

# CRS Report for Congress

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## U.S. National Science Foundation: An Overview

Christine M. Matthews  
Specialist in Science and Technology Policy  
Resources, Science, and Industry Division

### 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 majority of the research supported by the NSF is conducted at U.S. colleges and universities. Approximately 82.8% (\$2,634.1 million) of NSF's FY2001 \$3,179.9 million research and development (R&D) budget was awarded to U.S. colleges and universities.<sup>1</sup> Preliminary data reveal that for FY2001, the NSF provided approximately 55.5% 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.<sup>2</sup> In addition, NSF provides almost 30% of the total federal support for science and mathematics education. For more on NSF, see CRS Issue Brief IB10100, *Research and Development Funding: Fiscal Year 2003*, Michael E. Davey, Coordinator. 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.<sup>3</sup> Other federal agencies, in contrast, support mission-specific research (i.e., health, agriculture, defense).

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<sup>1</sup> National Science Foundation, *Federal Support for Research and Development: Fiscal Years 1999, 2000, and 2001*, Detailed Statistical Tables, NSF01-328, Arlington, VA, 2000. p. 55-57.

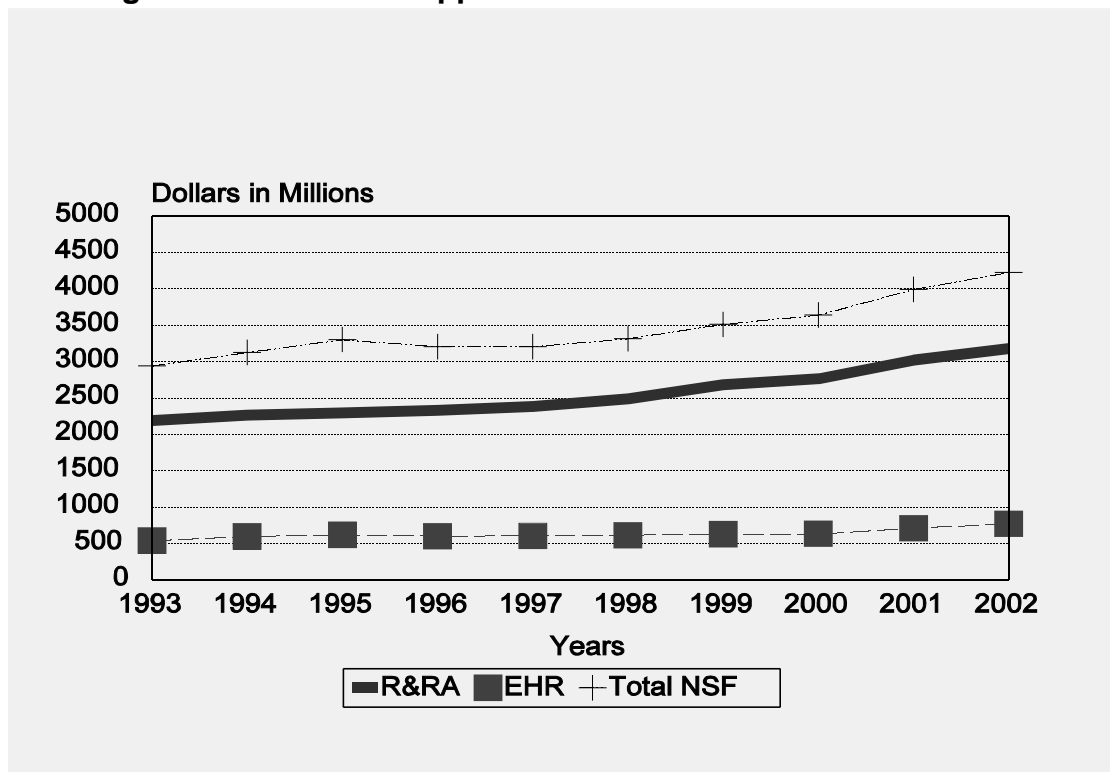
<sup>2</sup> *Ibid.*, p. 160.

<sup>3</sup> The NSF does not provide funding for research in clinical medicine, commerce, social work, or the arts and humanities.

The NSF provides support for investigator-initiated, merit-reviewed, competitively selected awards, state-of-the-art tools, instrumentation and facilities. The agency receives approximately 60,000 proposals annually, for research, graduate and postdoctoral fellowships, and science, mathematics, and engineering projects, and funds roughly one-third of them. Support is provided to academic institutions, industrial laboratories, private research firms, and major research facilities and centers. While the NSF does not operate any laboratories, it does support Antarctic research stations, selected oceanographic vessels, and national research centers. Additionally, the 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 82.8% (\$2,634.1million) of NSF's estimated FY2001 \$3,179.9 million research and development (R&D) budget was awarded to U.S. colleges and universities. Preliminary data reveal that in FY2001, NSF provided approximately 55.5% 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.<sup>4</sup>

**Figure 1. NSF R&D Support in Constant 1996 Dollars: 1993-2002**



<sup>4</sup> While the FY2001 R&D appropriation of \$3,179.9 million was only 3.9% of the total federal R&D budget, the agency plays an important role in maintaining the university-based research enterprise. The NSF provided 14.7% of all federally supported basic research and 22.9% of federal academic research. Ibid., p. 95, 96, 160.+ NSF was the second largest federal supporter of academic research in FY2001, eclipsed by the Department of Health and Human Services, which provided 59.1%. The Department of Defense, the third largest supporter of academic research, provided 6.1%. *Federal Funds for Research and Development: Fiscal Years 1999, 2000, and 2001*, p. 160-161.

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.

**Organization and Fiscal Year 2003 Request.** The NSF has enjoyed considerable growth during a period of constrained R&D budgets. When measured in current dollars, its total appropriation increased more than 74% in 10 years — FY1993, \$2,749.7 million; FY1998, \$3,425.7 million; and FY2002, \$4,788.9 million. Even when inflation is taken into account, its growth increased (in constant fiscal year 1996 dollars) by 43.7% during this 10-year period. The FY2003 request for the National Science Foundation (NSF) is \$5,035.8 million, a 5% (\$239.9 million) increase over the FY2002 estimate of \$4,795.9 million. Support is provided for several priority areas: biocomplexity in the environment (\$79.2 million, 36.3% above FY2002), information technology research (\$285.8 million, 3% above FY2002), learning for the 21<sup>st</sup> century (\$184.7 million, 27.5% above FY2002), nanoscale science and engineering (\$221.3 million, 11.3% above FY2002), mathematical sciences (\$60.1 million, 100.3% above FY2002), and social, behavioral and economic sciences (\$10 million, new in FY2003). The request provides a second installment of \$200 million for the President's Math and Science Partnerships program (MSP). Additional FY2003 highlights include increased funding for graduate students (\$26.2 million), continued support of plant genome research (\$75 million), increased investment in NSF's administration and management portfolio (\$268.1 million), and funding for the Partnerships for Innovation program (\$5 million). In FY2003, the Administration proposes the transfer of three programs from other agencies to the NSF. The proposed transfers include the National Sea Grant program, currently at the National Oceanic and Atmospheric Administration (\$57 million), Environmental Education, currently at the Environmental Protection Agency (\$9 million), and Hydrology of Toxic Substances, currently at the United States Geological Survey (\$10 million).

The FY2003 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 contained in the Research and Related Activities Account (R&RA). In addition to the directorates, the R&RA includes the U.S. Polar Research Programs (\$235.7 million), the U.S. Antarctic Logistical Support Activities (\$68.1 million), and Integrative Activities (\$110.6 million). The seven major directorates are described below.

**Biological Sciences (BIO).** The FY2003 request of \$525.6 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 \$526.9 million in FY2003, 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 FY2003 request of \$908.1 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 \$488 million in FY2003, 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 FY2003 request of \$691.1 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 FY2003 request of \$941.6 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 \$195.6 million in FY2003, 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 \$96.3 million in FY2003, a 20.6% decrease (\$25 million) from the FY2002 level. The MREFC, established in FY1995, supports the acquisition and construction of major research facilities and equipment that extend the boundaries of science, engineering, and technology. Seven projects are supported in this account for FY2003, five ongoing projects and two new projects - - construction of the Atacama Large Millimeter Array (\$30 million), the Large Hadron Collider (\$9.7 million), the Network for Earthquake Engineering Simulation (\$13.6 million), the South Pole Modernization Project (\$6 million), Terascale Computing Systems (\$20 million), Earthscope (\$35 million), and the National Ecological Observatory Network, Phase I (\$12 million). No funds are requested in FY2003 for the High-

Performance Instrumented Airborne Platform for Environmental Research (HIAPER) or the IceCube R&D project because they have been deemed to be of lower priority.

The FY2003 request for the Education and Human Resources Directorate (EHR) is \$908.1 million, a 3.8% increase (\$33.1 million) over FY2002. Support at the various educational levels in the FY2003 request is as follows: precollege, \$359.6 million; undergraduate, \$157.4 million; and graduate, \$136.9 million. Support at the precollege level includes \$200 million for the MSPI, a cornerstone of the President's education reform agenda. Programs at the undergraduate level include the Advanced Technological Education, Stokes Alliances for Minority Participation, Historically Black Colleges and Universities-Undergraduate Program, and Tribal Colleges and Universities Program. An increase of 21.7% in FY2003 for graduate level programs will allow NSF to raise the stipend of graduate fellows and to increase the number of offers to new fellows. Funding for the Experimental Program to Stimulate Competitive Research (EPSCoR) is \$75 million. An additional \$30 million from R&RA will support EPSCoR activities.

**Policy Issues.** In September 2001, NSF submitted to the Office of Management and Budget its report, *Large Facility Projects Management & Oversight Plan*<sup>5</sup>, detailing the schedule for implementing the major components of an improved system for selecting, managing, and overseeing large facilities.<sup>6</sup> The plan was an outgrowth of the directive received by the NSF from the Bush Administration to improve its oversight of large projects. The report provided a detailed implementation plan, including anticipated dates for the development of comprehensive guidelines and project oversight review, and the release of a large facility project manual. NSF acknowledged in the report that:

... The portfolio of facilities has grown and diversified to include distributed projects that challenge traditional management and oversight approaches. Emerging multidisciplinary science and engineering opportunities have resulted in NSF moving towards a greater number of large facility projects that are increasingly complex and present challenging technical and management issues. Growth and diversification require that NSF remain attentive to the ever-changing issues and challenges inherent in planning, construction, operation, management and oversight of large facility projects.<sup>7</sup>

Rita R. Colwell, director, NSF, stated that there is concern in the scientific community about the major realignment of federal research support across the scientific disciplines. Data indicate that from FY1980 to FY2001, research support for the life sciences increased from 36.1% to 47.2%. During that same time period, support for the physical sciences and engineering decreased from 41.7% to 29.8%.<sup>8</sup> Several members of

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<sup>5</sup> National Science Foundation, *Large Facility Projects Management & Oversight Plan*, September 10, 2001, Arlington, Virginia, 9 p.

<sup>6</sup> While NSF does not directly construct or operate the facilities it funds, it does retain responsibility for overseeing the successful performance and completion of the projects.

<sup>7</sup> This directive was contained in *A Blueprint for New Beginnings: A Responsible Budget for America's Priorities*, Executive Office of the President of the United States, January 2001, Washington, DC, p. 2.

<sup>8</sup> Based on data in Table 25, National Science Foundation, *Federal Funds for Research and* (continued...)

Congress and others in the scientific community have stressed the importance in monitoring the structure of the federal research portfolio in order to determine the priorities that should be assigned the various disciplines.<sup>9</sup>

There is added concern about the trend in federal versus private sector support for research. While total national R&D funding is at a high, the federal government's share of support for R&D has declined, losing ground to industry. The federal government provided 60.7% of R&D support in 1968, 44.9% in 1988, and 29.5% in 1998.<sup>10</sup> In March 2001, the NSB released a report on the allocation of federal resources for science and technology. The report stated that:

Today's environment demands effective management of the Federal portfolio for research, including a sustained advisory process that incorporates systematic participation by the science and engineering communities. Expert input is particularly important for decisions on long-term, high-risk investments in research-sponsored mainly by the federal government - which are steadily losing ground in the national research portfolio to short-term investments.<sup>11</sup>

On June 5, 2002, the House passed H.R. 4664 (H. Rept. 107-488), the National Science Foundation Authorization Act of 2002. The bill authorizes appropriations for NSF in FY2003 at \$5,515.3 million, FY2004 at \$6,342.6 million, and FY2005 at \$7,293.9 million. For the R&RA, H.R. 4664 provides \$4,138.4 million in FY2003, \$4,735.6 million in FY2004, and \$5,445.9 million in FY2005. The Senate version was introduced on July 29, 2002 S. 2817, the National Science Foundation Doubling Act, attempts to double the NSF budget over the next five years with the following authorizations: FY2003, \$5,536.4 million; FY2003, \$6,390.8 million; FY2005, \$7,378.3 million; FY2006, \$8,519.8 million; and FY2007, \$9,839.3 million. For R&RA, the authorizations for FY2003-FY2007 are \$4,174.8 million, \$4,842.8 million, \$5,617.7 million, \$6,516.5 million, and \$7,559.1 million, respectively.

On October 10, 2002, the House Committee on Appropriations reported H.R. 5605 (H. Rept. 107-740), VA/HUD and Independent Agencies Appropriations Bill, FY2003. The bill provides a total of \$5,422.9 million for NSF in FY2003, a 7.7% increase (\$387.1 million) above the request and a 12.8% increase (\$614.4 million) over the FY2002 level. Included in the total support is \$4,150 million for the R&RA and \$910.6 million for the EHR.

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<sup>8</sup> (...continued)

*Development, Detailed Historical Tables: Fiscal Years 1951-2001*, NSF01-331, Arlington, VA.

<sup>9</sup> House Committee on Science, "Members Raise Concern Over Balance of Federal R&D Budget" February 13, 2002, [<http://www.house.gov/science/welcome.htm>] and Washington Fax, "Congress Will Have to "Show Its Mettle" and Provide Cash to Balance Science Funding," February 15, 2002, [<http://www.washingtonfax.com/pl/2002/20020215.html>].

<sup>10</sup> *National Science Board, Science and Engineering Indicators 2000*, NSB00-1, Arlington, VA, January 13, 2000, p. A-22. See, also, National Science Foundation. Data Brief. "U.S. Industrial R&D Performers Report Increased R&D in 1999; New Industry Coding and Size Classifications for NSF Survey", NSF01-326, Arlington, VA, May 17, 2001, 4 p.

<sup>11</sup> National Science Board, "*The Scientific Allocation of Scientific Resources*", Discussion Draft for Comment, NSB01-39, Arlington, VA, March 28, 2001, p.1.