National Science Foundation

Summary of FY 2002
Budget Request to Congress




About the Front Cover

Arabidopsis thaliana

In December 2000, an international research team partially funded by NSF announced the completion of the first plant genome sequence. The species *Arabidopsis thaliana* has emerged as the plant counterpart of the laboratory mouse, offering clues to how a variety of living organisms behave genetically. This information has potentially widespread applications for agriculture, medicine and energy. NSF provides support for research that advances 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 processes that are internal to the organism as well as those that are external, and includes temporal frameworks ranging from measurements in real time through individual life spans, to the full scope of evolutionary time.
– Photo courtesy of Dr. Elliot Meyerowitz, California Institute of Technology

What happens if you blow on a floating bottle cap?

Kindergarten students at Buena Vista Elementary School in San Francisco learn about the properties of wind and water. NSF's support of science, mathematics, engineering, and technology education has enabled learners at all levels to broaden their scientific and technological literacy. NSF funds both formal and informal projects that strengthen learning environments for students at the pre-kindergarten through twelfth-grade levels, as well as provides opportunities for life-long learning to the general public. NSF also supports research on children, learning, and the influence of families and communities on child development, in order to determine the most effective approaches to teaching them.
– Photo courtesy of the Local Systemic Change Through Teacher Enhancement Project, EHR/ESIE

Circuits

Investments in engineering contribute to technological innovation that is vital to the nation's future economic strength, security, and quality of life. A major focus of the Foundation's investments is in emerging technologies—microsystems and nanotechnology, information technology and biotechnology. Support for research in these areas contributes to major advances in health care, manufacturing, business, education, and services. NSF supports fundamental research on engineering systems, devices, and materials, and the processes and methodologies that underpin them.
– Photo courtesy of the NSF photo library

Chemistry

NSF supports a strong and diverse portfolio of research and education in astronomical sciences, chemistry, materials research, mathematical sciences and physics. The purpose of this research is to deepen our understanding of the physical universe, to use this understanding in service to society and to prepare the next generation of scientists who are essential for continued progress. The mathematical and physical sciences underpin many other scientific endeavors and serve as the training ground for at least half of all doctoral scientists now employed in U.S. industry.
– Photo courtesy of Hercules Incorporated, Wilmington, Delaware

About the Back Cover

Lightning

Fundamental research in the geosciences advances scientific knowledge of Earth's environment, including resources such as water, energy, minerals, and biological diversity. These activities also advance our ability to predict natural phenomena of economic and human significance, such as weather, climate change, earthquakes, fish-stock fluctuations, and disruptive events in the solar-terrestrial environment. NSF is the principal source of federal funding for university-based basic research in the geosciences, providing over half of the total support for the atmospheric, earth, and ocean sciences.
– Photo courtesy of the National Center for Atmospheric Research/University Corporation for Atmospheric Research, Boulder, Colorado

Polar research

A scientist prepares to launch aerial research equipment to measure glacial retreat in Palmer Station, Antarctica. Polar researchers monitor and analyze recent changes in the Arctic ice cover and the West Antarctic Ice Sheet to better understand the potential impact of these changes on global climate change. The Arctic and Antarctic are premier natural laboratories whose extreme environments and geographically unique processes enable research not feasible elsewhere. NSF also supports projects that analyze the chemistry of ice cores as a record of global climate history; utilize astrophysical observations made in cold dry polar conditions to determine the evolution and structure of the universe; examine the effects on marine life of increased ultraviolet light resulting from ozone depletion; and elucidate adaptation mechanisms of organisms and ecosystems to harsh living conditions.
– Photo courtesy of Jim Lo Scalzo, a staff photographer for U.S. News & World Report, *who visited Palmer Station under the auspices of NSF's Antarctic Media Visitors Program.*

Instrumentation

One of the resonators from the Argonne Tandem Linear Accelerator System, Argonne National Laboratory. NSF provides support for large, state-of-the-art, multi-user facilities that are essential to the progress of research. Support for these unique national facilities is necessary to advance U.S. research capabilities and enhance participation in world-class research. NSF also invests in 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.
– Photo courtesy of the NSF photo library

Virtual reality

Computer visualization techniques, such as computer graphics, animation and virtual reality, have been pioneered with NSF support. Scientists in many disciplines use these sophisticated computer techniques to model complex events and visualize phenomena that cannot be observed directly. NSF promotes basic research and education in the computer and information sciences and engineering, and helps maintain the nation's preeminence in these fields. Such technologies affect nearly every facet of modern life, including agriculture, manufacturing, health and education. Research ranges from the study of basic principles of the creation, representation, storage, transmission, transformation and application of information to development of new algorithms, systems and applications of these research innovations.
– Photo courtesy of the NSF photo library

National Science Foundation

Summary of the FY 2002 Budget Request to Congress

NATIONAL SCIENCE FOUNDATION

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NATIONAL SCIENCE FOUNDATION

National Science Foundation Fiscal Year 2002 Budget Request Overview

The National Science Foundation requests $4.47 billion for Fiscal Year 2002, $56.1 million or 1.3 percent over FY 2001. This investment in the nation's future will train young scientists and engineers, create new knowledge, and develop cutting-edge tools that together will fuel economic prosperity and increase social well-being in the years ahead. NSF will provide leadership in the President's Math and Science Partnership, and sustained investments in NSF's core programming will contribute to progress across science and engineering.

Nothing is more central to the nation's prosperity than the ability to create and make use of knowledge. The technological innovation that is driving productivity gains in American industry depends increasingly on fundamental scientific research. Over the past five years alone, the information technology sector, which accounts for 8.3 percent of U.S. GDP, accounted for almost one-third of U.S. economic growth.

Today, however, global communications and rapid technological change have raised the bar on competition. Scientific knowledge is becoming the most sought after commodity in the world. The U.S. ranks only 6th among OECD nations in the share of GDP devoted to research and development. And, the latest results of international testing confirm that we need to strengthen math and science education at all levels. A 24-year-old in Japan is three times more likely than one in the U.S. to hold a bachelor's degree in engineering. In South Korea, the figure is 2.7 times; and in the European Union, 1.6. Securing U.S. world leadership in science and technology has never been more important to the future of the nation.

The productivity of the U.S. scientific and engineering community – the fruits of which can be seen in the information technology, communications, and biotechnology industries – depends critically on NSF support of fundamental research. 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. With these same investments, NSF supports the training of scientists and engineers who will provide the highly skilled workforce required in the new knowledge-based economy. NSF's programs directly enable the work of nearly 200,000 scientists, engineers, teachers, and students each year.

Funding levels for each of NSF's five appropriation accounts are shown in the table below.

NSF Funding by Appropriation
(Millions of Dollars)

	FY 2001 Current Plan	FY 2002 Request	Percent Change
Research and Related Activities	3,342.63	3,326.98	-0.5%
Education and Human Resources [1]	785.62	872.41	11.0%
Major Research Equipment	121.33	96.30	-20.6%
Salaries and Expenses	160.54	170.04	5.9%
Office of Inspector General	6.27	6.76	7.8%
Total, NSF	$4,416.39	$4,472.49	1.3%

Totals may not add due to rounding.
[1] Does not include $121 million in FY 2001 and $144 million in FY 2002 from H-1B Nonimmigrant Petitioner Fees.

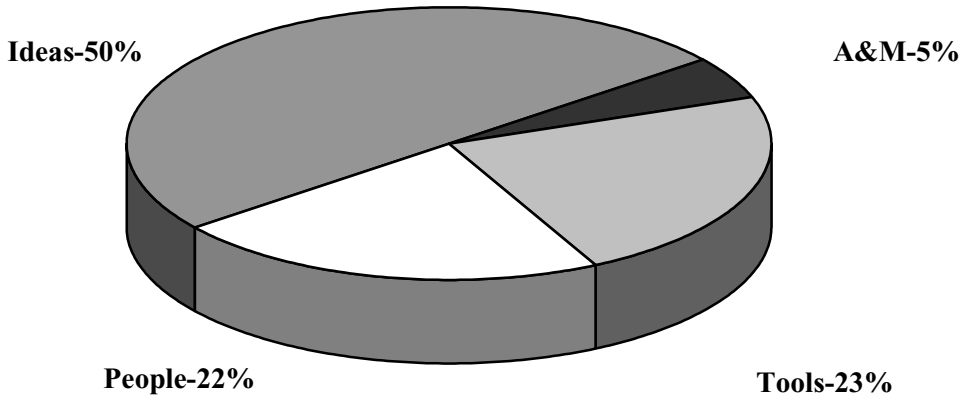
People, Ideas and Tools: NSF Strategic Goals

The FY 2002 Budget Request reflects NSF's strength – a broad base of research and education activities that provides the nation with the People, the Ideas, and the Tools needed to fuel innovation and economic growth. These are the three goals identified in the NSF strategic plan:

- **People –** *A diverse, internationally competitive and globally-engaged workforce*
- **Ideas –** *Discovery across frontiers, connected to learning, innovation and service to society*
- **Tools –** *Accessible, state-of-the-art information bases and shared tools*

People are NSF's most important product. They represent both the focus of our investments and the most important products of them. Support for programs specifically addressing NSF's Strategic Goal of People totals more than $1.0 billion in FY 2002, an increase of 12.8 percent over FY 2001. A major focus for these activities is in the Education and Human Resources (EHR) account. The EHR efforts are integrated with complementary efforts across the Foundation where the activities in the Research and Related Activities account contribute over $300 million of the $1.0 billion toward the People goal. Moreover, about 40 percent of the funding for research grants – an amount approaching $900 million in FY 2002 – provides support for researchers and students, including approximately 60,000 post doctorates, trainees, and graduate and undergraduate students. People generate the Ideas that are the currency of the new knowledge-based economy. Tools enable scientific discovery and provide access to unique education opportunities. They also open new opportunities for innovative applications well beyond the research arena. Advances in information technology are a striking example of this.

FY 2002 Budget Request of $4.47 Billion



These goals support NSF's mission to promote progress across all of science and engineering research and education. Funding levels associated with the Foundation's three strategic goals are shown in the table below.

NSF Budget by Strategic Goal
(Millions of Dollars)

	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate
People	816.11	888.31	1,002.19
Ideas	1,962.49	2,251.11	2,219.84
Tools	955.44	1,060.95	1,023.69
Administration and Management	189.32	216.03	226.77
Total, NSF	$3,923.36	$4,416.39	$4,472.49

Totals may not add due to rounding.
Does not include $25.1 million in FY 2000, $121 million in FY 2001, and $144 million in FY 2002 from H-1B Nonimmigrant Petitioner Fees.

HIGHLIGHTS AND PRIORITIES

The FY 2002 Budget Request builds on NSF's strength as the only agency of the federal government exclusively devoted to promoting basic research and education at all levels and across all fields of science and engineering.

Math and Science Partnership Initiative

The FY 2002 Budget Request proposes $200 million for the President's new Math and Science Partnership initiative. The purpose of this investment is to ensure that all K-12 students have the opportunity to perform to high standards. The Partnership initiative will provide funds for states and

local school districts to join with institutions of higher education, particularly with their departments of mathematics, science, and engineering, to strengthen K-12 math and science education. To accomplish this, the initiative will support a variety of partnership structures and approaches to address these issues:

- too few teachers who have been trained to teach math and science;
- too few schools offering a challenging curriculum with textbooks to support it; and
- too few students taking advanced course work.

The initiative will promote the development and use of effective, research-based approaches that can raise math and science standards for students, improve the quality of teachers and teaching materials, and create innovative ways to reach underserved schools. It will also emphasize the development of appropriate mechanisms to measure progress and assess accountability.

Financial Support for Graduate Students

The FY 2002 Budget will provide approximately $8.0 million (depending upon the number of awardees) to increase stipends for the Graduate Research Fellowships, the Graduate Teaching Fellowships in K-12 Education, and the Integrative Graduate Education and Research Traineeship programs. Stipends will increase from $18,000 to $20,500 for academic year 2002-2003. Financial support for graduate students in the science, mathematics, engineering, and technology disciplines is a critical component of ensuring a diverse and globally competitive workforce of scientists and engineers. Increasing stipends is one strategy to attract more U.S. citizens, nationals and permanent residents to graduate education in science and engineering. Currently, the average stipend level for graduate students in science and engineering disciplines is less than half the average wage for bachelor's degree recipients. This wide disparity may be a significant factor in declining graduate school enrollments for science and engineering disciplines. Between 1994 and 1997, first-time graduate school enrollments dropped 12.6 percent; enrollment figures for African-Americans fell 19.6 percent. A recent survey found that 57 percent of baccalaureate recipients did not apply to science and engineering graduate programs for financial reasons. Those with the largest undergraduate debt were least likely to continue on to graduate school. Underrepresented minorities were far more likely to borrow for undergraduate study and thus, account for a larger percentage of those citing financial reasons for not continuing their education.

Core Investments

NSF's "core" research and education activities sustain the health and vitality of the nation's science and engineering research and education in all fields and education at all levels. These funds support merit-reviewed research and education across the full NSF portfolio and will help provide balance across all fields. Investments in core research and education activities are essential to developing a diverse science and engineering workforce, and to advancing the frontiers of knowledge on a broad front.

A centerpiece of NSF's core investments in FY 2002 is the Interdisciplinary Mathematics program funded at $20.0 million. This emphasis on the mathematical sciences recognizes its increasingly critical role in advancing interdisciplinary science. Because mathematics is both a powerful tool for insight and a common language for science and engineering, this increased investment will accelerate exchange with other disciplines, bringing cutting-edge mathematics to problems in the physical, biological and social sciences. In FY 2002, NSF will focus on the management of large data sets, the modeling of uncertainty, and the modeling and prediction of complex non-linear systems. Some examples of the latter include studies of brain function, communication networks, modern economic behaviors, and the prediction of weather and ocean circulation.

Priority Areas

In addition to its investments in core research and education, NSF identifies and supports emerging opportunities in priority areas that hold exceptional promise to advance knowledge. The FY 2002 Budget Request emphasizes investments in four interdependent priority areas – Biocomplexity in the Environment (BE), Information Technology Research (ITR), Nanoscale Science and Engineering, and Learning for the 21st Century.

- **Biocomplexity in the Environment (BE)**. BE is a multidisciplinary effort that draws on new scientific and technological capabilities to investigate the interactions among ecological, social, and physical earth systems. The primary goal is to tackle the major challenge of synthesizing environmental knowledge across fields, systems, time, and space and forecasting the outcomes of those interactions. Computational and information technologies, real time sensing techniques, and genomics are some of the new probes of the dynamic web of interrelationships that arise when living things at all levels interact with their environment, that is, for understanding biocomplexity. The FY 2002 BE budget request builds on past investments in the core programs and in biocomplexity. For example, recently funded investigators are studying complex interactions shaping ecosystems of freshwater bays and lagoons, contaminant flux of the lower Mississippi River, dynamics of an invasive non-native species on the Pacific Coast, and marine mammal abundance in the western Arctic Ocean. BE will also invest in the development of new research instruments and software that will advance cross-disciplinary studies in the environment.

- **Information Technology Research (ITR)**. This priority area deepens research on software, networking, scalability, and communications to improve ways to gather, store, analyze, share, and display information. Because fundamental advances are possible in many areas where information technology meets other scientific disciplines (the effect of IT on molecular biology and medicine is a striking example), the FY 2002 ITR budget request expands fundamental research in multidisciplinary areas. Studies will explore how to make large-scale networking, software, and systems more reliable, stable, and secure to enable applications from telemedicine, to interactive education, to the remote operation of experimental apparatus. Other research will improve our understanding of human-computer interactions, and investigate the impact of IT on our society, on our economy, and on our educational system. Because the information technology sector has contributed substantially to recent U.S. economic growth, these investments remain a top priority. A specific emphasis area for FY 2002 is the interface of IT and biological research to evoke new cyber-information infrastructure.

- **Nanoscale Science and Engineering**. This priority area explores phenomena at molecular and atomic scales and new techniques to facilitate a broad range of applications. Recent advances have already begun to spawn useful new materials and promising innovations that will touch every part of our lives, from our medicine cabinets – with targeted drug delivery systems, vaccines, and electronic biosensors to detect cancer in its earliest stages – to our workplace, with faster, more efficient computers and networks. As countries currently compete for global preeminence in these technologies, this investment will strengthen U.S. leadership and boost efforts to build a nanotech-ready workforce. Activities range from investigation of biologically based systems that exhibit novel properties (useful for developing materials for implants) to the study of nanoscale control of structure and composition in new materials, as well as studies of the potential impact of nanotechnology on society.

- **Learning for the 21st Century**. The FY 2002 budget request for this priority area funds activities to expand our fundamental knowledge base on learning, explore the potential of information technology to facilitate and enhance learning, and integrate new understanding of learning and

technology into formal and informal educational settings. Research in cognitive neuroscience, computational linguistics, human-computer interactions, and learning environments will advance understanding of how students learn, frame questions, solve problems and employ skills to derive answers. Research, development and testing of educational tools incorporating information technology will provide a better understanding of how they can be used effectively in the classroom. Investments in Centers for Learning and Teaching, which link K-12 and higher education, will provide opportunities for teachers to gain new skills in the use of information technology in education, new knowledge in science and mathematics, and will allow them to integrate these with new research on learning. Applications of research results will increase opportunities for higher achievement for all students and produce a workforce able to meet the challenges of rapid scientific and technological change.

Funding levels for each of these priority areas are shown in the table below.

NSF Funding by Priority Area
(Dollars in Millions)

Priority Area	FY 2001 Current Plan	FY 2002 Request	Percent Change
Biocomplexity in the Environment	54.88	58.10	5.9%
Information Technology Research	259.43	272.53	5.0%
Nanoscale Science and Engineering	149.68	173.71	16.1%
Learning for the 21st Century	121.46	125.51	3.3%
Total, Priority Areas	$585.45	$629.85	7.6%

Totals may not add due to rounding.

Additional FY 2002 Highlights

Children's Research Initiative (CRI). Support for the Children's Research Initiative (CRI) is maintained at $5.0 million in FY 2002. The CRI focuses on theory-driven, policy-related research on children, learning, and the influence of families and communities on child development. The CRI also will support research related to enhancing literacy and improving math and science skills.

EPSCoR. Funding for EPSCoR (the Experimental Program to Stimulate Competitive Research) will total nearly $100.0 million. This includes $74.81 million provided through the Education and Human Resources appropriation, and up to $25.0 million provided through NSF's Research and Related Activities account, to enable EPSCoR researchers to participate more fully in NSF research activities.

H-1B Nonimmigrant Petitioner Fees. As provided in recent legislation to strengthen the technology workforce, approximately $144.0 million is anticipated from H-1B nonimmigrant fees for:

- Computer Science, Engineering and Mathematics (CSEM) Scholarships that provide a wide range of opportunities for study and training; and
- Private-Public Partnerships in K-12, covering activities in a range of areas such as the development of instructional materials, student externships, and professional development for math and science teachers.

Major Research Equipment. The Major Research Equipment account for FY 2002 will fund three continuing projects:

- Network for Earthquake Engineering Simulation ($24.40 million). The George E. Brown Jr. Network for Earthquake Engineering Simulation is a national collaboratory of approximately 20 geographically-distributed, shared-use experimental research equipment sites linked by a high performance Internet network and designed to facilitate earthquake engineering research and education.

- Large Hadron Collider ($16.90 million). The Large Hadron Collider, an internationally funded collaboration, is a superconducting particle accelerator that will advance fundamental understanding of matter. One example is a search for the Higgs particle, the existence and properties of which will provide a deeper understanding of the origin of mass of the known elementary particles. It will also enable a search for particles predicted by a powerful theoretical framework known as supersymmetry which will provide clues as to how the four known forces evolved from different aspects of the same "unified" force in the early universe.

- Terascale Computing System ($55.0 million). Funding supports the new terascale computing systems that will enable U.S. researchers in all science and engineering disciplines to gain access to leading edge computing capabilities in order to address problems of scope and scale that are inaccessible on current systems.

Plant Genome Research Program. The FY 2002 budget provides $65.0 million to support ongoing research on genomics of plants of major economic importance. The long-term goal of this program is to understand the structure, organization and function of plant genomes important to agriculture, the environment, energy and health.

2010 Project. With the completion of the genome of the model plant *Arabidopsis* in FY 2001, researchers began a systematic effort to determine the functions of the 20,000 to 25,000 genes of this flowering plant. Knowledge of the functions of the *Arabidopsis* genes will be of great value in understanding the basic biological processes in all flowering plants and in creating better products for society, from food to pharmaceuticals to environmentally benign agricultural and waste-treatment processes. The 2010 project is funded at $20.0 million in FY 2002.

Science and Technology Centers. The FY 2002 budget provides $25.62 million to initiate a new cohort of Science and Technology Centers in topics that span the range of disciplines supported by NSF.

Graduate Fellowships for K-12 Education (GK-12). The FY 2002 budget request for the GK-12 program totals $26.17 million. This program puts graduate students in K-12 classrooms, and exposes them to the opportunities and challenges of K-12 teaching, while introducing K-12 students and teachers to active researchers.

Increasing Management Efficiency.

The FY 2002 Budget Request provides $170.04 million for Salaries and Expenses, an increase of $9.50 million, or 5.9 percent, over FY 2001. This increase will improve NSF's ability to administer and manage its growing portfolio of program activities. Over the past decade, funding for NSF administration and management has remained relatively flat, despite robust increases in program responsibilities and budgets. While NSF has compensated for an increased workload by investing in information technology,

workload pressures are mounting in the areas of systems and data management, program management, and staffing and resource management. This year, NSF will complete work on a 5-year workforce plan, based on an already completed workforce planning study, that will delineate future needs in this area.

With the aim of further increasing efficiency, NSF will evaluate the need for management reforms in several other areas.

- NSF will complete a study, with the assistance of U.S. academic research universities, to determine whether increasing the average NSF grant size and duration would produce greater efficiency in the research process. One focus will be an assessment of whether time spent in writing proposals detracts significantly from time that would otherwise be spent conducting research.
- To enhance its capacity to manage multi-year, large facility projects, NSF is developing a plan to strengthen its ability to estimate costs and provide oversight of project development and construction. The plan will address the steps needed to expand current capacity and systems to accommodate new projects awaiting approval for funding. This management tool will help ensure that NSF is able to meet cost and schedule commitments for an expanded portfolio of major facility projects.

- In addition, NSF will work in partnership with NASA to convene a Blue Ribbon Panel to assess the effectiveness of the current organization of Federal support for astronomical sciences. NASA and NSF will turn over the undertaking of the study to the National Academy of Sciences.

Conclusion

Scientists, engineers, and educators in almost every field are on the threshold of new discoveries that could fundamentally change the products and processes of industry, spawn whole new sectors of the economy, and revolutionize teaching and learning at all levels. The investments proposed in NSF's FY 2002 Budget Request will help ensure that the U.S. keeps pace with these expanding opportunities in science and technology.

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 2002 Request for R&RA totals $3.33 billion, a 0.5 percent decrease from FY 2001. In FY 2002, support is provided research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, and Learning for the 21st Century. 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 processes that are internal to the organism as well as those that are external, and includes temporal frameworks ranging from measurements in real time through individual life spans, to the full scope of evolutionary time. The FY 2002 Request for BIO totals $483.11 million, a 0.5 percent decrease from FY 2001. 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 2002 request for CISE totals $470.36 million, a 1.6 percent decrease from FY 2001. This includes $155.48 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 2002 Request for ENG totals $431.05 million, $210,000 over FY 2001. 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 2002 Request of $558.54 million, a 0.6 percent decrease from FY 2001, 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.

- 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 2002 Request of $863.58 million, a 1.5 percent increase over FY 2001, 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.

- 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 2002, SBE's Request of $163.16 million, an 0.8 percent decrease from FY 2001, will provide support for the Children's Research Initiative as well as a broad array of research projects, including the human causes and consequences of extreme events, research on the sources of scientific discovery and technological innovations, cognitive neuroscience and research tracing human biological and behavioral changes over time.

- **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 2002, Polar Programs increases to $276.57 million, 1.2 percent over FY 2001. FY 2002 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 2002 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 2002 Request of $80.61 million for IA, a decrease of $17.14 million, or 17.5 percent, from FY 2001, includes $50.0 million for Major Research Instrumentation, $26.61 million in support of Science and Technology Centers and $4.0 million for STPI. The goal of the Major Research Instrumentation program is to improve the capabilities of science and engineering equipment for research and research training in our Nation's academic institutions. In FY 2002, six to eight new Science and Technology Centers are expected to be established, in topics across the range of disciplines supported by NSF.

Education and Human Resources

The FY 2002 Request for Education and Human Resources (EHR) is $872.41 million, an increase of 11.0 percent over FY 2001. In addition, $144.0 million is projected in FY 2002 from H-1B Nonimmigrant Petitioner Receipts for scholarships and K-12 education activities. EHR supports a cohesive and comprehensive set of activities which encompass every level of education and every region of the country. EHR also plays a leadership role in the Foundation's Learning for the 21st Century priority area by virtue of its extensive programming in education and human resource development. Highlights within EHR include:

- The President's Math and Science Partnerships Initiative will provide funds for states and local school districts to join with institutions of higher education, particularly with their departments of mathematics, science, and engineering, in strengthening K-12 math and science education. The initiative emphasizes ensuring that all students have the opportunity to perform to high standards, using effective, research-based approaches, improving teacher quality, and insisting on accountability for student performance.

- Increasing stipends for graduate students is a priority for the Foundation in FY 2002. NSF Fellows and Trainees in the Graduate Research Fellowship program, the Integrative Graduate Education and Research Training (IGERT) program, and the Graduate Teaching Fellows in K-12 Education (GK-12) program currently receive a stipend of $18,000 per year. For FY 2002, NSF is proposing an increase in stipends to an annual amount of $20,500, starting in academic year 2002-2003.

- Centers for Learning and Teaching which address comprehensive, long-term approaches to learning and teaching by strengthening the content knowledge of the diverse science and mathematics teaching corps and developing the next generation of experts to guide the development of instructional materials, classroom and large-scale assessments, education research, and informal education

- The Graduate Teaching Fellows in K-12 Education program allows K-12 teachers to utilize graduate and advanced undergraduate students as science and mathematics resources for their classrooms. These Fellows will assist teachers in the science and mathematics content of their teaching, demonstrate key science and mathematics concepts, and gain necessary pedagogical skills.

Major Research Equipment

The FY 2002 Request for Major Research Equipment (MRE) is $96.30 million, a decrease of $25.03 million, or 20.6 percent from FY 2001. The Major Research Equipment account provides funding for the construction and acquisition of major research facilities that provide unique capabilities at the

cutting edge of science and engineering. Operations and maintenance costs of the facilities are provided through R&RA.

In FY 2002, funding for three ongoing projects is requested through the Major Research Equipment account: the Large Hadron Collider (LHC), the Network for Earthquake Engineering Simulation (NEES) and Terascale Computing Systems.

Salaries and Expenses

The FY 2002 Request for Salaries and Expenses (S&E) is $170.04 million, an increase of 5.9 percent over FY 2001. 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 1,150 full-time equivalents (FTEs), provides for current administrative services, and enhances the agency's investment in information technology to increase productivity.

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 2002 Request for OIG is $6.76 million, an increase of 7.8 percent over FY 2001. The requested level supports 50 FTEs.

NSF Investments and Strategic Goals

NSF's investments reflect the Foundation's three strategic goals:

- 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 information-bases and shared research and education tools."

NSF's investments in People, Ideas, and Tools work in concert to support the agency's mission to promote progress in all aspects of science and engineering research and education.

NSF Budget by Strategic Goal
(Millions of Dollars)

	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate
People	816	888	1,002
Ideas	1,962	2,251	2,220
Tools	955	1,061	1,024
Administration and Management	189	216	227
Total, NSF[1]	$3,923	$4,416	$4,472

Totals may not add due to rounding.
[1]Does not include $25.1 million in FY 2000, $121 million in FY 2001, and $144 million in FY 2002 from H-1B Nonimmigrant Petitioner Fees.

People

At NSF, integrating research and learning is our highest priority, and the people involved in our projects represent both the focus of our investments and the most important outcomes of them. Across its science, mathematics, engineering, technology (SMET) research and education programs, NSF provides support for almost 200,000 people, including students, teachers, researchers, post-doctorates, and trainees. Support for programs specifically addressing the People goal is slightly more than $1.0 billion in FY 2002, an increase of 12.8 percent over FY 2001.

A major focus for these activities is the President's Math and Science Parnerships initiative beginning in FY 2002 and funded at $200 million. This initiative is focused in the Education and Human Resources (EHR) activity; however, activities that complement this initiative occur throughout the Foundation.

Overall, the research directorates contribute $306 million toward the People goal. Moreover, about 40 percent of the funding for research grants – an amount approaching $900 million in FY 2002 – provides support for researchers and students, including more than 60,000 post-doctorates, trainees, and graduate and undergraduate students.

The People goal – facilitating the creation of a diverse, internationally competitive and globally-engaged workforce of scientists, engineers, and well-prepared citizens is NSF's number one priority. In order to achieve this goal, NSF supports improvement efforts in formal and informal science, mathematics, engineering, and technology education at all levels – preK-12, undergraduate, graduate, professional development, and public science literacy projects that engage people of all ages in life-long learning. NSF also supports programs that integrate research and education, such as Integrative Graduate Education and Research Training (IGERT), Research Experiences for Undergraduates (REU) and the Faculty Career Early Development Program (CAREER). In partnership with the research and education community, state and local education agencies, civic groups, business and industry, and parents, NSF fosters the invigoration of research-informed standards-based SMET education at all levels.

NSF is also committed to enhancing diversity in the science and engineering workforce. The Foundation believes that an increased emphasis on enhancing the participation of individuals who are members of groups currently underrepresented in the science and engineering workforce will not only further scientific progress by promoting diversity of intellectual thought, but also meet the need for a technically trained workforce.

Ideas

Investments in Ideas support cutting edge research and education that yield new and important discoveries and promotes the development of new knowledge and techniques within and across traditional boundaries. These investments help maintain the nation's academic institutions at the forefront in science and engineering. The results of NSF-funded projects provide a rich foundation for broad and useful applications of knowledge and the development of new technologies. Support for Ideas also promotes the education and training of the next generation of scientists and engineers by providing them with an opportunity to participate in discovery-oriented projects.

Funding related to the strategic goal of Ideas totals $2,220 million in FY 2002, a decrease of 1.4 percent from FY 2001. This includes support for individuals and small groups devoted both to disciplinary and interdisciplinary research and education. Also included is funding for centers that provide a platform to address those scientific and engineering questions and research problems requiring the long-term, coordinated efforts of teams of scientists and engineers. NSF-funded centers provide an enhanced environment for broad interdisciplinary education at all levels. Support for centers totals $325 million in FY 2002.

Tools

Support related to the strategic goal of Tools totals $1,024 million in FY 2002, a 3.5 percent decrease from FY 2001. As the research issues we face increasingly involve phenomena at or beyond the limits of our measurement capabilities, many of these research areas can only be studied through the use of new generations of powerful tools. NSF investments provide state-of-the-art tools for research and education, such as instrumentation and equipment, multi-user facilities, digital libraries, research resources, accelerators, telescopes, research vessels and aircraft, and earthquake simulators. In addition, resources support large surveys and databases as well as computation and computing infrastructures for all fields of science, engineering, and education. Support includes funding for construction, upgrade, operations, and maintenance of facilities, and for the staff and support personnel needed to assist scientists and engineers in conducting research at the facilities.

Support for these unique national facilities is essential to advancing U.S. research and education and the need is driven predominantly by research opportunities and priorities. Investments in research facilities are necessary for scientists and engineers to do world-class research. NSF-supported facilities also stimulate technological breakthroughs in instrumentation, and are the site of research and mentoring for many science and engineering students. Because of their visibility and accomplishments, these facilities also enhance public awareness of science and the goals of scientific research through allied outreach activities.

Administration and Management

Administration and Management (A&M) totals $227 million in FY 2002, an increase of 5.0 percent over FY 2001. This increase of $10.74 million will provide the resources necessary for management of the agency. Most of the increase is for the salaries and expenses (S&E) and Office of the Inspector General (OIG) accounts to provide resources needed to manage the increased program levels appropriated in FY 2001.

A&M encompasses efforts to adopt advanced information technologies, enhance customer service, and ensure financial integrity. These investments are critical to NSF's performance as it faces a workload that is increasing in quantity and complexity. In addition, A&M provides the operating funds to support the NSF workforce in implementing activities to meet all of the agency's strategic goals.

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Federal Crosscuts

NSF will continue its active participation in federal crosscut areas in FY 2002, supporting research and education in, amongst others, the U.S. Global Change Research Program (totaling $187.30 million) and High Performance Computing and Communications and Information Technology Research (totaling $642.61 million).

Math and Science Partnerships Initiative

In FY 2002, NSF requests $200 million to initiate the President's Math and Science Partnerships initiative. The Parnerships initiative is part of the President's initiative *No Child Left Behind* to strengthen and reform K-12 education.

We know from national and international studies that today too many children are being left behind in math and science education, areas critical to success in an increasingly technological world. Too few of their teachers have the right preparation for teaching math and science; too few of their schools provide a rigorous, challenging curriculum; and, as a result, too few of them take the advanced coursework that leads to future opportunities. The first two of these failings are indicators of problems with the capacity of our education system to provide the prerequisites for learning to high standards that the Math and Science Partnerships initiative will address.

The Partnerships initiative will provide funds for states and local school districts to join with institutions of higher education, particularly with their departments of mathematics, science, and engineering, to strengthen math and science education. It is designed to mobilize the mathematicians, scientists, and engineers of higher education to be part of the solution to K-12 education – to help in raising math and science standards, providing math and science training for teachers, and creating innovative ways to reach underserved schools and students. It emphasizes ensuring that all students have the opportunity to perform to high standards, using effective, research-based approaches, improving teacher quality,

and insisting on accountability for student performance. One of its key objectives is to eliminate performance gaps between majority and minority and disadvantaged students.

As the initiative begins, state and local education agencies will be in different stages of readiness for partnering with institutions of higher education, as will the institutions themselves. While many states have already instituted such partnerships, either with individual institutions or with state systems, some will be exploring partnerships of this type for the first time. Implementation of the initiative must recognize these differences in readiness, allowing state and local education agencies and their partnering institutions to determine the challenges they face and to design collaborations that fit their needs.

NSF anticipates two major categories of activity under the Math and Science Partnerships initiative. Each requires the establishment or intensification of partnerships, plans for improving math and science education, and accountability mechanisms. They differ in the nature of the Parnerships and the location of leadership for the activity.

- **Infrastructure Partnerships** will provide a framework for states to partner with institutions of higher education to gauge their current status with respect to math and science education and to develop and implement plans for improvement. Infrastructure activities would be expected to be broad in scope and to be aimed at statewide coordinating functions such as teacher certification and concomitant teacher education programs, data generating capabilities, or aligning assessments to high standards. They would also target areas for more intense activity through other mechanisms.

- **Action Partnerships** will enable partners at state and local levels to act to improve math and science education through design and exploration of new models of action and adaptation of existing models to local circumstances. These awards assume an intensity of action that requires their control to vest locally, presumably in a school district or collection of such.

All activities will result in awards made through competitive processes that use merit review involving a rich mix of mathematicians, scientists, engineers, state and local education officials, teachers, educators, and researchers. Proposers will be asked to describe a plan of action, its importance in meeting the objectives of the Math and Science Partnerships initiative within the state, the research base that supports it, and the immediate and longer-term goals to which they are willing to be held accountable. Reviewers will be asked to give priority to projects that show the greatest potential for meeting the objectives of the Math and Science Parnerships initiative, particularly for addressing gaps in performance between majority and minority and disadvantaged students.

NSF will work with relevant communities to identify areas of action appropriate for the Math and Science Partnerships, to amplify the range of potential activities, to explore the types of accountability that best describe progress, and to identify a research-based set of effective practices to inform the partnerships. These communities are poised to act in a number of areas that are critical to success in the Parnerships initiative, having identified issues and possible mechanisms for action in areas such as:

- improving rigor and alignment of standards, curriculum, and assessments at the state, district, and school levels;
- leadership and support for professional development of teachers based on appropriate standards for teacher knowledge and skills;
- improving the preparation of teachers in math and science content areas as essential to improving student achievement;
- development of replicable or adaptable models of systemic reform for improving math and science achievement; and
- improved assessment and use of data, particularly the ability to disaggregate data by gender, race/ethnicity, and socioeconomic and educational background.

Long-term funding for the MSDI is as follows:

(Millions of Dollars)

FY 2002 Request	FY 2003	FY 2004	FY 2005	FY 2006
$200	$200	$200	$200	$200

Investments in Selected Priority Areas

The multidisciplinary priority areas for FY 2002 include Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, and Learning for the 21st Century. These priority areas are described on the following pages. Many of the activities within these priority areas are interrelated. Each of these priority areas makes investments that address all three of NSF's strategic goals.

Biocomplexity in the Environment

The case for increasing emphasis on fundamental science and engineering-based study of environmental systems derives from a convergence of two trends: the growing urgency of environmental issues and the realistic prospect of new scientific and technological capabilities that will significantly advance our ability to anticipate environmental outcomes and, thus, improve environmental decision-making.

At the close of the twentieth century, scientists and engineers were attentive to the profound dependencies between living and geophysical environmental systems. At the same time, many studies of environments and ecosystems began to document earthquakes, extinctions, and other phenomena characterized by abrupt changes, thresholds, and nonlinearities; in mathematical terms, behavior that is "complex." Concurrent with the emergence of these insights into bio- and geo- sciences, scientists and engineers also became aware of the extent and pervasiveness of human impacts on the environment. Human populations doubled within a human life span for the first time. Observations revealed stratospheric ozone depletion. Changes in land use resulted in dramatic changes in landscapes, water resources, and biodiversity. Awareness of the importance of these three characteristics of natural systems—interdependency, complexity, expanding human influence—led to a call for new ways to study, explore, and model environmental processes.

Fortunately, enabled by developments such as real time sensing techniques, computational and information technologies, and genomics, scientists began to tackle the intricacies of the interactions among biological, ecological, physical and earth systems, and to confront the challenges of forecasting the outcomes of those interactions.

Focusing resources on *Biocomplexity in the Environment* will give NSF the capability to respond to the demand for new approaches to investigating the interactivity of biota and the environment. Investigations are required to 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. The term "biocomplexity" refers to the dynamic web of often surprising interrelationships that arise when living things at all levels interact with their environment. The priority area 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.

Funding for the BE priority area is as follows:

(Millions of Dollars)

	FY 2001 Current Plan	FY 2002 Request	Change Amount	Change Percent
Biological Sciences	16.90	16.90	0.00	0.0%
Computer and Information Science and Engineering	6.10	6.10	0.00	0.0%
Engineering	2.69	3.69	1.00	37.2%
Geosciences	21.18	23.00	1.82	8.6%
Mathematical and Physical Sciences	5.35	5.35	0.00	0.0%
Social, Behavioral and Economic Sciences	1.25	1.65	0.40	32.0%
Office of Polar Programs	1.41	1.41	0.00	0.0%
Subtotal, Research and Related Activities	$54.88	$58.10	$3.22	5.9%

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 2002 environmental investment portfolio of over $825 million. The intellectual goals of the effort are to:

- synthesize environmental knowledge across fields, 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 research;
- integrate human and societal and ecological factors into investigations of the physical environment and environmental engineering and enhance research on decision-making and human environmental behaviors; and
- develop 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	FY 2001 Current Plan	FY 2002 Request	FY 2003	FY 2004
$50.00	$54.88	$58.10	$70.57	$83.31

FY 2002 Areas of Emphasis: NSF plans to invest $58.10 million in the interdisciplinary BE activities described below.

- **Dynamics of Coupled Natural and Human Systems –** quantitative understanding of the short- and long-term dynamics of how humans value and influence ecosystem services and natural resources, including consideration of landscapes and land use and the influences of uncertainty, resilience and vulnerability on societal institutions.

- **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 cycles (such as the carbon, nitrogen, or water cycle) and the influence of human and other biotic factors on those cycles.

- **Genome-Enabled Environmental Sciences and Engineering** – the use of genomic information to understand ecosystem functioning and the adaptation of organisms to ecological roles. Genome-enabled environmental research will allow us to study biocomplexity in depth on historical and global scales.

- **Instrumentation Development for Environmental Activities –** the development of instrumentation and software that takes advantage of advances in 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.

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

- environmental genomics – emphasis on the functions of genes in plants and in microbes, particularly microbes adapted to hostile environments, such as deep subsurface terrestrial, polar, and submarine habitats;
- earth systems studies – establishment of observatories and study centers that focus on geophysical and biogeochemical processes, including those at the molecular scale;
- materials use science and engineering – a comprehensive approach to materials resources, from natural cycling to recycling, remanufacturing, process redesign, materials design, and consumer use;
- environmental informatics – development of modeling, visualization, data mining, and other methods to integrate, access, and interpret very large data sets of environmental information; and
- social adaptation to hazards – emphasis on predictive capabilities and response to hurricanes, storms, and upper atmosphere disturbances, including the study of environmental Arctic change.

In all the topical areas described above, integration of education, including K-16 levels, is a critical element. Also, special attention will be paid to the inclusion of modeling and simulation methods for complex environmental systems and initiation of international collaborations through establishment of global networks in the major topical areas of the BE priority area.

Information Technology Research

Information Technology (IT) today has an essential role in every aspect of science, engineering, medicine, education, and other societal endeavors. It includes the automated creation and processing of information, as well as theoretical studies of the nature of information and the limits of computation. IT is causing far-reaching but little-explored changes throughout society. NSF's portfolio encompasses all of these areas. In FY 2000, the NSF Information Technology Research (ITR) program stressed fundamental research; in the second year, additional applications in science were added; and in the third year, the program will expand research in multidisciplinary areas, focusing on fundamental research at the interfaces between fields and disciplines.

Funding for the ITR priority area is as follows:

(Millions of Dollars)

	FY 2001 Current Plan	FY 2002 Request	Change Amount	Change Percent
Biological Sciences	5.45	5.45	0.00	0.0%
Computer and Information Science and Engineering	155.48	155.48	0.00	0.0%
Engineering	8.17	9.17	1.00	12.2%
Geosciences	10.90	10.90	0.00	0.0%
Mathematical and Physical Sciences	29.62	29.62	0.00	0.0%
Social, Behavioral and Economic Sciences	3.82	3.82	0.00	0.0%
Polar Programs	1.09	1.09	0.00	0.0%
Subtotal, Research and Related Activities	214.53	215.53	1.00	0.5%
Education and Human Resources	0.00	2.00	2.00	N/A
Major Research Equipment	44.90	55.00	10.10	22%
Total, ITR	$259.43	$272.53	$13.10	5.0%

Totals may not add due to rounding.

Long-term Goals: By expanding basic research in interdisciplinary areas, 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 three years will involve seven comprehensive and complementary 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 ITR priority area is as follows.

(Millions of Dollars)

FY 2000	FY 2001 Current Plan	FY 2002 Request	FY 2003	FY 2004
$126.00	$259.43	$272.53	$285.00	$297.74

FY 2002 Areas of Emphasis: Investments will emphasize the following research:

- **Large-Scale Networking**. Approximately $27.54 million will be used to support fundamental research in optical networking, simulation of network dynamics, fault tolerance and autonomous management of network resources, wireless networks, and scalability to improve performance and handling of transient interactions among billions of networked devices. Additional research networks will protect user privacy and security of sensitive information. Research will provide networks that are more stable, reliable, and resistant to failures. These higher levels of reliability and stability will contribute, for example, to next-generation air traffic control systems or to telemedicine's potential for remote monitoring, diagnosis, and care for homebound and isolated citizens.

- **High-end Computing**. Approximately $16.05 million will explore new computational substrates (such as quantum or DNA computing), communications, and systems architecture. All of these

must be integrated in parallel and distributed systems, which will soon involve millions of processors. Advances in photonics, nanodevices, sensors, actuators, opto-electronics, and smart fabrics make it possible to provide extremely fast and high-density processing power.

- **High-end Computation and Infrastructure**. About $116.35 million will enable terascale computational facilities. Cross-disciplinary collaborations will benefit greatly as research and education in the following applications are explored:
  - protein folding, neural modeling, and gene expression, areas which pose important algorithmic issues and could lead to a comprehensive model of the human body and its components at scales from molecules to organs to systems;
  - interactions between biological and physical components of ecosystems and pollutants, atmosphere, oceans and soil, requiring new models and new methods of data management;
  - meteorological forecasting, requiring new models and more detailed computations;
  - modeling earthquakes, requiring both better understanding and better computation;
  - oceanographic computations linked to biological studies of ocean productivity and biodiversity; and
  - high-end computing tools to accelerate the design and implementation of next generation manufacturing techniques such as photonic crystals, optical and electronic switching devices, sensors and detectors.

- **High-Confidence Software and Systems**. About $17.53 million will support a new generation of highly reliable and trustworthy IT systems, including safe, secure, and dependable information infrastructures and consumer products for an information society. Examples include:
  - hardened networks and information systems that detect and survive attacks;
  - robust software and system design, shared infrastructure, and system middleware to detect anomalous events; and
  - modeling and enforcing stability of software systems and the actual systems they control from safety-critical automotive and avionics systems, to implantable devices and advanced prosthetics.

- **Human-Computer Interaction and Information Management**. About $42.65 million will support research and education on mining and visualizing large data systems. Improved real-time access to databases will accelerate progress and aid in policy-making. Research will help in understanding how to integrate perception, cognition, and computation. Cognitive interfaces will allow people with severe disabilities to participate more fully in society. Interactions between medicine, robotics, and networking offer the hope of designing robotic assistants for the elderly and disabled.

- **Software Design and Productivity**. Funding of $33.07 million will focus on developing theory and technology for large embedded software applications subject to temporal, noise, synchronization and dependability constraints. The key technology components to be developed are: integrated modeling techniques, integrated modeling environments and model-based generators.

- **Social, Economic and Workforce Implications of IT and IT Workforce Development**. Approximately $19.34 million will focus on: universal participation in a digital society; information privacy and intellectual property; the use of technologies for science, education and work collaboration and learning; and how to cultivate a diverse and well educated IT workforce.

Nanoscale Science and Engineering

Nanoscale science and engineering encompasses the systematic organization, characterization, and manipulation of matter at atomic or molecular levels. Novel materials, devices, and systems—on the scale of nanometers—are revolutionizing science, engineering, and technology. Impossible to visualize,

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 microscopic computer chips.

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

(Millions of Dollars)

	FY 2001 Current Plan	FY 2002 Request	Change Amount	Change Percent
Biological Sciences	2.33	2.33	0.00	0.0%
Computer and Information Science and Engineering	2.20	6.20	4.00	181.8%
Engineering	55.27	70.30	15.03	27.2%
Geosciences	6.80	6.80	0.00	0.0%
Mathematical and Physical Sciences	83.08	88.08	5.00	6.0%
Total, Nanoscale Science and Engineering	$149.68	$173.71	$24.03	16.1%

Totals may not add due to rounding.

The National Nanotechnology Initiative (NNI) 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 and technology. In FY 2001, NSF is investing $149.68 million in a wide range of research and education activities in nanoscale science and technology, including approximately 15 nanotechnology research centers, which focus on electronics, biology, and optoelectronics.

This investment will be expanded in FY 2002 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. 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 objectives include laying a foundation of fundamental research for 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. This should result in the development of completely new technologies that contribute to improvements in health, advanced agriculture, conservation of materials and energy, and sustainability of the environment.

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

(Millions of Dollars)

FY 2001 Current Plan	FY 2002 Request	FY 2003	FY 2004	FY 2005
$149.68	$173.71	$186.18	$198.92	$224.98

FY 2002 Areas of Emphasis: NSF's planned investment for Nanoscale Science and Engineering in FY 2002 is $173.71 million. NSF five programmatic focus areas are:

- **Fundamental Research and Education.** The FY 2002 request includes $107.72 million for fundamental research and education, with special emphasis on:
  - *Biosystems at the Nanoscale* – Approximately $19.0 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, and nanoscale sensory systems, such as miniature sensors for early detection of cancer.
  - *Nanoscale Structures, Novel Phenomena and Quantum Control* – Approximately $36.72 million to create new materials and functional nanoscale structures and to 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 $25.50 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.
  - *Nanoscale Processes in the Environment* – Approximately $9.50 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.
  - *Multi-scale, Multi-phenomena Theory, Modeling and Simulation at the Nanoscale* – Approximately $17.0 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.

- **Grand Challenges.** Approximately $7.90 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 $29.39 million will provide support for four new research and education centers, a multidisciplinary, multi-sectoral network for modeling and simulation at the nanoscale. These funds will support the nanofabrication user facilities to come on line in FY 2002.

- **Research Infrastructure.** Approximately $19.90 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 $8.80 million will support student assistantships, fellowships and traineeships, curriculum development on nanoscience and engineering and development of new teaching tools. The impact of nanotechnology on society will be analyzed from legal, ethical, social, and economic perspectives. 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

Learning for the 21st Century addresses two interrelated challenges that are essential to meeting twenty-first century workforce challenges:

- understanding how people learn as individuals, and
- transferring that knowledge for use in collective learning environments and the development of tools for learning and instruction.

Through this priority area, NSF will continue to encourage the science and education communities to better understand learning in disciplinary contexts and to act on that understanding by developing materials, courses, and curricula implemented, such as through digital libraries and other web-based mechanisms. Communities will also develop field-specific methods for bridging levels of education and for maintaining lifelong learning capabilities.

Funding for Learning for the 21st Century priority area is as follows:

(Millions of Dollars)

	FY 2001 Current Plan	FY 2002 Request	Change Amount	Change Percent
Biological Sciences	1.70	1.70	0.00	0.0%
Computer and Information Science and Engineering	1.15	1.15	0.00	0.0%
Engineering	2.70	3.40	0.70	25.9%
Geosciences	2.45	2.45	0.00	0.0%
Mathematical and Physical Sciences	3.00	4.00	1.00	33.3%
Social, Behavioral and Economic Sciences	5.40	5.40	0.00	0.0%
Polar Programs	1.10	1.10	0.00	0.0%
Subtotal, Research and Related Activities	17.50	19.20	1.70	9.7%
Education and Human Resources	103.96	106.31	2.35	2.3%
Total, Learning for the 21st Century	$121.46	$125.51	$4.05	3.3%

Totals may not add due to rounding.

Long-term Goals: The long-term goals of Learning for the 21st Century priority area are:

- to generate the knowledge, people, and tools needed to develop a twenty-first century workforce that is second to none in its ability to use, adapt, and create scientific, mathematical, engineering, and technological (SMET) concepts in the workplace; and
- to develop a SMET workforce that fully reflects the strength of America's diversity.

While emphasizing the long-term objectives, the priority area also includes elements that address the needs of an American workforce able to make an immediate transition to a more technologically-oriented workplace.

Long-term funding for the Learning for the 21st Century priority area.

(Millions of Dollars)

FY 2001 Current Plan	FY 2002 Request	FY 2003	FY 2004	FY 2005
$121.46	$125.51	$137.98	$150.72	$176.78

FY 2002 Areas of Emphasis: Three elements form the underlying core of this priority area.

- **Multidisciplinary learning research** involves cross-cutting research in areas such as design of learning environments, human-computer interactions, cognitive psychology, cognitive neuroscience, computational linguistics, child development, sociology, and complex educational systems. Activities in this element include the Interagency Education Research Initiative (IERI), the newly revamped Research on Learning and Education (ROLE) program, and other research activities related to child learning and cognitive development.

- **Research, development, and testing of IT-enabled tools for learning** will facilitate and enhance learning opportunities. New technologies offer the possibility of providing truly learner-centered, independent learning environments for individuals or teams at any convenient place and time. Two sets of activities currently comprise this element: the National SMET Education Digital Library (NSDL), a prototype IT-based tool designed to increase the quality, quantity, and comprehensiveness of Internet-based education resources, and related development of discipline-focused resources, such as the Digital Library for Earth System Education (DLESE).

- **Activities that enable and strengthen the SMET learning continuum** provide a stronger linkage between formal and informal education. This is critical to developing and maintaining a highly skilled workforce. Preparing the workforce currently takes place largely in the context of formal education systems with well-defined transition points across levels of education. In contrast, developing the workforce takes place through a combination of on-the-job training, established training opportunities and/or formal education. Investments in this core element recognize that learning happens continuously and provide mechanisms to bridge gaps caused by organization of learning into discrete systems of formal and informal education. The Graduate Teaching Fellows in K-12 Education (GK-12) program, which provides graduate students with exposure to the opportunities and challenges of K-12 teaching, while bringing K-12 students and teachers together with active researchers, is an example of activities in this element.

NSF's **Centers for Learning and Teaching** (CLTs) provide lifelong learning opportunities for the nation's instructional workforce. CLTs involve partnerships among universities, school districts, state education agencies, informal science education institutions, as well as business and industry.

The Math and Science Partnerships Initiative also reflects many of the goals of Learning for the 21st Century. The Partnerships initiative emphasizes ensuring 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.

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Children's Research Initiative (CRI)

Support for the Children's Research Initiative (CRI) will be maintained at $5.0 million annually for the period from FY 2001 through FY 2005. The CRI focuses on theory-driven, policy-related research on children, learning, and the influence of families and communities on child development. The CRI also will support research to enhance literacy and improve math and science skills. Support will be provided to centers, teams, and individual investigators to conduct research and related activities in accordance with community-based planning and development efforts. Specifically, the FY 2001 CRI announcement invited proposals in four general categories:

- research centers to conduct multidisciplinary, integrative research;
- incubation or planning grants so that research groups can engage in planning that will lead to collaborative, large-scale, center research projects;
- workshops and small conferences that will help build capacity for integrative, multidisciplinary research; and
- standard research proposals from individual investigators addressing CRI research issues.

CRI competitions will continue with provision made for limited support for incubation and planning activities, as well as workshops and conferences focused on stimulating research and communication across communities. Funding also will be provided for smaller-scale, individual investigator-conducted research projects. In the future, it is anticipated that a larger share of CRI funding will go to multidisciplinary, integrated research centers offering opportunities for advancing fundamental understanding of child development.

Funding for CRI is as follows:

(Millions of Dollars)

FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate
$4.99	$5.00	$5.00	$5.00	$5.00

Strategic Goals and NSF Budget Structure

The following table provides FY 2002 funding for strategic goals and budget accounts.

NATIONAL SCIENCE FOUNDATION
BY STRATEGIC GOAL AND ACCOUNT

(Millions of Dollars)

			FY 2002 Request						
NSF Accounts	FY 2000 Actual	FY 2001 Current Plan	People	Ideas	Tools	A&M	FY 2002 Request	$ Change Request over Plan	% Change Request over Plan
FY 2000 Actual	**$3,923.36**		**$816.11**	**$1,962.49**	**$955.44**	**$189.32**			
FY 2001 Current Plan		**$4,416.39**	**$888.31**	**$2,251.11**	**$1,060.95**	**$216.03**			
BIO[1]	418.29	485.42	48.55	364.73	64.16	5.67	483.11	-2.31	-0.5%
CISE	388.57	477.90	56.93	288.09	117.62	7.72	470.36	-7.54	-1.6%
ENG	379.82	430.84	69.45	351.67	2.80	7.13	431.05	0.21	0.0%
GEO	487.64	562.19	19.40	318.89	217.28	2.97	558.54	-3.65	-0.6%
MPS	755.88	850.84	97.55	538.02	221.59	6.42	863.58	12.74	1.5%
SBE	162.11	164.44	10.41	120.17	28.03	4.55	163.16	-1.28	-0.8%
OPP	258.33	273.26	3.50	72.41	197.31	3.35	276.57	3.31	1.2%
IA	129.25	97.75	0.00	26.61	54.00	0.00	80.61	-17.14	-17.5%
Research & Related Activities	**$2,979.90**	**$3,342.63**	**$305.79**	**$2,080.59**	**$902.79**	**$37.81**	**$3,326.98**	**-$15.66**	**-0.5%**
Education & Human Resources [1]	**$683.58**	**$785.62**	**$696.40**	**$139.25**	**$24.60**	**$12.16**	**$872.41**	**$86.79**	**11.0%**
Major Research Equipment	**$105.00**	**$121.33**	**$0.00**	**$0.00**	**$96.30**	**$0.00**	**$96.30**	**-$25.03**	**-20.6%**
Salaries & Expenses	**$149.28**	**$160.54**	**$0.00**	**$0.00**	**$0.00**	**$170.04**	**$170.04**	**$9.50**	**5.9%**
Office of Inspector General	**$5.60**	**$6.27**	**$0.00**	**$0.00**	**$0.00**	**$6.76**	**$6.76**	**$0.49**	**7.8%**
Total, National Science Foundation	**$3,923.36**	**$4,416.39**	**$1,002.19**	**$2,219.84**	**$1,023.69**	**$226.77**	**$4,472.49**	**$56.09**	**1.3%**
H-1B Visa	*$25.06*	*$121.00*	*$144.00*				*$144.00*	*$23.00*	*19.0%*
Total NSF, Including H-1B	*$3,948.42*	*$4,537.39*	*$1,146.19*	*$2,219.84*	*$1,023.69*	*$226.77*	*$4,616.49*	*$79.09*	*1.7%*

[1] The agency routinely closes out awards that are past the expiration date. Several awards, including $4 million in BIO and $1.84 million in EHR, were terminated in FY 2000 due to incorrect award expiration dates. The expiration dates on these awards were corrected later in the year and the awards were reopened and the balances restored. The closing of the awards are reported as recoveries and the reopening of the awards are accounted for as upward adjustments to prior year obligations. Therefore, actual obligations for BIO are $418.29 million and for EHR are $683.58 million.

NATIONAL SCIENCE FOUNDATION

People

People are NSF's most important product. At NSF, linking research and learning is our highest priority, and the people involved in our projects represent both the focus of investment and our most important product. Across the Foundation's programs, NSF provides direct support for almost 200,000 people, including teachers, students, researchers, post-doctorates, and trainees. Support for programs specifically addressing NSF's Strategic Goal of "People — A diverse, internationally competitive and globally-engaged workforce of scientists, engineers and well-prepared citizens" totals $1,002 million in FY 2002, an increase of nearly 13 percent over FY 2001 (H-1B Nonimmigrant Petitioner Receipts will increase total support to over $1,146 million).

Support by Level of Education
(Millions of Dollars)

	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate
PreK-12	278	273	363
Undergraduate	190	233	230
Graduate & Professional	269	284	321
Other Support[1]	78	98	89
Total, People	$816	$888	$1,002

Totals may not add due to rounding.
[1] Excludes estimates of $25 million in FY 2000, $121 million in FY 2001, and $144 million in FY 2002 from H-1B Nonimmigrant Petitioner Receipts.

NSF's investments in ideas and tools also create investments in people. 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. The Foundation places a high priority on formal and informal science, mathematics, engineering, and technology (SMET) education at all levels — preK-12, undergraduate and graduate, professional, and public science literacy that engages people of all ages in life-long learning. NSF activities are also aimed at enhancing the diversity of the science and engineering workforce and increasing participation and achievement of underrepresented groups, with special attention paid to development of those who are beginning careers in science and engineering. 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 of the United States. The rapid globalization of science and technology also provides expanded opportunities for NSF-supported U.S. researchers to train internationally.

PreK-12 Education

The FY 2002 NSF Request for PreK-12 programs is $363.02 million, an increase of $89.69 million or nearly 33 percent over FY 2001.

- In FY 2002, NSF will initiate the President's Math and Science Partnership Initiative (MSPI) to provide funds for states to join with institutions of higher education in strengthening K-12 math and science education. More than 20 states have begun to form partnerships with colleges and universities for the purpose of raising math and science standards for students, providing math and science training for teachers, and creating innovative ways to reach underserved schools. The President is requesting $200.0 million for MSPI for FY 2002, and $1.0 billion over five years. States that access these funds will establish partnership agreements with state colleges, universities, community colleges, and school districts, with the goal of improving student achievement in K-12 math and science. The success of partnerships between states and institutions of higher education will be measured through performance indicators such as improving student performance on state assessments, increasing student participation in advanced courses in math/science and their success in passing advanced placement exams, and increasing the numbers of teachers that major in math or science.

- As part of the Math and Science Partnership Initiative (MSPI), $110.0 million is redirected from NSF education programs toward the initiative's $200.0 million level in FY 2002. Investments from the Foundation's systemic reform efforts, which have partnerships similar to those envisioned for the MSPI program, will provide about $65.2 million for the Initiative. Additional support comes from programs linked to teacher enhancement ($32.02 million), instructional materials development ($5.10 million), and teacher preparation ($8.0 million).

- Support for NSF's Centers for Learning and Teaching (CLT) program, initiated in FY 2001, totals $20.17 million, the same as FY 2001. CLTs address two components of SMET 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.

Undergraduate Education

The FY 2002 Request for programs to improve undergraduate education is $229.7 million, $3.19 million less than the FY 2001 Request. The decrease is due to the completion of two Engineering Education Coalition Programs. Highlights in FY 2002 include:

- Funding for Advanced Technological Education, with emphasis on the nation's community colleges to strengthen science and mathematics preparation of technicians for a high-performance workplace of the future, is $39.16 million, as in FY 2001.

- Minority Serving Institutions (MSIs) encourage members of underrepresented groups to pursue SMET education. NSF supports several MSI programs including the Tribal Colleges Undergraduate Program, funded at $9.98 million in FY 2002, the Historically Black Colleges and Universities – Undergraduate Program, with requested funding of $14.97 million, and the Model Institutions of Excellence at $10.02 million.

- NSF's Foundation-wide Research Experiences for Undergraduates program requests funding of $41.96 million for FY 2002, an increase of $2.66 million. This program promotes active research participation by undergraduates in all scientific areas supported by NSF.

- Course, Curriculum, and Laboratory Improvement activities focus on identification, development, adaptation, and implementation of curricular and laboratory education materials and instructional models. Funding requested for these activities increases by $1.36 million to $57.54 million.

- The Request also includes $11.18 million for Scholarship for Service to recruit and educate the next generation of information technology managers for the federal government by awarding scholarships for the study of information security.

Graduate & Professional Education

The FY 2002 Request for graduate and professional programs totals $320.53 million, an increase of $36.55 million over FY 2001.

- Increasing stipends for graduate students is a priority for the Foundation in FY 2002. NSF Fellows and Trainees in the Graduate Research Fellowship program, the Integrative Graduate Education and Research Training (IGERT) program, and the Graduate Teaching Fellows in K-12 Education (GK-12) program currently receive $18,000 per year. For FY 2002, NSF is proposing an increase in stipends to an annual amount of $20,500, starting in academic year 2002-2003.

- NSF's Graduate Research Fellowship program will increase by $4.78 million overall to $63.15 million in FY 2002. The increase will bring the number of students selected under this program to 900 annually. This program selects the most promising science and engineering students in the U.S. and provides support in terms of stipends and cost of education allowances for their graduate education.

- Funding for the Graduate Teaching Fellows in K-12 Education (GK-12) program, which supports graduate and advanced undergraduate SMET students as content resources for K-12 teachers in the classroom, will increase by $3.4 million to a total of $26.17 million.

- Support for the Integrative Graduate Education and Research Training (IGERT) program will increase by $8.57 million to $39.18 million in FY 2002. In addition to raising the stipend for IGERT students, this increase will provide for about 240 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 through the involvement of underrepresented groups. The program attracts a large number of proposals representing the full range of NSF science and engineering disciplines.

- Support for the Faculty Early Career Development (CAREER) program will total nearly $118.84 million, an increase of $3.20 million. This NSF-wide activity emphasizes the early development of academic careers by presenting this prestigious award to new faculty who are most likely 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 total $16.0 million, an increase of $6.99 million over FY 2001. ADVANCE is an integral part of the Foundation's multifaceted strategy to help realize a diverse science and engineering workforce.

Other Support

The FY 2002 Budget Request for the activities below is $88.95 million, a decrease of $9.18 million with phasing out of the Partnerships for Innovation program.

- Informal Science Education activities will be supported at $56.0 million in FY 2002. Projects included in this activity promote the general public's understanding of science, mathematics, engineering, and technology through media (e.g., print, film, television) and informal organizations (e.g., museums, parks, zoos, libraries, community groups). Priorities include outreach to smaller communities and underrepresented groups.

- Evaluation efforts will be funded at $12.64 million in FY 2002, focusing on accountability, e.g., monitoring, impact studies, and program evaluations, pursued with an orientation to measurement, data collection, and reporting requirements necessary to support GPRA.

- The Program for Gender Equity (PGE) will be funded at $11.19 million. PGE supports education and research activities fostering increased participation of women and girls in SMET.

- The Program for Persons with Disabilities (PPD) will be funded at $5.28 million for FY 2002. PPD supports efforts to increase the participation and achievement of individuals with disabilities in SMET education and research by emphasizing projects building and strengthening alliances among higher education, K-12 educational systems, and business and industry.

- In addition, an estimated $144.0 million from H-1B nonimmigrant petitioner fees will be made available to NSF for computer science, engineering, and mathematics scholarships and K-12 activities.

FY 2002 Performance Goal for People

The following table summarizes NSF's FY 2002 Performance Goal for People. For additional information, see the FY 2002 Performance Plan.

FY 2002 Performance Goals for People

Strategic Outcomes	No.	Annual Performance Goals[1] for Strategic Outcomes	FY 2002 Areas of Emphasis
PEOPLE **<u>Outcome Goal:</u> To develop "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."**	**III-1a**	***NSF's performance for the People Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement for the majority (4 of 7) of the following indicators:*** • Development of well-prepared scientists, engineers or educators whose participation in NSF activities provides them with the capability to explore frontiers of the future. • Improved science and mathematics performance for U.S. K-12 students involved in NSF activities; • Professional development of the SMET instructional workforce involved in NSF activities; • Expansion of NSF contributions to development of a diverse workforce through increased participation of underrepresented groups (women, underrepresented minorities, persons with disabilities) in NSF activities; • Participation of NSF scientists and engineers in international studies, collaborations, or partnerships; • Enhancement of undergraduate curricular, laboratory, or instructional infrastructure; and • Communication with the pubic in order to provide information about the process and benefits NSF-supported science and engineering activities.	**President's Math and Science Partnership initiative:** K-12 Education **Priority area: Learning for the 21st Century** Centers for Learning and Teaching (CLT) Graduate Teaching Fellows in K-12 Education (GK-12) **Broadening Participation:** Minority-Serving Institutions (MSI) programs **Graduate Student Stipends:** Increasing stipends for GRF, GK-12, and IGERT
	III-1b	At least half of the states will activate partnerships with institutions of higher education aimed at strengthening K-12 math and science education through the President's Math and Science Partnership initiative. These partnerships can involve local school districts, and will address issues such as preparation and professional development of math and science teachers, implementation of high standards for math and science, and gaps in performance between majority and minority and disadvantaged students.	
	III-1c	After three years of support, over 80 percent of schools participating in systemic initiative programs will: (1) implement a standards-based curriculum in science and mathematics; (2) further professional development of the instructional workforce; and (3) improve student achievement on a selected battery of tests.	

[1] These performance goals are stated in the alternate form provided for in GPRA legislation.

Highlights (People)

In order to build capacity in schools and school districts to implement science and mathematics standards-based instruction, the **New Jersey Statewide Systemic Initiative (NJ SSI)** has organized seven regional centers and collaborating specialty sites with institutions of higher education and professional organizations. The specialty sites—institutions or organizations that provide special expertise, such as curriculum implementation, technology, parental involvement, and equity—are assisting with the systemwide scale-up. In coordination with the regional centers, the specialty sites have developed programs focused on reaching teachers, schools or districts that have not previously been involved with the NJ SSI. The NJ SSI has furthered professional development for teachers in mathematics in 317 or 95% of the 332 participating schools for three years or more and in science in 311 or 94% of the schools.

Solving a Murder: Students participating in the NSF-supported Research Experiences for Undergraduates Site in Rapid Prototyping at the Milwaukee School of Engineering helped solve a local murder case that had been unsolved for two years. By developing a technique for creating a facial image from a skull, police were able to identify the victim which lead to apprehension of the perpetrator. The FBI is now interested in working with the School to develop advanced forensic techniques based on the method.

The World We Create, an exhibit at the Louisville Science Center, features 40 hands-on science activities and over 400 graphic panels highlighting science careers, inventors, and problem-solving strategies. Developed with direct participation of private sector partners, the exhibit both serves visitors to the Center and reaches out across the State of Kentucky. Exhibit experiences encourage teamwork and cooperative learning, and focus on physical science, engineering, and mathematics. Since opening in June 1997, the exhibit and associated programs have reached almost 1.5 million visitors in this rural state of only four million. Twelve science demonstrations, 30 inquiry-based gallery activities, a training video for staff and volunteers, a Teacher's Guide, a Family Guide, an Inventor Book, and four in-depth curriculum guides have been prototyped, tested, and revised to enhance and extend the interactive exhibits.

Antarctic Integrative Biology Course. This month-long, international, advanced-level training course is taught in Antarctica at the Crary Science and Engineering Center, McMurdo Station, Antarctica. The goal is to introduce both graduate students and faculty to interdisciplinary modes of research through the study of the unique characteristics of Antarctic marine organisms that allow them to succeed in such extreme environments. The course includes lectures emphasizing physiological, biochemical, and molecular adaptations as well as laboratory investigations and field work in the nearby marine and terrestrial environments. The course attracts an extremely competitive group of students and scientists and introduces new researchers to Antarctica. The participants for January 2000 included 15 graduate students, five postdocs, and five faculty. Of these, 14 were from the U.S. and 11 from other countries.

Project Increases Participation of Women in Computer Science Education and Career Paths. NSF supports activities in computer and information science and engineering designed to expand opportunities for women, minorities, and persons with disabilities. Among its most successful projects is the Distributed Mentor Project (DMP) from the Computer Research Association. A longitudinal evaluation by the University of Wisconsin shows the DMP to be spectacularly successful at meeting its primary goal of increasing the number of women entering graduate school in Computer Science and Engineering (CS&E). Of the DMP participants – about 25 women a year — over 50% were enrolled in graduate or professional school the year following their graduation. This compares to results of a 1994 Baccalaureate & Beyond study which found that 29% of men and 3% of women entered graduate or professional school within one year of graduation. Both studies focused only on graduates with GPA's greater than or equal to 3.5.

Research on the Matanuska Glacier: Augustana College is a Research Experience for Undergraduates award site which allows undergraduate students to conduct research for six weeks on the Matanuska Glacier, a large valley glacier in south central Alaska. Students participate in field work that involves collecting water samples, maintaining equipment, downloading data, filtering water for suspended sediment, and tabulating data. Students complete their undergraduate thesis projects at their home institutions and present their results at a national meeting.

Summer Internships Abroad: Summer Institute in Japan for American Graduate Students in Science and Engineering and the Research Experience Fellowships for Young Foreign Researchers provide opportunities for U.S. graduate students in science and engineering to participate in summer programs in Asia. Since their start in Japan in 1990 and in Korea in 1995, the programs have enabled a total of 756 American graduate students to gain first-hand experience in a Japanese, Korean or Taiwanese research laboratory. In addition to a research internship, these programs provide introductory foreign language training and exposure to science and science-policy infrastructure. The goals of the program are to introducing them to Japanese, Korean and Taiwanese science and engineering research laboratories and to initiate personal relationships that will better enable students to collaborate with foreign counterparts in the future. A long-term goal of the program is to enable the U.S. to gain maximum benefit from international scientific and technical interactions.

The **Quarknet** program partners high school physics teachers and their students with particle physics research groups at 60 U.S. universities and laboratories. It is also associated with the collider experiments at FermiLab. Students are learning fundamental physics, investigating particle physics through live, online data and collaborating with students worldwide. QuarkNet is a new program just beginning its second year. Twenty-three lead teachers completed eight-week research appointments last year; 25 teachers hold appointments this year. All have attended a one-week orientation workshop at FermiLab. The QuarkNet program is having a broad impact as well, with 107 teachers attending three-week workshops offered by last year's lead teachers. One of the successes of QuarkNet is building the confidence of teachers to the point where they are making substantial contributions to the research enterprise.

The *Administrators Working for Change* project developed and validated a year-long course (equivalent to two graduate level courses) for K-12 administrators. The courses were shown to improve administrators' ability (a) to communicate the mathematics that students should be taught; (b) to better analyze mathematics instruction that they observed, and (c) to communicate the essential elements of mathematics reform. The courses are being used by NSF Local Systemic Change projects and are being made available to universities and school districts.

Electronic Classrooms. Prof. Gregory Abowd, Georgia Institute of Technology, a CAREER awardee, is developing a prototype classroom environment named *eClass* which captures the rich interaction that occurs in a typical university lecture. Lectures are captured on an electronic whiteboard or on top of prepared slides using ZenPad, a Java applet. The electronic annotations, audio, video, and even Web browser activity are all automatically recorded and time-stamped. After the lecture, ZenPad automatically weaves the captured events together into a set of standard HTML Web pages. The need for note taking is reduced and students can focus their energies on engaging in and better understanding of the classroom discussion. A collaborative discussion space, CoWeb, has also been incorporated so that discussions are now anchored to relevant parts of the lecture, and the lecture extends into other activities outside of the classroom experience.

Virtual Community Links Critically Ill and Children with Disabilities: NSF's Collaborative Research on Learning Technologies Program, supports the Center for Innovative Learning Technologies (CILT), whose research activities address the assessment and improvement of mathematics and learning

skills through the development of collaborations between highly interdisciplinary teams of individuals and organizations and the development and diffusion of leading-edge technologies into learning environments. As one of its activities, CILT launched PatchWorx, a website connecting critically ill and children with disabilities all over the world in an online community. The site (http://www.patchworx.org) enables critically ill youngsters to share hopes and experiences through chatrooms, discussion boards, email and interactive activities.

Materials Research Science and Engineering Centers (MRSECs). In FY 2000, the MRSECs supported K-12 science and engineering outreach activities that reached about 360 teachers and 18,000 students. The MRSEC at Northwestern University, directed by Robert P.H. Chang, developed the Materials World Modules (MWM) program, which provides inquiry-based educational modules on materials topics to supplement the middle and high school science and math curricula. The modules have been used by over 9,000 teachers in 14 states and in U.S. Army base schools in nine foreign countries. An advanced, Internet-based version of the current MWM program that meets the national science standards is currently being developed with co-support from NSF. (http://mwm.ms.northwestern.edu/index.html)

Research on Speech Used at School for the Hearing Impaired. At the University of Colorado, Boulder, NSF-supported researchers are working on a 3-D animated conversational agent, BALDI, that combines speech recognition, understanding, and synthesis with facial animation technologies to converse with students. BALDI helps children who are profoundly deaf to develop their conversational skills by showing them how to understand and produce spoken language. In addition to helping students accurately produce expressive speech, the interactive system's curriculum development software lets teachers and students customize classwork. This project is the first to integrate emerging language technologies to create an animated conversational agent, and to apply this agent to learning and language training. Results from this project can be incorporated into animated conversational agents for non-hearing impaired applications such as learning new languages, e.g., English as a Second Language. They may also be useful for diagnosing or treating speech and reading disorders.

University Addresses the Transition from High School to College. In an effort to increase minority student participation in research, Florida A&M University, under a NSF Minority Institutional Infrastructure Program award, has created an outreach effort that has lead to a significant increase in student enrollment. The project targeted pre-college students from local and regional schools and community organizations with outreach activities to encourage students to get involved in computing as a career. Activities included "roadshow" presentations such as *Introduction to Voice Activated Computer Systems, Introduction to Robots,* and *Careers in Computing.*

Assessing Genetic Damage. The Mathematical and Theoretical Biology Institute (MTBI) at Cornell University focuses on supporting research opportunities for underrepresented minorities who have expressed interest in conducting research in applied mathematics or related fields. These research experiences are offered to undergraduate students who have had no prior research experiences and who have completed their sophomore or junior year of college in a mathematically related discipline. One of the many successes of this program was that a group of students developed a mathematical model for assessing genetic damage on HIV populations after anti-retroviral therapy.

Numbers of People Involved in NSF Activities

Nearly 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.

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	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate
Senior Researchers	25,100	27,010	26,660
Other Professionals	8,471	9,140	8,970
Postdoctoral Associates	4,782	5,250	5,130
Graduate Students	21,834	24,630	24,500
Undergraduate Students	29,849	31,940	31,840
K-12 Students	11,598	11,690	11,710
K-12 Teachers	82,999	84,050	84,090
Total Number of People [1]	184,633	193,710	192,900

[1] Does not include individuals to be funded through H-1B Nonimmigrant Petitioner Receipts in FY 2001 and FY 2002.

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. Up to 20 percent of these students receive support through programs such as the NSF Graduate Fellowships, Integrative Graduate Education and Research Training Program (IGERT), and NSF Graduate Teaching Fellows 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 or 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

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

(Millions of Dollars)

	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate
Ideas	$1,962	$2,251	$2,220

FY 2002 support for Ideas totals $2,220 million, a decrease of $31 million, or 1.4 percent, below FY 2001. This provides funding for research projects that include 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 four 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 2002, 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 2002 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, mathematics, engineering, and technology (SMET) education.

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

- Interdisciplinary mathematics: $20.0 million will enhance the transfer of results and applications from mathematics and statistics research to the science and engineering disciplines, challenge the limits of current mathematical theories, and develop a new cadre of researchers who are trained in both mathematics and science.

- Research in cognitive neuroscience: emphases on the neuroscience of child development, language, and social behavior.

- Genome enabled science: emphases on activities from genome sequencing and the assembly of primary sequence databases through functional analyses, also known as "functional genomics," to integrative research.

- Quantum science and engineering: address new opportunities in the quantum realms of physics, materials research, chemistry, biological molecules, mathematics, quantum computing and quantum communications, cosmology and engineering.

- Planetary energetics and dynamics: studies of tectonic and mass-energy dynamics at the continent-ocean interface will aid in the mitigation and prediction of earthquakes, storms, and storm tracks.

- Human-computer systems: emphases include instantaneous translation, access to meaningful information, and information relevant to contexts.

- Engineering the service industry: emphasize decentralized decision making and information sharing in complex systems.

- The Experimental Program to Stimulate Competitive Research (EPSCoR), a State-NSF partnership, will continue to support improvements in academic research competitiveness. In FY 2002, funding for EPSCoR through the Education and Human Resources appropriation totals $74.81 million. Linkages between EPSCoR and other NSF-supported research activities are expected to result in up to $25 million in additional funding directed to research in EPSCoR states.

- The Small Business Innovation Research (SBIR) program is supported at the mandated level of at least 2.5 percent of extramural research. The program will total $70.65 million, level with FY 2001.

Also included within support for Ideas are funds for fundamental research within the Foundation's four priority areas:

Biocomplexity in the Environment (BE) – At the leading edge of environmental science and engineering, this multidisciplinary priority area focuses on understanding interdependency, complexity, and human influences in natural systems. Activities explore new models of dynamic behavior, feedback between highly-coupled systems across spatial and temporal scales, and relationships between organisms and their physical environments. This investment will increase our understanding of human impacts on the environment; improve scientific and technical capabilities for environmental studies, data management, and long-term investigations; and enhance our ability to forecast environmental conditions, thus improving environmental decision-making.

Information Technology Research (ITR) – To improve ways to gather, store, analyze, share and display information, this multi-agency priority area, led by NSF, expands research on software, networking, scalability, and communications. The program increases access to terascale computing power, enabling researchers to tackle problems previously considered too complex to address – such as long-range weather forecasting, simulation of galaxy formation, and protein folding. FY 2002 will expand our research in multidisciplinary areas, focusing on fundamental research at the interfaces between scientific areas, including information technology. Additional investments will support research on the uses and impact of IT on our society, on our economy, and on our educational system. Because the information technology sector has contributed substantially to recent U.S. economic growth, these investments must remain a top priority.

Nanoscale Science and Engineering – In its second year, the multi-agency National Nanotechnology Initiative will expand fundamental research on phenomena at molecular and atomic scales and develop new techniques to facilitate application. Recent advances have already begun to spawn useful new materials and promising innovations that will touch every part of our lives, from our medicine cabinets – with targeted drug delivery systems, vaccines, and electronic biosensors to detect cancer in its earliest stages – to our workplace – with faster, more efficient computers and networks. As countries currently compete for global preeminence in these technologies, this investment will strengthen U.S. leadership and boost efforts to build a nanotech-ready workforce.

Learning for the 21st Century – The multidisciplinary learning research component of this priority area contributes to NSF's investment in Ideas. It involves cross-cutting 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. Activities in this element include the Interagency Education Research Initiative (IERI), the Research on Learning and Education (ROLE) program, and other research activities related to child learning and cognitive development.

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. Center programs involve a number of scientists and engineers working together on fundamental research addressing the many facets of complex problems;

- To include a strong educational component that establishes a team-based cross-disciplinary research and education culture to train 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)

	Year of Program Initiation	FY 2000 No. of Centers	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate
Engineering Research Centers and Groups	1985	36	55	63	62
Science & Technology Centers	1987	17	52	41	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	23	31	31	31
Materials Centers	1994	29	54	58	54
Center for Ecological Analysis and Synthesis	1995	1	2	2	2
Long-Term Ecological Research Program	1980	24	17	17	17
Earthquake Engineering Research Centers	1988	3	6	6	6
Chemistry Centers	1998	12	10	9	9
Mathematical Sciences Research Institutes	1982	3	8	8	15
Information Technology Centers	2000	33	33	50	53
Other Centers[1]	NA	3	6	9	15
TOTAL		250	$288	$309	$325

Totals may not add due to rounding.

[1] Other Centers include the Research Centers on the Human Dimensions of Global Change, the National Consortium on Violence Research and Physics Frontiers Centers.

FY 2002 support for centers is about $325 million, an increase of approximately $15 million over FY 2001.

- Information Technology Centers, initiated in FY 2000, support fundamental research in information technology that incorporates scientific applications or addresses social, ethical and workforce issues. An increment of $3.0 million for this program will provide support for an additional 3-5 awards in FY 2002.

- FY 2002 funding of $62.32 million will support 20 ongoing Engineering Research Centers and 16 Engineering Research Groups. FY 2002 funding of $5.99 million will be provided for the three ongoing Earthquake Engineering Centers. These centers have formed partnerships with industry and other practitioners to produce significant knowledge, technology and educational advances that strengthen industry and prepare a science and technology workforce capable of innovating in a broad range of technology fields.

- NSF will continue support for the Science and Technology Centers program. Support at a level of $19.49 million for the five new centers awarded in FY 2000 will continue. Funding for the remaining 12 STCs in the second cohort ends in FY 2001 in accordance with plans. The rollover of these funds will support an FY 2002 competition at a level of $25.62 million to establish a new cohort of STCs.

- Funding for Materials Centers will decrease by $3.31 million to a total of $54.25 million. Up to three new Materials Research Science and Engineering Centers and one new International Materials Institute will be established through open competition for a total of $4.0 million. Funding will be

generated by phasing out existing Centers. The new centers will focus on critical areas such as nanoscience and engineering, information technology, and the interface between materials and biology.

- The Physics Centers program will increase by $5.50 million, to a total of $10.50 million, to establish at least two additional Physics Frontier Centers. This will support a total of up to four centers to catalyze new areas such as atom lasers, quantum information science, computational physics, biological physics, and astrophysics.

- As part of the interdisciplinary mathematics area of emphasis, increased funding of $7.0 million for the Mathematical Sciences Research Institutes will provide support for up to four new Institutes in interdisciplinary mathematical sciences.

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

FY 2000 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 and Groups [1]	147	439	$55	$100	10,482
Science & Technology Centers	91	160	$52	$76	2,756
Industry/University Cooperative Research Centers and State/Industry/University/Cooperative Research Centers	115	753	$6	$69	1,901
Centers of Research Excellence in Science and Technology	10	96	$9	$9	2,900
Plant Genome Virtual Centers	50	27	$31	$3	2,800
Materials Centers	80	280	$54	$55	5,500
Long Term Ecological Research Program	167	116	$17	$30	2,500
Earthquake Engineering Research Centers	39	111	$6	$11	171
Chemistry Centers	51	75	$10	$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.
[1] Number of Participating Institutions, Number of Partners, Total Leveraged Support and Number of Participants are for Engineering Research Centers only. Data for Engineering Research Groups is not available.

FY 2002 Performance Goal for Ideas

The following table summarizes NSF's FY 2002 Performance Goal for Ideas. For additional information, see the FY 2002 Performance Plan.

Strategic Outcomes	No.	Annual Performance Goals[1] for Strategic Outcomes	FY 2002 Areas of Emphasis
IDEAS **<u>Outcome Goal:</u>** **To enable "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."**	**III-2**	**NSF's performance for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority (4 of 6) of the following indicators:** ● Discoveries that expand the frontiers of science, engineering, or technology; ● Discoveries that contribute to the fundamental knowledge base; ● Leadership in fostering newly developing or emerging areas; ● Connections between discoveries and their use in service to society; ● Connections between discovery and learning or innovation; and ● Partnerships that enable the flow of ideas among the academic, public or private sectors.	Balance of portfolio, including projects that are innovative, risky, or multidisciplinary Priority areas: - Biocomplexity in the Environment - Information Technology Research - Nanoscale Science and Engineering Core research and education activities - Interdisciplinary mathematics

[1] This performance goal is stated in the alternate form provided for in GPRA legislation.

Highlights (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.

Efficient Map-making in 3-D Settings With Mobile Robots: Mapping unfamiliar terrain or buildings with robots has high potential for working in hazardous or distant places. With accurate maps, robots can find their way and with accurate robot navigation, maps can be made. But like the chicken and egg problem, when neither is present it has been difficult for computers to get started on either task. At Carnegie Mellon University, Sebastian Thrun has developed a new statistical mapping algorithm that enables teams of mobile robots equipped with 2D-laser range finders to build joint maps together in real-time. The new method is fast and remarkably robust and can generate accurate maps of large cyclic environments even in the absence of any odometric data, in real-time and on a low-end computer. Thrun's work received the Best Conference Paper Award at the *2000 IEEE International Conference on Robotics and Automation* held in San Francisco in April 2000.

Urban Ecology: A Baltimore Ecosystem Study is focusing on how people at different scales – households, neighborhoods, and municipalities – affect water quality in the regional watersheds. Initial research has shown a significant relationship between concentration of political and economic power in the city and the different levels of investment in green infrastructure among neighborhoods. Additional research is focusing on how households affect water quality through irrigation, use of fertilizers and pesticides, as well as on how such land management practices vary with household demographic and socioeconomic characteristics.

Keeping Structures Safe: The use of de-icing salts and chloride-containing additives on concrete has caused a large increase in the number of structures – e.g., bridges, buildings and port structures – having problems with corroded steel. To help solve this problem, researchers at Carnegie Mellon University are developing a new electronic chip that uses nuclear magnetic resonance (NMR) to detect the chloride ion in concrete. Detection using NMR typically requires large expensive devices; this team is going to make it possible with a single chip. The team includes professors from civil engineering, chemical engineering, electrical engineering and physics. The NMR chip will help the country maintain its structures better and more economically. NMR chips placed throughout structures can warn engineers when the free chloride level in the concrete reaches a dangerous level so that steps can be take to prevent corrosion and loss of the structure.

Neural Networks: Scientists attempting to understand the human brain have developed computer models called neural networks which try to simulate the computational power of the nervous system. For every human action involving vision, memory, or language, the brain enlists dynamic interacting populations of nerve cells to perform that task. New approaches use a nonlinear neural network combined with computer simulations that mimic the way humans solve problems, not like a digital computer, but by memorizing facts, simplifying, and estimating answers. Progress in these areas has contributed to the design of "smart" machines and other forms of artificial intelligence.

Evidence that the cosmos is "flat": A microwave telescope borne by a huge balloon for 10½ days 120,000 feet over Antarctica provided detailed observational evidence that the large-scale geometry of the universe is flat. The research, supported by NSF and NASA, was published in *Nature* and widely publicized, including in the *New York Times* and the *Washington Post,* on April 27, 2000. The telescope provided high angular resolution images of the heat produced in the Big Bang 12-15 billion years ago. The intense heat still is detectable as a faint glow called cosmic microwave background radiation. Point-to-point variations in the heat reveal structure in the universe when it was only 300,000 years old.

Cracks Along Continental Shelf: Researchers have discovered cracks along the edge of the continental shelf off the coast of Southern Virginia formed by continuous and massive blowouts of gas. The implications of these findings – published in Geology, May 2000 – are important for geohazards on the East Coast of the United States because they could trigger landslides and tsunamis. Similar gas blowouts have damaged or destroyed oilrigs in the Gulf of Mexico and the North Sea.

Router Improvements Widely Adopted: Internet traffic is growing at incredible rates. Optical communications technologies are able to accommodate these increases, but there is a severe bottleneck in the electronics implementing the packet routing functions. High impact pioneering research in how Internet routers look up addresses rapidly to achieve high throughput resulted in new techniques that initially decreased the address lookup time by a factor of eight without the addition of new hardware. These ideas have been patented and licensed to several routing-equipment manufacturers, including Lucent, GTE, NEC, and Microsoft. NSF's research support has created an entirely new approach to designing high-speed Internet routers, which will address the needs of a multi-billion dollar market.

Nobel Laureates in Chemistry: The 1999 Nobel Prize in Chemistry was awarded to Ahmed Zewail for his pioneering real-time studies of the ultrafast making and breaking of chemical bonds. Alan J. Heeger, Alan G. MacDiarmid and Hideki Shirakawa shared the Nobel Prize for Chemistry in 2000 for the discovery and development of conductive polymers, so-called polymer metals. Zewail has been continuously funded by the NSF for 20 years. NSF has supported the collaboration between Heeger, a physicist and MacDiarmid, a chemist, since the 1970s.

Control of Invasive Fire Ants: Researchers have discovered that the growing threat of imported Brazilian fire ants to native North American ecosystems is associated with a lack of natural enemies such as phorid flies. In Brazil, these flies are important parasites that affect fire ant behavior and competition with other ant species. The absence of natural enemies has allowed a tremendous expansion of exotic fire ants throughout much of the U.S. with significant ecological and economic harm. Project findings have reached popular audiences through reports on National Public Radio, CNN, and the BBC. Knowledge gained from this research may open the way for effective control of this disastrous invasive species.

Anticipating "Brownouts": NSF-supported researchers have discovered new methods to anticipate "brownouts" in electric power systems due to voltage collapse problems. Software implementing these methods is being adopted by electric utilities. The new software allows utilities to quickly assess the transfer capability based on operational voltage stability margins. The models take into account power system conditions and limitations. Utilities can determine whether it is likely that their power needs will be met or the potential conditions under which there may be problems that will require other power sources. Researchers are helping to assess the new markets for electricity as they emerge and to provide a fundamental understanding of the effects of these new markets on electric power system reliability.

Technology Investment and Student Achievement: Project Hiller is a longitudinal study in which 40 incoming freshmen and 20 teachers have been supplied with laptop computers every year for three years in a Union City, NJ school of almost exclusively Hispanic students with limited competence in English. Results have shown consistent increases in student achievement brought about by long-term investment in technology and the reform of curriculum and teaching. The researchers found that technology, used well, improves achievement, makes students feel both knowledgeable and competent, increases teachers' expectations of these students, and serves to create a culture among students in which it is acceptable to be academically successful. Within each track, Hiller participants posted higher scores than non-Hiller peers across the board in every subject, and mean scores for Hiller general track students in each subject were higher than the mean scores for non-Hiller honor students.

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 provide access to state-of-the-art facilities essential to the progress of research. Support for these unique national facilities is necessary to advance U.S. capabilities required for world-class research. NSF also invests in 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 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate
Academic Research Fleet	44	57	60
Advanced Networking Infrastructure	44	45	44
Gemini Observatories	8	9	11
Incorporated Research Institutions for Seismology	12	13	13
Laser Interferometer Gravitational Wave Observatory	21	19	24
Major Research Equipment	105	121	96
Major Research Instrumentation	50	75	50
National Astronomy Centers (including ALMA)	71	86	91
National Center for Atmospheric Research	70	73	72
National SMETE Digital Library	16	27	27
Ocean Drilling Program Facilities	30	31	31
Partnerships for Advanced Computational Infrastructure	71	71	71
Polar Science, Operations and Logistics	193	197	197
Research Resources	112	125	122
Other Tools[1]	109	114	116
Total, Tools	$955	$1,061	$1,024

Totals may not add due to rounding.

[1] Includes physics, materials research, ocean sciences, atmospheric sciences, and earth sciences facilities, CESR, the National High Field Mass Spectrometry Center, the MSU Cyclotron, the National High Magnetic Field Laboratory (NHMFL), the Science and Technology Policy Institute, Science Resource Studies, and the National Nanofabrication Users Network.

The FY 2002 Request for tools totals $1,024 million, a $37 million decrease from FY 2001. 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 (MRE) 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 2002 support for the Academic Research Fleet totals $59.90 million, a $2.70 million, or 4.7 percent, increase over FY 2001 to provide the resources necessary for enhanced research in fields related to biocomplexity and planetary dynamics.

Advanced Networking Infrastructure (ANI)

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 2002 support for ANI facilities is $43.91 million, a decrease of $800,000, or 1.8 percent, from FY 2001.

Gemini Observatories

The two Gemini Telescopes will offer world class capabilities and unique opportunities to the scientific community. In particular, these telescopes are optimized for operation in the infrared region and will be able to use adaptive optics, which at these wavelengths will 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. Normal science operations are expected to commence at the Chilean site in FY 2001. The FY 2002 Budget Request includes $11.0 million for the Gemini Observatories, $2.37 million over FY 2001, with an emphasis on support for operations at the two sites.

Incorporated Research Institutions for Seismology (IRIS)

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 2002 support for IRIS totals $12.80 million, an increase of $200,000, or 1.6 percent, over FY 2001.

Laser Interferometer Gravitational-Wave Observatory (LIGO)

The 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, several other institutions are also involved. LIGO consists of identical but widely separated detectors, one in Hanford, Washington and the other in Livingston, Louisiana, that will be used for fundamental physics experiments to directly detect gravitational waves and gather data on their sources. In FY 2002, $24.0 million is requested, an increase of $4.9 million, in accordance with the funding schedule for LIGO operations.

Major Research Equipment (MRE)

(Dollars in Millions)

	FY 2000 Actual	FY 2001 Current Plan	FY 2002 Request
Atacama Large Millimeter Array R&D	8.0	6.0	--
HIAPER	8.5	12.5	--
Large Hadron Collider	15.9	16.4	16.9
Network for Earthquake Engineering Simulation	7.7	28.1	24.4
Polar Support Aircraft Upgrades	12.0	--	--
South Pole Station	16.9	13.5	--
Terascale Computing Systems	36.0	44.9	55.0
TOTAL, MRE	$105.0	$121.3	$96.3

Totals may not add due to rounding.

A total of $96.30 million is requested through the MRE account for three ongoing projects:

- Large Hadron Collider (LHC) is planned to be the world's highest energy accelerator facility. 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). Continued funding of $16.90 million is requested in FY 2002.

- 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 $24.40 million is requested in FY 2002.

- 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 $55.0 million in FY 2002.

NSF is not requesting additional funds in FY 2002 for four projects, the Atacama Large Millimeter Array Research and Development Project (ALMA R&D), the High-performance Instrumented Airborne Platform for Environmental Research (HIAPER), the Polar Support Aircraft Upgrades and the South Pole Station Modernization program. Maintenance of the ALMA infrastructure is funded in the R&RA account. Funding for the Polar Support Aircraft Upgrades and the South Pole Station Modernization program is completed. No new starts are proposed. Additional information can be found in the MRE section.

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 improve the quality and expand the scope of research and research training in science and engineering, and to foster the integration of research and education by providing instrumentation for research-intensive learning environments. In FY 2002, NSF requests $50.0 million, a decrease of $24.83 million from FY 2001, 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 2002 Request includes $102 million (including support for Gemini):

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 2002 Request includes $9.40 million for NAIC, $720,000 less than FY 2001, and emphasis will be 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; and the National Solar Observatory, in Arizona and New Mexico, and the U.S. Gemini Office which 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. In FY 2002, the Global Oscillation Network Group (GONG) at NOAO will continue monitoring small-scale oscillations of the sun, permitting studies of the sun's interior structure. The instrumentation for the Synoptic Optical Long-term Investigation of the Sun (SOLIS) will continue refined studies of the Sun's atmosphere and surface, including determining conditions which give rise to solar flares. The FY 2002 Request includes $32.02 million for NOAO, $1.50 million over FY 2001.

The National Radio Astronomy Observatory (NRAO) is headquartered at 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 2001, the Green Bank Telescope in West Virginia will transition from commissioning to operations. Following a one-time increment in FY 2001 that enabled major improvements in facilities infrastructure and attention to deferred maintenance, the FY 2002 Request includes $40.13 million for NRAO operations, $5.30 million less than FY 2001.

The FY 2002 Request also includes an additional $9.0 million for the Atacama Large Millimeter Array (ALMA). Funding within the Major Research Equipment Account for Phase I of this project was completed in FY 2001. In FY 2002, funds provided through the Astronomy Subactivity will maintain the established infrastructure for this project while consideration of the Phase II construction project continues. This is a proposed international project being undertaken in partnership with the European, Canadian and possibly Japanese communities.

National Center for Atmospheric Research (NCAR)

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 2002, more than 1,500 researchers and students will use the facilities and approximately 150 visiting scientists will stay for extended periods. NSF's FY 2002 support for NCAR totals $71.90 million, a decrease of $750,000, or 1.0 percent, from FY 2001.

National SMETE Digital Library

A National SMETE Digital Library (NSDL) responds to needs articulated by the NSF, the academic community, and corporate leaders for accelerating much needed improvements in science, mathematics, engineering, and technology education (SMETE). 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 2002 will total $26.80 million, a decrease of $350,000, or 1.3 percent, from FY 2001.

Ocean Drilling Program Facilities

The Ocean Drilling Program is a multinational program of basic scientific research in the oceans which 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. Operational support for this activity is shared by seven international partners, comprising 20 countries. NSF's FY 2002 support for Ocean Drilling Program facilities totals $31.0 million, an increase of $500,000, or 1.6 percent, over FY 2001.

Partnerships for Advanced Computational Infrastructure (PACI)

Partnerships for Advanced Computational Infrastructure 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. The $70.71 million requested in FY 2002 will permit the PACI program, now in its fourth year, to continue the era of terascale computing. In FY 2002, 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 2002 support for Polar Science Operations and Logistics totals $197.31 million. 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 2002, funding for Research Resources decreases $3.35 million to a total of $121.56 million.

Other Tools

This category includes:

- Science resources studies are a vital tool for researchers and policymakers, providing them with data and information that is the basis for the making of informed decisions and policy formulation about the nation's science, engineering and technology enterprise. The primary statistical series produced by the Division of Science Resources Studies include the education and employment of scientists and engineers and the performance and financial support of research and development;

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

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

- Support for the Science and Technology Policy Institute 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 identify options for achieving those objectives;

- An increment of $3.50 million to strengthen 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 physics, materials research, ocean sciences, atmospheric sciences, and earth sciences, and the National High Field FT-ICR Mass Spectrometry Center.

FY 2002 GPRA Performance Goals for Tools

Strategic Outcomes	No.	Annual Performance Goals[1] for Strategic Outcomes	FY 2002 Areas of Emphasis
TOOLS **Outcome Goal:** **To provide "broadly accessible, state-of-the-art information-bases and shared research and education tools."**	**III-3**	***NSF's performance for the Tools Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority (4 of 6) of the following indicators:*** • Provision of facilities, databases or other infrastructure that enable discoveries or enhance productivity of NSF research or education communities; • Provision of broadly accessible facilities, databases or other infrastructure that are widely shared by NSF research or education communities; • Partnerships with other federal agencies, national laboratories, or other nations to support and enable development of large infrastructure projects; • Use of the Internet to make SMET information available to NSF research or education communities; • Development, management, or utilization of very large data sets and information-bases; and • Development of information and policy analyses that contribute to the effective use of science and engineering resources.	• Investments in Major Research Equipment (MRE) • Continued Investments in: ◦ Major Research Instrumentation (MRI) Program ◦ Science & Engineering information, reports, and databases ◦ Scientific databases and tools for using them ◦ National SMETE Digital Library

[1] These performance goals are stated in the alternate form provided for in GPRA legislation.

FY 2002 GPRA Performance Goals for Tools

Performance Area	No.	Annual Performance Goals for Successful Management
Construction and Upgrade of Facilities	**IV-9a**	For 90 percent of facilities, keep construction and upgrades within annual expenditure plan, not to exceed 110 percent of estimates.
	IV-9b	Ninety percent of facilities will meet all major annual schedule milestones by end of the reporting period.
	IV-9c	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-10**	For 90 percent of facilities, keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time.

Highlights (Tools)

High Technology Microscopes: NSF support of advances in microscope-related technology has resulted in the development of the confocal microscope and more recently, the development of both the "two-photon" and "near-field scanning optical" microscopes. Two-photon confocal microscopy has now become a standard component of laboratory instrumentation in the area of cell biology, and has resulted in a better understanding of the basic biological processes in both plants and animals. Moreover, the movement of confocal and two-photon microscopy from an experimental tool to commercial production has resulted in net gains for the U.S economy, as the market for high technology products is a worldwide market.

National Science, Mathematics, Engineering, and Technology Education Digital Library (NSDL): Substantial progress is being made in laying the groundwork for the NSDL. Key user services and supporting technical standards are being developed at the University of Missouri and the National Center for Atmospheric Research. A demonstration project at the University of California-Berkeley is integrating NSDL collections and services, and intellectual property rights management models are under development at Columbia University. Advanced user tools to map, visualize, and analyze collected data sets are being developed at Cornell University, and management tools for video content are being developed at Carnegie Mellon University. The teacherLIB project at Eastern Michigan University and the Virtual Teacher Resource Center at Ohio State are providing the information infrastructure and content for seamless access to high quality learning materials for pre- and in-service teachers.

National Nanofabrication Users Network (NNUN). The NNUN, established in 1994, is a national integrated network of nanofabrication user facilities at Cornell, Stanford, Howard, Pennsylvania State, and the University of California, Santa Barbara. This investment supports the national infrastructure and education needs for the burgeoning nanoscience and technology research field by providing access, on-site and electronically via the Internet, to advanced nano- and micro-fabrication capabilities for researchers in diverse disciplines in academe, industry and government. The NNUN facilities provide capabilities for advanced lithographic, etching, deposition and growth processes in a variety of materials, together with the expertise needed to fabricate nanometer-scale structures, custom devices, and circuits. Since its establishment, users from 29 states, 7 foreign countries, and over 50 start-up companies have used the facilities. The number of unique users has reached over 1,400, an increase of about 30% from the previous year. Significant growth has occurred in the external academic user base in emerging areas of biology and chemistry through outreach efforts to these communities.

Brain Image Database: Brain scans are an important tool for medical science, basic research and education, but this expensive technology is often out of reach for many institutions. A multidisciplinary team of cognitive neuroscientists, computer scientists, psychologists, and mathematicians has developed a repository for images of human brain scans that is available free to researchers and educators worldwide. The National Functional Magnetic Resonance Imaging (fMRI) Data Center has been established with a 5-year grant from NSF. The brain images come from fMRI results published in peer-reviewed journals. Once the data are received, all traces of personal identity information are removed and the image files are converted into a standard format. "Computational tools were essential to the triumph of the human genome project, and we want to bring this power into brain research," says Michael Gazzaniga, director of Dartmouth's Center for Cognitive Neuroscience. Researchers and educators with modest budgets will now have access to recent fMRI data.

Auto-Nowcaster. The Auto-Nowcaster system, jointly sponsored by the Federal Aviation Administration, the Department of the Army, the National Weather Service, and NSF under the U.S. Weather Research Program, provides one-hour nowcasts of thunderstorms and strong winds. The Sterling Virginia National Weather Forecast Office's severe storm warnings for 1998 were far moreaccurate than any previous year, and they give partial credit to the Auto-Nowcaster system for the improvement.

Partnerships for Advanced Computational Infrastructure (PACI): PACI researchers are creating innovative ways to harness computing power to solve heretofore unsolvable problems. Scientists at the National Computational Science Alliance (NCSA) located at the University of Illinois, along with scientists at the University of Iowa and Argonne National Laboratory, have demonstrated the power of combining computers at multiple locations. By linking over 1,000 computers from around the world-computers from five different vendors operating together as a single parallel computer-they solved a quadratic assignment that has been unsolved for over 30 years: to find the lowest cost assignment of facilities to locations that will minimize the cost of moving material flows. Quadratic assignment problems arise in such varied applications as locating factories, hospital layouts and designing computer chips.

Ultraviolet (UV) Monitoring Network. The National Science Foundation Ultraviolet (UV) Monitoring Network was established in 1987 by the NSF Office of Polar Programs in response to serious ozone depletion reported in Antarctica. The first instruments were installed in 1988 and the network has operated since then. The network was the first automated, high-resolution UV scanning spectroradiometer network in the world. It has been successfully operated in the harshest environments on Earth (Antarctica and the Arctic) and is currently providing data to researchers studying the effects of ozone depletion on terrestrial and marine biological systems. Network data is also used to develop and verify models of atmospheric light transmission and ozone depletion impacts. Data is available at no cost to all interested parties via CD-ROM or the Internet.

NSF's **Science Resources Studies** (SRS) responsible for the collection, dissemination and analysis of information on the nation's scientific and technical resources. SRS' primary statistical series include the education and employment of scientists and engineers and the performance and financial support of research and development. Users traditionally had obtained SRS information through publications and general-purpose databases. Recently, however, SRS' web site has become the main interface. These data provide a vital tool for researchers and policymakers. For example, the databases and website recently were utilized to inform the policy debate on H-1B visas for high-tech workers. The web site provides complete access to SRS publications, related reports and databases. The SRS databases are WebCaspar, an integrated database of statistical data dealing with science and engineering at U.S. academic institutions and SESTAT, an integrated system covering the employment of scientists and engineers in the nation.

Quieter Solid State Laser Patented Following LIGO Supported Development. The Laser Interferometer Gravitational-Wave Observatory (LIGO) provides 10W of single frequency light to measure the disturbance of LIGO's arm cavities caused by the passage of gravitational waves. LIGO's requirement for solid-state infrared lasers as ultra-stable light sources for each of its interferometers required teaming university laser scientists with industry. That teaming has now led to a new commercial product, the Lightwave 6000 laser (http://www.lightwaveelectronics.com/solutions/model_6000.htm) and a patent for a new laser stabilization technique by a LIGO industrial partner, Lightwave Electronics of Mountain View, California. The partnership has continued to develop improvements. One of the requirements of the project, the stringent amplitude (brightness) stability, led Lightwave to develop a new optical technique that uses a nonlinear optical parametric oscillator. This oscillator, for which Lightwave has a patent pending, offers a broadband suppression of amplitude noise. This development, which will help the next generation of LIGO detectors to meet their ever-tightening sensitivity goals, is expected to be of interest in industrial applications requiring quiet laser interferometry. For example, the oil industry uses low-noise laser-fiber interferometers to sense the presence of oil though variations in the propagation of induced seismic disturbances.

Administration and Management

Administration and Management (A&M) totals $226.77 million in FY 2002, an increase of five percent over FY 2001. The S&E and OIG accounts increase by approximately $10 million to fund the statutory pay increase, space rental costs, enhancements to information systems, and additional oversight activities.

The A&M function includes administrative costs that are funded through the Research and Related Activities (R&RA) and the Education and Human Resources (EHR) accounts as well as the Salaries and Expenses (S&E) and Office of Inspector General accounts.

A&M also includes the resources to support the agency's salaries, benefits, and training of persons employed at the NSF; general operating expenses, including key initiatives to advance the agency's information systems technology; audits and other Inspector General activities.

(Millions of Dollars)

	FY 2000 Actual	FY 2001 Current Plan	FY 2002 Request	Change Amount	Change Percent
Salaries and Expenses	$149.28	$160.54	$170.04	$9.50	5.9%
Program Accounts (R&RA & EHR)	33.94	48.67	49.42	0.75	1.5%
Financial Statement Audit	0.50	0.55	0.55	0.00	0.0%
Travel	[12.00]	[14.00]	[15.00]	[1.00]	[7.1%]
Subtotal, A&M	183.72	209.76	220.01	10.25	4.9%
Office of Inspector General [1]	5.60	6.27	6.76	0.49	7.8%
Total, Administration and Management	$189.32	$216.03	$226.77	$10.74	5.0%

Totals may not add due to rounding.

[1] FY 2001 Current Plan total excludes $114,000 in FY 2000 Carryover funds.

Although NSF has had healthy increases in its program responsibilities and budgets in recent years, salaries and expenses have remained relatively flat. The NSF budget increased 13.6 percent in FY 2001; however, the increase for administration costs covered only pay raises, information technology contractual labor costs, and travel. While the agency has been able to manage with small increases allocated for administration and management in the past, the Congress and NSF's Office of Inspector General (OIG) have raised questions about whether NSF can successfully manage future growth. Concerns about the adequacy of staffing come at a time when the government as a whole is facing succession planning and recruiting problems. Additionally, NSF's reliance on Intergovernmental Personnel Act (IPA) personnel, who serve on a term basis, poses a challenge to the agency to make certain that personnel are adequately trained to administer grants. During FY 2001, the Congress directed the NSF OIG to evaluate

the Foundation's management of its growing program responsibilities. As a result, the OIG is planning audit work in this area to ensure that the agency has a reasonable strategy for managing its human capital.

As part of an ongoing Foundation effort to improve operations, a NSF Workforce Committee, comprised of staff from all areas of the agency, is developing a five-year strategic plan for optimum development and utilization of NSF's human capital. The objectives of the committee are to evaluate current human resource profiles, project workforce needs into the future, develop strategies for closing the gaps in current and future human resources needs, and begin a dialogue around the most appropriate development and utilization of staff in core businesses. The results of this study will assist in establishing agency-wide priorities and goals.

The Foundation's A&M activities are funded through four appropriations accounts. In the FY 2002 A&M request, percentage-wise the greatest increase is for the S&E and OIG accounts – see table above for details. However, A&M-related expenses supporting the R&RA and EHR appropriations are almost constant with FY 2001 as shown in the following table.

(Millions of Dollars)

	FY 2000 Actual	FY 2001 Current Plan	FY 2002 Request	Change Amount
Program Accounts:				
R&RA Appropriation[1]	24.66	37.06	37.81	0.75
EHR Appropriation[1,2]	9.78	12.16	12.16	0.00
Total, Program Accounts	$34.44	$49.22	$49.97	$0.75

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.

Salaries and Expenses

- The FY 2002 request for Personnel Compensation and Benefits (PC&B) is $117.51 million, an increase of $4.16 million over the FY 2001 Current Plan. Within the proposed increase, PC&B will provide the resources to maintain the current FTE level of 1,150, including comparability and locality pay increases and higher benefits costs.

- The FY 2002 request for General Operating Expenses (GOE) is $52.53 million, an increase of $5.34 million over the FY 2001 Current Plan. GOE funds the entire range of operating expenses that are necessary for the agency to administer its programs. The GOE level for FY 2002 provides for advances in the agency's information systems technology – to enhance the information infrastructure, to promote e-business opportunities, and to provide for increasing IT contractor costs. It also provides for rental payments to the General Services Administration for existing and newly acquired space. Additionally, an increase in travel funds in FY 2002 is necessary to continue supporting the merit review process and to increase oversight and outreach travel. This request will ensure both a reliable merit review process and the oversight as recommended by the agency's Inspector General. OIG reports continue to cite the lack of travel funds for oversight of NSF's awards as a major management challenge.

Program Accounts

- The FY 2002 request for administrative activities funded through programmatic accounts remains relatively flat with the FY 2001 Plan. Some examples of administrative activities funded through programmatic accounts are: grants to institutions for temporary assignments of visiting program managers (IPAs), associated costs for their travel and equipment, and contracts supporting direct programmatic-related services.

Office of Inspector General

- The FY 2002 request for the OIG is $6.76 million, an increase of $490,000 over the FY 2001 Current Plan. Under the proposed increase, which will be applied to the higher costs associated with personnel compensation and benefits, OIG will continue to shift its base resources to improve its oversight of NSF's programs and awardees. 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.

The NSF FY 2002 staffing level remains equal to FY 2001 Current Plan level. The table below shows the NSF workforce by account and full-time equivalent employment.

(Millions of Dollars)

	FY 2000 Actual	FY 2001 Current Plan	FY 2002 Request
Federal Employees:			
Salaries and Expenses	1,153	1,150	1,150
Inspector General	44	50	50
Arctic Research Commission	3	4	4
Subtotal, Federal FTE	1,200	1,204	1,204
Non-Federal Employees:			
IPAs	106	140	140
Detailees to NSF	5	10	10
Contractors Performing Administrative Functions	136	210	210
Subtotal, Non-Federal FTE	247	360	360
Total, Workforce FTE	1,447	1,564	1,564

FY 2002 A&M Highlights

Highlights of the FY 2002 A&M request include the following major initiatives that support improvements to the Foundation's information technology infrastructure in areas such as management of proposal submission, review, award, and financial activities. An NSF Academy will be established to ensure that the NSF workforce is adequately trained to meet existing and emerging challenges in the workplace.

Electronic Business

The recent enactment of the Federal Financial Assistance Management Improvement Act of 1999 has significant implications for NSF's activities and development of electronic systems. The new act sets tight deadlines for planning and implementation of a wide variety of functions that are critical to NSF's mission; including streamlining basic assistance processes, participation in interagency efforts for electronic initiatives, and assisting award recipients in their abilities to meet reporting requirements. While NSF has been a leader in many of these activities, the deadlines of this Act require accelerated system development and greater concentration of resources in activities supporting interagency consistency and customer support. Increased funding is necessary to ensure that the Foundation has the resources not only to meet these challenging deadlines, but also to provide a leadership role in this federal effort.

NSF's business has been changing, and A&M funding has not kept pace with program increases. Therefore, in spite of an aggressive use of technology, NSF has found that it takes a significant effort on the part of the agency staff to implement the complex, interdisciplinary programs. These programs require coordination within the Foundation, with other federal agencies, and among the numerous and diverse science and engineering communities. The scientific complexity that results from these interdisciplinary programs is reflected in the management of proposal submission, review, award, and financial activities. It is critical that the Foundation makes further investments in the agency's information systems that will enable NSF to handle its increasing workload. To meet this growing workload, the Foundation has actively pursued the use of advanced information technologies to improve the way NSF does business and reduce the administrative burden on NSF's customers and staff.

With the FastLane project, NSF has made substantial progress in achieving its goal of a streamlined, paperless electronic grant submission and review process. The Foundation initiated FastLane as a research project in 1994 to test the feasibility of complete electronic handling of proposal processing and grant administration and to explore the capability of electronic processing to reduce the workload burden on both NSF and the research community. FastLane enables NSF and its customer community to conduct and facilitate business transactions and exchange information electronically using the World Wide Web.

In September 1998, the Director of NSF issued Important Notice 123 to university and college presidents and the heads of other grantee organizations. It contained NSF's vision for paperless proposal and award processing. In addition to outlining the steps NSF is taking to bring the vision to reality, the Important Notice included a schedule of when five basic functions will be required for use by our grantees (i.e., mandatory electronic proposal submission.) This notice was NSF's public commitment to using electronic processing for its standard business processes. The final deadline in the Important Notice was October 1, 2000 and the deadline was successfully met and passed without incident.

In addition to increased efficiency and reduced administrative burden, the benefits to be derived from FastLane are increased access by researchers and the public to information about NSF-supported research, and reduced proposal and award processing time. Since its inception, FastLane has experienced accelerating growth in all areas while requiring ever-expanded infrastructure resources to maintain and improve the system. This service that began as an experiment with 16 university partners currently has over 4,000 registered organizations and over 200,000 registered users.

FastLane functions handle the processing associated with proposal preparation and submission, proposal review, proposal status inquiry, award notification, project reports, and award search. These modules were used by grantee institutions to submit over 24,000 proposals (more than 80 percent of the total), over 100,000 reviews, and over 18,000 project reports in FY 2000.

Presently, NSF distributes over $2.5 billion annually via FastLane using an Internet browser with forms capability. FastLane acts as an automated teller machine via the web for our grantee community allowing requests for cash to be deposited directly into an awardee's bank account through an entirely electronic process. NSF processed approximately 2,200 requests in 1996, the first full year of operation for FastLane cash requests. Four years later, NSF had over 13,000 cash requests, or nearly a 500 percent increase, in user participation. At this time, 40 to 60 grantees request and receive cash through FastLane every day. FastLane opened the electronic Federal Cash Transaction Reports (FCTR) for use in January 1998, allowing grantees to submit their required quarterly reporting on expenditures to NSF in a seamless business-to-business fashion. The FCTR is a "downloadable" report that is accessible by the grantee's internal accounting system. The resulting report is then "uploaded" back to FastLane and processed directly into NSF's financial accounting system. The process requires no manual intervention. Only about 25 percent of NSF grantees took advantage of the electronic FCTR in the first year. Now, all FCTRs are submitted via FastLane. This accounts for approximately 30,000 active NSF awards with a total net award value of approximately $12.8 billion.

Among the enhancements made to FastLane in FY 2000 were the release of reviews on-line to principal investigators (PIs), availability of award letters online to PIs and organizations, on-line registration of new organizations, improved system reliability, and enhanced password security for our users. The external FastLane Help Desk was expanded from four to six persons to provide centralized, dedicated support to our external users. Many more systems enhancements will continue as needed to provide excellent customer service.

FastLane is now used for 99.8 percent of proposal submissions. To maintain this state-of-the-art system, we must continually enhance FastLane operations and infrastructure, expand the Help Desk hours, and provide ongoing training to NSF's personnel in its use. The required infrastructure includes high-speed servers, storage, and memory. Most importantly, the infrastructure requires significant investments in system security and contracts to maintain and improve the FastLane programs.

The FastLane system is continuously updated as new technologies emerge. Of course, making the system truly user-friendly is a key goal based upon feedback from the research community. When the FastLane planning began in 1994, NSF recognized that the opportunities presented by advances in the Internet and the World Wide Web would have a significant impact on how work is accomplished. The initial project was based on what was known of the capabilities of the Internet and Web at that time. Based on their experiences with FastLane, the user community has identified new opportunities that were not envisioned in 1994. We expect the requirement for new enhancements to continue to expand as new opportunities emerge and as the Web continues to evolve.

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.

FinanceNet

NSF is the support custodian for FinanceNet (www.financenet.gov). The government's Internet "homepage" sponsored by the United States Chief Financial Officer's Council for financial management improvement initiatives and the government-wide internet portal site for information on all federal, state, and local surplus and abandoned property. As the virtual clearinghouse for federal financial management information, FinanceNet is a shared government-wide resource that produces various Internet services to facilitate communication and collaboration among government financial managers and related parties and provides a shared, interagency platform for seeking solutions in virtual environment for common government-wide problems. FinanceNet has proven to be an important interactive tool.

In FY 2000, there were nearly 175,000 subscribers to FinanceNet's daily public and private list servers.

NSF Academy

The Academy initiative, which was conceived in FY 2001, is intended to provide a central resource for the training, education, and development of NSF staff at all levels. The mission of the NSF Academy is to promote an organizational culture that values continuous learning and capitalizes on new technology and its promise for enhanced performance. The Academy is a workplace initiative that integrates a variety of learning opportunities linked to NSF's mission, philosophy, and goals. The initiative seeks to provide professional development for every NSF staff member in order to build a workforce with the competencies to meet future challenges. The Academy will encompass all existing learning and development activities as well as create new initiatives, programs, and processes to ensure the continual development of NSF staff.

FY 2002 PERFORMANCE GOALS FOR MANAGEMENT

The performance goals for management provide information about the means and strategies NSF uses in support of its outcome goals and articulates performance goals for the investment process by which NSF shapes its portfolio of awards. These goals also address whether centrally funded and coordinated administrative activities are managed efficiently and effectively in support of NSF's mission. See the FY 2002 Performance Plan included in this justification for further detail.

Performance Area	No.	Annual Performance Goals for Successful Management
Proposal and Award Process		
Use of Merit Review	IV-1	At least 85% of basic and applied research funds will be allocated to projects that undergo merit review.
Implementation of Merit Review Criteria – Reviewers[1]	IV-2	Reviewers will address the elements of both generic review criteria at a level above that of FY 2001.
Implementation of Merit Review Criteria – Program Officers[1]	IV-3	Program Officers will consider elements of both generic review criteria in making decisions to fund or decline proposals.
Customer Service – Time to Prepare Proposals	IV-4	Ninety-five percent of program announcements will be available to relevant individuals and organizations at least three months prior to the proposal deadline or target date.
Customer Service – Time to Decision	IV-5	For 70 percent of proposals, NSF will be able to inform applicants whether their proposals have been declined or recommended for funding within six months of receipt.
Diversity – Reviewer Pool	IV-6	Members of underrepresented groups will show increased participation in NSF proposal review activities over FY 2001. (New Goal)
Award Portfolio		
Award Size	IV-7a	NSF will increase the average annualized award size for research projects to a level of $113,000, compared to a goal of $110,000 in FY 2001.
Award Duration	IV-7b	NSF will maintain the FY 2001 goal of 3.0 years for the average duration of awards for research projects.

[1] These performance goals are stated in the alternate form provided for in GPRA legislation.

Performance Area	No.	Annual Performance Goals for Successful Management (Continued)
Award Oversight and Management		
Award Oversight	IV-8	NSF will review its large infrastructure projects in order to identify best management practices. (New Goal)
Business Practices		
Electronic Business	IV-11	NSF will continue to advance the role of "e-business" in review, award, and management processes.
Security Program	IV-12	NSF will implement an agency-wide security program in response to the Government Information Security Reform Act. (New Goal)
Human Resources and Workplace		
NSF Staff -- Diversity	IV-13	NSF will show an increase over FY 2000 in the total number of hires to NSF science and engineering positions from underrepresented groups.
Workforce Training	IV-14	NSF will establish an internal NSF Academy to promote continuous learning for NSF staff. (New Goal)

Note: Goals IV-9 and IV-10 on facilities oversight are covered under Performance Goals for Tools

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 2000 Actual	FY 2001 Estimate	FY 2002 Estimate
Number of Requests for Funding[1]	43,570	45,310	47,110
Dollars Requested (in billions)[1]	$23.22	$25.07	$26.58
Total Number of Awards	20,027	20,950	20,770
Statistics for Competitive Awards			
Number	9,720	10,140	9,930
Funding Rate	32%	32%	30%
Median Annualized Award Size[2]	$78,133	$83,590	$85,440
Average Annualized Award Size[2]	$105,800	$110,400	$113,690
Average Duration (yrs.)[2]	2.8	2.9	2.9
Percent of Competitive Research			
Grants to New Investigators	28%	29%	29%

[1] FY 2001 and FY 2002 data does not include requests for funding for H-1B scholarship activity.

[2] Statistics for award size and duration are for research grants only.

(Dollars in Thousands)

PROGRAM	FY 2000 ACTUAL	FY 2001 REQUEST	FY 2001 CURRENT PLAN	FY 2002 REQUEST	CHANGE FY 2002 Req/FY01 Curr Plan AMOUNT	CHANGE FY 2002 Req/FY01 Curr Plan PERCENT
BIOLOGICAL SCIENCES						
MOLECULAR AND CELLULAR BIOSCIENCES						
Molecular & Cellular Biosciences Research Projects	$105,738	$133,150	$124,220	$121,240	-$2,980	-2.4%
Total	105,738	133,150	124,220	121,240	-2,980	-2.4%
INTEGRATIVE BIOLOGY AND NEUROSCIENCE						
Integrative Biology & Neuroscience Research Projects	95,140	119,690	111,660	112,640	980	0.9%
Total	95,140	119,690	111,660	112,640	980	0.9%
ENVIRONMENTAL BIOLOGY						
Environmental Biology Research Projects	89,363	119,230	109,870	111,740	1,870	1.7%
Total	89,363	119,230	109,870	111,740	1,870	1.7%
BIOLOGICAL INFRASTRUCTURE						
Research Resources	49,344	62,710	58,460	56,040	-2,420	-4.1%
Human Resources	15,682	16,730	16,350	16,450	100	0.6%
Total	65,025	79,440	74,820	72,490	-2,330	-3.1%
PLANT GENOME RESEARCH						
Plant Genome Research Projects	63,028	59,630	64,860	65,000	140	0.2%
Total	63,028	59,630	64,860	65,000	140	0.2%
Total, BIO [1]	$418,295	$511,140	$485,420	$483,110	-$2,310	-0.5%

[1] The agency rountinely closes out awards that are past the expiration date. Several awards including $4 million in BIO were terminated in FY 2000 due to incorrect award expiration dates. The expiration dates on these awards were corrected later in the year and the awards were reopened and the balances restored. The closing of the awards are reported as recoveries and the reopening of the awards are accounted for as upward adjustments to prior year obligations. This causes obligations to be technically correct but overstated by the amount of the upward adjustments. In the case of BIO, $4 million resulting in a net funding level of $414.33 million in FY 2000 for an increase of $71.09 million in FY 2001.

(Dollars in Thousands)

PROGRAM	FY 2000 ACTUAL	FY 2001 REQUEST	FY 2001 CURRENT PLAN	FY 2002 REQUEST	CHANGE FY 2002 Req/FY01 Curr Plan AMOUNT	CHANGE FY 2002 Req/FY01 Curr Plan PERCENT
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING						
COMPUTER-COMMUNICATIONS RESEARCH						
Computer-Communications Research	$60,241	$69,160	$65,490	$64,390	-$1,100	-1.7%
Total	60,241	69,160	65,490	64,390	-1,100	-1.7%
INFORMATION AND INTELLIGENT SYSTEMS						
Information and Intelligent Systems Research	41,429	53,700	48,840	48,020	-820	-1.7%
Total	41,429	53,700	48,840	48,020	-820	-1.7%
EXPERIMENTAL AND INTEGRATIVE ACTIVITIES						
Experimental and Integrative Activities	57,845	63,320	60,950	57,810	-3,140	-5.2%
Total	57,845	63,320	60,950	57,810	-3,140	-5.2%
ADVANCED COMPUTATIONAL INFRASTRUCTURE AND RESEARCH						
Advanced Computational Infrastructure	70,741	75,830	73,710	73,710	0	0.0%
Advanced Computational Research	7,266	8,320	7,890	6,510	-1,380	-17.5%
Total	78,007	84,150	81,600	80,220	-1,380	-1.7%
ADVANCED NETWORKING INFRASTRUCTURE AND RESEARCH						
Advanced Networking Infrastructure	43,743	45,400	44,710	43,910	-800	-1.8%
Advanced Networking Research	16,912	23,370	20,830	20,530	-300	-1.4%
Total	60,655	68,770	65,550	64,440	-1,110	-1.7%
INFORMATION TECHNOLOGY RESEARCH (ITR)						
Information Technology Research (ITR)	90,390	190,000	155,480	155,480	0	0.0%
Total	90,390	190,000	155,480	155,480	0	0.0%
Total, CISE	$388,567	$529,100	$477,900	$470,360	-$7,540	-1.6%

(Dollars in Thousands)

PROGRAM	FY 2000 ACTUAL	FY 2001 REQUEST	FY 2001 CURRENT PLAN	FY 2002 REQUEST	CHANGE FY 2002 Req/FY01 Curr Plan AMOUNT	CHANGE FY 2002 Req/FY01 Curr Plan PERCENT
ENGINEERING						
BIOENGINEERING AND ENVIRONMENTAL SYSTEMS						
Bioengineering and Environmental Systems	$34,205	$42,050	$39,210	$38,450	-$760	-1.9%
Total	34,205	42,050	39,210	38,450	-760	-1.9%
CHEMICAL AND TRANSPORT SYSTEMS						
Chemical and Transport Systems	44,243	54,390	50,720	50,150	-570	-1.1%
Total	44,243	54,390	50,720	50,150	-570	-1.1%
CIVIL AND MECHANICAL SYSTEMS						
Civil and Mechanical Systems	48,255	56,190	53,260	52,180	-1,080	-2.0%
Total	48,255	56,190	53,260	52,180	-1,080	-2.0%
DESIGN, MANUFACTURE, AND INDUSTRIAL INNOVATION						
Design, Manufacture, and Industrial Innovation	47,292	55,660	51,360	50,870	-490	-1.0%
Small Business-Industrial Innovation	62,141	77,700	74,830	74,830	0	0.0%
Total	109,434	133,360	126,190	125,700	-490	-0.4%
ELECTRICAL AND COMMUNICATIONS SYSTEMS						
Electrical and Communications Systems	45,283	58,870	53,970	57,090	3,120	5.8%
Total	45,283	58,870	53,970	57,090	3,120	5.8%
ENGINEERING EDUCATION AND CENTERS						
Engineering Education and Centers	98,400	111,640	107,480	107,480	0	0.0%
Total	98,400	111,640	107,480	107,480	0	0.0%
Total, ENG	$379,819	$456,500	$430,840	$431,050	$210	0.0%

(Dollars in Thousands)

PROGRAM	FY 2000 ACTUAL	FY 2001 REQUEST	FY 2001 CURRENT PLAN	FY 2002 REQUEST	CHANGE FY 2002 Req/FY01 Curr Plan AMOUNT	CHANGE FY 2002 Req/FY01 Curr Plan PERCENT
GEOSCIENCES						
ATMOSPHERIC SCIENCES						
Atmospheric Sciences Research Support	$95,632	$118,260	$117,070	$115,870	-$1,200	-1.0%
National Center for Atmospheric Research	68,615	75,750	71,380	70,630	-750	-1.1%
Total	164,247	194,010	188,450	186,500	-1,950	-1.0%
EARTH SCIENCES						
Earth Sciences Project Support	65,809	78,000	78,280	79,190	910	1.2%
Instrumentation and Facilities	27,164	31,000	28,470	28,520	50	0.2%
Continental Dynamics	9,182	9,510	9,060	9,080	20	0.2%
Total	102,155	118,510	115,810	116,790	980	0.8%
OCEAN SCIENCES						
Ocean Section	81,539	102,040	97,580	96,100	-1,480	-1.5%
Integrative Programs Section	67,980	85,370	83,290	82,850	-440	-0.5%
Marine Geosciences Section	71,720	83,070	77,060	76,300	-760	-1.0%
Total	221,239	270,480	257,930	255,250	-2,680	-1.0%
Total, GEO	$487,641	$583,000	$562,190	$558,540	-$3,650	-0.6%

(Dollars in Thousands)

PROGRAM	FY 2000 ACTUAL	FY 2001 REQUEST	FY 2001 CURRENT PLAN	FY 2002 REQUEST	CHANGE FY 2002 Req/FY 01 Curr Plan AMOUNT	CHANGE FY 2002 Req/FY 01 Curr Plan PERCENT
MATHEMATICAL AND PHYSICAL SCIENCES						
ASTRONOMICAL SCIENCES						
Astronomy Research and Instrumentation	$42,961	$59,790	$53,940	$54,710	$770	1.4%
Facilities	79,568	79,910	94,700	101,550	6,850	7.2%
Total	122,529	139,700	148,640	156,260	7,620	5.1%
CHEMISTRY						
Chemistsry Research & Infrastructure	138,628	161,990	153,520	153,460	-60	0.0%
Total	138,628	161,990	153,520	153,460	-60	0.0%
MATERIALS RESEARCH						
Materials Research	163,285	185,290	179,510	170,680	-8,830	-4.9%
National Facilities	27,250	35,320	30,240	34,740	4,500	14.9%
Total	190,535	220,610	209,750	205,420	-4,330	-2.1%
MATHEMATICAL SCIENCES						
Mathematical Sciences	105,975	130,210	121,480	141,480	20,000	16.5%
Total	105,975	130,210	121,480	141,480	20,000	16.5%
PHYSICS						
Physics Research	106,616	142,770	131,650	124,720	-6,930	-5.3%
Facilities	61,687	55,880	55,880	58,850	2,970	5.3%
Total	168,303	198,650	187,530	183,570	-3,960	-2.1%
MULTIDISCIPLINARY ACTIVITIES						
Multidisciplinary Activities	29,911	30,000	29,910	23,390	-6,520	-21.8%
Total	29,911	30,000	29,910	23,390	-6,520	-21.8%
Total, MPS [1]	$755,881	$881,160	$850,840	$863,580	$12,740	1.5%

[1] The National High Magnetic Field Laboratory (NHMFL) will be funded at $20 million, an increase of $2.5 million above the FY 2001 Request, which is in accordance with the FY 2001 Budget Request (page 176). The NHMFL underwent a comprehensive review that resulted in a five year award (FY 2001-2006) that was approved by the National Science Board in October, 2000.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2000 ACTUAL	FY 2001 REQUEST	FY 2001 CURRENT PLAN	FY 2002 REQUEST	CHANGE FY 2002 Req/FY01 Curr Plan AMOUNT	CHANGE FY 2002 Req/FY01 Curr Plan PERCENT
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES						
SOCIAL AND ECONOMIC SCIENCES						
Social and Economic Sciences	$61,072	$72,060	$66,100	$65,840	-$260	-0.4%
Total	61,072	72,060	66,100	65,840	-260	-0.4%
BEHAVIORAL AND COGNITIVE SCIENCES						
Behavioral and Cognitive Sciences	46,058	59,290	56,810	56,560	-250	-0.4%
Total	46,058	59,290	56,810	56,560	-250	-0.4%
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES						
International Cooperative Scientific Activities	39,929	26,880	25,730	25,120	-610	-2.4%
Total	39,929	26,880	25,730	25,120	-610	-2.4%
SCIENCE RESOURCES STUDIES						
Science Resource Studies	15,055	16,910	15,800	15,640	-160	-1.0%
Total	15,055	16,910	15,800	15,640	-160	-1.0%
Total, SBE [1]	$162,114	$175,140	$164,440	$163,160	-$1,280	-0.8%
UNITED STATES POLAR RESEARCH PROGRAMS	$189,935	$222,810	$210,800	$213,970	$3,170	1.5%
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES	$68,400	$62,600	$62,460	$62,600	$140	0.2%
INTEGRATIVE ACTIVITIES	$129,252	$119,230	$97,750	$80,610	-$17,140	-17.5%
Subtotal, RESEARCH AND RELATED ACTIVITIES	$2,979,904	$3,540,680	$3,342,630	$3,326,980	-$15,650	-0.5%
Carryover			7,523		-7,523	-100.0%
Total, RESEARCH AND RELATED ACTIVITIES	$2,979,904	$3,540,680	$3,350,153	$3,326,980	-$23,173	-0.7%

[1] For FY2000, SBE includes a transfer of $15.4M from the U.S. International Development Cooperation Agency for an award to the U.S. Civilian Research and Development Foundation.

(Dollars in Thousands)

PROGRAM	FY 2000 ACTUAL	FY 2001 REQUEST	FY 2001 CURRENT PLAN	FY 2002 REQUEST	CHANGE FY 2002 Req/FY01 Curr Plan AMOUNT	CHANGE FY 2002 Req/FY01 Curr Plan PERCENT
EDUCATION AND HUMAN RESOURCES						
MATH & SCIENCE PARTNERSHIPS						
Math & Science Partnerships	$0	$0	$0	$200,000	$200,000	n/a
Total	0	0	0	200,000	200,000	n/a
EDUCATIONAL SYSTEM REFORM						
Educational System Reform	113,009	109,510	110,440	45,250	-65,190	-59.0%
Total	113,009	109,510	110,440	45,250	-65,190	-59.0%
OFFICE OF INNOVATION PARTNERSHIPS						
Innovation Partnership Activities	3,911	0	9,980	0	-9,980	-100.0%
Experimental Program to Stimulate Competitive Research (EPSCoR)	51,708	48,410	74,830	74,810	-20	0.0%
Total	55,619	48,410	84,810	74,810	-10,000	-11.8%
ELEMENTARY, SECONDARY AND INFORMAL EDUCATION						
Instructional and Assessment Materials Development	36,981	33,800	34,090	28,990	-5,100	-15.0%
Teacher & Student Development	101,584	111,700	112,640	80,620	-32,020	-28.4%
Informal Science Education	47,644	46,000	55,880	56,000	120	0.2%
Total	186,209	191,500	202,610	165,610	-37,000	-18.3%
UNDERGRADUATE EDUCATION						
Curriculum, Laboratory & Instructional Development	60,541	75,710	76,090	75,740	-350	-0.5%
Workforce Development	56,207	64,850	64,860	56,860	-8,000	-12.3%
Total	116,748	140,560	140,950	132,600	-8,350	-5.9%
GRADUATE EDUCATION						
Graduate Student Support	78,683	89,450	87,750	95,500	7,750	8.8%
Total	78,683	89,450	87,750	95,500	7,750	8.8%
HUMAN RESOURCE DEVELOPMENT						
Undergraduate/ Graduate Student Support	34,189	44,850	51,020	50,770	-250	-0.5%
Research & Education Infrastructure	22,523	23,010	23,200	23,200	0	0.0%
Opportunities for Women and Persons with Disabilities	20,574	14,020	16,470	16,470	0	0.0%
Total	77,287	81,880	90,690	90,440	-250	-0.3%
RESEARCH, EVALUATION AND COMMUNICATION						
Research	43,609	55,160	55,730	55,560	-170	-0.3%
Evaluation	12,420	12,540	12,640	12,640	0	0.0%
Total	56,028	67,700	68,370	68,200	-170	-0.2%
Subtotal, EHR	683,583	729,010	785,620	872,410	86,790	11.0%
H-1B Nonimmigrant Petitioner Receipts	25,058	31,000	121,000	144,000	23,000	19.0%
Carryover [1]			9,793		0	0.0%
Total, EHR [2]	$708,641	$760,010	$916,413	$1,016,410	$99,997	10.9%

[1] Carryover excludes $49.9 million of H-1B Nonimmigrant Petitioner receipts; these funds will be obligated through the EHR activity.

[2] The agency rountinely closes out awards that are past the expiration date. Several awards were terminated in FY 2000 due to incorrect award expiration dates. The expiration dates on these awards were corrected later in the year and the awards were reopened and the balances restored. The closing of the awards are reported as recoveries and the reopening of the awards are accounted for as upward adjustments to prior year obligations. This causes obligations to be technically correct but overstated by the amount of the upward adjustments. In the case of EHR, $1.8 million resulting in a net funding level of $681.74 million in FY 2000 for an increase of $103.88 million in FY 2001.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2000 ACTUAL	FY 2001 REQUEST	FY 2001 CURRENT PLAN	FY 2002 REQUEST	CHANGE FY 2002 Req/FY01 Curr Plan AMOUNT	CHANGE FY 2002 Req/FY01 Curr Plan PERCENT
MAJOR RESEARCH EQUIPMENT	$105,000	$138,540	$121,332	$96,300	-$25,032	-20.6%
Carryover [1]			70,975		-70,975	0.0%
Total, MRE	$105,000	$138,540	$192,307	$96,300	-$96,007	0.0%
SALARIES AND EXPENSES	$149,280	$157,890	$160,540	$170,040	$9,500	5.9%
OFFICE OF INSPECTOR GENERAL	$5,600	$6,280	$6,270	$6,760	$490	7.8%
Carryover			114		-114	0.0%
Total, OIG	$5,600	$6,280	$6,384	$6,760	$376	5.9%
Subtotal, NATIONAL SCIENCE FOUNDATION	$3,948,425	$4,603,400	$4,537,392	$4,616,490	$79,098	1.7%
Carryover [2]			88,405		-88,405	0.0%
TOTAL, NATIONAL SCIENCE FOUNDATION	$3,948,425	$4,603,400	$4,625,797	$4,616,490	-$9,307	-0.2%

[1] In FY 2000 $70.97 million was carried over into FY 2001 largely in support of the South Pole Station Modernization project.

[2] Carryover excludes $49.9 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.

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