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U.S. National Science Foundation: An Overview

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Summary

The National Science Foundation (NSF) was created by the National Science Foundation Act of 1950, as amended (P.L. 81-507). The NSF has the broad mission of supporting science and engineering in general and funding basic research across many disciplines. The agency provides support for investigator-initiated, merit-reviewed, competitively selected awards, state-of-the-art tools, and instrumentation and facilities. The majority of the research supported by the NSF is conducted at U.S. colleges and universities. Approximately 82% ($2,790.2 million) of NSF's FY2003 $3,403.6 million research and development (R&D) budget was awarded to U.S. colleges and universities.[1] Preliminary data reveal that for FY2003, the NSF provided approximately 53.4% of all federally funded **basic** research conducted at the nation's colleges and universities, with the exclusion of biomedical research sponsored by the National Institutes of Health. In addition, NSF provides almost 30% of the total federal support for science and mathematics education. This report will be updated periodically.

Background. The NSF's primary responsibility is to maintain the health and vitality of the U.S. academic science and engineering enterprise. In addition to ensuring the nation's supply of scientific and engineering personnel, the NSF promotes academic basic research and science and engineering education across many disciplines.[2] Other federal agencies, in contrast, support mission-specific research (i.e., health, agriculture, defense).

The NSF provides support for investigator-initiated, merit-reviewed, competitively selected awards, state-of-the-art tools, instrumentation and facilities. The agency receives approximately 40,000 proposals annually, for research, graduate and postdoctoral

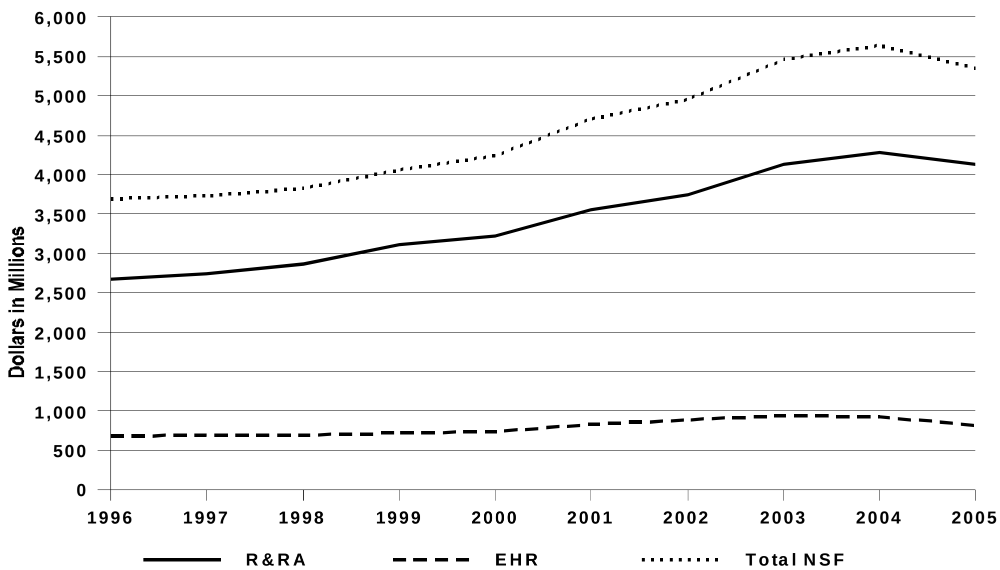
[1] National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 2001, 2002,and 2003*, Detailed Statistical Tables, NSF04-310, Arlington, VA, March 2004, Table C-10.

[2] The NSF does not provide funding for research in clinical medicine, commerce, social work, or the arts and humanities.

fellowships, and science, mathematics, and engineering projects, and makes about 11,000 new funding awards. Support is provided to academic institutions, industrial laboratories, private research firms, and major research facilities and centers. While NSF does not operate any laboratories, it does support Antarctic research stations, selected oceanographic vessels, and national research centers. Additionally, NSF supports university-industry relationships and U.S. participation in international scientific ventures.

Most of the research supported by the NSF is conducted at U.S. colleges and universities. Approximately 82% ($2,790.2 million) of NSF's estimated FY2003 $3,403.6 million research and development (R&D) budget was awarded to U.S. colleges and universities. Preliminary data reveal that in FY2003, NSF provided approximately 53.4% of all federally funded **basic** research conducted at the nation's colleges and universities, with the exclusion of biomedical research sponsored by the National Institutes of Health.[3]

NSF R&D Support in FY2004 Constant Dollars, FY1996 -FY2005



Source: National Science Foundation FY2006 Budget Request to Congress, p. 29.

The NSF is an independent agency in the executive branch and under the leadership of a presidentially appointed Director and a National Science Board (NSB) composed of 24 scientists, engineers, and university and industry officials involved in research and education. The NSB and the Director make policy for the NSF.

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[3] While the FY2003 R&D appropriation of $3,403.6 million for NSF was only 3.5% of the total federal R&D budget, the agency plays a significant role in maintaining the academic research enterprise. NSF provided 12.3% of all federally supported basic research and 12.1% of federal academic research. In addition, NSF was the second largest federal supporter of academic research in FY2003, eclipsed by the Department of Health and Human Services, which provided 64.6%. The Department of Defense, the third largest supporter of academic research, provided 5.8%. *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003,* Tables C-10, and C-29.

Organization and Fiscal Year 2006 Request. The NSF has witnessed considerable growth during a period of constrained research budgets. When measured in current dollars, its total appropriation increased more than 70.7% in 10 years — FY1996, $3,206.3 million; FY2000, $3,923.4 million; and FY2005, $5,472.8 million. Even when inflation is taken into account, its growth increased (in constant FY2004 dollars) by 45.2% during this 10-year period. The FY2006 request for NSF is $5,605 million, a 2.4% ($132.2 million) increase over the FY2005 estimate of $5,472.8 million. The FY2006 request provides support for several interdependent priority areas: biocomplexity in the environment ($84 million), human and social dynamics ($39 million), mathematical sciences ($89 million), and nanoscale science and engineering ($243 million). Other priority areas include those of strengthening core disciplinary research, broadening participation in the science and engineering workforce, and sustaining organizational excellence in management practices. Support for cyberinfrastructure is proposed at $509 million and will allow for funding of modeling, simulation, data storage, and other communications advances. The NSF contends that this level of funding should make cyberinfrastructure more powerful and accessible to researchers and educators through widely shared research facilities. Increasing grant size and duration has been a long-term priority for NSF. The funding rate for research grants has declined from approximately 30% in the late 1990s to an estimated 20% in FY2005. In the FY2006 request, NSF will increase the rate to 21%, while maintaining current gains in award size and duration. (Grants funded by NSF are for approximately $137,000 for a three year period). NSF recognizes that international research partnerships are critical to the nation in maintaining a competitive edge, addressing global issues, and capitalizing on global economic opportunities. To address these particular needs, the FY2006 request proposes $35 million for the Office of International Science and Engineering. Additional FY2006 highlights include funding for the National Nanotechnology Initiative ($343.8 million), investments in Climate Change Science Program ($196.9 million), and continued support for homeland security ($344 million).

The FY2006 request supports seven major directorates and other programs and activity accounts. The directorates are the Biological Sciences; Computer and Information Science and Engineering; Education and Human Resources; Engineering; Geosciences; Mathematical and Physical Sciences; and Social, Behavioral, and Economic Sciences. Six of the seven directorates are in the Research and Related Activities Account (R&RA). In addition to the directorates, the R&RA includes the U.S. Polar Research Programs ($319.4 million), the U.S. Antarctic Logistical Support Activities ($67.5 million), and Integrative Activities ($134.9 million). The seven major directorates are described below.

Biological Sciences (BIO). The FY2006 request of $581.8 million for the BIO Directorate supports programs structured to improve scientific understanding of biological phenomena, ranging from the study of fundamental molecules of living organisms to the complexity of biological systems. Types of support provided include research workshops, symposia, conferences, the improvement of research collections, purchase of scientific equipment, and operation of research facilities.

Computer and Information Science and Engineering (CISE). The CISE Directorate, proposed at $620.6 million in FY2006, supports programs focused on the fundamental understanding of computing and information processing, and the use of state-of-the-art computational techniques in scientific and engineering research. Currently, areas of research emphasized are parallel processing, automation and robotics, large-scale integrated electronic systems, scientific computing, and networking.

Education and Human Resources (EHR). The FY2006 request of $737 million for EHR supports science, engineering, mathematics, and technology education. People receiving support from the EHR include senior researchers, postdoctoral associates, graduate and undergraduate students, and teachers and students at the precollege level. Additional support is provided to individuals through informal science activities. More than 150,000 people are involved in the various activities and programs of the EHR.

Engineering (ENG). The ENG, with a request of $580.7 million in FY2006, is directed at enhancing the long-term economic strength and security of the Nation by fostering innovation and excellence in engineering education and research. It focuses on integrating education and research in interdisciplinary areas such as information and communication technologies, biotechnology, and environmental research.

Geosciences (GEO). The FY2006 request of $709.1 million for the GEO Directorate provides support to programs that promote knowledge and discussions concerning earth, including the sun, atmosphere, continents, oceans, and interior, and the linkages among them. One of the objectives of the GEO is to expand the knowledge of the biological, chemical, geological, and physical processes in the ocean, and at its boundaries, with the atmosphere and the earth's crust.

Mathematical and Physical Sciences (MPS). The FY2006 request of $1,086.2 million for the MPS would fund programs designed to increase the knowledge base in the relevant sciences; improve the quality of educational programs, with emphasis at the undergraduate level; improve the rate at which research efforts are translated into societal benefits; and increase the diversity of approaches and individuals in the mathematical and physical sciences.

Social, Behavioral, and Economic Sciences (SBE.) The SBE Directorate, proposed at $198.8 million in FY2006, supports programs directed at developing basic scientific knowledge about human behavior, culture, interaction, and decisionmaking, and about social, political, and economic systems, organizations, and institutions. The SBE also serves as the nation's primary data source on science and engineering human, institutional, and financial resources.

Other Program Activities and Accounts.

The Major Research Equipment and Facilities Construction (MREFC) account is funded at $250 million in FY2006, a 43.9% increase ($76.3 million) over the FY2005 level. The MREFC supports the acquisition and construction of major research facilities and equipment that extend the boundaries of science, engineering, and technology.[4] Of all federal agencies, NSF is the primary supporter of "forefront instrumentation and facilities for the academic research and education communities." In the MREFC, first priority for funding is directed at ongoing projects. Second priority is given to projects

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[4] For expanded discussion see CRS Report RS21267, *National Science Foundation: Major Research Equipment and Facility Construction*, by Christine M. Matthews.

that have been approved by the NSB for "new starts." Those projects receiving support in the FY2006 request are Atacama Large Millimeter Array Construction ($49.2 million), EarthScope ($50.6 million), IceCube Neutrino Observatory ($50.5 million), Rare Symmetry Violating Processes ($41.8 million), and Scientific Ocean Drilling Vessel ($57.9 million). While there are no new starts proposed in the FY2006 request, additional NSB-approved projects are proposed for startup in FY2007 and FY2008.

The FY2006 request for the EHR is $737 million, a 12.4% decrease ($104.2 million) from the FY2005 estimate. The EHR portfolio is focused on increasing the technological literacy of all citizens, preparing the next generation of science, engineering, and mathematics professionals, and closing the achievement gap in all scientific fields. Support at the various educational levels in the FY2006 request is: precollege, $140.8 million; undergraduate, $135 million; and graduate, $155 million. The request provides $60 million for the Math and Science Partnerships program (MSP), a 24.4% decrease from FY2005. Funding in the FY2006 request will provide support for ongoing awards, in addition to data collection, evaluation, knowledge management, and dissemination. No new partnership awards are proposed in the FY2006 request. Several programs are directed at increasing the number of underrepresented minorities in science and engineering — Black Colleges and Universities Programs ($25 million), Tribal Colleges and Universities Program ($10 million), Louis Stokes Alliances for Minority Participation ($35 million), and Centers of Research Excellence in Science and Technology ($18.5 million). Funding for the Experimental Program to Stimulate Competitive Research (EPSCoR) is $94 million in the FY2006 request, almost level to the FY2005 estimate.

Policy Issues. On February 2, 2004, the NSB released a report that was mandated by Section 22 of the NSF Authorization Act of 2002. The report, *Fulfilling the Promise*, addressed the unmet needs of the agency and determined what infrastructure was needed to support NSF's programmatic expansion through FY2007.[5] The recommendations provided in the report are based on the budget levels contained in the authorization.[6] The NSB recommended a total investment of $19 billion for the NSF to sustain its position in science and technology. The report focused on funding for key strategic areas — $1.2 billion for advanced tools and cyber infrastructure, $1 billion to improve research productivity and student opportunities, $700 million toward building a competitive workforce, $200 million for maintaining management excellence, and $200 million to increase the number and diversity of institutions receiving awards. The FY2006 request for NSF is 34% below what was recommended in the authorizing legislation. The NSB contends that increasing the number and length of research awards should be one of the highest priorities of the agency. However, a slight 0.3% increase is proposed for research grants in the FY2006 request. In addition, the support for the EHR in the FY2006 request represents the second year of deceased funding for science and mathematics education. One of the priorities of the NSF is to advance the productivity of research for students and teachers and to increase the number of U.S. students pursuing scientific and technical

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[5] National Science Board, *Fulfilling the Promise: A Report to Congress on the Budgetary and Programmatic Expansion of the National Science Foundation*, NSB03-151, December 4, 2003, Arlington, VA, 20 pp.

[6] P.L. 107-368, National Science Foundation Authorization Act of 2002, provides the following authorization levels: FY2003, $5,536.4 million; FY2004, $6,390.8 million; FY2005, $7,378.3 million; FY2006, $8,519.8 million; and FY2007, $9,839.3 million.

disciplines. Many in the scientific community question how this can still be accomplished with the decrease in support for science education.[7] The proposed cuts in funding for several science education programs and the proposed shift of support for other programs to the Department of Education are not only questioned by the scientific community, but by several members of Congress.[8]

There has been considerable debate in the academic and scientific community and in Congress about the management and oversight of major projects selected for construction and the need for prioritization of potential projects funded in the MREFC account. The NSF was directed to improve its oversight of large projects by developing an implementation plan that included comprehensive guidelines and project oversight review. One continuing question focused on the selection process for including major projects in the upcoming budget cycle. In February 2004, the National Academies released the congressionally mandated study of the process for prioritization and oversight of projects in the MREFC account.[9] The report recommended a more open process for project selection, broadened participation from various disciplines, and well-defined criteria for the selection process. The report states that in addition to there being a backlog of approved but unfunded projects, there is a lack of support for disciplines conducting idea-generating activities, and lack of funding for conceptual development, planning, and design. Because of the changing nature of science, the report noted that NSF should be able to reconsider facilities at every stage in their development. At the October 13, 2004 meeting of the NSB, NSF was directed to begin implementation of the proposed facility project review and prioritizing process outlined in the report. In December 2004, the NSB announced that new guidelines for the development, review, and approval of major projects will be available in June 2005. Also to be released in March of 2005 is an NSF Facility Plan, detailing facilities under construction and those being considered for future funding. A centralized and automated cost-tracking system will be developed to monitor full life-cycle costs of large facility projects. It is anticipated that the cost-tracking system will be operational during FY2005.[10]

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[7] NSF reports that since the 1980s, foreign countries (Organisation for Economic Co-operation and Development countries) have increased their investment in science and engineering education at rates higher than the United States.

[8] See for example House Committee on Science, Subcommittee on Research, *National Science Foundation Budget and Management Challenges*,2005, Testimony of Honorable Bob Inglis, 109th Cong., 1st Sess., March 9, 2005, [http://www.house.gov/science/hearings/research05/mar09].

[9] National Academy of Sciences, Committee on Science, Engineering, and Public Policy and Global Affairs Division, *Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation*, Washington, DC, January 14, 2004, 215 pp.

[10] National Science Foundation, Office of the Inspector General, *Survey of Large Facility Projects Management and Oversight Division*, OIG05-6-002, Arlington, VA, December 29, 2004, 10 pp.