NATIONAL SCIENCE FOUNDATION

The President's Proposal:

- Provides a significant budget increase to further sustain and build U.S. world leadership in science, engineering, and technology;
- Invests in leading-edge discovery in science and engineering to provide breakthroughs in information technology, nanotechnology, climate change research, and fundamental research related to homeland security;
- Significantly strengthens National Science Foundation programs that emphasize the physical sciences, such as physics, chemistry, and astrophysics;
- Provides enhanced infrastructure to strengthen research capabilities in astronomy, physics, earthquake research, and the environment;
- Improves the quality of math and science education through the President's Math and Science Partnership program; and
- Attracts more of the most promising U.S. students into graduate level science and engineering by providing larger annual stipends.

The Agency's Major Challenges:

- Managing and overseeing adequately a growing portfolio of awards; and
- Ensuring the health and safety of participants in the U.S. Antarctic Program.

National Science Foundation

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Number of Employees: 1,300

2003 Spending: $4.9 billion

Major Assets: U.S. Antarctic Program facilities and five federally funded research and development centers.

The National Science Foundation (NSF) invests in basic research that forms the backbone of many science and engineering disciplines and capabilities in the United States. The agency provides merit-based awards to individual researchers and groups at about 2,000 U.S. colleges, universities, and other institutions. Although NSF represents less than four percent of the total federal budget for research and development, it accounts for approximately 13 percent of all federal support for basic research and 40 percent of non-life-science basic research at U.S. academic institutions. NSF's broad support for basic research, particularly at U.S. academic institutions, provides not only a central source for discovery in many fields, but also encourages and supports development of the next generation of scientists and engineers.

NSF evaluates proposals based on the merit of the proposed activity, including its prospective impact on society. NSF ensures quality in its programs by using competitive merit review of grant proposals, coupled with periodic external review of the research and education programs that fund those grants.

An Agency in the Fast Lane

In fulfilling its mission, NSF has used its funding efficiently and effectively. Of the federal funds it receives, 95 percent go to educational and research institutions and contractors; NSF's direct overhead amounts to only five percent. Funding for the agency has grown significantly in the past decade, while the agency's staffing level has remained flat. The agency has accommodated the increase in funding and responsibilities through effective use of information technology. For instance, its FastLane grants processing system electronically processes almost 100 percent of the 30,000 proposals NSF receives annually. Nearly 200,000 scientists, engineers, and researchers use this system to submit proposals, review proposals, and report project results. Thanks to the FastLane system, NSF reduced its proposal handling costs significantly, despite having a 19-percent increase in applications for graduate fellowships and a 10-percent increase in proposals processed. As an indication of the dramatic effect the system has had on reducing paper-based transactions, in 2002 alone, NSF slashed its paper and supply costs by 26 percent and its postage costs by 44 percent. The agency achieved $500,000 in savings, not including administrative savings from staffing efficiencies.

NSF is also the only agency to receive the highest rating (green) for status in two of the government-wide President's Management Agenda initiatives. In the initial assessment period, NSF was the lone agency to receive the top rating for financial management. During 2002, NSF became the first federal agency to receive the top rating for the E-Government initiative. In addition, assessments using the Program Assessment Rating Tool (PART) reinforce the favorable conclusions of many external evaluations of these and other programs at NSF.

The isolated South Pole Station, currently under construction in Antarctica.

Nevertheless, there are major hurdles on the horizon. Members of the Congress and the NSF Inspector General have questioned whether the agency will be able to adequately manage its growing portfolio, particularly in providing adequate oversight of its awards. The agency also is vulnerable to a wave of retirements. Sixty-three percent of NSF's executives and 57 percent of its scientists and engineers are eligible to retire within the next four years. Another concern stems from NSF's responsibility for overseeing the U.S. Antarctic Program, which includes the ongoing $133 million modernization of South Pole Station. Through contracts and agreements, the agency coordinates the provision of the planes, ships, buildings, and logistics to enable the research and education efforts of more than 2,000 scientists and support staff in Antarctica. NSF's Inspector General has identified the agency's safety and health program as a high-risk area because of the hazardous environmental conditions, isolation, and the difficulties of delivering medical services in Antarctica. The South Pole and other NSF Antarctic facilities are completely inaccessible to aircraft during the winter months. Good infrastructure is crucial for the health and safety of Antarctic participants, requiring improved planning and budgeting. In particular, the maintenance and upgrades of aging buildings and facilities in Antarctica will continue to be a management challenge.

Underwriting Cutting-Edge Discovery in Science and Engineering

The majority of NSF grant recipients' work is basic research. Basic research has yielded important scientific discoveries that have boosted economic growth and enhanced the quality of life through advances such as better weather forecasting, laser technology, and earlier detection of cancer. Basic research in emerging fields such as nanotechnology will provide new capabilities and generate more discoveries that will further improve the quality of life.

Although private industry has expanded its support for basic research over the past several years, most of its research focuses on short-term efforts that can bring new products to market. Federal investments in basic research lay a long-term foundation for breakthrough applications in areas not usually supported by private industry.

What's in the Fridge?

NSF-supported researchers have found Antifreeze Proteins (AFPs) in fish, insects, spiders, plants, and microorganisms. Because AFPs lower the freezing point of water inside these organisms, they are able to survive low temperatures without damage. The most active AFPs are in insects: researchers investigating freeze resistance and tolerance in beetles and other insects in Alaska have uncovered the property in 13 insects and two spiders. The study of AFPs may yield information that will advance preservation of food and of biomedical materials, making it possible to avoid the potentially damaging effects caused by the formation of ice crystals during freezing.

The Administration's overall aim is to reinforce NSF investment in areas that will link discovery to innovation and learning, to maximize the likely benefit to society. For example, nanotechnology, which involves the building of small and large structures atom by atom, holds promise for the development of technologies that could range from higher-performance materials to advanced, microscopic biomedical instruments.

The President's Budget emphasizes research in several highly promising, multidisciplinary areas that address key science and engineering needs and opportunities. Besides nanotechnology, the 2004 Budget provides significant NSF funding for fundamental research related to homeland security, information technology, and climate change. The requested investment will move research forward rapidly, while training the scientists and engineers who will spur innovation and transform these fields.

The President's Budget invests aggressively in the physical sciences. Modern health science uses sophisticated approaches that are increasingly reliant on the physical sciences and associated analytical tools. For instance, the development of magnetic resonance imaging (MRI), among the 20th Century's greatest advances in diagnostic technology, depended heavily on advanced concepts from physics. Only with renewed support of research and equipment for fields such as physics, chemistry, and materials science will the nation be able to take full advantage of recent major investments in the health sciences. Similarly, physical science investments will spur progress in other areas, such as energy, agriculture, and the environment.

The budget provides a 13-percent increase (or a $100 million boost) for NSF programs that emphasize the physical sciences, such as awards for individual researchers and for centers in physics, chemistry, and astrophysics research. This represents a 36-percent increase ($227 million) over investments of five years ago.

Sharpening Tools for Science and Engineering

NSF invests in widely accessible science and engineering tools, including instruments, equipment, facilities, databases, and large surveys. The agency does not directly operate the large facilities that

it supports, except those of the U.S. Antarctic Program. NSF primarily makes awards to universities and non-profit organizations to construct, manage, and operate large facility projects. Approximately 25 percent of NSF's funding is directed toward research equipment and the construction, upgrade, and operation of research facilities.

The PART analysis indicates the overall purpose of NSF's investment in research infrastructure (Tools) is clear and that the program is meeting most of its annual goals. However, NSF's process for prioritizing investments in large facilities is not readily apparent, allowing little insight into program priorities. The Administration will improve the transparency of the selection process for large facility projects. For the first time, NSF will provide the Congress a rank ordering of all approved large facility construction projects and a discussion of how these projects were selected, approved, and prioritized.

The President's Budget enhances science infrastructure capabilities in astronomy, earthquake research, and the environment. The budget continues construction of the international Atacama Large Millimeter Array telescope in Chile and the EarthScope projects across the United States. The Atacama Large Millimeter Array will be the world's most sensitive, highest resolution, millimeter-wavelength telescope. It will serve as a testing platform for theories of star birth and stellar evolution, galaxy formation and evolution, and the evolution of the universe itself. EarthScope will provide several research instruments, some portable, to investigate the structure and evolution of the North American continent and the physical processes controlling earthquakes and volcanic eruptions. These instruments will provide significant data to assess and mitigate national risks associated with earthquakes, volcanic eruptions, and landslides. The budget also initiates construction of IceCube, a South Pole facility to detect neutrinos. Neutrinos are one of the fundamental particles that make up the universe and are also one of the least understood.

Improving the Quality of Math and Science Education

Concerns persist over the state of mathematics and science education in the United States. The 1999 update of the Third International Math and Science Study compared American students with students in other countries in math and science. It found that U.S. fourth graders did relatively well in both subjects, but by the time they reached their senior year in high school, U.S. students ranked very low compared to students in other countries. In 2000, the National Assessment of Educational Progress showed no improvement since 1996 in U.S. student performance in science and limited improvement in math.

Math and science achievement directly depends on programs run through state and local educational systems. NSF supports and studies new models for teaching math and science that, if effective, can be adopted by state and local districts.

Math and Science Partnership Awards

In September 2002, NSF and the Department of Education announced the first awards under the new Math and Science Partnership program. NSF and Education made 24 awards worth an anticipated $240 million over five years, which will affect at least two million students in 11 states. A key part of President Bush's No Child Left Behind education plan, these new awards aim to enhance the performance of U.S. students in mathematics and science.

The 2004 Budget proposes to improve the quality of math and science in grades K–12 through the President's Math and Science Partnership program. The program builds on NSF's record of supporting models that enhance math and science curricula. For example, over the first six years of the NSF-funded Chicago Urban Systemic Initiative, the percentage of fourth grade students meeting Illinois state standards in science increased from 46 to 66. The Math and Science Partnership program provides funds for

states and local school districts to join with institutions of higher learning to improve students' skills in math and science.

Attracting U.S. Students into Science and Engineering

Fewer U.S. students are choosing to go into graduate science and engineering programs. Since 1993, enrollment of U.S. students in these programs has dropped nine percent. During the same period, enrollment of foreign students with temporary visas increased three percent. The President's Budget proposes to attract the most promising U.S. students into graduate-level science and engineering programs by providing more competitive stipends.

The 2004 Budget continues a multi-year effort to increase the annual stipends for NSF's fellowship and trainee programs, this year from $25,000 to $30,000. This new level marks a big leap from 2001, when annual stipends were $18,000. Reducing the financial pressures students face significantly affects their choice of science or engineering as a career – thanks in part to the increase in stipends in 2002, there was a dramatic increase in applications for NSF fellowships and traineeships, up from 6,900 in 2001 to 8,200 in 2002. The Administration intends to examine more thoroughly how effective the stipend increases have been in attracting and retaining U.S. graduate students in science and engineering.

Performance Evaluation of Select Programs

For the 2004 Budget, the Administration reviewed two NSF programs using the PART: one for research infrastructure Tools and one for NSF's Geosciences Directorate. Identifying these two areas as "programs" was not useful for budget decisions – the Tools area comprises too many individual programs, and budget decisions do not tend to align with the Directorate structure. The Administration will consider different NSF program assessment categories for the 2005 Budget. The following table summarizes these two assessments. For further details on these assessments, see the NSF section in the *Performance and Management Assessments* volume.

Program	Rating	Explanation	Recommendation
Tools	Effective	The assessment indicates that the overall purpose of the program is clear and it is meeting the majority of its annual goals. However, the process for ranking investments in large facilities allows little insight into program priorities.	With this budget, NSF will rank all large facility construction projects and discuss how these projects were selected and prioritized.
Geosciences Directorate	Moderately Effective	The assessment indicates that the overall purpose of the program is clear, but NSF's annual goals, applied to Geosciences for this assessment, are too broad to be useful in tracking how the program will improve scientific understanding and its application.	The Administration will develop better annual goals for NSF programs as part of the agency's revision of its strategic plan by this spring and the development of the 2005 Budget.

Update on the President's Management Agenda

	Human Capital	Competitive Sourcing	Financial Performance	E-Government	Budget and Performance Integration
Status					
Progress					

Arrow indicates change in status since baseline evaluation on September 30, 2001.

NSF achieved a green status rating in E-Government that joins its green status for financial performance. NSF did so by making significant progress in fixing identified information security problems. NSF also has made significant progress in the Human Capital initiative, including establishing the NSF Academy for ongoing staff training and issuing revised senior executive performance management objectives to better align with the agency's strategic plan. Progress in the Competitive Sourcing and Budget and Performance Integration initiatives, however, trails. Progress in Competitive Sourcing was downgraded because the agency has still not committed to competing any of its commercial positions, and has not developed a competitive sourcing plan. For Budget and Performance Integration, NSF has just finished a plan for getting to green in this initiative, but it first needs to revise its strategic plan to develop better annual goals and measures before its progress rating improves.

National Science Foundation

(In millions of dollars)

	2002 Actual	Estimate	
		2003	2004
Spending			
Discretionary Budget Authority:			
Research and Related Activities	3,613	3,783	4,106
Education and Human Resources	894	908	938
Major Research Equipment and Facility Construction	139	126	202
Salaries and Expenses	170	203	226
Inspector General	7	8	9
Total, Discretionary budget authority	4,823	5,028	5,481
Mandatory Outlays:			
H-1B Fee Programs	26	101	78
All other programs	31	41	27
Total, Mandatory outlays	57	142	105