. Every aspect of our lives – the way our economy operates, the ways we govern ourselves, the ways we learn, and the ways we communicate and relate to one another – has been changed by transportation, communications, and information technologies. With biotechnology, we are changing our sources and amounts of food, our abilities to diagnose disease, and the nature and range

of medical therapies. And we are on the verge of even greater changes with nanoscale science and engineering. These changes have given the U.S. advantages over many other nations, and they have contributed to U.S. economic well-being and quality of life. But the changes made with technology also bring greater risks and call into question the extent to which contributions from technological innovation can be sustained.

The changes being created as a result of technological developments are happening so rapidly that laws and regulations, political and social institutions, schools and businesses, and society are being challenged to keep up. For example, U.S. economic data are inadequate for a global, information-driven economy and a world of e-commerce. Property rights, and laws governing markets, are not relevant to many new products and services. Technologies to limit, if not avoid, social and environmental harms or to gain a competitive advantage are not fully employed by organizations and businesses. Schools too often use technology to automate the way teachers teach, rather than to transform education.

Moreover, technological change may involve risks. Advances in information technology will increase risks to individual privacy. Greater reliance on technology for economic/financial transactions, health care, transportation, electric power generation and distribution, and communications leads to greater risks of widespread failures in these complex, critical systems. And a growing disparity of access to technology among diverse segments of society and among countries increases the risks of social tensions.

Globalization has also contributed to the rapid changes industrialized countries have fueled with technology. The world continues to become increasingly interdependent. Imports, exports, and foreign investment between nations continue to increase. More jobs require higher levels of education and the U.S. is becoming increasingly dependent on immigration to meet the needs for many specialized skills. Multinational corporations are a major part of the global economy and have reduced the control of national governments over the flow of financial as well as human capital.

Scientific and technological advances have placed the U.S. ahead of the competition in the global economy. But these same advances also provide other countries with broad and immediate access to scientific and technological information and other means to more readily be the first to develop a new technology and bring it to the global market. As a result, the country's current advantage may not be sustained.

If the U.S. is to maintain this standing and further the contributions of science and technology to economic well-being and quality of life, knowledge must be developed that will ensure continued, sustained leadership in technological innovation. This will involve the development of knowledge with which new technologies can be created to meet changing human needs; knowledge that will stimulate technological innovation through new markets, property rights, and other social frameworks; and knowledge that will enable individuals, organizations, and society to take greater advantage of technology and anticipate and prepare for the social, economic, and environmental effects.

The rapidly changing capabilities for society, associated with technological development, also provide the public with new opportunities to interact with the natural environment. Major improvements in observation, analytical, and modeling capabilities have greatly enhanced the potential to understand and more accurately predict the weather and short-term changes in ecosystems resulting from both natural processes and human activities. However, our understanding of these interactions over longer time periods is still fragmentary, and decisions about many longer-term environmental issues are made with incomplete information and uncertainty. As part of the President's Climate Change Research Initiative, the NSF will undertake a program in coordination with other federal agencies that focuses on decision-making under uncertainty related to climate change.

Funding for the Social, Behavioral and Economic Sciences priority area is seeded at $10.0 million in FY 2003, all within the SBE Activity. Included in the total is $5.0 million for research on risk management as part of the Climate Change Research Initiative.

Long-term Goals: Developing the necessary knowledge requires investing in new research in the social, behavioral, and economic sciences. From FY 2003 through FY 2007 this investment will generate the knowledge from the following:

- **Research on human factors in the design and development of technology**, leading to technologies to enhance human capabilities.

- **Research on social frameworks for scientific and technological innovation**, suggesting changes in our social frameworks to further stimulate scientific discovery and the responsible development of technology.

- **Research on adaptation to technological change**, enabling our society to take greater advantage of technology and to anticipate and prepare for its consequences.

Long-term funding for the SBE priority area is as follows:

(Millions of Dollars)				
FY 2003 Request	FY 2004	FY 2005	FY 2006	FY 2007
10.00	20.00	30.00	40.00	50.00

FY 2003 Areas of Emphasis: In the first year, funding will focus on basic research that is primed for major advances because of new research tools or new data or because of prior research with successful applications that can be extended through new methods or different perspectives. Specifically, this priority area will concentrate on:

- Research on risk management with special reference to issues related to climate change. With the added funding, NSF will support a research program designed to produce new understandings of how to manage risks associated with climate change as well as new tools, perspectives, and information that will assist individuals, groups, and organizations with the development of public policies and private-sector decisions. NSF will coordinate the development of this program with other federal agencies participating in the U.S. Global Change Research Program.
- Research on game theory and empirical methods in economics and political science.
- Research on computational linguistics, speech recognition, and cognitive neuroscience, all areas where technological advances have created new tools for social scientists.

It is an opportune time to lay the foundation for an increased investment in the social, behavioral, and economic sciences to achieve these purposes. As these sciences have become more quantitative, they are creatively adapting and using technologies to advance the frontiers of knowledge with new data, models, methodologies, and modes of conducting research, including new methods of observation and experimentation.

Math and Science Partnership

The underlying philosophy of the Math and Science Partnership (MSP) is that collaborations of school systems, higher education, and other partners will increase the capacity of preK-12 educational systems, to provide requisites for learning to high standards in science and mathematics as a national priority, to ensure the future strength of the nation that derives from scientific advances and a science-literate citizenry. MSP is a cornerstone of the President's education policy, *No Child Left Behind*, which states that *"...we have fallen short in meeting our goals for educational excellence. The academic achievement gap between rich and poor, Anglo and minority is not only wide, but in some cases is growing wider still.... Among the underlying causes for the poor performance of U.S. students in the areas of math and science, three problems must be addressed — too many teachers teaching out-of-field; too few students taking advanced coursework; and too few schools offering a challenging curriculum and textbooks."*

The strategic focus of the Math and Science Partnership is to engage the nation's higher education institutions, local, regional and state school districts and other partners in preK-12 reform by calling for a significant commitment by colleges and universities to improving the quality of science and mathematics instruction in the schools and to investing in the recruitment, preparation and professional development of highly competent science and mathematics teachers. MSP, as a major national effort, is an investment intended to serve *all* students so that learning outcomes can no longer be predicted based on race/ethnicity, socio-economic status, gender or disability.

A defining feature of MSP is the development and implementation of productive partnerships among the major stakeholders, with each partnership requiring commitments from one or more local school systems and one or more higher education entities, and including other partners that bring additional assets to preK-12 teaching and learning. These other partners can include industrial organizations, which bring unique insights on workforce needs to the partnerships, state education agencies, and not-for-profit entities with a commitment to science and mathematics education. Institutions of higher education who partner in MSP are expected to tap their disciplinary departments in science, technology, engineering, and mathematics (STEM) as well as their education departments. The insistence that higher education must play a critical role in preK-12 educational reform, especially in support of professional education throughout the career of preK-12 teachers, distinguishes MSP from prior NSF-supported systemic efforts.

A second distinguishing feature of MSP is that it will not be an isolated set of local partnerships, but will become part of the NSF and national STEM education portfolio of interconnected sites whose experiences will help generate the capacity of the nation to serve all students well. Further, by involving the MSP awardees in a nationwide network of educational researchers and practitioners, the program will contribute to the development of a greater U.S. capacity to analyze and learn from the experience of large-scale change and to apply this knowledge to preK-12 STEM teaching and learning.

MSP seeks to improve student outcomes in high-quality mathematics and science by all students, at all preK-12 levels. The partnerships expect to contribute to increases in student achievement across-the-board, as well as reductions in achievement gaps in mathematics and science education among diverse student populations differentiated by race/ethnicity, socio-economic status, gender or disability. To achieve these long-term outcomes, MSP will support the development, implementation, and sustainability of exemplary partnerships addressing the following goals:

Goal 1: To significantly enhance the capacity of schools to provide a challenging curriculum for every student, and to encourage more students to participate in and succeed in advanced mathematics and science courses.

Goal 2: To increase and sustain the number, quality, and diversity of preK-12 teachers of mathematics and science, especially in underserved areas, through further development of a professional education continuum that considers traditional preservice education as well as alternative routes into the profession (e.g., scientists and engineers wishing to shift careers to preK-12 teaching, professional development during early phases of a career (i.e., induction), and continued professional growth (inservice) in mathematics and science for preK-12 teachers.

Goal 3: To contribute to the national capacity to engage in large-scale reform through participation in a network of researchers and practitioners that will share, study and evaluate educational reform and experimental approaches to the improvement of teacher preparation and professional development.

Goal 4: To engage the learning community in the knowledge base being developed in current and future NSF Centers for Learning and Teaching, and Science of Learning Centers.

The FY 2002 Current Plan for MSP is $160.0 million. In FY 2002, MSP will provide support for two types of partnership efforts, those that are comprehensive in nature and those that are more targeted in their expected outcomes, focusing on solutions to specific problems in the improvement of preK-12 science and math education. Some of the targeted awards may also be used to provide technical assistance to build capacity in those districts lacking the infrastructure or ability to be competitive initially for a comprehensive award. It is anticipated that the partnerships will share a number of key characteristics that will facilitate MSP reaching the above goals. For example, partnerships will design high learning expectations into all math and science classes, and will ensure that educators effectively match local and state standards to curricula, learning technology, instruction and assessment.

MSP funding in FY 2002 will also be used to support a combination of technical assistance, evaluation, and research grants and contracts. It is expected that research on learning and the application of math and science education models to a wide range of learning environments will be a key component of MSP and will contribute to the national understanding of how to introduce and sustain successful education reform in math and science.

NSF's intent is to develop creative and innovative approaches on a continuing basis to achieve the purposes of MSP. An assessment of lessons learned from the FY 2002 efforts will likely lead to changes in the program in FY 2003.

The U.S. Department of Education will be sponsoring numerous programs that support the President's initiative, and NSF and the Department of Education are planning program linkages to manage the federal investment in math and science education for the greatest effectiveness.

Proposed funding for the Math and Science Partnership is as follows:

(Millions of Dollars)

FY 2002 Current Plan	FY 2003 Request	FY 2004	FY 2005	FY 2006
160.0	200.0	200.0	200.0	200.0

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Federal Crosscuts

NSF will continue its active participation in federal crosscut areas in FY 2003, supporting research and education in the U.S. Global Change Research Program at $188.30 million, the Networking and Information Technology Research and Development (formerly HPCCIT) program at $678.74 million, and the National Nanotechnology Initiative at $221.25 million. In addition, in FY 2003, the Administration proposes to institute a new Climate Change Research Initiative, which is a multiagency effort with a strong focus toward short-term outcomes and deliverables. NSF will participate in four specific areas: understanding the North American Carbon Cycle, research on climate change risk management, developing sensors to measure carbon dioxide and methane; and measuring and understanding the impact of black carbon. The request includes $15.0 million to address these focused research challenges.

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Strategic Goals and NSF Budget Structure

The following table provides FY 2003 funding for strategic goals and budget accounts.

NATIONAL SCIENCE FOUNDATION
BY STRATEGIC GOAL AND ACCOUNT

(Millions of Dollars)

			FY 2003 Request						
NSF Accounts	FY 2001 Actuals	FY 2002 Current Plan	People	Ideas	Tools	A&M	FY 2003 Request	$ Change Request over Plan	% Change Request over Plan
FY 2001 Actuals	**$4,459.87**		**$894.39**	**$2,296.77**	**$1,054.99**	**$213.72**			
FY 2002 Current Plan		**$4,795.88**	**$993.50**	**$2,431.07**	**$1,144.62**	**$226.68**			
BIO	485.95	508.41	50.24	419.39	52.04	3.95	525.62	17.21	3.4%
CISE	478.15	514.88	53.33	328.57	139.29	5.74	526.94	12.06	2.3%
ENG	433.37	472.32	78.09	399.11	4.30	6.47	487.98	15.66	3.3%
GEO	563.60	609.47	35.02	413.31	234.74	8.00	691.07	81.60	13.4%
MPS	854.08	920.45	116.53	597.11	222.49	5.44	941.57	21.12	2.3%
SBE	177.22	168.79	11.02	143.35	37.99	3.25	195.61	26.82	15.9%
OPP[1]	282.28	297.81	4.77	73.77	222.77	2.50	303.81	6.00	2.0%
IA	97.64	106.51	5.00	47.61	58.00	0.00	110.61	4.10	3.8%
Research & Related Activities	**$3,372.30**	**$3,598.64**	**$354.01**	**$2,422.22**	**$971.62**	**$35.35**	**$3,783.21**	**$184.57**	**5.1%**
Education & Human Resources	**$795.42**	**$875.00**	**$732.69**	**$137.22**	**$23.60**	**$14.57**	**$908.08**	**$33.08**	**3.8%**
Major Research Equipment & Facilities Construction	**$119.24**	**$138.80**	**$0.00**	**$0.00**	**$126.28**	**$0.00**	**$126.28**	**-$12.52**	**-9.0%**
Salaries & Expenses	**$166.33**	**$176.40**	**$0.00**	**$0.00**	**$0.00**	**$210.16**	**$210.16**	**$33.76**	**19.1%**
Office of Inspector General	**$6.58**	**$7.04**	**$0.00**	**$0.00**	**$0.00**	**$8.06**	**$8.06**	**$1.02**	**14.5%**
Total, National Science Foundation[2]	**$4,459.87**	**$4,795.88**	**$1,086.70**	**$2,559.44**	**$1,121.50**	**$268.14**	**$5,035.79**	**$239.91**	**5.0%**
Proposed Federal Employee Retirement Costs[3]									
Salaries & Expenses	*$5.80*	*$6.36*				*$7.21*			
Office of Inspector General	*$0.26*	*$0.28*				*$0.36*			
Total NSF, Excluding Retirement Costs	$4,453.81	$4,789.24	$1,086.70	$2,559.44	$1,121.50	$260.57	$5,028.21	$232.34	4.9%
H-1B Visa	*$78.51*	*$90.00*					*$92.50*	*$2.50*	*2.8%*
Total NSF, Excluding Retirement Costs & Including H-1B	*$4,538.38*	*$4,885.88*	*$1,086.70*	*$2,559.44*	*$1,121.50*	*$260.57*	*$5,120.71*	*$234.84*	*4.8%*
Percent Increase over Prior Year, Including Retirement Costs & H-1B Visa		**7.5%**	**9.4%**	**5.3%**	**-2.0%**	**18.3%**	**5.0%**		

[1] Included in OPP for FY 2002 is $300K in emergency appropriation funds for Christchurch security.

[2] Includes proposed Pension and Health Costs as in footnote 3.

[3] Pension and Health Costs as proposed by the Administration's Costs Integration Legislation requiring agencies to pay their full share of the accrued cost of retirement beginning in FY 2003.

People

"A diverse, internationally competitive and globally-engaged workforce of scientists, engineers and well-prepared citizens"

The linkage of research and learning is a defining characteristic of all NSF investments. Across the Foundation's programs, NSF activities involve over 200,000 people. This includes researchers, graduate students and post-doctorates engaged in cutting edge research, as well as teachers and students at all grade levels who benefit from NSF-supported projects aimed at developing and implementing high quality math and science education. Support for programs specifically addressing NSF's Strategic Goal of People totals $1.09 billion in FY 2003, an increase of 9.4 percent over FY 2002. (H-1B Nonimmigrant Petitioner Receipts will increase total support to $1.18 billion.)

Support by Level of Education
(Millions of Dollars)

	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate
PreK-12	277	327	374
Undergraduate	236	245	242
Graduate & Professional	281	325	376
Other Support	100	97	94
Total, People[1]	$894	$994	$1,087

Totals may not add due to rounding.
[1] Excludes $76.81 million in FY 2001, and estimates of $90 million in FY 2002, and $92.5 million in FY 2003 from H-1B Nonimmigrant Petitioner Receipts.

The funds associated with the Foundation's People goal primarily address education and training opportunities for the nation's current and future scientists and engineers and the instructional workforce that influences the science and math capabilities of the citizenry. Funds associated with NSF's other strategic goals, Ideas and Tools, also advance the People goal. Education is an integral component of all research projects as the skills and training needed for the next generation of scientists, engineers, and technologists are provided within the context of the research experience and the state-of-the-art tools used in these efforts.

The Foundation places a high priority on formal and informal science, technology, engineering, and mathematics (STEM) education at all levels -- preK-12, undergraduate, graduate, professional, and public science literacy that engages people of all ages in lifelong learning. NSF programs are intended to increase opportunities for all students to learn mathematics and science, prepare for and complete higher education, join the workforce as competent and contributing members, and become well-informed, science-literate citizens.

PreK-12 Education

The FY 2003 NSF Request for preK-12 programs is $374.26 million, an increase of $47.52 million or 14.5 percent over FY 2002.

- The Math and Science Partnership (MSP) will provide funds for preK-12 schools to unite with institutions of higher education and other partners (including industry) in strengthening preK-12 math and science education. The President is requesting $200.0 million for MSP for FY 2003, an increase of $40.0 million from the FY 2002 level. Schools will establish partnership agreements with colleges, universities, and community colleges. The success of partnerships will be measured through performance indicators such as increasing student participation in advanced courses in math/science and their success in passing advanced placement exams, and increasing the numbers of prospective teachers who major in math or science.

- Support for NSF's Centers for Learning and Teaching (CLT) program, initiated in FY 2001, totals $28.0 million, an increase of $6.86 million over FY 2002. CLTs address two critical components of STEM education: (1) strengthening teacher content knowledge, and (2) developing the next generation of experts to guide development of instructional materials, classroom, and large-scale assessments, education research and evaluation, and informal education.

- Funding of $9.0 million (proposed to be transferred from the Environmental Protection Agency) will be used to establish and enhance environmental science education activities. At NSF, this will complement and expand existing environmental education programs. In addition, NSF will develop a comprehensive program that will fund a broad suite of environmental science education activities in the preK-12 levels, in informal education venues and at the undergraduate level.

- K-12 private-public partnership programs, funded through the H-1B visa program, support activities in a range of areas such as materials development, student externships, and math and science teacher professional development. Funds for these activities are expected to be about $37.50 million.

Undergraduate Education

The FY 2003 Request for programs to improve undergraduate education is $242.21 million, $2.86 million less than the FY 2002 Request. Highlights in FY 2003 include:

- NSF's Foundation-wide Research Experiences for Undergraduates (REU) program requests funding of $44.83 million for FY 2003, an increase of $800,000. REU supports active research participation by undergraduate students and seeks to expand student participation in science and engineering research areas supported by NSF, whether disciplinary, interdisciplinary, or educational in focus.

- Funding for the Advanced Technological Education (ATE) program, which improves technological education at the undergraduate and secondary school levels, is $38.16 million, a $950,000 decrease from FY 2002. ATE supports activities such as curriculum development, preparation and professional development of college faculty and secondary school teachers, and internships and field experiences for faculty, teachers, and students. With an emphasis on two-year colleges, the program focuses on the education of technicians for high-technology fields.

- The Request includes $11.18 million for Federal Cyber Service: Scholarship for Service to recruit and educate students entering the fields of information assurance and computer security and to increase the capacity of the United States higher education enterprise to continue to produce professionals in these fields. Students receiving scholarships will, upon graduation, work for a federal agency as their Federal Cyber Service commitment.

- The Course, Curriculum, and Laboratory Improvement (CCLI) program improves the quality of science, technology, engineering, and mathematics education for all students, and targets activities affecting learning environments, course content, curricula, and educational practices. Dissemination, adaptation,

and implementation activities are also key elements of this program. Funding requested for the CCLI program and other related activities decreases by $870,000 to $55.53 million.

- Enhancing diversity is key to all NSF activities, and several of the Foundation's programs target groups that are currently underrepresented in the STEM community. NSF's Tribal Colleges and Universities Program ($9.98 million in FY 2003), the Historically Black Colleges and Universities – Undergraduate Program ($13.97 million), the Louis Stokes Alliances for Minority Participation program ($26.53 million), and the Model Institutions of Excellence program ($9.81 million) are examples of this agency-wide focus on diversity.

- The Noyce Scholarship activity, designed to encourage talented mathematics, science and engineering students to pursue teaching careers in elementary or secondary schools, is funded at $4.0 million for FY 2003. In addition to scholarships for individual students, universities and colleges will provide in-service and pre-service training and support.

- The new Science, Technology, Engineering and Mathematics Talent Expansion Program (STEP) established in FY 2002 is funded at $2.0 million in FY 2003. Grants will be provided to colleges and universities to undertake steps necessary to increase the number of undergraduate math and science majors.

- In addition, an estimated $55.0 million from H-1B nonimmigrant petitioner receipts will be made available to NSF for the Computer Science, Engineering, and Mathematics Scholarships (CSEMS) program. CSEMS provides scholarships for academically talented, financially disadvantaged students, enabling them to enter the high-technology workforce following completion of an associate, baccalaureate, or graduate level degree in computer science, computer technology, engineering, engineering technology, or mathematics.

Graduate & Professional Education

The FY 2003 Request for graduate and professional programs totals $376.40 million, an increase of $51.69 million over FY 2002.

- Increasing stipends for students in the three NSF-supported graduate education programs is the highest priority for the Foundation in FY 2003. NSF Fellows and Trainees in the Graduate Research Fellowships (GRF) program, the Integrative Graduate Education and Research Traineeships (IGERT) program, and the Graduate Teaching Fellowships in K-12 Education (GK-12) program currently receive $21,500 per year. For FY 2003, NSF is proposing an increase of $37.43 million to raise stipends to an annual amount of $25,000, starting in academic year 2003-2004, and to increase the number of students in these programs.

    - NSF's GRF program will increase by $8.86 million overall to $80.56 million in FY 2003. This flagship program selects and supports the most promising science and engineering students in the U.S. and provides support for stipends and cost of education allowances for their graduate education. Approximately 2,350 students will be supported.

    - The GK-12 program supports graduate and advanced undergraduate students in science and engineering as content resources for K-12 teachers while providing students the opportunity to develop teaching skills. Funding will increase by $14.90 million to a total of $41.44 million. A new competition, which will bring the program to a planned level of about 800 students, is supported with this increase.

- Support for the IGERT program will increase by $13.67 million to $53.79 million in FY 2003. In addition to raising the stipend for IGERT students, this increase will provide for approximately 220 new trainees in the program. IGERT is distinguished from other training programs in that it has a strong emphasis on interdisciplinary training, innovation in graduate education, and broadening participation of underrepresented groups.

- The Vertical Integration of Research and Education (VIGRE) program will increase by $10.0 million to $26.0 million. VIGRE supports preparation of students for the wide range of career opportunities available in the mathematical sciences and encourages a greater readiness on the part of departments in the mathematical sciences to initiate or improve education activities that lend themselves to integration with research, especially activities that stimulate interaction among scholars across academic and departmental boundaries.

- Support for the Faculty Early Career Development (CAREER) program will total $122.68 million, an increase of $1.75 million. This NSF-wide activity emphasizes the early development of academic careers by presenting this award to new faculty who are poised to become academic leaders of the future.

- Funding for ADVANCE, to increase the participation and advancement of women in all fields of science and engineering, will increase by $1.14 million to $17.14 million in FY 2003. ADVANCE is an integral part of the Foundation's multifaceted strategy to help realize a diverse science and engineering workforce.

Other Support

The FY 2003 Budget Request for the activities below is $93.83 million, a decrease of $3.16 million.

- Informal Science Education activities will be supported at $55.0 million in FY 2003, a decrease of $920,000. Projects included in this activity promote the general public's understanding of science, technology, engineering, and mathematics through media (e.g., print, film, television) and informal science organizations (e.g., museums, parks, zoos, libraries, community groups). Priorities include outreach to smaller communities and underrepresented groups.

- The Partnerships for Innovation (PFI) program will be funded at $5.0 million in FY 2003 for a total of $34.49 million since the inception of the program in FY 2000. The PFI program builds innovation capacity by linking new knowledge and knowledge-rich workforce to economic growth and other societal benefits through the partnership endeavors of a diverse range of colleges and universities, private sector firms, local, state, and federal government entities and other organizations.

- Evaluation efforts will be funded at $12.64 million. Evaluation has gained currency throughout government and within the education enterprise as a part of a move toward greater accountability, oversight, and management of public resources. NSF's evaluation program 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.

- The Program for Gender Equity in Science, Mathematics, Engineering, and Technology (PGE) will be funded at $10.51 million. The generally low participation of women in science, technology, engineering, and mathematics is a national concern. PGE is committed to overcoming barriers that have discouraged the early and continuing interest in STEM, and to developing interest, knowledge, and involvement of girls and young women in these fields.

- The Program for Persons with Disabilities (PPD) will be funded at $5.28 million. PPD supports efforts to increase the participation and achievement of individuals with disabilities in STEM education and research by emphasizing projects building and strengthening alliances among higher education, K-12 educational systems, and business and industry.

FY 2003 Performance Goal for People

The following table summarizes NSF's FY 2003 Performance Goal for People. For additional information, see the FY 2003 Performance Plan.

Strategic Outcomes	No.	Annual Performance Goals for Strategic Outcomes[1]	FY 2003 Areas of Emphasis: For investment in emerging opportunities	FY 2003 Areas of Emphasis: For GPRA reporting
PEOPLE **<u>Outcome Goal:</u> Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."**	**III-1a**	***NSF's performance[2] for the People Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** • Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future; • Contributions to development of a diverse workforce through participation of underrepresented groups[3] in NSF activities; • Development or implementation of other notable approaches or new paradigms[4] that promote progress toward the PEOPLE outcome goal.	❑ Math and Science Partnership ❑ Priority Areas: - Learning for the 21st Century Workforce: - Centers for Learning & Teaching ❑ Graduate Student Stipends: - Increasing stipends for GRF, IGERT and GK-12	❑ PreK-12 Education, e.g., - Systemic Reform ❑ Undergraduate Education, e.g., - REU ❑ Graduate and Professional Development, e.g., - IGERT, GK-12 - CAREER ❑ Priority Areas, e.g., - Learning for the 21st Century Workforce - Centers for Learning & Teaching ❑ Broadening Participation, e.g., - Partnerships for Innovation - Programs that serve under-represented groups
	III-1b	NSF will significantly enhance the quality of preK-12 mathematics and science education available to all students in Math and Science Partnership schools. Performance Indicators: • Evidence of high quality programs addressing issues related to teacher workforce capacity, including preservice education and inservice professional development of math and science teachers as well as alternative routes into the profession (e.g., scientists and engineers becoming teachers). • Evidence within Partnership school systems of the infrastructure needed to improve math and science education and to measure improvement, i.e., the adoption of standards-based curricula and of appropriate assessments of student achievement, as well as the initiation of the collection of achievement data that can be disaggregated by ethnicity, socioeconomic status, gender, etc.		

1 These performance goals are stated in the alternate form provided for in GPRA legislation.
2 For individual programs performance assessment in practice refers to a majority of relevant indicators only.
3 For example, women, underrepresented minorities, or persons with disabilities.
4 For example, broad-based, program-wide results that demonstrate success related to improved math and science performance for preK-12 students, or professional development of the STEM instructional workforce, or enhancement of undergraduate curricular/laboratory/instructional infrastructure, or highly synergistic education and research activities, or international collaborations, or communication with the public regarding science and engineering.

Highlights of Recent Accomplishments (People)

Examples of accomplishments of NSF-supported education and training programs are described below.

For students who might not otherwise consider a career in science or engineering, the chance to work in a active research laboratory can make a difference. At Fort Valley State University in Georgia, a group of ten women and/or minority undergraduates worked last summer with research scientists through NSF's **Research Experiences for Undergraduates** (REU) program in biology. The students, who were selected competitively from small schools in the Southeast, are getting ten weeks of hands-on lab experience in fields such as cell biology, genetic engineering, tissue culture, molecular genetics, environmental sciences, entomology and biochemistry. Each student is conducting a research project and preparing a scientific presentation.

NSF Scholarship for Service Awards were presented to six universities as part of an interagency, public/private effort to meet the nationwide needs for computer security and information assurance professionals. Under the scholarship program, students selected by universities will be prepared to receive bachelors' degrees in information assurance and computer security. The students will have internship opportunities with federal agencies, and then upon graduation, work for the federal government on the basis of one year of service for each year of scholarship education received. The demand for information security professionals is high, and many graduates are expected to stay with the government, providing a cadre of young professionals to make a significant contribution to federal security programs over the long term. The federal Office of Personnel Management will manage the placement of interns and graduates from the scholarship program. The universities selected to receive the NSF scholarship monies have been named Centers for Excellence by the National Security Agency, as established by Presidential directive.

U. S. preeminence in today's world demands the kind of graduate education in science and engineering that is exemplified in **Integrative Graduate Education and Research Traineeships (IGERT)** projects. For example, ongoing IGERT projects have focus areas that are proving critical to national security areas such as smart sensors, wireless networking, and computational analysis of social and organizational systems. The work in this last area was conducted by an IGERT project at Carnegie-Mellon University, and was cited in national news reports for its contribution in the nation's response to the terrorist attacks of September 11, 2001. The work involves developing software to analyze how organizations interact and to identify key links in an organization. It is being applied to analysis of terrorist organizational networks.

Texas A&M University's Information Technology in Science **Center for Learning and Teaching** is becoming a model of cross-campus collaboration on key educational research projects. In its first year, the Center has developed its first cohort of science education specialists and created five teams that involve 17 faculty members and their graduate students in biology, chemistry, geoscience, and physics. Each project is developing a specific technology that will be introduced in secondary classrooms, addressing science topics in areas where students have difficulties mastering key concepts as identified by statewide assessments. Examples of the project teams include the Environmental Science team, which applies information technology to the fundamental concepts of the risk assessment process to evaluate best practices for minimizing human and ecological risk.

City students make gains in math and science, according to a summary report on urban programs making up NSF's Urban Systemic Initiatives (USI). Eight years ago, NSF undertook the USI program, a bold initiative to encourage and invest in system-wide reform of K-12 mathematics and science education in some of the most disadvantaged urban school systems. Students in these systems were performing poorly in mathematics and science, with wide gaps evident between minority and majority students. USI was designed to enable cities to implement wide-ranging reforms through standards-based curricula, professional development for teachers, and accountability for achievement through data collection and assessment. Now, an external evaluation team reports some dramatic payoffs from these investments. The external evaluation,

Academic Excellence for All Urban Students, found that in most of the 22 USI cities, students are taking more math and science courses and increasing achievement levels, as demonstrated through various assessment tools. Minority students, meanwhile, are making even greater gains in enrollments and performance, reducing the "achievement gap" between themselves and majority students.

An **Advanced Technological Education (ATE)** project led by Texas' College of the Mainland, in collaboration with the Gulf Coast Process Technology Alliance, is leading the development of a competency-based curriculum driven by industrial needs that provides a portable national credential for process technicians – in particular, those in the petrochemical and refining industries. Process technology programs also serve other chemical industries as well as pharmaceuticals, pulp and paper, and power generation. In this effort, 29 community colleges and universities in 13 states are collaborating with 22 industrial partners such as ExxonMobil, Chevron, Dupont, Dow Chemical, and Shell Chemical. More than 150 process technicians, supervisors, and trainers are involved in developing the process technology curriculum. Over 10,000 high school students will be involved in outreach activities. Pathways are being developed to four-year programs for process technicians. During the first three years of Center operations, it plans to involve more than 5,000 students in associate degree programs in process technology. Activities include curriculum development, professional development, capacity building, dissemination, and evaluation. The industry partners show that hiring an associate degree graduate from these programs results in a 65 percent reduction in basic training time (about $3,400 per hire), a 40 percent reduction in qualification time, and a 37 percent improvement in safety performance.

The second wave of graduate students is now enriching K-12 classrooms through NSF's **Graduate Teaching Fellowships in K-12 Education** (GK-12) program, an innovative educational program enabling talented graduate and advanced undergraduate students in science, technology, engineering and mathematics to teach their younger peers in K-12 schools. Planned as a pilot effort in 1999, the GK-12 program received positive responses from colleges and universities, as well as from elementary and secondary schools. The 25 new awards will significantly expand the program nationwide. Under GK-12, institutions are responsible for recruiting the teaching fellows from their campus science, mathematics and engineering departments. Graduate students in the program receive annual stipends plus a cost-of-education allowance. Undergraduate students will receive as much as $5,000 per academic year, plus up to an additional $5,000 for service during the summer.

Web Site Links Classrooms and Scientists During Major Expedition: In the spring of 2001, NSF funded an interdisciplinary team of 34 scientists, technicians, and engineers to explore a newly discovered vent field in the Indian Ocean. The team mapped the area and collected biological samples, samples of vent and smoker fluid and plumes, and rocks and sediment samples from the seafloor. Findings of new hydrothermal vent animals and ancient bacteria may help scientists better explain how and whether the fauna living at hydrothermal vents in the Atlantic and Pacific Oceans are genetically related. The research expedition was fully integrated with an educational component called "Dive and Discover," co-funded with the Woods Hole Oceanographic Institution and Ohio's Center of Science and Industry. "Dive and Discover" involved live web casts, interactive links between students and scientists, and companion materials that assisted teachers in explaining the science and technology behind the cruise. The Indian Ocean expedition was one of a series of field expeditions in the Pacific and Indian Oceans.

An educational materials development project based at Hampshire College and sponsored by the **Course, Curriculum, and Laboratory Improvement** (CCLI) program is bringing together the educational community, a leading scientific organization and the National STEM Education Digital Library. It builds upon the expertise of the Ecological Society of America (ESA) to create a peer-reviewed, Digital Library-based resource to help faculty become more innovative teachers and students become active participants in learning ecology. The project establishes a process for creating an evolving collection of contemporary issues, experiments and resources in ecology and making it widely available electronically through ESA. The project should serve as a catalyst in enhancing scholarship in science teaching.

For one group of high school teachers, the summer curriculum includes experiments with such high-tech wonders as space rockets, surgical robots and water quality monitoring instruments. A group of 25 teachers gathered last summer at Johns Hopkins University in Baltimore, Maryland for an introduction to engineering, offered through NSF's **Research Experiences for Teachers (RET)** in engineering. The program encourages professional development by involving the teachers in NSF projects and promoting relationships between local school districts and the engineering research community. In addition to tutorials on engineering design, manufacturing techniques and lab safety, the teachers conduct hands-on research alongside professional engineers in projects encompassing physics, genetics, robotics, biology and environmental quality.

The first **"Director's Awards for Distinguished Teaching Scholars"** were presented to seven scientists and engineers who have excelled in their research and have communicated the results to their students and the general public. Each recipient shares NSF's "highest honor for excellence in both teaching and research" and receives $300,000 over four years to continue and expand their work beyond their institutions. The awards recognize and encourage scientists and engineers to be more involved in education, both in the classroom on subjects in which they are already well-versed, or by engaging students and citizens in public forums on contemporary issues.

Numbers of People Involved in NSF Activities

Over 200,000 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.

	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate
Senior Researchers	27,601	28,810	29,700
Other Professionals	9,904	10,250	10,675
Postdoctoral Associates	5,608	5,935	6,115
Graduate Students	25,461	26,525	27,555
Undergraduate Students	31,044	31,940	32,255
K-12 Students	11,335	11,350	11,405
K-12 Teachers	83,401	84,460	84,580
Total Number of People [1]	194,354	199,270	202,285

[1] Does not include individuals to be funded through H-1B Nonimmigrant Petitioner Receipts.

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 less than five years ago, 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 balance 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.

Ideas

Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."

In order to achieve NSF's mission, one of the agency's key strategies is to support the most promising ideas in research and education. The expected outcome of these investments is a fundamental knowledge base that enhances progress in all of science and engineering and partnerships that connect discovery and learning to innovation and service to society.

(Millions of Dollars)

	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate
Ideas	$2,297	$2,431	$2,560

FY 2003 support for Ideas totals $2.56 billion, an increase of $128.37 million, or 5.3 percent, above FY 2002. This provides funding for research projects that support researchers and postdoctoral associates as well as undergraduate and graduate assistants. Funds are also provided for items necessary for performing research, such as instrumentation and supplies, and for related costs such as travel and conference support. Research in core disciplinary areas as well as studies within NSF's six priority areas are included within funding for Ideas. Through outreach activities, NSF seeks out and supports excellent proposals from groups and regions that traditionally have not fully participated in science, mathematics, and engineering.

Support provided primarily to further NSF's other strategic outcomes, People and Tools, is essential for facilitating Ideas – discovery across the frontier of science and engineering, connected to learning, innovation, and service to society. NSF's investment in People promotes the integration of research and education and ensures that the U.S. has world-class scientists and engineers, a workforce that is scientifically and mathematically strong, and a public that understands and can take full advantage of basic concepts of science, mathematics, engineering and technology. Support for Tools provides access to state-of-the art facilities and platforms, which are essential for world-class research.

In FY 2003, NSF will continue its efforts to increase the average size of awards. This effort will contribute to increasing the efficiency of the Foundation's merit review process and achieve greater cost-effectiveness for both NSF and the university community.

The FY 2003 Request focuses on areas that build strength in the science and engineering disciplines, enable the development of new and emerging fields, and provide leadership to improve the health and continued vitality of the nation's science, technology, engineering, and mathematics (STEM) research and education enterprise.

Areas of emphasis within NSF's core research will include:

- CyberTrust Security focuses on research to understand and build systems that can be trusted. Elements of "trust" include privacy (keeping unauthorized people out of systems), integrity (assuring that messages received or files read are not corrupted), authentication (techniques to really know who you are communicating with), and availability (making sure that systems are available to do the intended jobs; preventing denial of service attacks.)

- The 21st Century Biology combines theory, experiments, informatics, and technologies for an integrative systems approach to biological research, which is becoming increasingly multidisciplinary, multidimensional, information driven, and education-oriented.

- Sub-glacial lake exploration emphasizes instrumentation development for measuring the physical parameters in Antarctic sub-glacial lakes that have been buried under thousands of meters of ice for millions of years, and for remote sampling of microscopic life forms.

- Sensor technologies include nano/micro-scale sensors, wireless communications, functional materials with selective absorption capabilities, and nondestructive evaluations and remote sensing. An increase in core funding will enhance homeland security capabilities while creating a workforce knowledgeable in the operation and deployment of these technologies.

- Behavioral and cognitive sciences involve human cognition including work in the multidisciplinary field of cognitive neuroscience, computational linguistics, and research tracing human biological and behavioral changes over time.

- Natural hazards research incorporates multidisciplinary approaches for examining natural hazards in the U.S., including earthquakes, floods, and tornadoes to further our understanding of these phenomena and to work toward reducing their social and economic costs.

- Quantum information science is a new field of science and technology. It aims to understand how certain fundamental laws of physics discovered early in the twentieth century can be harnessed to dramatically improve the acquisition, transmission, and processing of information by combining and drawing on the disciplines of physical science, mathematics, computer science, and engineering.

- Core research in mathematics involves the transfer of results and applications between mathematics and statistics research and the science and engineering disciplines, challenges the limits of current mathematical theories, and develops a new cadre of researchers who are trained in both mathematics and science.

- The Experimental Program to Stimulate Competitive Research (EPSCoR), a State-NSF partnership, will continue to support improvements in academic research competitiveness. In FY 2003, funding for EPSCoR through the Education and Human Resources Appropriation totals $75.0 million. Linkages between EPSCoR and other NSF-supported research activities are expected to result in up to $30 million in additional funding directed to research in EPSCoR states.

- The Small Business Innovation Research (SBIR) program and Small Business Technology Transfer (STTR) program are supported at the mandated level of at least 2.5 percent of extramural research. SBIR will total $78.98 million, an increase of 3.9 percent over FY 2002, and STTR will total $4.67 million, an increase of 3.8 percent over FY 2002.

- Hydrology of Toxic Substances involves a transfer of $10.0 million from the U.S. Geological Survey (USGS) National Research Program of Water Resources Investigations to NSF. NSF will establish a new study-area within the Hydrologic Sciences Program focused on the science of water quality at the interface of natural and human systems. Based on the USGS Toxics Program, this new effort in water quality will be reoriented to focus on the fundamental processes affecting water quality.

- The Sea Grant Program involves a transfer of $57.0 million from the National Oceanic and Atmospheric Administration (NOAA) to NSF. NSF will operate it as a competitive merit-based research, education, and outreach program focused on development of marine resources.

Also included within support for Ideas are funds for fundamental research within the Foundation's six priority areas; Biocomplexity in the Environment; Information Technology Research; Nanoscale Science and Engineering; Learning for the 21st Century Workforce; Mathematical Sciences; and Social, Behavioral and Economic Sciences.

Centers

NSF supports a variety of individual centers and centers programs, which contribute to NSF's investment in Ideas. The centers play a key role in furthering the advancement of science and engineering in the U.S., particularly through their encouragement of interdisciplinary research and the integration of research and education. While the programs are diverse, the centers generally share common commitments:

- To address scientific and engineering questions with a long-term, coordinated research effort by involving a number of scientists and engineers working together on fundamental research addressing the many facets of long-term complex problems;

- To include a strong educational component that establishes a team-based cross-disciplinary research and education culture to educate the nation's next generation of scientists and engineers to be leaders in academe, industry and government; and

- To develop partnerships with industry that help to ensure that research and education are relevant to national needs and that knowledge migrates into innovations in the private sector.

The center programs, which contribute to the Ideas goal, are listed below.

(Millions of Dollars)

	Program Initiation (year)	FY 2001 # of Centers	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate
Engineering Research Centers	1985	32	$63	$62	$62
Science & Technology Centers	1987	17	$40	$45	$45
Industry/University Cooperative Research Centers	1973	53	$5	$5	$5
State/Industry/University Cooperative Research Centers	1991	3	$1	$1	$1
Centers of Research Excellence in Science and Technology	1987	10	$9	$9	$9
Plant Genome Virtual Centers	1998	22	$31	$31	$31
Materials Centers	1994	29	$50	$53	$53
Center for Ecological Analysis and Synthesis	1995	1	$2	$3	$3
Long-Term Ecological Research Program	1980	24	$18	$18	$19
Earthquake Engineering Research Centers	1988	3	$6	$6	$6
Chemistry Centers	1998	13	$8	$14	$10
Mathematical Sciences Research Institutes	1982	3	$9	$13	$14
Information Technology Centers	2000	66	$59	$68	$70
Nanoscale Science and Engineering Centers	2001	6	$13	$14	$14
Physics Frontiers Centers	2003	3	$7	$12	$13
Science of Learning Centers	2003	-	-	-	$20
SBE Centers[1]	NA	6	$6	$6	$5
TOTAL		291	$327	$359	$380

Totals may not add due to rounding.

[1] SBE Centers include the Research Centers on the Human Dimensions of Global Change, the National Consortium on Violence Research, and Children's Research Centers.

Additional information for selected centers supported by NSF is provided below:

FY 2001 Estimates for Selected Centers
(Millions of Dollars)

	Number of Participating Institutions	Number of Partners	Total NSF Support	Total Leveraged Support	Number of Participants
Engineering Research Centers	147	515	$63	$140	3,634
Science & Technology Centers	106	121	$40	$45	2,877
Industry/University Cooperative Research Centers and State/Industry/University Cooperative Research Centers	114	772	$6	$69	2,038
Centers of Research Excellence in Science and Technology	62	44	$9	$9	2,900
Plant Genome Virtual Centers	70	22	$31	$6	2,800
Materials Centers	82	285	$50	$68	5,515
Long Term Ecological Research Program	178	117	$18	$43	2,578
Earthquake Engineering Research Centers	111	40	$6	$14	392
Physics Frontiers Centers	3	-	$7	$1	100
Chemistry Centers	52	75	$8	$2	630

Number of Participating Institutions: all academic institutions which participate in activities at the centers.
Number of Partners: the total number of non-academic participants, including industry, states, and other federal agencies at the centers.
Total Leveraged Support: funding for centers from sources other than NSF.
Number of Participants: the total number of people who utilize center facilities, not just persons directly supported by NSF.

Description of NSF Centers

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.

NSF support of $63 million in FY 2001 was leveraged by an additional $140 million in support from industry, other federal agencies, the universities, and ten states. These 515 firms involved partnerships and collaborations in research with faculty from 147 institutions in the U.S. and abroad. In FY 2003, NSF will provide a total of approximately $62 million, level funding with FY 2002, to support 19 centers across a broad range of technologies, including three Nanoscale Science and Engineering Centers and up to two new ERCs.

Science and Technology Centers

The 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 other sources totaled approximately $44.9 million in FY 2001.

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. For example, adaptive optics technology is being developed to investigate how far the correction of visual aberrations can extend the limits of human vision through customized contact lenses and improved laser refractive surgical procedures. NSF's FY 2003 support for the STC program is approximately $45 million.

Industry/University Cooperative Research Centers and State/Industry/University Cooperative Research Centers

Industry depends on the Industry/University Cooperative Research Centers (I/UCRCs) and State I/UCRCs to provide a steady stream of enabling technologies critical to advancing their manufacturing processes, information technology support systems, and new product lines. In FY 2001, there were 56 of these highly-leveraged centers, representing a total NSF investment about $6 million. NSF's investment generated $69 million in additional cash and substantial "in-kind" contributions for the centers. Another indication of high payoff from the supporters of the I/UCRCs is that they have invested over $160 million per year to fund follow-up internal research and implementation activities in their organizations as a result of the centers' research results.

In FY 2003, NSF will provide approximately $6 million for the Industry/University Cooperative Research Centers program, providing support to 54 traditional I/UCRCs and the three remaining State I/UCRCs.

Centers of Research Excellence in Science and Technology

The Centers of Research Excellence in Science and Technology (CREST) program upgrades the research capabilities of the most productive minority institutions. Through strong alliances with other universities and laboratories, the Centers produce new knowledge and increase student presence in science, technology, engineering, and mathematics in their region. NSF will provide about $9 million for CREST in FY 2003. This funding level will support nine Centers and an additional special research Center to help faculty participate more fully in NSF's other research programs.

Plant Genome Virtual Centers

The Plant Genome Research subactivity supported twenty-two Plant Genome Collaboratories or Virtual Centers in FY 2001 at a total investment of $31 million. These are multi-institutional networks where coordinated, multi-disciplinary investigator teams pursue comprehensive, interdisciplinary research on the structure, organization and function of plant genomes relevant to economically important plants or plant processes. NSF support for Plant Genome Virtual Centers in FY 2003 will total $31 million.

Of 22 Centers supported in FY 2001, 16 are continuations of awards made earlier; 4 are successful renewals of virtual centers initiated in FY 1998; and 2 are newly established centers. The 22 Centers involve 222 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 70 institutions in 27 States. International collaborators are involved in a number of areas of center research including the potato, wheat, and model legume projects.

One of the two new awards will investigate the genetic control of form and function in flowers, from flowering to seed production. The objective is to characterize the genes controlling the differentiation of flower cells and examine genes that play a central role in development of plant features. The project takes full advantage of data, information, technologies and research resources produced by the recipients of the Plant Genome Research Program during the last four years.

Materials Centers

The Materials Centers program supports interdisciplinary materials research addressing fundamental problems of intellectual and strategic importance. The centers have strong links to industry and other sectors, and support educational partnerships with other institutions. There were 29 Materials Research Science and Engineering Centers within this program in FY 2001, and an open competition for new and recompeting centers is underway in FY 2002. Annual NSF support for individual centers ranges from less than $1.0 million to more than $4.0 million. Additional support from non-NSF sources for these centers totaled $68 million in FY 2001. NSF's FY 2003 support for the program is approximately $53 million. Support will be continued for up to three new International Materials Institutes established in FY 2002 to foster and enhance interaction in materials research and education between U.S. and foreign investigators.

Materials Centers include broad-based centers with diverse research agendas as well as those which are more focused. The centers feature cutting-edge materials research in areas such as polymers, biomimetic and biomolecular materials, nanostructured materials, electronic and photonic materials, superconducting and superhard materials, oxide surfaces and magnetic systems, micromechanical systems, magnetic materials, sensors, deformation and fracture, materials synthesis and processing, and fundamental condensed-matter phenomena.

Center For Ecological Analysis and Synthesis

The Center for Ecological Analysis and Synthesis (CEAS) 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 problems. NSF's FY 2003 support for the CEAS program is about $3 million.

Long Term Ecological Research Program

The Long Term Ecological Research (LTER) program 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 allows regional, national and international synthesis efforts.

In FY 2002 NSF is supporting 24 LTER sites that are representative of major ecosystems, including two sites in Antarctica and two in Alaska, one in Arctic Alaska. The LTER Program has taken the lead in establishing a worldwide ecological research network by electronically linking the U.S. LTER network with research sites in Europe, Latin America, and the Asia/Pacific region.

NSF's FY 2003 support for the LTER program is approximately $19 million.

Earthquake Engineering Research Centers

The three Earthquake Engineering Research Centers (EERCs) focus at the systems level, integrate research and education, and develop 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 rapidly becoming major contributors in the field both in the U.S. and internationally. In FY 2001, NSF provided a total of approximately $6 million to three EERCs, which leveraged this support with $14.0 million from universities, three states, and industry. FY 2003 support is maintained at $6 million.

Chemistry Centers

Chemistry Centers include the Environmental Molecular Sciences Institutes, the Collaborative Research Activities in Environmental Molecular Sciences, Collaborative Research in Chemistry, and the Center for Molecular Sciences. These centers support a wide range of activities from developing a molecular understanding of the environment to investigation of fundamental steps in chemical reactions. In FY 2003, NSF will provide approximately $10 million to support these centers.

Mathematical Sciences Research Institutes

The institutes provide a national resource for in-depth research in the mathematical sciences and for exciting 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 2003, NSF will provide about $14 million for up to three new institutes in interdisciplinary mathematical sciences.

Information Technology Centers

As part of the Information Technology Research (ITR) program begun in FY 2000, NSF began support for 33 new center projects. These focus on major challenges for information technology research and often address interdisciplinary themes. In FY 2001, the number of center projects increased by about 100 percent. In FY 2002, 3-5 new centers will be initiated. In support of their long-term mission, some centers will develop testbeds and may include education and outreach components. Other centers will be virtual centers that join geographically separate investigators with individualized expertise or instrumentation linked by high-performance networks. Some of these virtual centers will foster research on distributed computing and applications. In FY 2003, NSF will fund the Information Technology Research Centers at the level of approximately $70 million.

Nanoscale Science and Engineering Centers

As part of the multiagency National Nanotechnology Initiative, NSF awarded six new centers in FY 2001. Research and education are focused on a scale ranging from the size of individual atoms to that of large molecules. Research at the nanoscale aims to advance the development of the ultra-small technology that will transform electronics, materials, medicine, environment 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 to 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 2003, NSF will provide continuing support to the six centers at approximately $14 million.

Physics Frontiers Centers

The Physics Frontiers Centers program was initiated in FY 2001. These centers provide critical resources and needed 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 will be a key element of this program, and each center will have a significant outreach and infrastructure component. In FY 2003, NSF will provide a total of $13.0 million, an increase of $1.0 million, for support of seven Centers. The program is expected to grow in subsequent years through additional competitions, in which existing Centers will periodically be required to recompete.

Science of Learning Centers

NSF's investment in Science of Learning Centers (SLC), set to begin in FY 2003, will build on the Foundation's support for learning research in multiple disciplines including biology, psychology, education, neuroscience, cognitive science, linguistics, computer and information science, robotics, mathematics and statistics, engineering, the physical sciences, and the social and behavioral sciences. SLCs will be organized around a unifying research focus and an effective implementation strategy that will achieve all three of the SLC principal goals: (1) advancing the understanding of learning, through research on the learning process, the context of learning, and/or learning technologies; (2) strengthening the connections between science of learning research and educational and workforce development, in a manner that mutually advances both; and (3) building effective collaborative research communities with sufficient resources and organizational capacity to respond to new educational and workforce challenges, and capitalize on new research opportunities and discoveries. FY 2003 support for the SLCs totals $20.0 million.

Research Centers on the Human Dimensions of Global Change

NSF has supported a consortium of Research Centers on the Human Dimensions of Global Change since FY 1995. The goals of these centers are to facilitate the progress of Human Dimensions of Global Change (HDGC) research; promote the education and training of researchers ranging from undergraduate to postdoctoral levels; and foster interdisciplinary and multidisciplinary research collaborations on HDGC issues. NSF's FY 2003 support for the two HDGC centers totals $2.30 million, a $1.0 million reduction from FY 2002. This reduction is part of a planned phase-down in core support for these centers.

National Consortium on Violence Research

NSF supports the National Consortium on Violence Research (NCOVR), which is engaged in a program of capacity building in the violence research community. The Consortium's activities focus on training the next generation of researchers in interdisciplinary approaches to understanding interpersonal violence and to increase the participation of underrepresented groups in research on violence. NCOVR also seeks to facilitate collaborative methodological research and the promotion of intellectual exchange that cuts

across disciplines. NSF expects to provide about $1.0 million in support for the Consortium in FY 2002. Support for FY 2003, contingent on review of a renewal proposal in 2003, will be $1.0 million.

Children's Research Centers

The Children's Research Initiative (CRI) received new emphasis in FY 2001 to support a variety of research activities in areas of human sciences. Most prominent under CRI are three research centers that are funded at $500,000 each for 5 years. Together, these centers represent a new thrust in the field of integrative developmental science. Individually, the centers represent leading edge research about children and media, developmental science, and the integration and dissemination of developmental science to inform both research and policy. Centers are located at the University of North Carolina and Cornell University. A third center is a collaboration among four universities: Georgetown University, Northwestern University, University of Texas-Austin, and University of California-Los Angeles

FY 2003 GPRA Performance Goal (Ideas)

The following table summarizes NSF's FY 2003 Performance Goal for Ideas. For additional information, see the FY 2003 Performance Plan.

Strategic Outcome	**No. Annual Performance Goal for Strategic Outcomes**[1]	**FY 2003 Areas of Emphasis**	
		For investment in emerging opportunities:	**For GPRA reporting, as relevant:**
IDEAS **<u>Outcome Goal:</u> Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."**	**III-2** ***NSF's performance[2] for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** • Discoveries that expand the frontiers of science, engineering, or technology; • Connections between discoveries and their use in service to society; • Partnerships that enable the flow of ideas among the academic, public or private sectors; and • Leadership in fostering newly developing or emerging areas.	❑ Priority areas: - Biocomplexity in the Environment - Information Technology Research - Nanoscale Science and Engineering - Learning for the 21st Century Workforce - Science of Learning Centers (SLC) - Mathematical Sciences - Social, Behavioral and Economic Sciences ❑ Core research and education activities ❑ Climate Change Research Initiative (CCRI)	❑ Balance of portfolio, including projects that are innovative, high-risk, or multidisciplinary ❑ Priority Areas: e.g., <u>Current</u> - Biocomplexity in the Environment - Information Technology Research - Nanoscale Science and Engineering <u>Former</u> - Life and Earth's Environment - Information Technology for the 21st Century - Knowledge and Distributed Intelligence ❑ Core research and education activities ❑ Centers, e.g., - STCs, ERCs, MRSECs. ❑ EPSCoR

[1] This performance goal is stated in the alternate form provided for in GPRA legislation.
[2] For individual programs, performance assessment in practice refers to a majority of relevant indicators only.

Highlights of Recent Accomplishments (Ideas)

NSF investments in fundamental research provide support for cutting-edge research and education in many fields and help to maintain the nation's capacity to conduct research in science and engineering. Selected examples of accomplishments of NSF-supported investments are described below.

World Trade Center Response. In the wake of the tragic events of September 11, 2001, NSF has responded in a wide variety of ways, ranging from the development of displays and workshops set in public venues, to direct consultation on timely engineering and societal issues. Perhaps the most dramatic examples stem from the leadership provided by the research community. With a record response time, NSF allocated $300,000 within 3 weeks to support over half-a-dozen awards to allow researchers to access critical data from 'Ground Zero' in a timely manner. Projects included the 'Forensic Study of Steel and Fire Protection from the World Trade Center Collapse' and 'Palm Pilot/GPS-Digital Data Collection for Damage Assessment.' Early access to the WTC site allowed for critical analysis of structural failure and the development of future strategies to prevent such failures. NSF also worked with the Quick Response Research Program of the Natural Hazards Research and Applications Information Center to fund studies of the aftermath of the September 11th attacks in New York City and Washington, D.C.

Advances in the immune responses of shrimp. The Experimental Program to Stimulate Competitive Research (EPSCoR) supports an Integrative Research Program in Marine Genomics in South Carolina that is designed to analyze the shrimp host response to infection and stress at the level of gene expression, using a functional genomics approach. Although shrimp are susceptible to viral diseases that affect both commercially aquacultured and wild shrimp in the Atlantic coastal fishery, little is known about their immune systems and how they fight viral infections. Over 40 immune-function genes in both Pacific and Atlantic white shrimp have been identified, advancing our knowledge and permitting direct studies of shrimp immune responses to viral infection. Atlantic shrimp are the staple of the shrimp fishery industry in South Carolina.

Beyond DNA Sequencing. DNA sequence data is an essential tool but is not enough to tell us everything about how an organism develops and functions. Building on the large and growing store of information amassed in the international sequence databases, biologists are now able to tackle the next frontier in biology, functional genomics, which combines genome sequence information with data from other biological research to study what genes do - that is, how patterns of sequence are related to patterns of function. NSF's first major program in functional genomics, the "2010 Project" began in FY 2001, and will continue through the year 2010. Its goal is to determine the functions of the 25,000 genes of the flowering plant, *Arabidopsis thaliana*. The 28 newly funded projects include participants from 43 institutions in 20 states. The awards total $43.8 million over four years and are the first under this activity. One example of the projects funded researchers from New York University, the University of California-San Diego, and the University of Illinois at Urbana-Champaign to apply the latest bioinformatic software tools to create a publicly accessible web database cataloguing gene functions related to nitrogen metabolism. Because nitrogen is a key element in the growth of all plants, this research will have a broad impact on the understanding of plant development.

Space Weather Disturbs Earth's Magnetic Field. The Antarctic network of surface magnetometers has produced new insights into the triggering of plasma instabilities by ultra-low frequency waves in the Earth's magnetic field. Disturbances in the solar wind that arrive at the Earth within minutes to days after a violent event on the Sun are referred to as space weather. The largest space weather disturbances are produced by coronal mass ejections and fast solar wind streams emanating from coronal holes, which distort the Earth's magnetic field and inject energy into the magnetosphere. This produces the aurora but

also relativistic electrons, a source of radio and television interference, hazards to orbiting spacecraft, and current surges in power lines.

Thinning Arctic Sea Ice Cover. The cause of a rapid, decade-long thinning of Arctic Ocean sea ice in the 1990s, which has been widely reported in the press in the past two years, is largely attributed to changes in atmospheric circulation. The potential disappearance of the sea ice is critical to understanding future climates because of the role of surface reflectance from snow and sea ice in the Arctic in global climate change feedbacks.

New Power Source for Pentium IV Chips. A collaborative research project between the Center for Power Electronic Systems based at Virginia Tech and five of its industrial collaborators including Intel made a significant advance in power management for future generations of microprocessors. They developed a multi-phased voltage regulator module which resulted in a four fold improvement in power efficiency in a chip. Today every Intel chip is powered by this multi-phased approach to power management.

Visualization of Power Systems Optimizes Performance. The Industry/University Collaborative Research Center for Power Systems Engineering, a consortium of eleven universities with Cornell in the lead, is helping the power industry deal with power management in a deregulated environment. The center developed a power system reliability and cost efficiency simulation program that is being implemented by two power utilities. One of the utilities, the Tennessee Valley Authority (TVA), reports that the simulations and the visualization of the results are helping to optimize the performance of its power distribution system, while making significant savings in power supply costs.

Extra-solar Planets. A major impetus to the observational and theoretical studies of the formation of stars and their planetary disks has been provided in the last few years by the discovery of extra-solar planets. The most recent discovery, by the team from the University of California at Berkeley, the Carnegie Institute of Washington, and the University of California at Santa Cruz, found a planet three-quarters the mass of Jupiter in a circular orbit around the solar-like star 47 Ursa Majoris. Although 70 extra-solar planets have been found thus far, this is the first system with two planets in circular orbits, and at distances that make the planetary system similar to our own.

Fast Lightning. The National Center for Atmospheric Research scientist Eric Defer has analyzed data on a set of short-duration intra-cloud lightning flashes that last only 23 millionths of a second, illuminating a new class of lightning that is thousands of times faster than those previously observed. An intra-cloud flash on average lasts about a quarter of a second. Cloud-to-ground lightning flashes can last more than a second. Researchers found that out of about 5,400 flashes observed, only 83 were cloud-to-ground. More than 800 intra-cloud flashes had durations of less than a millisecond. Many of these lasted no more than 23 microseconds. Researchers do not understand what makes these flashes so short-lived. This is the first analysis relating such flashes to radar output. The short-duration lightning tends to occur at heights of 6 to 10 kilometers (4-7 miles) within the storm, in close proximity to the strongest updrafts and the most intense radar reflectivities found at those heights. It is hoped that eventually these ultraquick flashes might someday serve as a real-time tool for judging storm severity.

Students and Faculty Study Population Dynamics. The California State University at Los Angeles (CSULA) Center for Environmental Analysis (CEA-CREST) established a strong partnership with the NSF National Center for Ecological Analysis and Synthesis at the University of California - Santa Barbara (UCSB) that has resulted in formation of a workgroup on spatially structured dynamics involving Stanford University, UC - Berkeley, UCSB and CSULA. This collaboration exposes CEA-CREST students and faculty to the nation's top experts on modeling population dynamics in marine landscapes.

New Database to Save Endangered Languages. The emergence of English and Spanish as the dominant languages of global commerce is causing many other tongues to fall into disuse. This trend alarms social scientists worldwide because linguistic research not only provides cultural information, but also insight into the diverse capabilities of the human mind. To combat the decrease in the number and diversity of languages and to capitalize on a growing store of digitized linguistic data, a team of NSF-funded researchers at Wayne State University, Eastern Michigan University, the University of Pennsylvania, and the University of Arizona is developing an endangered languages database and a central information server that will allow users to access the material remotely by computer. The project will collect data on endangered languages and devise a Web-based protocol so that new and existing data will be accessible to researchers and native speakers everywhere.

Tools

"To provide broadly accessible, state-of-the-art and shared research and education tools."

In pursuit of its mission to provide a widely accessible, state-of-the-art science and engineering infrastructure, NSF invests in Tools. NSF provides support for large, multi-user facilities, which allow researchers access to essential state-of-the-art facilities. Support for these unique national facilities is necessary to advance U.S. capabilities required for world-class research. NSF investments include Internet-based and distributed user facilities, advanced computer resources, research networks, major research instrumentation, research resources, digital libraries, and large databases, all of which contribute to a state-of-the-art science and engineering infrastructure resource. Facilities and resources supported are shown in the table below:

(Millions of Dollars)

	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate
Academic Research Fleet	59	60	62
Advanced Networking Infrastructure	45	48	47
Gemini Observatories	9	12	13
Incorporated Research Institutions for Seismology	13	13	13
Laser Interferometer Gravitational Wave Observatory	19	26	30
Major Research Equipment and Facilities Construction	119	139	126
Major Research Instrumentation	75	76	54
National Astronomy Centers	86	87	84
National Center for Atmospheric Research	73	78	75
National STEM Education Digital Library	28	28	28
Ocean Drilling Program Facilities	31	31	30
Partnerships for Advanced Computational Infrastructure	71	74	71
Polar Science, Operations and Logistics	210	219	223
Research Resources	104	106	106
Other Tools[1]	115	148	160
Total, Tools	$1,055	$1,145	$1,122

Totals may not add due to rounding.

[1] Includes computational sciences, physics, materials research, ocean sciences, atmospheric sciences, and earth sciences facilities, Cornell Electron Storage Ring (CESR), the National High Field Mass Spectrometry Center, the MSU Cyclotron, the National High Magnetic Field Laboratory (NHMFL), the Science and Technology Policy Institute (STPI), Science Resources Statistics (SRS), and the National Nanofabrication Users Network (NNUN).

The FY 2003 request for Tools totals $1,122 million, a $23.0 million decrease from FY 2002. Operations and maintenance of multi-user facilities and research resources are funded through the Research and Related Activities (R&RA) and the Education and Human Resources (EHR) Accounts; major construction projects are funded through the Major Research Equipment and Facilities Construction (MREFC) Account.

Academic Research Fleet

The Academic Research Fleet includes ships, submersibles and large shipboard equipment necessary to support NSF-funded research and the training of oceanographers. Twenty-eight ships are included in the U.S. academic fleet, and are operated on behalf of the research community primarily through NSF funding. Large ships are used for distant-water, expeditionary projects such as global change research; intermediate-sized ships support individual investigator research; and smaller regional ships are available for local and coastal research. Special purpose ships are used for submersible and remotely operated vehicle studies. NSF's FY 2003 support for the Academic Research Fleet totals $62.0 million, a $2.10 million increase over FY 2002, to provide the resources necessary for enhanced research in fields related to biocomplexity and planetary dynamics.

Advanced Networking Infrastructure (ANI)

Advanced Networking Infrastructure (ANI) activities enable and expand scholarly communication and collaboration by providing researchers and educators with network access to high performance, remote scientific facilities including supercomputer facilities and information resources. The very high performance Backbone Network Service (vBNS), now in a three-year, no-cost extension phase, together with the high performance connections program, have led to the development of a new level of networking for the nation's research universities, including the UCAID/Internet2 operated network Abilene. ANI participates in the interagency Next Generation Internet activity to complement the university-led Internet2 effort jointly supported by the participating universities and the private sector. In the Next Generation Internet program, ANI focuses on advanced, high performance network connectivity between research institutions, and contributes to the basic infrastructure for high-end research applications. NSF's FY 2003 support for ANI facilities is $46.62 million, a decrease of $980,000 from FY 2002.

Gemini Observatories

The two Gemini Telescopes, developed and operated through an international partnership with Chile, Canada, the United Kingdom, Brazil, Argentina and Australia, offer world-class capabilities and unique opportunities to the scientific community. In particular, these telescopes are optimized for operation in the infrared region and are able to use adaptive optics, which at these wavelengths provide a resolving power almost twice that of the Hubble Space Telescope. The northern telescope, located on Mauna Kea in Hawaii, achieved first light in December 1998 and began operations on schedule in July 2000. First light at the southern observatory at Cerro Pachon, Chile was achieved in November 2000. Science operations commenced at the Chilean site in FY 2001. The FY 2003 Budget Request includes $12.60 million for the Gemini Observatories, an increase of $340,000 over FY 2002, with an emphasis on support for operations at the two sites.

Incorporated Research Institutions for Seismology (IRIS)

Incorporated Research Institutions for Seismology (IRIS) was created in 1986 to install and operate a global network of seismometers, provide portable seismometers for regional studies, and establish a data management system to provide on-line, distributed access to data on global seismic activity. The IRIS facility serves the needs of the national and international seismology community by making available seismic sensors and data acquisition systems. In addition, a portion of the Global Seismic Network

operated by IRIS is an integral component of the nation's nuclear test ban treaty monitoring capabilities. NSF's FY 2003 support for IRIS remains at the FY 2002 level of $13.10 million.

Laser Interferometer Gravitational-Wave Observatory (LIGO)

The Laser Interferometer Gravitational Wave Observatory (LIGO) construction project began in FY 1992 as a collaboration between physicists and engineers at the California Institute of Technology and the Massachusetts Institute of Technology to test the dynamical features of Einstein's theory of gravity and to study the properties of intense gravitational fields from their radiation. Today, many other institutions are also involved. LIGO consists of identical but widely separated detectors, one in Hanford, Washington, and the other in Livingston, Louisiana, that are used for fundamental physics experiments to directly detect gravitational waves and gather data on their sources. In FY 2003, $29.50 million is requested, an increase of $3.55 million over FY 2002, in accordance with the funding schedule for LIGO operations.

Major Research Equipment and Facilities Construction (MREFC)

(Millions of Dollars)

PROJECTS	FY 2001 Actual	FY 2002 Plan	FY 2003 Request
Atacama Large Millimeter Array (ALMA) Construction (Phase II)		12.50	30.00
Atacama Large Millimeter Array (ALMA) R&D (Phase I)	5.99		
EarthScope: USArray, SAFOD, PBO			35.00
High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER)	12.47	35.00	
IceCube Neutrino Detector		15.00	
Large Hadron Collider (LHC)	16.36	16.90	9.72
Network for Earthquake Engineering Simulation (NEES)	28.14	24.40	13.56
National Ecological Observatory Network (NEON)[1]			12.00
South Pole Station	11.38		6.00
Terascale Computing Systems[1]	44.90	35.00	20.00
Total, Major Research Equipment and Facilities Construction (MREFC)	$119.24	$138.80	$126.28

Totals may not add due to rounding.
[1] An additional $3 million for NEON operations, and $7.0 million for Terascale operations, is funded through the R&RA Account in FY 2003.

A total of $126.28 million is requested through the MREFC Account to initiate two new projects and to support five ongoing projects. Requested funds total $47.0 million for the two new projects:

- EarthScope is planned as 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. The three components of the project are the USArray, the San Andreas Fault Observatory at Depth (SAFOD), and the Plate Boundary Observatory (PBO). Initial funding of $35.0 million is requested for this project.

- National Ecological Observatory Network (NEON) will be a continental scale research instrument consisting of 10 geographically distributed observatories, networked via state-of-the-art communications, for integrated studies to obtain a predictive understanding of the nation's environments. In addition, NEON will serve as a biological early detection system that will provide an

- invaluable resource and a front line of homeland defense - both for its scientific potential and for enabling rapid detection of chemical and biological terrorist threats. Initial funding of $12.0 million is requested for this project for proof of concept prototyping, and will support the initiation of construction and networking of two initial sites.

A total of $79.28 million is requested for the five ongoing projects:

- Atacama Large Millimeter Array (ALMA) Construction (Phase II) is the construction phase of the Atacama Large Millimeter Array project, supported in partnership through NSF; NRC (Canada); European Southern Observatory and CNRS (France), PPARC (UK), MPG (Germany), NFR(Sweden), NfRA (Netherlands); with the possible addition of Japan. ALMA is planned as a millimeter wave interferometer made up of 64 12-meter antennas and will be an aperture-synthesis radio telescope operating in the wavelength range from 3 to 0.4 mm. The research and development phase of this project will be completed in FY 2002 and construction initiated. Funding of $30.0 million is requested in FY 2003 to continue construction.

- Large Hadron Collider (LHC) is planned to be the world's highest energy accelerator facility. Funded in partnership with CERN (the European Organization for Nuclear Research) and DOE, NSF participation includes contributing to the construction of two high-energy particle detectors, ATLAS (A Toroidal Large Angle Spectrometer) and CMS (the Compact Muon Solenoid), through cooperative agreements and subawards to over 50 U.S. universities. Continued funding of $9.72 million is requested in FY 2003.

- Network for Earthquake Engineering Simulation (NEES) will upgrade, modernize, expand and network major facilities including shake tables used for earthquake simulations, large reaction walls for pseudo-dynamic testing, centrifuges for testing soils under earthquake loading, and field testing facilities. Continued funding of $13.56 million is requested in FY 2003.

- South Pole Station will be expanded to provide support infrastructure and utilities for 150 people, versus the original capacity for 110. This will accommodate increased interest in science at the South Pole. Requested funding of $6.0 million in FY 2003 also includes revised estimates due to increased fuel costs and weather-related schedule delays of cargo shipments.

- Terascale Computing Systems will provide access to scalable, balanced, terascale computing resources for the broad-based academic science and engineering community served by NSF. Requested funding for Terascale facilities totals $20.0 million in FY 2003.

NSF is not requesting additional funds in FY 2003 for two projects: the High-performance Instrumented Airborne Platform for Environmental Research (HIAPER) and the IceCube Neutrino Detector. Initial operations support for NEON is funded through the R&RA account. Funding for the Polar Support Aircraft Upgrades is completed. Additional information can be found in the MREFC section.

In addition to funding requested through the MREFC Account, funds are being spent for early planning, design, research and development of potential future MREFC projects. Typically these early planning investments are funded within the Research and Related Activities Account. Whether these projects ever become formal candidates for the MREFC Account will be determined by a systematic planning and review process to determine their scientific merit, feasibility, and readiness. When possible, these projects are identified and discussed in the Tools section of each subactivity. Planned and incurred costs are identified through FY 2003. Since these projects are only in the early planning and development stages, they have not been prioritized.

Once a project has been submitted for MREFC funding, it must undergo a multi-phase review and approval process. The process begins with a review by the MREFC Panel, which makes recommendations to the NSF Director with attention to criteria such as scientific merit, importance, readiness and cost-benefit. The Director then selects candidates for National Science Board (NSB) consideration. The NSB then approves, or not, projects for inclusion in future budget requests.

The Director selects from the group of NSB-approved projects those appropriate for inclusion in a budget request to OMB, and after discussion with OMB, to the Congress. Hence, in addition to the seven MREFC projects for which funding is requested, there are several NSB approved projects for which NSF is not requesting additional funds in FY 2003. These are: the High-performance Instrumented Airborne Platform for Environmental Research (HIAPER), the IceCube Neutrino Detector, Rare Symmetry Violating Processes (RSVP), Ocean Observatories, and Scientific Ocean Drilling. These projects, including their costs, are further discussed in the MREFC section or in the Tools section of the cognizant activity.

Major Research Instrumentation (MRI)

The Major Research Instrumentation program is designed to improve the condition of scientific and engineering equipment for research and research training in our nation's academic institutions. This program seeks to foster the integration of research and education by providing instrumentation for research-intensive learning environments. In FY 2003, NSF requests $54.0 million, a decrease of $21.90 million from FY 2002, for continued support of the acquisition and development of research instrumentation for academic institutions.

National Astronomy Centers

The three National Astronomy Centers receive approximately 93 percent of their funding from NSF. The FY 2003 Request totals $96.93 million (including support for the U.S. share of operations for the International Gemini Observatory):

The main facility of the National Astronomy and Ionosphere Center (NAIC) is the 305-meter-diameter radio and radar telescope located at Arecibo, Puerto Rico. NAIC is a visitor-oriented national research center devoted to scientific investigations in radio and radar astronomy and atmospheric sciences. NAIC provides telescope users with a wide range of research and observing instrumentation, including receivers, transmitters, movable line feeds, and digital data acquisition and processing equipment. A major upgrade to the radio telescope and radar was recently completed. The FY 2003 request includes $9.0 million for NAIC, $400,000 less than FY 2002, with emphasis on extending the high frequency capabilities of the upgraded telescope.

The National Optical Astronomy Observatories (NOAO) provide for research in ground-based optical and infrared astronomy. NOAO includes Kitt Peak National Observatory, outside Tucson, Arizona; Cerro Tololo Inter-American Observatory, in Chile; the National Solar Observatory, in Arizona and New Mexico, and the U.S. Gemini Office that provides support for U.S. astronomers to use the Gemini Observatory. Large optical telescopes, observing equipment, and research support services are made available to qualified scientists. Activities in FY 2003 include continued design planning for the Advanced Technology Solar Telescope (ATST), an instrument that will use new techniques such as adaptive optics, to investigate a wide range of questions in solar physics. The FY 2003 request includes $31.70 million for NOAO base funding, plus $4.0 million for the Telescope Systems Instrumentation Program (TSIP) through NOAO, an overall decrease of $1.0 million from FY 2002.

The National Radio Astronomy Observatory (NRAO) is headquartered in Charlottesville, Virginia, and operates radio telescopes at sites in Arizona, New Mexico, and West Virginia. NRAO makes radio astronomy facilities available to qualified visiting scientists and provides staff support for use of the large radio antennas, receivers, and other equipment needed to detect, measure, and identify radio waves from astronomical objects. In FY 2003, the Robert C. Byrd Green Bank Telescope will enter full science operations and the Very Large Array will continue to be improved with its planned program of enhancements and expansion. The FY 2003 request includes $39.63 million for NRAO operations, $800,000 less than FY 2002.

National Center for Atmospheric Research (NCAR)

National Center for Atmospheric Research (NCAR) facilities serve the entire atmospheric sciences research community and part of the ocean sciences community. Facilities available to university, NCAR, and other researchers include an advanced computational center providing resources and services well suited for the development and execution of large models and for the archiving and manipulation of large data sets. NCAR also provides research aircraft, which can be equipped with sensors to measure dynamic physical and chemical states of the atmosphere. In addition, one airborne and one portable ground-based radar system are available for atmospheric research as well as other surface sensing systems. Roughly 30 percent of the funding for NCAR is provided by non-NSF sources. In FY 2003, more than 1,500 researchers and students will use the facilities and approximately 150 visiting scientists will stay for extended periods. NSF's FY 2003 support for NCAR totals $74.87 million, a decrease of $3.02 million from FY 2002.

National STEM Education Digital Library

A National STEM Education Digital Library (NSDL) responds to needs articulated by the NSF, the academic community, and corporate leaders for accelerating improvements in science, technology, engineering and mathematics (STEM) education. The NSDL, capitalizing on recent developments in digital libraries, will provide: a forum for the merit review and recognition of quality educational resources; a mechanism for electronic dissemination of information about high-quality educational materials, pedagogical practices, and implementation strategies; a centralized registry and archive for educational resources; and a resource for research in teaching and learning. In addition, the NSDL will provide an infrastructure to support and accelerate the impact of NSF programs. For example, developers of curricula and courses will benefit from awareness and knowledge of extant instructional materials, as well as information on their implementation. NSF support for the NSDL in FY 2003 totals $27.50 million, a decrease of $960,000 from FY 2002.

Ocean Drilling Program Facilities

The Ocean Drilling Program is a multinational program of basic scientific research in the oceans that uses drilling and data from drill holes to improve fundamental understanding of the role of physical, chemical, and biological processes in the geological history, structure, and evolution of the oceanic portion of the Earth's crust. Seven international partners, comprising 20 countries, share operational support for this activity. NSF's FY 2003 support for Ocean Drilling Program facilities totals $30.0 million, a decrease of $1.0 million from FY 2002.

Partnerships for Advanced Computational Infrastructure (PACI)

The Partnerships for Advanced Computational Infrastructure program provides access to, and support for, high-end computing for the national scientific and engineering community, and the development and application of the necessary software, tools and algorithms for use on scalable, widely distributed

resources. Funding for FY 2003 is requested at $71.49 million, a decrease of $2.42 million from FY 2002. In FY 2003, emphasis will be on scaling additional applications' codes to be ready for transitions to the Terascale Computing Systems. Archiving and visualization of very large data resources will continue to be crucial to support research in disciplinary areas. The education, outreach and training component of PACI will continue to broaden and accelerate the capability of the nation to utilize the advanced computational capabilities being developed.

Polar Science, Operations and Logistics

NSF's FY 2003 support for Polar Science, Operations and Logistics totals $222.77 million, an increase of $4.15 million over FY 2002. Polar facilities make research possible in the remote and hazardous Antarctic continent, where all infrastructure must be provided. In accord with U.S. Antarctic policy, three year-round Antarctic research stations are operated and maintained - McMurdo Station on Ross Island, Palmer Station on Anvers Island, and Amundsen-Scott South Pole Station. In addition, necessary facilities include ski-equipped and fixed-wing aircraft, helicopters, research vessels (including a specially constructed ice-breaking research vessel), and an ice-strengthened supply and support ship. Logistical support for polar facilities is supplied in part by the Department of Defense. These facilities support research activities sponsored by NSF, NASA, DOI/USGS, DOC/NOAA, DOE and DOD.

Arctic facilities include camps and sites for studies of greenhouse gases, monitoring stations for research on ultra-violet radiation, ice coring sites for studies of global climate history, high latitude radar observatories and magnetometers for upper atmospheric research, use of the U.S. Coast Guard Cutter *Healy*, and the use of a vessel from the academic research fleet for oceanographic research in the Arctic Ocean.

Research Resources

Research Resources supports a range of activities throughout the Research and Related Activities Account including: multi-user instrumentation; the development of instruments with new capabilities, improved resolution or sensitivity; upgrades to field stations and marine laboratories; support of living stock collections; facility-related instrument development and operation; and the support and development of databases and informatics tools and techniques. These various resources provide the essential platforms and tools for effective research in all areas of science and engineering. In FY 2003, funding for Research Resources increases by $70,000, to a total of $106.36 million.

Other Tools

This category includes:

- Funding for Science Resources Statistics, a vital tool for researchers and policymakers, providing them with data and information that is the basis for making informed decisions and formulating policy about the nation's science, engineering and technology enterprise. The primary statistical series produced by the Science Resources Statistics Subactivity include the education and employment of scientists and engineers and the performance and financial support of research and development. NSF is requesting an additional $8.50 million for implementation of the extensive redesign and data collection of its samples and surveys, a decadal process necessary to reflect the results of the Decennial Census;

- Funding for the operations and maintenance of the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University;

- Continued support for the operation and maintenance of the Cornell Electron Storage Ring (CESR) at Cornell University;

- Funding for the Science and Technology Policy Institute (STPI) to provide 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;

- Continued support for user programs and facilities at the National High Magnetic Field Laboratory (NHMFL), enabling the NHMFL to properly maintain and upgrade a unique set of continuous and pulsed-field magnets for users across a wide range of disciplines; and

- Continued support for the National Nanofabrication Users Network (NNUN), an integrated network of nanofabrication user facilities at Cornell University, Stanford University, Howard University, Pennsylvania State University, and University of California at Santa Barbara.

Other items within this category include facilities for computational sciences, physics, materials research, ocean sciences, atmospheric sciences, and earth sciences, the National High-Field FT-ICR Mass Spectrometry Center, and operations and maintenance of the Terascale Computing Centers.

FY 2003 GPRA PERFORMANCE GOALS (TOOLS)

Strategic Outcomes	No.	Annual Performance Goals for Strategic Outcomes[1] (Continued)	FY 2003 Areas of Emphasis	
			For investment in emerging opportunities:	For GPRA reporting, as relevant:
TOOLS **Outcome Goal: Providing "broadly accessible, state-of-the-art and shared research and education tools."**	III-3	***NSF's performance[2] for the Tools Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** Development or provision of tools[5] that enables discoveries or enhances productivity of NSF research or education communities; Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure; Development or implementation of other notable approaches or new paradigms[6] that promote progress toward the TOOLS outcome goal.	Major Research Equipment and Facilities Construction (new investments): NEON, EarthScope, ALMA II Science Resources Statistics (SRS) Survey Redesign National STEM Education digital library	Major Research Equipment and Facilities Construction (current and former): e.g., ALMA I, LIGO, Gemini, LHC, NEES, SPSM, Terascale Computing Major Research Instrumentation (MRI) Program Science and Engineering policy analyses, information, reports and databases Scientific databases and tools for using them, including the National STEM Education digital library

1 These performance goals are stated in the alternate form provided for in GPRA legislation.
2 For individual programs, performance assessment in practice refers to a majority of relevant indicators only.
5 For example, includes research and education infrastructure such as large centralized facilities, or integrated systems of leading-edge instruments, or databases, or widely utilized, innovative computational models or algorithms, or information that provides the basis for a shared-use networked facility.
6 For example, broad-based, program-wide results that demonstrate success related to management/utilization of large data sets/information bases, or development of information and policy analyses, or use of the Internet to make STEM information available to NSF research or education communities, or exceptional examples of broadly accessible tools shared by NSF research and education communities.

Highlights of Recent Accomplishments (Tools)

Providing widely-accessible, state-of-the-art science and engineering infrastructure is an essential part of NSF's mission. Support for these unique national facilities is necessary to advance U. S. capabilities required for world-class research.

Partnerships for Advanced Computational Infrastructure (PACI): PACI researchers are creating a powerful new tool for using resources on the national "grid" of high-performance research networks. The Web-based portal grid will help computer scientists, and other scientists and engineers by simplifying and consolidating access to advanced computing systems supported by NSF. Representatives from the National Partnerships for Advanced Computational Infrastructure (NPACI), the National Computational Science Alliance (NCSA), the Pittsburgh Supercomputing Center, and NASA have conducted a series of workshops targeting specific technologies and resources to include in the effort. The portal will integrate these and additional new technologies, such as the Network Weather Service and the San Diego Supercomputing Center Storage Resource Broker. NPACI unites 46 universities and research institutions to build the computational environment for tomorrow's scientific discovery. PACI also provides support to NCSA, which is developing a prototype for an advanced computational infrastructure for the 21st Century. NCSA includes more than 50 academic, government and industry research partners from across the United States.

National Science, Technology, Engineering, and Mathematics Education Digital Library (NSDL): A collaborative project is being conducted by the University Corporation for Atmospheric Research (UCAR), Cornell University and Columbia University to develop the essential technical and organizational infrastructure to support the coordination and management of the digital library's distributed collections, as well as the design and implementation of core services. Overall project management and key community building and outreach efforts are being conducted through UCAR. Team members at Cornell have primary responsibility for development of the software and networking infrastructure, and team members at Columbia are responsible for sustainability plans and intellectual property and digital rights management issues. At the second annual NSDL All-Projects meeting in December 2001, a technical architecture was presented that supports a "spectrum of interoperability" across diverse collections and services, as well as an organizational basis for engaging the educational community in the building of the digital library. All projects of NSDL will be working toward an initial "launch" of the digital library in late Fall 2002.

Refurbishment of ALVIN with Plans for Replacement: The manned deep-sea research submersible operated by Wood's Hole Oceanographic Institute's National Deep Sea Submergence Facility underwent a major overhaul and recertification in 2001. The ALVIN, which began operating in 1964, has been an extraordinary tool for exploring the deep ocean. A design study for an ALVIN replacement with greater depth capabilities also was funded this year.

Advances in Nanotechnology: Scientists at Pennsylvania State University have developed a precise method for making nanoscale, closely-spaced metal wires. The process could speed miniaturization of electronic devices used for circuits, high-density data storage and sensors. The new process fabricated wires that range from 15-70 nanometers wide and a few micrometers long and are spaced 10 to 40 nanometers apart. Using organic molecules as "molecular rulers," scientists expanded the molecules into nano-scale structures with precise amounts of spacing between them, and then used those spaces as miniature molds for gold wires. The ability to create such precisely sized, parallel nano-wires is expected to be useful in the development of molecular electronics, in which molecules connected by such wires will serve as transistors, switches and other electronic devices. NSF, the Army Research Office (ARO), the Defense Advanced Research Projects Agency (DARPA), and the Office of Naval Research (ONR) funded this research. It was conducted at one of NSF's National Nanofabrication Users Network (NNUN)

facilities. NNUN provides research and industrial communities with infrastructure and equipment to make nanoscale devices in small quantities. NNUN focuses research on control of properties at the atomic-molecular level, their assembly into nanostructured materials, and the utilization of the improved materials as building blocks for engineering applications, such as thin films and coatings, advanced chemical catalysts, artificial biomaterials, and novel optoelectronic devices.

Scientists at Harvard University have pioneered an entirely new technique for manipulating matter at the nanoscale. The Harvard group uses a low-energy beam of ions (charged atoms) to poke tiny holes in thin films and membranes, producing structures that in turn may be used to make solid-state devices with a variety of applications ranging from nano-electronics to medicine. They call the technique "ion-beam sculpture" and have used it, for example, to fabricate a robust electronic detector capable of registering single DNA molecules in aqueous solution. Such detectors may find use in rapid sequencing of DNA for medical diagnostics and rapid drug design for large populations.

Researchers at Northwestern University have made a significant development in the use of nanotubes in fabricating a flat panel screen display. The prototype screen uses hundreds of thousands of stationary nanotubes, which emit electrons to light up pixels on the screen. Unlike a standard Cathode Ray Tube (CRT) screen, in which one electron beam emitted from a hot filament moves rapidly back and forth to light the pixels, each pixel is lit by its own electron beam. The screen can be slim, the emission steady. And the resolution is extremely high. Once nanotubes can be manufactured in bulk, large screens could be fabricated very cheaply without expensive lithographic techniques.

New Instrumentation for Antarctic Borehole Research: Several new instruments have been developed for glaciology: hot water ice-drilling equipment, ice-coring equipment, and borehole video equipment and methodology. The ice borehole video probe, built by the Jet Propulsion Laboratory, is an instrument that enables visual observation of ice rock material at depth in glaciers and ice sheets, accessed in water-filled boreholes drilled by the hot-water-jet ice drilling method. Borehole video will probably be of much importance in the exploration of Lake Vostok. Data recovered from these instruments has improved understanding of mechanisms of ice stream formation, implications for possible collapse of the West Antarctic ice sheet, and potential effects on sea level.

Icebreaker *Healy* Steams to Arctic on First Science Cruise to Study Crust Formation: Researchers funded by NSF sailed on the maiden scientific voyage of the U.S. Coast Guard's newest icebreaker to study one of the world's slowest growing oceanic ridges, with an eye to understanding how the Earth's crust forms. The USCGC *Healy*, outfitted as a scientific research vessel with input from NSF and the University-National Oceanographic Laboratory System (UNOLS), carried out the Arctic Mid-Ocean Ridge Expedition (AMORE) from late June until early October 2001. The *Healy* later sailed with the German research vessel Polarstearn to sample and study the Gakkel Ridge, a little known geological feature in the Atlantic Ocean. Among the important discoveries on this expedition were the recovery of fresh sulfides indicating hydrothermal vent presence in the Arctic Ocean, and an as yet unexplained "discontinuity" of volcanic activity along the Gakkel Ridge.

Internet Advancement through Network Middleware: Current networked applications are managed at the "endpoints" – all the functionality of applications is custom-built into applications that run over the simple services provided by the "best-effort" Internet. Middleware is a new software level for developing distributed applications; it will provide more convenient, high level services for networked applications such as network storage, authentication, or auctions. These services, in turn, will reduce the cost of software while increasing functionality and reliability. Futuristic applications will be enabled, such as requests for a later flight made on a wireless device, which then brokers for best times and prices, arranges payment for a new ticket and refund for the unused ticket, and downloads an e-ticket into the user's hands. NSF is funding awards for middleware test beds for development and deployment.

Third-Generation Virtual Reality Devices under Development: Researchers at the Electronic Visualization Laboratory (EVL) at the University of Illinois, Chicago are pioneers in virtual reality (VR) research focusing on developing tools, techniques and hardware to support real-time, highly interactive visualization. Current efforts, funded through NSF's Major Research Instrumentation program, continue through the development of VR devices, software libraries/toolkits and applications for collaborative exploration of data over national and global high-speed networks – often called "tele-immersion." After building first and second-generation VR devices (CAVE in 1991 and the ImmersaDesk in 1995) to support tele-immersion applications, EVL is now conducting research in third-generation VR devices to construct variable resolution and desktop-office-sized displays. They continue to develop and refine a robust and VR-device-independent software library, as well as the software tools for building tele-immersion applications. This software infrastructure supports collaboration in design, training, scientific visualization, and computational steering in VR. Through advanced networking techniques, researchers can access distributed computing, storage and display resources more efficiently than ever.

Creation of the National Historical Geographic Information System (NHGIS): A major infrastructure project funded by NSF at the University of Minnesota - Twin Cities has established the National Historical Geographic Information System (NHGIS) to upgrade and enhance U. S. Census databases from 1790 to the present. This includes the digitization of all census geography so that place-specific information can be readily used in geographic information systems. The NHGIS consists of three major components:

- Data and Documentation will gather all extant machine-readable census summary data, perform data verification through paper census tabulations, harmonize formats and documentation of all files, and produce standardized documentation per the recently developed Data Documentation Initiative (DDI);
- Mapping will create consistent historical electronic boundary files for tracts, towns and boroughs, counties and larger geographical units; and
- Data-Access will create a powerful but user-friendly, Web-based browser and extraction system based on the new DDI metadata standard.

The completed system will provide public access free of charge to both documentation and data, with results in the form of tables or maps. Through these activities, the NHGIS will become a resource that can be used widely for social science training, by the media, for policy research at state and local levels, by the private sector, and in secondary education.

Bow-Shock Observed Near Galactic Center: The Gemini Observatories, newest of the large facilities available to the US astronomical community, passed from commissioning and construction into early science operations in this fiscal year. With both telescopes obtaining data, astronomers have full sky coverage with identical 8-meter-class telescopes for the first time ever. Results from Gemini North are already appearing in the press, with the first demonstration data of the galactic center having been released to the public. Using an adaptive optics system that was funded by NSF and built by the University of Hawaii, these images represent the sharpest images ever obtained over such a large area of our Galaxy's center. The images clearly reveal the morphology of a previously unresolved object called IRS-8 as a 'bow-shock' from a star moving rapidly relative to a gas cloud.

Administration and Management

The FY 2003 Budget Request of $268.14 million for Administration and Management (A&M) – five percent of the agency's total budget request - represents an increase of $41.46 million, or 18.3 percent, over the FY 2002 Current Plan. A&M supports the agency's high-performing workforce and its state-of-the-art physical and IT-enabled business infrastructure.

(Millions of Dollars)

	FY 2001 Actual	FY 2002 Current Plan	FY 2003 Request	Change Amount	Change Percent
Salaries and Expenses [1]	$166.33	$176.40	$210.16	$33.76	19.1%
Program Accounts (R&RA & EHR)	40.26	42.69	49.22	6.53	15.3%
Financial Statement Audit	0.55	0.55	0.70	0.15	27.3%
Travel	[13.00]	[15.00]	[16.00]	[1.00]	[6.7%]
Subtotal	207.14	219.64	260.08	40.44	18.4%
Office of Inspector General [1]	6.58	7.04	8.06	1.02	14.5%
Total, A&M	**$213.72**	**$226.68**	**$268.14**	**$41.46**	**18.3%**
Retirement Accruals[1]					
Salaries and Expenses	-5.80	-6.36	-7.21	-0.85	13.4%
Office of Inspector General	-0.26	-0.28	-0.36	-0.08	28.6%
Adjusted Total, A&M	**$207.66**	**$220.04**	**$260.57**	**$40.53**	**18.4%**

Totals may not add due to rounding.

[1]Includes Pension and Health Costs as proposed by the Administration's Costs Integration Legislation requiring agencies to pay their full share of the accrued cost of retirement beginning in FY 2003.

This request reflects findings from the first stages of a comprehensive, strategic assessment of NSF's A&M responsibilities. Over its 50-plus year history, NSF's commitment to excellence in supporting research and education has consistently been matched by its high standards and commitment to innovation in administration and management. Continuing this tradition of excellent stewardship requires a level of investment that reflects NSF's increasing responsibilities, the growing complexity of its workload, and new requirements for both IT and physical security.

- In FY 2001, the number of proposals received by NSF rose to nearly 32,000 from 29,500 the previous fiscal year. Yet, the same staffing level managed this 8 percent increase in workload. Furthermore, while NSF's budget has more than doubled since 1990, staffing has remained constant.

- The scope and complexity of NSF's programs also continue to expand. Leading-edge activities require partnership approaches in project development, review, execution, and oversight. NSF

therefore recognizes the need to explore new approaches to its working environment and IT infrastructure that encourage collaboration and promote more effective knowledge management.

- This request also includes key initiatives that will improve the security of NSF's IT systems and its physical infrastructure. For example, one of NSF's GPRA performance goals for successful management is to implement an agency-wide security program in response to the Government Information Security Reform Act.

NSF's focus on demonstrating management excellence is sharpened through attention to specific issues. For example, the President's Management Agenda mandates that NSF, like other agencies, demonstrates consistent results through proven management practices in: Human Capital Management; Achieving e-Government; Competitive Sourcing; Financial Management; and Integrated Budget and Performance Management. In addition, the agency also proactively addresses management challenges identified through internal review and oversight as well as those identified by the agency's Inspector General and the General Accounting Office.

- In financial management, NSF was the only government agency to receive the highest possible rating on the recently-issued President's Management Scorecard.

- NSF has also shown administrative leadership by establishing a chartered, external advisory group to provide guidance to the agency's CIO and CFO.

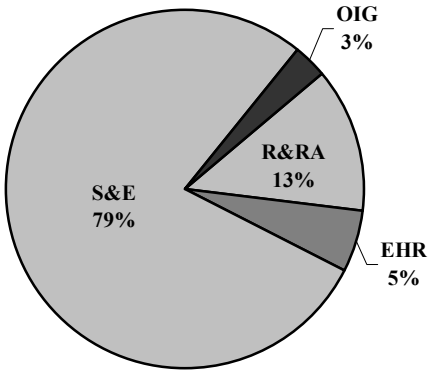
Recently, the NSF Inspector General concluded that NSF needs increased staffing to ensure that it continues to achieve high standards of pre- and post-award management excellence while its portfolio grows in size and complexity. The FY 2003 Budget addresses these concerns by increasing full-time equivalent (FTE) positions in mission-focused areas – the first increase in more than a decade.

In addition, funding is provided for the full range of general operating expenses needed to support the workforce and its program management responsibilities. These include increases to maintain and develop NSF's existing portfolio of IT systems as well as initiating the development for our next generation corporate system, the Proposal, Review, and Awards Management Integration System (PRAMIS).

The Administrative and Management Portfolio

The Foundation's A&M activities are funded through four appropriations accounts: Research and Related Activities, Education and Human Resources, Salaries and Expenses, and the Office of Inspector General.

FY 2003 Administration and Management:
Funding Sources by Appropriation



Salaries and Expenses

The FY 2003 Budget Request for Salaries and Expenses (S&E) is $210.16 million, an increase of $33.76 million, or 19.1 percent, over the FY 2002 Current Plan of $176.40 million. This includes funding for Personnel Compensation and Benefits ($139.64 million in FY 2003) and General Operating Expenses ($70.52 million in FY 2003).

- Within the proposed increase, the FY 2003 Request Level is sufficient to fully fund 1,217 FTEs, an increase of 67 FTEs. It also covers higher benefit costs and anticipated statutory pay and locality increases.

- The agency contribution to employee benefits is increasing because a higher percentage of the workforce is covered by the Federal Employee Retirement System (FERS), which requires higher agency contributions than the Civil Service Retirement System (CSRS) plan. Additionally, S&E includes Pension and Health Costs as proposed by the Administration's Cost Integration Legislation requiring agencies to pay their full share of accrued cost of retirement beginning in FY 2003.

The FY 2003 request for General Operating Expenses (GOE) is $70.52 million, an increase of $20.33 million over the FY 2002 Current Plan. GOE includes NSF's entire range of program and administrative support functions.

- The GOE level for FY 2003 provides for advances in the agency's information technology systems – to enhance the information infrastructure and security, to promote e-business, and to provide for increasing IT contractor costs.

- It provides for rental payments to the General Services Administration.

- Additionally, an increase in travel funds in FY 2003 will foster a more comprehensive approach to program oversight, monitoring, and outreach – especially for large facility projects and other large NSF awards.

Program Accounts

A&M-related expenses supporting the R&RA and EHR appropriations increase by approximately $7 million to a total of $49.92 million, a 15.5 percent increase, as shown in the following table.

(Millions of Dollars)

	FY 2001 Actual	FY 2002 Current Plan	FY 2003 Request	Change Amount	Change Percent
Program Accounts:					
R&RA Appropriation[1]	25.66	28.97	35.35	6.38	22.0%
EHR Appropriation[1,2]	15.15	14.27	14.57	0.30	2.1%
Total, Program Accounts	$40.81	$43.24	$49.92	$6.68	15.4%

Totals may not add due to rounding.
[1] Financial statement audit costs are included in the above program accounts.
[2] Excludes A&M expenses for H-1B Nonimmigrant Petitioner Receipts.

- These costs include funding for personnel appointments under the Intergovernmental Personnel Act (IPAs) and their associated travel and operating costs as well as administrative contracts and requisitions that directly support programs.

- A&M also includes funding for Foundation-wide evaluation contracts, as well as development costs associated with NSF customer-focused information technology projects, such as FastLane.

Office of Inspector General

The FY 2003 request for the OIG is $8.06 million, an increase of $1.02 million over the FY 2002 Current Plan. The proposed increase includes the addition of 3 FTE to the OIG staff following recommendations by the National Science Board and the Senate Committee on Governmental Affairs calling for measured growth in the number of audits conducted at organizations that receive NSF funding. The balance of the increase will permit modest growth in the areas of contract support for audits, technological capability, staff training, and outreach activities. Funding for the financial statement audit contract is charged to the appropriations being audited. OIG support costs - such as rent and communications - are provided in the Salaries and Expenses appropriation.

Additionally, OIG includes Pension and Health Costs as proposed by the Administration's Cost Integration Legislation requiring agencies to pay their full share of accrued cost of retirement beginning in FY 2003 is requested.

Highlights FY 2003 A&M

Highlights of the FY 2003 A&M request include the major initiatives in Electronic Government and Human Capital Management, consistent with the President's Management Agenda.

Electronic Government

NSF is a leader in the use of information technology to advance its mission to promote the progress of science, education, and engineering. The Foundation continues to advance discovery and to exercise leadership in science and engineering research and education while taking steps to promote the dissemination, integration and application of new knowledge.

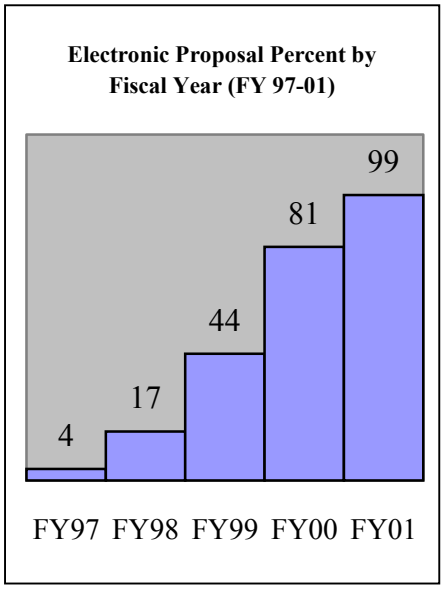
In October 2000, NSF became the first government agency to conduct all essential business interactions and transactions with its customers electronically. This allowed NSF to continue receiving and processing proposals without interruption during the recent mail emergencies following the anthrax attacks.

The award-winning FastLane system exemplifies a high level of excellence and achievement in information systems design and implementation. For example:

- Over 200,000 scientists and engineers, including the country's top researchers and educators, use FastLane's web-based systems to submit proposals for funding, for proposal peer-review, and to report on the progress of their government-funded research and education projects.

- Universities and other organizations request funding increments, cash payments, and reports on billions of dollars in expenditures through FastLane.

The results of NSF's e-Government initiatives are significant. In FY 2001, NSF processed more than:



- 32,000 Electronic Proposals (over 99% of all proposals)
- 130,000 Electronic Reviews
- 6,000 Electronic Graduate Research Fellowships
- 21,000 Electronic Grantee Progress Reports
- 7,000 Electronic Post-Award Actions
- 13,000 Electronic Requests
- $4.0 Billion Distribution of Funds

In addition, NSF has been and continues to be an active leader in interagency electronic grant initiatives through the new government-wide e-Grants initiative, the Federal Demonstration Partnership, and other activities. In particular, the common interagency grant portal, known as the Federal Commons, directly benefits from NSF's trail-blazing efforts and the strong foundation provided by NSF's information systems and electronic grants processing.

FastLane positions NSF to fulfill the vision of a fully integrated electronic proposal and award system to provide quick, secure and paperless processing. In FY 2001, NSF successfully completed a GPRA initiative to conduct 10 paperless process proof-of-concept pilots using FastLane systems. In addition to FastLane, there are a number of internal legacy systems that process more than 10,000 new grants awarded each year from the roughly 32,000 competitive proposals submitted by the science and engineering research and education communities.

- Recently, NSF implemented a new Awards System, a prototype for high-functionality in automating electronic grants processing, and, based on a successful pilot, has implemented a web-based interactive system for panelist peer-review of proposals.

- In addition, for related IT systems, NSF completed in a multi-year effort to convert central applications from a mainframe environment to a client-server environment and to implement a state-of-the-art corporate telecommunication system that integrates telephones and computers.

In the future, NSF will follow a disciplined approach for ensuring that new investments needed to optimize business value and mission performance are planned and evaluated within the context of an overall Enterprise Architecture framework. The NSF Integrated Enterprise Architecture will (1) provide a blueprint for defining current business processes, applications, information resources, and technical infrastructure; (2) support definition of the knowledge bases, applications, and supporting technology that are needed to support evolving NSF mission needs; and (3) define a crisp transition strategy and plan for achieving an integrated Enterprise Architecture that is consistent with NSF business goals and operational priorities.

Highlights of new information technology investments are:

PRAMIS: NSF's first phase of implementing next-generation e-government capabilities will focus on NSF's two principal business processes: (1) Merit Review and (2) Award Management and Oversight. The centerpiece of this will be the design, development, and implementation of the Proposal, Review, and Awards Management Integration System (PRAMIS). NSF's phased approach for implementing next-generation e-government capabilities will result in delivery of high-priority technologies and capabilities to uphold the Foundation's management excellence.

PRAMIS will improve internal NSF processing as a complement and extension to the common processes and products planned for the government-wide e-Grants initiative and Federal Commons, focusing on integration and improvement of internal functions. As with FastLane, NSF will ensure that internal business process improvements and IT capabilities are integrated with the government-wide e-Grants initiative to streamline and simplify electronic grants management across the government.

PIMS: The Program Information Management System (PIMS) is a web application that will provide a robust data architecture for the front-end of the NSF program information life cycle. Program officers will use the system to manage information about their programs, including detailed business rules that can be leveraged by other NSF data systems at later stages in the life cycle. The system will support a completely electronic review and approval process for information development and publishing, and the resulting database will enable dynamic web publishing of accurate, consistent information on all NSF web sites.

Knowledge Management: As part of NSF's phased approach for implementing next-generation e-government capabilities, opportunities for improving productivity for common functions will be addressed. In the knowledge management area, key projects to promote the dissemination, integration, and application of new knowledge are planned. These include human capital knowledge bases, a final projects report knowledge base, and a Committee of Visitors repository.

Customer Service: To enhance customer service, NSF will continue implementation of a new "Customer Care" initiative and commercial call tracking software to improve support for the over 200,000 external customers from research and education institutions.

Infrastructure: In FY 2003, NSF will also support evolving legacy administrative systems into more robust and consistent government-wide and commercial enterprise solutions.

Remote Access: NSF will continue to advance the application of current and emerging technologies such as wireless and videoconferencing to support evolving telecommuting and remote access needs.

Information and Physical Security: The Foundation is focused on assuring that NSF infrastructure and critical assets are appropriately protected while maintaining an open and collaborative environment for scientific research and discovery. NSF has established a strong and comprehensive Information Technology Security program that is consistent with government-wide guidance and patterned after industry best practices. This program encompasses all aspects of information security, including policy and procedures, risk assessments and security plans, managed intrusion detection services, vulnerability assessments, and technical and management security controls.

The NSF approach is based on a fundamental philosophy of risk management where information technology security risks are assessed, understood, and mitigated appropriately. This approach allows NSF to implement appropriate layers of protective measures and controls to ensure the privacy, integrity, and security of information and information technology resources needed by NSF and the broad research community – while allowing appropriate access and availability to users. In FY 2003, NSF will focus increased resources on improving physical and information technology security. Specifically, in FY 2003, NSF will initiate a major project to implement the use of "smart" technology to restrict and monitor employee and visitor access and entry into NSF facilities, and to improve access controls to e-business applications and capabilities. Other planned improvements include enhancements to network, telephone, and corporate infrastructure, and additional investments in risk assessments, security plans and controls, and penetration testing. These investments will ensure that the risk of unauthorized access to facilities, systems and information using various manual and automated checkpoints and controls is appropriately mitigated.

NSF Academy

The NSF Academy is being developed in support of the agency's vision of growing as a learning organization, with learning opportunities woven into the fabric of the organization's business processes and practices. It will provide the agency's workforce with a comprehensive suite of organization and career-enhancing programs. The Academy will also provide innovative training modules for the NSF community to familiarize them with NSF's electronic business systems.

A range of new learning activities is being developed and/or piloted at this time:

Developing IT competency for NSF's e-business environment: This year, 24-hour on-line access tutorials for NSF's e-business processes will be launched. One tutorial explains the Electronic Proposal Processing System, with information on the role of all participants involved in proposal review including the details of managing and executing the Integrated Panel System. We are planning to have information available to those serving on NSF panels so that panelists, who are dispersed around the country can become familiar with the electronic business systems and the role of the panelist prior to arrival at NSF.

The Academy's goals are to have an on-line tutorial for all new major business systems at the time they are introduced. The PIMS (described above) will be the first project for which a web-based tutorial will accompany its release.

Distance Learning: The Academy is piloting distance learning. We are subscribing to off-the-shelf courses to offer a greater number of classes that NSF staff can use at any time. The first pilot with

supervisory staff was very successful. It included topics such as coaching and project management. There will be pilots for the major occupations at NSF to ensure that our investment in Distance Learning is well-managed. Courses available through distance learning will be embedded in the curricula for each job category.

Leadership: The Academy has begun a three-pronged approach to leadership – based upon conducting needs assessments for program officers, administrative staff, and executives. We are supporting the leadership initiative with an orientation that addresses leadership competencies, beginning with a special orientation for Division Directors. Part of the curriculum for Division Directors will be an annual seminar that will be offered this fiscal year.

Curricula development, succession planning, career development, certification programs, and support for Academic learning: NSF plans a robust learning program to ensure that all staff members have the required competencies for their current job, for jobs as they move through the rapidly changing e-business environment, and for professional development in general. With input from NSF staff, we will be developing plans to help support an array of learning activities.

Human Capital Management

For more than 50 years, NSF has enabled discovery, learning and innovation by drawing upon its talented, diverse workforce. The agency's flexible, agile workforce of high-end knowledge workers includes approximately 600 permanent and visiting scientists and engineers (approximately 65% of the agency's scientists and engineers are permanent government employees), 450 business and operations personnel, 350 program support personnel, and approximately 210 on-site contractors, including IT contractors, mail room personnel, proposal processing personnel, Help Desk and Information Center personnel.

Workforce categories are shown in the following tables.

Detail of NSF Workforce by FTE

	FY 2001 Actual	FY 2002 Current Plan	FY 2003 Request	Change Amount
Federal Employees:				
Salaries and Expenses	1,170	1,150	1,217	67
Inspector General	46	50	53	3
Arctic Research Commission	4	4	4	0
Subtotal, Federal FTE	1,220	1,204	1,274	70
Non-Federal Employees:				
IPAs	106	140	140	0
Detailees to NSF	4	5	5	0
Contractors Performing Administrative Functions	210	210	210	0
Subtotal, Non-Federal FTE	320	355	355	0
Total, Workforce FTE	1,540	1,559	1,629	70

DISTRIBUTION OF FULL-TIME EQUIVALENT (FTE) FOR FY 2001

	Federal Employees	Intergovernmental Personnel Act Appointments
Biological Sciences	101	14
Budget, Finance, Award Management	120	0
Computer & Information Science & Engineering	53	18
Cooperative Education Program (Student Aides)	33	0
Education & Human Resources	110	24
Engineering	127	13
Geosciences	90	11
Mathematical & Physical Sciences	115	14
Office of Information & Resource Management	162	0
Office of the Director	83	3
Office of Polar Programs	43	1
Social, Behavioral and Economic Sciences	133	8
Subtotal, Actual FTE Usage	1,170	106
Office of Inspector General	46	0
Total, Actual FTE Usage	1,216	106

The FY 2003 Request includes 67 additional (FTE) – 50 FTE to support existing NSF programs and 17 FTE to support additional programs proposed to be transferred to NSF from other agencies. The additional positions will be allocated based on an agency-wide review of critical human capital needs that is part of the comprehensive Strategic Business Analysis scheduled to begin in FY 2002. An example of a possible allocation of these positions follows:

NSF will recruit approximately 35 FTEs to strategically enhance program/business management expertise within the agency. Individuals recruited will:

- Complement existing workforce expertise in critical science and engineering fields in research and education, thus positioning the agency to respond to increasingly complex, interdisciplinary science and engineering opportunities and challenges; and

- Strengthen the agency's project and business-related acumen.

In addition to strengthening workforce core competencies, individuals hired will relieve growing workload pressures on current NSF project/program managers, thereby allowing increased attention to critical areas such as award management and oversight, performance assessment and accountability. To ensure the continued effective planning, management and oversight of facility projects, the agency will dedicate at least 7 of the approximately 35 positions to these activities. New Major Research Equipment and Facilities Construction (MREFC) projects such as NEON and Earthscope will be allocated a dedicated FTE. As part of the agency-wide review, ongoing MREFC projects will be reviewed to ensure that the appropriate level of project management exists and additional FTE will be provided if warranted.

NSF will also recruit approximately 15 FTEs as science/engineering assistants. Based on several internal pilots to-date, NSF has found that many of the recurring tasks performed by Ph.D.-level scientists and engineers can, in fact, be effectively carried out by individuals with bachelors or masters degrees in science or engineering. Science/engineering assistants perform duties such as developing program

announcements, researching and recommending reviewers, writing panel reports, responding to questions from principal investigators, and synthesizing information from project reports. The recruitment of science/engineering assistants will allow Ph.D. level scientists and engineers to focus on more of the substantive science and engineering issues associated with program and proposal/award management and oversight. This strategic recruitment promises both efficiency and effectiveness improvements in NSF business processes.

An additional 17 FTE will support the establishment and management of three programs transferred from other agencies: Sea Grants, Environmental Education, and Toxic Hydrology Research.

Recent A&M Accomplishments

Electronic Recruitment: e-Recruit is a web-based system that automates the government hiring process and allows NSF's Division of Human Resources Management (HRM) to develop and post vacancies electronically. E-Recruit will allow HRM to reengineer its business processes so that staff spend less time on paper-intensive work such as rating and ranking applications, corresponding with candidates, and setting up panels.

The e-Recruit system will manage the bulk of the rating and ranking. HR staff will then provide a quality review of the top candidates, only spending time on those who certify their expertise high enough to warrant referral, instead of spending countless hours reviewing applications from individuals who would not even make a first cut. Applicants fill out an on-line resume and answer a series of job-specific questions. e-Recruit screens out ineligible and unqualified applicants, applies federal rules such as Veterans' preference and CTAP/ICTAP, notifies applicants of their eligibility, rates and ranks applicants based on their answers to the questions and generates a web-based certificate of rated and ranked applicants for the manager to view.

- e-Recruit allows HRM to realize cost savings with the phase out of printing and mailing hard copy vacancy announcements.

- e-Recruit will enable NSF to reach a more diverse audience through direct links to web-based recruitment mechanisms and organizations that lead efforts to broaden participation in science and engineering. For example, it will link to one system that via email, instantly notifies hundreds of HBCUs, Hispanic-serving institutions, plus the leading professional organizations that focus on underrepresented groups.

- And, most significantly, the typical time from posting a vacancy announcement to having a new employee on board is expected to shrink from several months (currently) to approximately six weeks with e-Recruit.

Empowering Front-Line Employees: NSF's Division of Grants and Agreements (DGA) has recently revised its Delegation levels of authority to allow grants specialists to approve actions at the lowest possible levels while still maintaining appropriate accountability and internal controls. DGA has a streamlining committee that is working with the Foundation-wide e-grants initiative to streamline the processing of routine, low-risk grants as much as possible.

- These changes will position DGA staff for the future by requiring less time to be spent on low-risk, routine activities and providing more time to address high-risk actions, on-site monitoring and project oversight.

- In addition, these changes provide DGA staff with greater decision-making responsibility, development of higher competencies, and increased job growth potential.

Budget Internet Information System (BIIS) and Enterprise Information System (EIS): The Budget Internet Information System (http://ntalpha.bfa.nsf.gov) contains information on GPRA issues such as processing time and award size. It is easily accessible to the public via the Web and is used extensively by the academic community and research and development press. Information currently available includes:

- Funding Rate by State and Organization: Contains information on number of competitive proposals and awards, funding rate, NSF processing time, award duration, and award size. The information can be obtained by discipline and includes ten years of trend data.

- Award Listings by Organization, State, and Institution: Includes information on funding by state and institution, broken out by academic and industrial performers with detail by discipline and award.

- Award Summary by Top Institutions: Shows information on funding by the top institutions, broken out by academic and industrial performers with detail by discipline and award for the past five years.

The Enterprise Information System (EIS) is an internal NSF, user-friendly system that informs and empowers NSF program and financial managers as they make budget and planning decisions. The EIS includes financial and personnel information. For example, a summary of grant budgets for all NSF awards is available. This includes budgets for investigator salaries, funding for undergraduates and graduates, indirect costs, and equipment costs. Trends and current status of projects also are available.

FY 2003 GPRA PERFORMANCE GOALS (MANAGEMENT)

Performance Area	No.	Annual Performance Goals for Management
Proposal and Award Processes[1]		
Use of Merit Review	IV-1	At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.
Implementation of Merit Review Criteria – Reviewers[2]	IV-2	At least 70 percent of reviews will address aspects of both generic review criteria.
Implementation of Merit Review Criteria – Program Officers[2]	IV-3	For at least 80 percent of decisions to fund or decline proposals, program officers will comment on aspects of both generic review criteria.
Customer Service – Time to Prepare Proposals	IV-4	Ninety-five percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.
Customer Service – Time to Decision	IV-5	For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of receipt.
Award Portfolio		
Award Size	IV-6	NSF will increase the average annualized award size for research grants to a level of $125,000, compared to a goal of $113,000 in FY 2002.
Award Duration	IV-7	NSF will maintain the FY 2002 goal of 3.0 years for the average duration of awards for research grants.
Award Oversight and Facilities Management		
Construction and Upgrade of Facilities	IV-8	For 90 percent of projects, keep construction and upgrades within annual expenditure plan, not to exceed 110 percent of estimates.
	IV-9	Ninety percent of construction / upgrade projects will meet all major annual schedule milestones.
	IV-10	For all construction and upgrade projects initiated after 1996, when current planning processes were put in place, keep total cost within 110 percent of estimates made at the initiation of construction.
Operations and Management of Facilities	IV-11	For 90 percent of facilities, keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time.

[1]Development of an additional performance goal in FY 2003 for reviewer pool diversity will be assessed once the FY 2002 goal of establishing a baseline for participation of members of underrepresented groups in the NSF reviewer pool is completed.
[2]These performance goal will undergo both quantitative and qualitative assessment.

FY 2003 GPRA PERFORMANCE GOALS (MANAGEMENT, CONTINUED)

Performance Area	No.	Annual Performance Goals for Management (Continued)
Business Practices		
Electronic Business	IV-12	NSF will continue to advance "e-business" by receiving through FastLane and processing electronically 90 percent of Principal Investigator award transfers.
	IV-13	NSF will continue to advance "e-business" by creating a functional web-based Electronic Jacket available for use by NSF staff by the end of FY 2003.
Information Technology Security	IV-14	NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's IT infrastructure and critical assets. Performance Indicators: - 100 percent of mission-critical systems will have documented risk assessments. - 100 percent of mission-critical systems will have approved security plans on file.
Human Resources and Workplace		
NSF Staff – Diversity	IV-15	NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers (S&E). Performance indicator: Initiate development of a NSF S&E diversity plan.
	IV-16	NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering positions from underrepresented groups.
Workforce	IV-17	NSF will align or develop competency-based curricula, through the NSF Academy, that provide cross-functional, work-based team learning opportunities. Performance Indicator: Initiation of curriculum development activities that address program management, leadership development, and technology and business process training.
	IV-18	NSF will develop competency-based, occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. Performance Indicators: - Identification of workforce competencies for two or more of NSF's strategic business processes. - Initiate identification of competency-based, classification alternatives.

NSF Funding Profile

The Number of Requests for Funding is a count of all proposals and requests for additional funding on continuing awards. Additional funding on continuing awards is contingent upon availability of funds and whether the results achieved are determined to warrant further support. Dollars Requested includes all dollars associated with the requests for funding.

Total Number of Awards is a count of the awards funded in the fiscal year. It includes both new awards and the second and subsequent years of a continuing award.

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. 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 winning an award when submitting proposals to NSF.

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

Average duration is the length of the award in years. The duration calculation is limited to research projects and excludes other categories of awards which fund infrastructure-type activities such as equipment and conference awards, which do not require multi-year support.

NSF FUNDING PROFILE

	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate
Number of Requests for Funding [1]	43,515	44,550	45,900
Dollars Requested (in millions) [1]	$28,784	$28,910	$30,000
Total Number of Awards	20,923	21,590	22,050
Statistics for Competitive Awards			
Number	9,925	10,430	10,630
Funding Rate	31%	32%	32%
Statistics for Research Grants			
Number of Research Grants	6,220	6,390	6,580
Median Annualized Award Size	$84,612	$86,000	$87,400
Average Annualized Award Size	$113,601	$113,000	$125,000
Average Duration (yrs.)	2.9	3.0	3.0

[1] FY 2002 and FY 2003 data do not include requests for funding for H-1B scholarship activity.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2001 ACTUAL	FY 2002 REQUEST	FY 2002 CURRENT PLAN	FY 2003 REQUEST	CHANGE FY 2003 Req/FY02 Curr Plan AMOUNT	CHANGE FY 2003 Req/FY02 Curr Plan PERCENT
BIOLOGICAL SCIENCES						
MOLECULAR AND CELLULAR BIOSCIENCES						
Molecular & Cellular Biosciences Research	$114,132	$121,240	$114,600	$111,556	-$3,044	-2.7%
Total	114,132	121,240	114,600	111,556	-3,044	-2.7%
INTEGRATIVE BIOLOGY AND NEUROSCIENCE						
Integrative Biology & Neuroscience Research	96,430	112,640	101,420	98,726	-2,694	-2.7%
Total	96,430	112,640	101,420	98,726	-2,694	-2.7%
ENVIRONMENTAL BIOLOGY						
Environmental Biology Research	96,610	111,740	102,490	99,768	-2,722	-2.7%
Total	96,610	111,740	102,490	99,768	-2,722	-2.7%
BIOLOGICAL INFRASTRUCTURE						
Research Resources	46,466	56,040	46,170	47,944	1,774	3.8%
Human Resources	22,125	16,450	22,350	24,376	2,026	9.1%
Total	68,591	72,490	68,520	72,320	3,800	5.5%
EMERGING FRONTIERS						
Emerging Frontiers	45,116	0	46,380	68,250	21,870	47.2%
Total	45,116	0	46,380	68,250	21,870	47.2%
PLANT GENOME RESEARCH						
Plant Genome Research	65,073	65,000	75,000	75,000	0	0.0%
Total	65,073	65,000	75,000	75,000	0	0.0%
Total, BIO	$485,952	$483,110	$508,410	$525,620	$17,210	3.4%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2001 ACTUAL	FY 2002 REQUEST	FY 2002 CURRENT PLAN	FY 2003 REQUEST	CHANGE FY 2003 Req/FY02 Curr Plan AMOUNT	CHANGE FY 2003 Req/FY02 Curr Plan PERCENT
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING						
COMPUTER-COMMUNICATIONS RESEARCH						
Computer-Communications Research	$65,579	$64,390	$69,810	$70,170	$360	0.5%
Total	65,579	64,390	69,810	70,170	360	0.5%
INFORMATION AND INTELLIGENT SYSTEMS						
Information and Intelligent Systems Research	49,139	48,020	52,060	50,610	-1,450	-2.8%
Total	49,139	48,020	52,060	50,610	-1,450	-2.8%
EXPERIMENTAL AND INTEGRATIVE ACTIVITIES						
Experimental and Integrative Activities	61,030	57,810	62,670	62,160	-510	-0.8%
Total	61,030	57,810	62,670	62,160	-510	-0.8%
ADVANCED COMPUTATIONAL INFRASTRUCTURE AND RESEARCH						
Advanced Computational Infrastructure	73,975	73,710	79,910	78,490	-1,420	-1.8%
Advanced Computational Research	7,566	6,510	7,060	6,930	-130	-1.8%
Total	81,541	80,220	86,970	85,420	-1,550	-1.8%
ADVANCED NETWORKING INFRASTRUCTURE AND RESEARCH						
Advanced Networking Infrastructure	44,691	43,910	47,600	46,620	-980	-2.1%
Advanced Networking Research	20,781	20,530	22,260	21,290	-970	-4.4%
Total	65,471	64,440	69,860	67,910	-1,950	-2.8%
INFORMATION TECHNOLOGY RESEARCH (ITR)						
Information Technology Research (ITR)	155,392	155,480	173,510	190,670	17,160	9.9%
Total	155,392	155,480	173,510	190,670	17,160	9.9%
Total, CISE	$478,152	$470,360	$514,880	$526,940	$12,060	2.3%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2001 ACTUAL	FY 2002 REQUEST	FY 2002 CURRENT PLAN	FY 2003 REQUEST	CHANGE FY 2003 Req/FY02 Curr Plan AMOUNT	CHANGE FY 2003 Req/FY02 Curr Plan PERCENT
ENGINEERING						
BIOENGINEERING AND ENVIRONMENTAL SYSTEMS						
Bioengineering and Environmental Systems	$39,468	$38,450	$41,790	$43,870	$2,080	5.0%
Total	39,468	38,450	41,790	43,870	2,080	5.0%
CHEMICAL AND TRANSPORT SYSTEMS						
Chemical and Transport Systems	50,610	50,150	56,770	58,940	2,170	3.8%
Total	50,610	50,150	56,770	58,940	2,170	3.8%
CIVIL AND MECHANICAL SYSTEMS						
Civil and Mechanical Systems	53,266	52,180	56,060	57,750	1,690	3.0%
Total	53,266	52,180	56,060	57,750	1,690	3.0%
DESIGN, MANUFACTURE, AND INDUSTRIAL INNOVATION						
Design, Manufacture, and Industrial Innovation	51,866	50,870	55,670	57,580	1,910	3.4%
Small Business-Industrial Innovation	74,833	74,830	80,530	83,650	3,120	3.9%
Total	126,699	125,700	136,200	141,230	5,030	3.7%
ELECTRICAL AND COMMUNICATIONS SYSTEMS						
Electrical and Communications Systems	53,841	57,090	64,830	66,700	1,870	2.9%
Total	53,841	57,090	64,830	66,700	1,870	2.9%
ENGINEERING EDUCATION AND CENTERS						
Engineering Education and Centers	109,483	107,480	116,670	119,490	2,820	2.4%
Total	109,483	107,480	116,670	119,490	2,820	2.4%
Total, ENG	$433,367	$431,050	$472,320	$487,980	$15,660	3.3%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2001 ACTUAL	FY 2002 REQUEST	FY 2002 CURRENT PLAN	FY 2003 REQUEST	CHANGE FY 2003 Req/FY02 Curr Plan AMOUNT	CHANGE FY 2003 Req/FY02 Curr Plan PERCENT
GEOSCIENCES						
ATMOSPHERIC SCIENCES						
Atmospheric Sciences Research Support	$117,082	$115,870	$125,400	$145,320	$19,920	15.9%
National Center for Atmospheric Research	71,819	70,630	76,620	73,600	-3,020	-3.9%
Total	188,902	186,500	202,020	218,920	16,900	8.4%
EARTH SCIENCES						
Earth Sciences Project Support	87,443	88,270	95,530	116,940	21,410	22.4%
Instrumentation and Facilities	28,170	28,520	30,870	36,200	5,330	17.3%
Total	115,613	116,790	126,400	153,140	26,740	21.2%
OCEAN SCIENCES						
Ocean Section	98,760	96,100	104,000	120,010	16,010	15.4%
Integrative Programs Section	82,820	82,850	93,600	104,000	10,400	11.1%
Marine Geosciences Section	77,508	76,300	83,450	95,000	11,550	13.8%
Total	259,088	255,250	281,050	319,010	37,960	13.5%
Total, GEO	$563,603	$558,540	$609,470	$691,070	$81,600	13.4%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2001 ACTUAL	FY 2002 REQUEST	FY 2002 CURRENT PLAN	FY 2003 REQUEST	CHANGE FY 2003 Req/FY 02 Curr Plan AMOUNT	CHANGE FY 2003 Req/FY 02 Curr Plan PERCENT
MATHEMATICAL AND PHYSICAL SCIENCES						
ASTRONOMICAL SCIENCES						
Astronomical Sciences	$148,738	$156,260	$165,860	$161,250	-$4,610	-2.8%
Total	148,738	156,260	165,860	161,250	-4,610	-2.8%
CHEMISTRY						
Chemistry Research	154,282	153,460	162,890	160,800	-2,090	-1.3%
Total	154,282	153,460	162,890	160,800	-2,090	-1.3%
MATERIALS RESEARCH						
Materials Research	209,674	205,420	219,510	219,320	-190	-0.1%
Total	209,674	205,420	219,510	219,320	-190	-0.1%
MATHEMATICAL SCIENCES						
Mathematical Sciences	121,441	141,480	151,480	181,870	30,390	20.1%
Total	121,441	141,480	151,480	181,870	30,390	20.1%
PHYSICS						
Physics Research	187,537	183,570	195,880	193,310	-2,570	-1.3%
Total	187,536	183,570	195,880	193,310	-2,570	-1.3%
MULTIDISCIPLINARY ACTIVITIES						
Research Project Support	32,405	23,390	24,830	25,020	190	0.8%
Total	32,405	23,390	24,830	25,020	190	0.8%
Total, MPS	$854,077	$863,580	$920,450	$941,570	$21,120	2.3%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2001 ACTUAL	FY 2002 REQUEST	FY 2002 CURRENT PLAN	FY 2003 REQUEST	CHANGE FY 2003 Req/FY02 Curr Plan AMOUNT	CHANGE FY 2003 Req/FY02 Curr Plan PERCENT
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES						
SOCIAL AND ECONOMIC SCIENCES						
Social and Economic Sciences	$65,968	$65,840	$68,110	$77,610	$9,500	13.9%
Total	65,968	65,840	68,110	77,610	9,500	13.9%
BEHAVIORAL AND COGNITIVE SCIENCES						
Behavioral and Cognitive Sciences	57,231	56,560	58,510	65,300	6,790	11.6%
Total	57,231	56,560	58,510	65,300	6,790	11.6%
INTERNATIONAL SCIENCE AND ENGINEERING						
Office of International Science and Engineering	38,189	25,120	25,990	27,000	1,010	3.9%
Total	38,189	25,120	25,990	27,000	1,010	3.9%
SCIENCE RESOURCES STATISTICS						
Science Resource Statistics	15,836	15,640	16,180	25,700	9,520	58.8%
Total	15,836	15,640	16,180	25,700	9,520	58.8%
Total, SBE [1]	$177,224	$163,160	$168,790	$195,610	$26,820	15.9%
UNITED STATES POLAR RESEARCH PROGRAMS	$214,122	$213,970	$229,740	$235,740	$6,000	2.6%
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES	$68,160	$62,600	$68,070	$68,070	$0	0.0%
INTEGRATIVE ACTIVITIES	$97,644	$80,610	$106,510	$110,610	$4,100	3.8%
Subtotal, RESEARCH AND RELATED ACTIVITIES	$3,372,301	$3,326,980	$3,598,640	$3,783,210	$184,570	5.1%
Carryover			1,923		-1,923	-100.0%
Total, RESEARCH AND RELATED ACTIVITIES	$3,372,301	$3,326,980	$3,600,563	$3,783,210	$182,647	5.1%

[1] In FY 2001, SBE's Office of International Science and Engineering includes a transfer of $13.75 million from the U.S. International Development Cooperation Agency for an award to the U.S. Civilian Research and Development Foundation.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2001 ACTUAL	FY 2002 REQUEST	FY 2002 CURRENT PLAN	FY 2003 REQUEST	CHANGE FY 2003 Req/FY02 Curr Plan AMOUNT	CHANGE FY 2003 Req/FY02 Curr Plan PERCENT
EDUCATION AND HUMAN RESOURCES						
MATH & SCIENCE PARTNERSHIP						
Math & Science Partnership	$0	$200,000	$160,000	$200,000	$40,000	25.0%
Total	0	200,000	160,000	200,000	40,000	25.0%
EDUCATIONAL SYSTEM REFORM						
Educational System Reform	110,296	45,250	45,190	40,250	-4,940	-10.9%
Total	110,296	45,250	45,190	40,250	-4,940	-10.9%
EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCoR)						
Innovation Partnership Activities	14,326	0	11,000	0	-11,000	-100.0%
Experimental Program to Stimulate Competitive Research (EPSCoR)	74,924	74,810	80,000	75,000	-5,000	-6.3%
Total	89,250	74,810	91,000	75,000	-16,000	-17.6%
ELEMENTARY, SECONDARY AND INFORMAL EDUCATION						
Instructional and Assessment Materials Development	34,016	28,990	28,950	28,990	40	0.1%
Teacher & Student Development	113,024	80,620	80,510	87,450	6,940	8.6%
Informal Science Education	55,807	56,000	55,920	55,000	-920	-1.6%
Total	202,846	165,610	165,380	171,440	6,060	3.7%
UNDERGRADUATE EDUCATION						
Curriculum, Laboratory & Instructional Development	76,244	75,740	85,630	79,740	-5,890	-6.9%
Workforce Development	64,621	56,860	56,780	55,860	-920	-1.6%
Total	140,865	132,600	142,410	135,600	-6,810	-4.8%
GRADUATE EDUCATION						
Graduate Student Support	88,076	95,500	105,500	128,380	22,880	21.7%
Total	88,076	95,500	105,500	128,380	22,880	21.7%
HUMAN RESOURCE DEVELOPMENT						
Undergraduate/ Graduate Student Support	50,567	50,770	55,200	50,770	-4,430	-8.0%
Research & Education Infrastructure	22,783	23,200	25,770	23,200	-2,570	-10.0%
Opportunities for Women and Persons with Disabilities	16,952	16,470	16,450	16,240	-210	-1.3%
Total	90,302	90,440	97,420	90,210	-7,210	-7.4%
RESEARCH, EVALUATION AND COMMUNICATION						
Research	61,304	55,560	55,480	54,560	-920	-1.7%
Evaluation	12,479	12,640	12,620	12,640	20	0.2%
Total	73,782	68,200	68,100	67,200	-900	-1.3%
Subtotal, EHR	795,417	872,410	875,000	908,080	33,080	3.8%
H-1B Nonimmigrant Petitioner Receipts	78,512	144,000	90,000	92,500	2,500	2.8%
Carryover [1]			201		0	0.0%
Total, EHR	$873,929	$1,016,410	$965,201	$1,000,580	$35,379	3.7%

[1] Carryover excludes $59.7 million of H-1B Nonimmigrant Petitioner receipts; these funds will be obligated through the EHR activity.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2001 ACTUAL	FY 2002 REQUEST	FY 2002 CURRENT PLAN	FY 2003 REQUEST	CHANGE FY 2003 Req/FY02 Curr Plan AMOUNT	CHANGE FY 2003 Req/FY02 Curr Plan PERCENT
MAJOR RESEARCH EQUIPMENT	$119,242	$96,300	$138,800	$126,280	-$12,520	-9.0%
Carryover [1]			73,093		-73,093	0.0%
Total, MRE	$119,242	$96,300	$211,893	$126,280	-$85,613	40.4%
SALARIES AND EXPENSES	$160,528	$170,040	$170,040	$202,950	$32,910	19.4%
Retirement Accrual	5,802		6,364	7,210	846	13.3%
Total, S&E	$166,330	$170,040	$176,404	$210,160	$33,756	19.1%
OFFICE OF INSPECTOR GENERAL	$6,317	$6,760	$6,760	$7,700	$940	13.9%
Carryover			73			
Retirement Accrual	260		280	360	80	28.6%
Total, OIG	$6,577	$6,760	$7,113	$8,060	$947	13.3%
Subtotal, NATIONAL SCIENCE FOUNDATION	$4,538,379	$4,616,490	$4,885,884	$5,128,290	$242,406	5.0%
Carryover [3]			75,290		-75,290	0.0%
Retirement Accrual	-6,062		-6,644	-7,570	-926	13.9%
TOTAL, NATIONAL SCIENCE FOUNDATION	$4,532,317	$4,616,490	$4,954,530	$5,120,720	$166,190	3.4%

Totals may not add due to rounding

[1] In FY 2001 $73.09 million was carried over largely in support of the South Pole Station Modernization project.

[2] Carryover excludes $59.7 million of H-1B Nonimmigrant Petitioner receipts; these funds will be obligated through the EHR activity.

ABOUT THE NATIONAL SCIENCE FOUNDATION

NSF is an independent federal agency created by the National Science Foundation Act of 1950 (P.L. 81-507). Its aim is to promote and advance progress in science and engineering in the United States. The idea of such a foundation was an outgrowth of the important contributions made by science and technology during World War II. From those first days, NSF has had a unique place in the Federal government: it is responsible for the overall health of science and engineering across all disciplines. In contrast, other federal agencies support research focused on specific missions, such as health or defense. The Foundation is also committed to ensuring the nation's supply of scientists, engineers, and science and engineering educators.

NSF funds research and education in science and engineering. It does this through grants and cooperative agreements to almost 2,000 colleges, universities, K-12 schools, businesses and other research institutions in all parts of the United States. The Foundation accounts for about one-quarter of federal support to academic institutions for basic research.

NSF receives approximately 30,000 proposals each year for research and education and training projects, of which approximately 10,000 are funded, and several thousand applications for graduate and postdoctoral fellowships. These typically go to universities, colleges, academic consortia, nonprofit institutions, and small businesses. The agency operates no laboratories itself but does support national research centers, user facilities, certain oceanographic vessels, and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, U.S. participation in international scientific efforts, and educational activities at the K-12 level as well as universities and colleges.

The Foundation is led by a presidentially appointed Director and governed by the National Science Board (NSB). The Board is composed of 24 members, representing a cross section of American leadership in science and engineering research and education; appointed by the President to 6-year terms, with one-third appointed every 2 years; and selected solely on the basis of established records of distinguished service. The NSF Director is a member ex-officio of the Board. In addition to governance of the Foundation, the Board serves the President and the Congress as an independent advisory body on policies affecting the health of U.S. science and engineering and education in science and engineering.

NSF is structured much like a university, with grants-making divisions for the various disciplines and fields of science and engineering, and for science, math, engineering and technology education. NSF also uses a variety of management mechanisms to coordinate research in areas that cross traditional disciplinary boundaries. The Foundation is helped by advisors from the scientific community and from industry who serve on formal committees or as ad hoc reviewers of proposals. This advisory system, which focuses on both program direction and specific proposals, involves approximately 50,000 scientists and engineers a year. NSF staff members who are experts in a specific field or area make award recommendations; applicants get anonymous verbatim copies of peer reviews.

Awardees are wholly responsible for doing their research and preparing the results for publication; the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals on behalf of all qualified scientists and engineers and strongly encourages women, minorities, and people with disabilities to compete fully in its programs. In accordance with federal statutes and regulations and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from NSF.

For more information on NSF programs and plans, see NSF's website at http://www.nsf.gov/.