OVERVIEW

National Science Foundation FY 2004 Budget Request Overview

By any measure, National Science Foundation investments in basic research and education have returned rich dividends to the nation. Recent advances at the frontiers of science and engineering have significantly increased the nation's capability to transform knowledge into economic value, meet enduring social needs, and respond to the new challenge of enhancing homeland security.

To continue these accomplishments, the National Science Foundation requests $5.48 billion for FY 2004, $453 million or 9 percent over the FY 2003 Request of $5.03 billion. These investments will sustain and build U.S. global leadership in science, engineering and technology, and assist the U.S. in addressing priorities of immediate national importance.

NSF Funding by Appropriation
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Request	Request	Amount	Percent
Research and Related Activities	3,615.97	3,783.21	4,106.36	323.15	8.5%
Education and Human Resources [1]	866.11	908.08	938.04	29.96	3.3%
Major Research Equipment & Facilities Construction	115.35	126.28	202.33	76.05	60.2%
Salaries and Expenses	169.93	202.95	225.70	22.75	11.2%
Office of Inspector General	6.70	7.70	8.77	1.07	13.9%
Total, NSF	$4,774.06	$5,028.22	$5,481.20	$452.98	9.0%

Totals may not add due to rounding.
[1] Does not include $57.31 million in FY 2002 and an estimate of $65.68 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees. Legislation for the activity expires in FY 2003.

Nothing is more important to our nation's prospects than the ability to create and make use of knowledge. We face significant national and international challenges in the areas of security, the economy, health and the environment. Exceptional opportunities for rapid progress in meeting these challenges are emerging at the leading edge of research – in such areas as information technology, nanotechnology, climate change research, and fundamental research related to homeland security.

Our ability to move rapidly across new frontiers of knowledge not only depends critically on discovery and innovation, but also on addressing the National Science Foundation's continuing challenge: building a globally competitive, diverse workforce with mathematical, scientific, engineering, and technological skills that are the best in the world.

Although U.S. workers are the most productive by any measure, demand is rapidly increasing for more sophisticated science and math skills in the workplace. A Commerce Department study concludes that in less than two decades 60 percent of the nation's jobs will require technical skills possessed by only 22 percent of today's workers. New technologies and the rapid pace of change are fundamentally altering how we learn and work.

To meet this challenge, all children must receive an education in math and science that will allow them to participate fully in society and contribute to its continuing progress. The President's Math and Science Partnership Program highlights the need for a focused effort to accomplish this task.

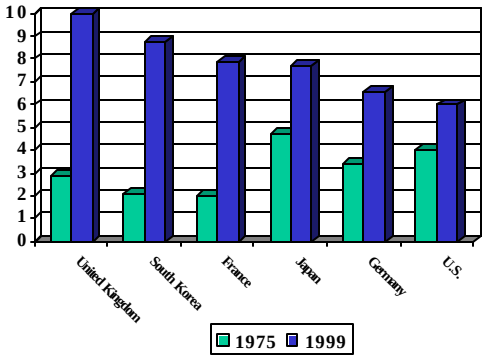
The number of students earning degrees in science and engineering has been declining in recent years in all fields except the life and social sciences. Raising graduate fellowship stipends signals that the nation values those who choose careers in science, technology, engineering and mathematics, and rewards them for it. And the response of students to these fellowship opportunities has demonstrated their value as an incentive.

The nation is facing a watershed moment as our demographics change swiftly. Women and minorities are underrepresented in the science and engineering professions. While women comprise half of the college-educated workforce, they fill only 10 percent of the country's engineering jobs. Ethnic minorities hold only 7 percent of all science and engineering jobs. Yet these two groups are the fastest growing segments of the U.S. workforce.

More must be done immediately to broaden participation. Success in capitalizing on the nation's great diversity can expand our prosperity and help to fulfill the promise of equity. We know that diversity gives strength to the fabric of our society. It will be our strongest suit for enabling the future.

The changes sweeping our economy and society are at work globally, increasing competition for knowledge, and putting a premium on highly skilled knowledge workers. Today, only 6 percent of U.S. 24-year-olds have earned degrees in the natural sciences or engineering, trailing students in other major nations, many of which have doubled and tripled their science and engineering degree output over the past decade. Nations worldwide are taking steps to lift the quality of education and keep their students at home; they are increasing investments in science and technology research and education to unprecedented levels.

Percent of 24-year-old population with Natural Science/Engineering Baccalaureate Degrees



Our nation's best prospects for maintaining our leadership rest on a similar strategy. Developing native talent and seizing current opportunities to expand the frontiers of knowledge to spur innovation will keep the U.S. at the forefront of science and technology. It will also produce the range of sophisticated options we need to solve the complex challenges facing the nation. Achieving these goals requires a level of public investment that reflects the increased importance of science and engineering to economic and social prosperity and national security.

NSF's role in the nation's research and education enterprise is critical. Although NSF accounts for less than 4 percent of federal research and development spending, it supports nearly 50 percent of non-medical basic research at our colleges and universities. The investments proposed in NSF's FY 2004 Request aim to meet these challenges and propel us to global leadership in the knowledge economy of the twenty-first century.

People, Ideas, and Tools: NSF Strategic Goals

National Science Foundation investments produce outcomes at the core of the research and education enterprise: a world-class science and engineering workforce; new knowledge across the frontiers of science and engineering; and the tools to get the job done efficiently and effectively. Expressed simply, but effectively, as *People, Ideas,* and *Tools*, these long-term strategic goals reflect the changing role and increased significance of science and engineering in the 21st Century.

NSF Budget by Strategic Goal
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Estimate	Estimate	Amount	Percent
People [1]	994.79	1,086.70	1,152.87	66.17	6.1%
Ideas	2,436.28	2,559.45	2,696.04	136.59	5.3%
Tools	1,112.41	1,121.50	1,340.93	219.43	19.6%
Administration and Management	230.58	260.57	291.36	30.79	11.8%
Total, NSF	$4,774.06	$5,028.22	$5,481.20	$452.98	9.0%

Totals may not add due to rounding.
[1] Does not include $57.31 million in FY 2002 and an estimate of $65.68 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees. Legislation for the activity expires in FY 2003.

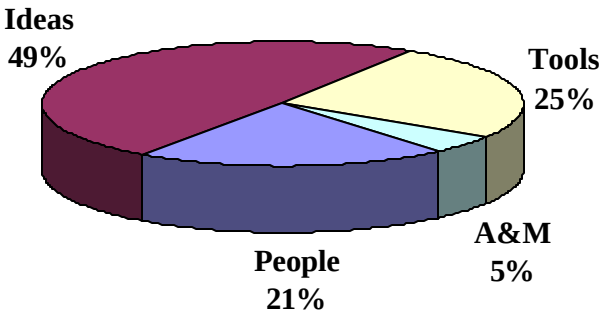
Investments in *People* are key to developing the nation's full talent and increasing the productivity of our workforce. Each year, NSF supports more than 200,000 people – teachers, students, and researchers at every educational level and across all disciplines in science and engineering. NSF's FY 2004 priorities aim to attract more students to graduate study in science and engineering, improve the quality of preK-12 math and science education, and advance research on learning to improve classroom practices and workforce preparation strategies.

Investments in *Ideas* build the intellectual capital that drives technological innovation and spurs economic growth. The nation can draw on this stock of knowledge – as it did in response to the tragic events of 9/11 – in times of changing national circumstances, or to pursue path-breaking opportunities and develop a portfolio of options for the future. State-of-the-art *Tools* and facilities boost the overall productivity of the research and education enterprise. NSF's strategy is to invest in instruments that add unique value to research and are accessible and widely shared among researchers across the nation.

To get the most leverage from its investments in *People, Ideas* and *Tools*, NSF integrates research and education activities, promotes effective collaborations and partnerships, and invests in intellectual capital for the long-term.

In FY 2004, the Request includes $1.2 billion in program investments to meet the strategic goal of People, $2.7 billion for Ideas, $1.3 billion for Tools, and $291 million for Administration and Management.

FY 2004 Budget Request of $5.48 Billion



People: Investing in the Nation's Talent

Leadership in today's knowledge economy requires world-class scientists and engineers and a national workforce that is strong scientifically, technologically and mathematically. NSF programs aim to improve the quality and reach of science, engineering, and mathematics education and enhance student achievement. Embedded in all NSF programs are efforts to build a more inclusive and globally engaged workforce that fully reflects the strength of our diverse population. Therefore, the NSF FY 2004 investment priorities target educational challenges of major national importance.

Attracting Talent to Science and Engineering Careers. Recruiting and retaining more U.S. graduate students in science and engineering remains a challenge and a high priority for NSF. In recent years, the number of engineers graduating from our universities has decreased by 20 percent. Doctorates in science and engineering have dropped by 7 percent since 1998.

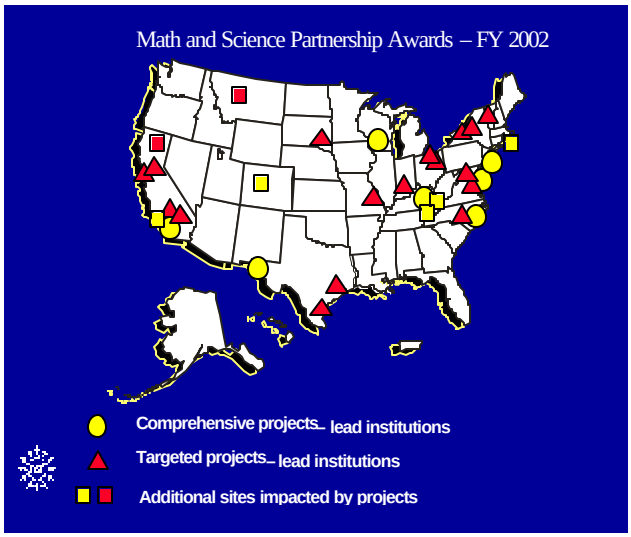
Low levels of stipends and an increasing burden of debt are among the principal factors that discourage students from continuing science and engineering studies. These financial pressures are particularly severe among minority students, who are more likely to borrow for undergraduate study. Stipend levels for the nation's outstanding graduate students must be increased in order to be competitive with opportunities in the general workforce.

NSF has steadily increased stipend support for graduate fellowship programs from $15,000 in FY 1999 to $30,000 proposed in FY 2004. This strategy has already produced results. Applications for NSF graduate fellowships increased from 6,900 in 2001 to 8,200 in 2002.

In FY 2004 NSF will continue and expand this multi-year effort to attract the most promising students into graduate level science and engineering by raising stipends for graduate fellowship programs and increasing the number of students receiving fellowships.

Math and Science Partnership. High levels of achievement in mathematics, science and engineering are increasingly necessary for success in the complex, high technology workplace of the 21st Century. Children need high-quality learning environments to develop these complex skills, beginning early and continuing throughout their education.

The FY 2004 budget proposes $200.0 million to continue and strengthen NSF's leadership role in the President's Math and Science Partnership, a centerpiece of the *No Child Left Behind* initiative. This represents the third year of a $1.0 billion, five-year investment to enhance the performance of all U.S. students in mathematics and science and improve the quality of preK-12 math and science education.



The program links states and local school districts with science, mathematics, engineering and educational faculty in colleges and universities to improve preK-12 math and science educational practices, train teachers, and create innovative ways to reach out to underserved students and schools. The Math and Science Partnership program supports the development and application of evidence-based approaches to math and science education. The goal is to improve teacher performance and professional development, and to provide a challenging and engaging curriculum for every student.

Workforce for the 21st Century. The nation's economic vitality, national security, and social well being depend fundamentally on world-class scientists and engineers and a national workforce that is scientifically, technically and mathematically strong. NSF will capitalize on its experience with investments in science and engineering education to design a program that joins elements from the most successful activities, and approaches curriculum development innovatively. Drawing elements from existing NSF programs – e.g., LSAMP, GK-12, IGERT, and CREST – collaborators at an institution will design a suite of complementary, integrated activities that reaches from preK-12 through postdoctoral levels. The goal is to develop an innovative and seamless route of advancement for students. The FY 2004 investment totals $8.5 million.

The Science, Technology, Engineering and Mathematics Talent Expansion Program (STEP). Established in FY 2002, STEP provides grants to colleges and universities to establish programs to increase the number of undergraduate math and science majors. The FY 2004 Request is $7.0 million, an increase of $5.0 million or 250 percent over the FY 2003 Request.

Noyce Scholarships. The Noyce Scholarships address the shortage of highly trained K-12 teachers by providing scholarships to talented mathematics, science and engineering students who wish to pursue teaching careers in elementary or secondary schools. FY 2004 funding for the program is $4.0 million, equal to the FY 2003 Request.

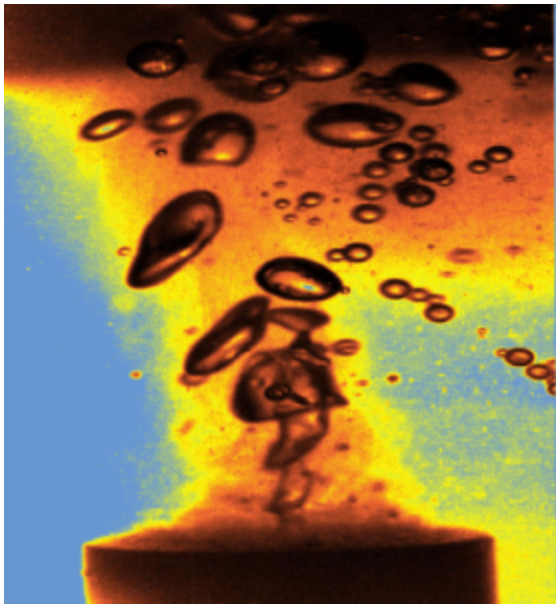
Ideas: Opening New Frontiers for Discovery, Learning and Innovation

One of NSF's hallmarks is supporting the most promising ideas in research and education. These investments produce the fundamental knowledge base that enhances progress in all of science and engineering and also fosters partnerships that connect discovery and learning to innovation and service to society.

Investments in Core Disciplines. NSF investments are aimed at the frontiers of science and engineering, where advances in fundamental knowledge drive innovation and progress. To address the nation's

economic, security, and social needs, NSF provides balanced support across the full range of science and engineering disciplines.

The FY 2004 Request places special emphasis on investments in the physical sciences. The physical sciences produce advances and associated analytical tools that bring progress to a host of areas – from medical imaging to environmental restoration to high-speed computing and communications. With renewed support for research and equipment for fields such as physics, chemistry, mathematics, and materials research, the nation will be able to take full advantage of the recent major investments in the health sciences and will also reap benefits in numerous other areas, such as energy, agriculture, and the environment. Support for NSF's mathematical and physical sciences activity increases by 12.7 percent in the FY 2004 Request to a level of $1,061 million, a $120 million increase over the FY 2003 Request of $942 million.



Sonoluminescence – the transformation of sound energy into light – has been observed for decades. Now, Chemists supported by the NSF have for the first time measured the chemical reactions and light emission from a single bubble excited by sound waves, an advance with potential industrial and medical applications.

NSF relies on a competitive, merit-based process to identify the most promising research directions in established fields, and increasingly, to open new frontiers across a broad front of disciplines through multidisciplinary investigations. The continuing vitality of core disciplines is the lifeblood of the research and education enterprise.

It is particularly important in today's research climate, where advances in one field can rapidly lead to new insights in others. The accelerating pace of discovery, combined with new information and communication tools, has produced unprecedented opportunities for these synergies. Information research and technology, for example, have enabled rapid progress in virtually every discipline from molecular biology to astronomy, and from particle physics to the social and behavioral sciences.

NSF's long-term goal is to increase the size and duration of research grants to ensure high productivity among researchers and improve opportunities for training students. This investment strategy is consistent with the findings of a recent survey of NSF-supported principal investigators and institutions. The FY 2004 Request continues to work toward the goal of increasing the average size and duration of awards to $250,000 per year for 5 years.

Priority Areas

NSF Funding by Priority Area
(Dollars in Millions)

Priority Area	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biocomplexity in the Environment	58.96	79.20	99.83	20.63	26.0%
Information Technology Research	277.22	285.83	302.61	16.78	5.9%
Nanoscale Science and Engineering	204.48	221.25	248.99	27.74	12.5%
Mathematical Sciences	30.00	60.09	89.09	29.00	48.3%
Human and Social Dynamics	N/A	10.00	24.25	14.25	142.5%
Workforce for the 21st Century	N/A	N/A	8.50	8.50	N/A
Total, Priority Areas	$570.66	$656.37	$773.27	$116.90	17.8%

In addition to a balanced portfolio of investments in core disciplines, NSF identifies and supports emerging opportunities that hold exceptional promise to advance knowledge in areas of critical importance for addressing national interests. Investments in these priority areas move novel research rapidly forward, and provide a cadre of scientists and engineers with new skills and new perspectives to exploit new knowledge for transfer of the results to industry.

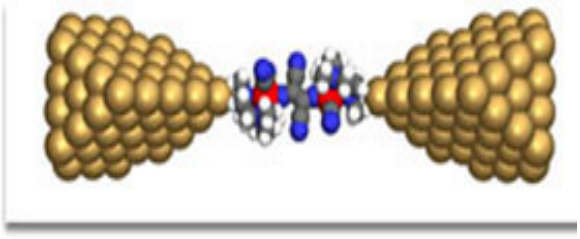
In close collaboration with the science and engineering community, NSF has identified six priority areas in which to make a sustained level of investment. In FY 2004, NSF will build on our previous pilot effort in the social, behavioral and economic sciences to initiate a *Human and Social Dynamics* priority area. In addition, NSF will continue to fund four established priority areas: Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, and Mathematical Sciences. The new Workforce for the 21st Century priority area was discussed above in the People section.

Biocomplexity in the Environment ($99.83 million). Biocomplexity describes the dynamic web of interrelationships that arise when living things at all levels – from molecular structures to genes to organisms to ecosystems to urban centers – interact with the environment. Investigations in this priority area will improve environmental forecasting capabilities, enhance decision-making tools, and integrate human, social and ecological factors into investigations of the physical environment and environmental engineering. The FY 2004 program will support a wide range of education and research activities, including sequencing the genomes of microorganisms of importance to agriculture, food, forestry, and water quality, or as potential bioterrorism threats.

Information Technology Research ($302.61 million). Today, information technology is woven into every aspect of the economy and society. It has opened new frontiers for exploration in every field of research, in engineering design and manufacturing, and in education. The Information Technology Research priority area will deepen fundamental research on large-scale networks, and the creation of new integrative software and advanced architectures for high-end computing. To address critical economic and homeland security issues, NSF will support research to address the pressing need for safe, secure, and dependable information infrastructures for national security and consumer protection, and the education of a new class of information security and assurance professionals.

Nanoscale Science and Engineering ($248.99 million). Nanoscale science and engineering encompasses the systematic organization, manipulation and control of matter at atomic, molecular and supramolecular levels. Novel materials, devices and systems – with their building blocks on the scale of nanometers – expand possibilities in science, engineering and technology. In FY 2004,

investments will be expanded to develop and strengthen promising fields, (including nanobiotechnology, manufacturing at the nanoscale, and education) to establish the science and engineering infrastructure and workforce needed to exploit the opportunities of these new capabilities. NSF activities are part of the larger National Nanotechnology Initiative, a crosscutting program involving close collaboration and coordination among federal research agencies.



One of the most promising areas of nanoscale research is the development of single molecule transistors. This transistor consists of an individual molecule bridging two gold electrodes.

Mathematical Sciences ($89.09 million). The mathematical sciences provide powerful tools for insight and a common language for science and engineering. FY 2004 investments in Mathematical Sciences will deepen support for fundamental research in the mathematical sciences and statistics, and the integration of mathematical and statistical research and education across the full range of science and engineering disciplines. Additional work will focus on the challenge of handling large data sets such as those generated by today's sophisticated sensors and observation systems, and on improving methods for assessing uncertainty and forecasting singular events, research that may improve the reliability of power grids, air traffic control, and the Internet. To strengthen mathematical skills, NSF will support innovative educational activities that foster closer connections between research and education in the mathematical sciences.

Human and Social Dynamics ($24.25 million). Building on previous support for enhanced programs in the social, behavioral and economic sciences, NSF will develop a priority area focused on Human and Social Dynamics. Uncertainty and rapid change are inescapable features of life in the 21st Century. This priority area draws on recent convergence of research in biology, engineering, information technology, and cognitive science to investigate the causes and ramifications of change and its complex consequences – cultural, economic, individual, political and social. Funding in FY 2004 will support a wide range of activities, including creating large-scale data resources and advancing methodological frontiers to enable research. Studies will advance our understanding of decision-making, risk and uncertainty, and explore how to translate this knowledge into improved decision-making. Other investigations will explore agents of change, such as globalization and democratization, the evolution of society and its interaction with climate, geography and environment, and the implications of cultural and spatial variation for conflict and assimilation.

Fundamental Research to Enhance Homeland Security. The FY 2004 Request includes investments in fundamental research that will help address new homeland security challenges facing the nation. The Ecology of Infectious Diseases program, jointly sponsored by NSF and the National Institutes of Health, and NSF's Microbial Genome Sequencing program will contribute to a better understanding of potential bioterrorism threats and how to combat them. The Scholarship for Service program, which trains students in information security and assurance in exchange for service in federal government agencies, will increase the nation's capacity to protect vital information infrastructure. Investments in Critical Infrastructure Protection address the need to identify vulnerabilities and strengthen protection for the nation's critical infrastructure – for example, power grids, transportation networks, and water supply systems. National Security-Related Information Technology research supports a portfolio of promising

research with potential homeland security applications. The budget request also includes funds to upgrade security at the U.S. Antarctic Program facilities.

Climate Change Research Initiative (CCRI). As part of the Administration's multi-agency Climate Change Research Initiative, NSF will support research to reduce uncertainty in critical areas of climate change knowledge and provide timely information to facilitate policy decisions. NSF will establish three to five interdisciplinary centers to improve understanding of risk management, risk communication, and decision making in relation to climate change. The FY 2004 investment in these centers is $4.5 million. Additional research will advance understanding of abrupt and rapid climate change. Interdisciplinary studies of ocean circulation, combined with studies of paleoclimate records, will document the frequency, temporal resolution, and spatial extent of past rapid climate change. These investigations will complement NSF's ongoing programs in climate change science. The total FY 2004 investment for CCRI increases by $10.0 million to a total of $25.0 million.

Science of Learning Centers. Recent advances in cognitive and behavioral sciences, linguistics, neuroscience, engineering, computer science, psychology, and mathematics have converged to create important research opportunities in the science of learning. The FY 2004 budget provides $20.0 million, equal to the FY 2003 Request, to fund 3-5 new multi-disciplinary, multi-institutional Science of Learning Centers to enhance understanding of how people learn, how the brain stores information, and how to best use new information technology to promote learning.

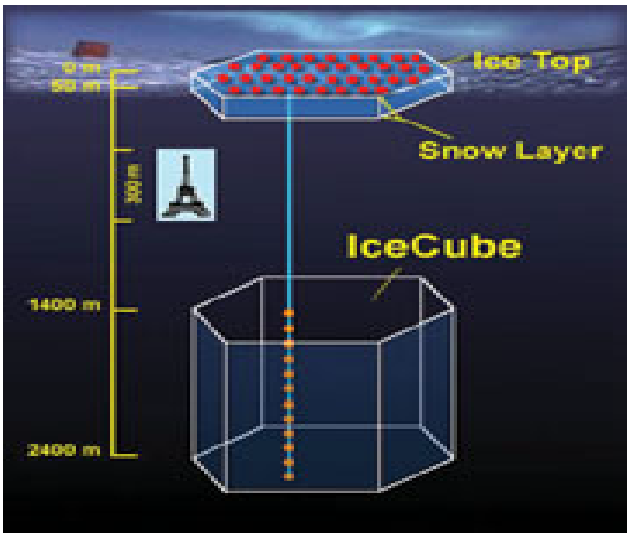
Tools: Getting the Job Done

Funding for U.S. academic research infrastructure has not kept pace with rapidly changing technology, expanding research opportunities, and increasing numbers of users, as has been recognized by the ongoing National Science Board task force on *Science and Engineering Infrastructure for the 21st Century*. To address this challenge, the NSF FY 2004 Request includes increases for a wide range of infrastructure investments.

CyberInfrastructure. NSF's proposed investment of $20.0 million for Cyberinfrastructure will bring next-generation computer and networking capabilities to researchers and educators nationwide. Building on past NSF investments in high-performance computing and networks, Cyberinfrastructure will integrate high-performance computers and high-bandwidth networks with sensors, large data repositories, and new computational, analytical and visualization tools.

Major Research Equipment and Facilities Construction. The Major Research Equipment and Facilities Construction (MREFC) Account totals $202.3 million, an increase of $76.1 million, and will fund seven continuing projects in FY 2004:

- Atacama Large Millimeter Array (ALMA) Construction ($50.84 million)
- EarthScope ($45.0 million)
- High-performance, Instrumented, Airborne Platform for Environmental Research (HIAPER) ($25.53 million)
- IceCube ($60.0 million)
- National Ecological Observatory Network (NEON) ($12.0 million)
- Network for Earthquake Engineering Simulation ($8.0 million)
- South Pole Station Modernization ($960,000)



The FY 2004 Request provides $60 million in funding for the IceCube project.

Major Research Instrumentation. NSF investments in Major Research Instrumentation support a wide variety of mid-sized state-of-the-art research equipment, and reach a broad range of institutions, including non-Ph.D-granting colleges and universities, and community colleges. Such investments play a critical role in training students and developing a skilled workforce. The FY 2004 Request for MRI totals $90.0 million, a $36.0 million increase (67 percent) over the FY 2003 Request of $54.0 million, with special emphasis on support for minority-serving institutions.

Other Small and Mid-Sized Infrastructure. The budget request also includes an increase of $22.5 million for Research Resources, funded through NSF's Directorates and programs. Total funding provided is $128.9 million.

Other FY 2004 Highlights

Broadening Participation. The FY 2004 Request places special emphasis on investments aimed at broadening participation in science and engineering.

- NSF's **Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)** increases by 43 percent, from just under $14 million in the FY 2003 Request to nearly $20 million in the FY 2004 Request, an increase of $6 million.

- The **Louis Stokes Alliances for Minority Participation Program (LSAMP)**, which has helped to generate a significant increase in the number of minority students earning baccalaureate degrees in science and engineering, receives a 23 percent increase in funding. The FY 2004 Request rises to $32.7 million from the FY 2003 Request of $26.5 million, an increase of $6.2 million.

- The **ADVANCE** program, another key component of NSF's multifaceted strategy to realize a diverse scientific and engineering workforce, also sees a 23 percent increase, rising to $21.2 million in the FY 2004 Request from the FY 2003 Request of $17.1 million, an increase of $4.0 million.

- The **Partnerships for Innovation** program doubles in funding, receiving $10.0 million in the FY 2004 Request, an increase of $5.0 million over FY 2003. The program aims to stimulate the

transformation of knowledge created by the national research and education enterprise into innovations that create new wealth, build strong local, regional and national economies and improve the national well-being.

- The **Experimental Program to Stimulate Competitive Research (EPSCoR)** builds the capacity of educational institutions to participate more fully in NSF research activities. Funding in FY 2004 totals about $105.0 million, including $75.0 million provided through the Education and Human Resources Appropriation, and approximately $30.0 million provided through cofunding from the Research and Related Activities Account.

Plant Genome Research Program. The FY 2004 budget provides $75.0 million to support ongoing research on the genomics of plants of major economic importance. Multi-investigator teams will investigate the functional genomics of plants, conduct large-scale genome sequencing and develop tools for plant genomics studies. Funding is provided for a program of Young Investigator Awards in Plant Genome Research proposed in FY 2003.

Administration and Management. The FY 2004 Request includes a $291.4 million investment in administration and management, an increase of $30.8 million (12 percent) over the FY 2003 Request of $260.6 million. Excellence in the management of NSF's portfolio is essential to the achievement of the agency's mission and goals. NSF's investments in administration and management respond both to the growing complexity of its work and to new requirements for accountability and transparency in its processes. In FY 2004, NSF will continue its leadership in eGovernment and financial management, and pursue further improvements in large facility management and human resource management. NSF will also continue to support new requirements for both IT and physical security.

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Page 2: National Science Board, *Science and Engineering Indicators – 2002*. Arlington, VA: National Science Foundation, 2002 (NSB-02-1), Figure 2-27.
Page 5: National Science Foundation, Directorate for Education and Human Resources.
Page 6: K. S. Suslick and K. J. Kolbeck, University of Illinois
Page 8: Hongkun Park, Harvard University/Jeffrey Long, University of California, Berkeley
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