6

National Science Foundation in the FY 2009 Budget

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HIGHLIGHTS

- The National Science Foundation (NSF) is once again targeted for major funding increases as part of the President's American Competitiveness Initiative (ACI). The FY 2009 request for NSF is $6.9 billion, $822 million or 13.6 percent above the final FY 2008 level (see Table II-7). In FY 2008, NSF and other federal research agencies received appropriations far below the amounts requested by the Administration in the ACI and the amounts authorized in the America COMPETES Act (P.L. 110-69).

- Overall NSF R&D funding—excluding education, training, and overhead costs—would rise to $5.2 billion, an increase of 15.5 percent. This increase comes after several years of flat funding and elevates total NSF R&D funding to an all-time high in real terms.

- Research and Related Activities (R&RA) would increase to $5.6 billion, a $790 million or 16.4 percent increase. All of the research directorates would receive increases on the order of 9 to 20 percent in FY 2009 after what was essentially flat funding in FY08.

- NSF estimates that it will provide a total 13,000 competitive awards and 8,880 research grants in FY 2009. Despite this increase, competition for grants will remain difficult, with NSF expected to be able to fund just 26 percent of competitive awards and 23 percent of research grant proposals it receives.

- The President is proposing to fund NSF's Education and Human Resources (EHR) programs at $790 million, a $65 million or 8.9 percent increase over FY 2008.

- The Major Research Equipment and Facilities Construction (MREFC) account would be funded at $148 million, a decrease of $58 million or 28.2 percent. According to NSF, the reason for the steep decline in funding for MREFC is due to the completion of several major projects and the Administration's decision not to fund the Alaska Regional Research Vessel, the National Ecological Observatory Network (NEON), and the Ocean Observatories Initiative in FY 2009.

AGENCY OVERVIEW

NSF's Mission: Since its founding in 1950, the Foundation has played an extraordinary role in American scientific discovery. In contrast to other federal agencies that support research focused on specific missions and despite its small size, it is the only federal agency with responsibility for the health of science and engineering across all disciplines. The NSF is also charged with ensuring the nation's supply of scientists, engineers, and science and engineering educators.

NSF accomplishes its mission with remarkable efficiency. Approximately 94 percent of the agency's budget goes to support the actual conduct of research and education, with less than six percent going to internal operations, administration and management.

NSF Support: NSF plays a crucial role in the support of university-based research, sending more than 80 percent of its total R&D support to colleges and universities. NSF provides 22 percent of federal support of basic research at academic institutions and is the second-largest sponsor of research at colleges and universities, after the National Institutes of Health (NIH). In several areas, including engineering, physical sciences, social sciences and environmental sciences, it is the principal federal source of support of academic research. While NSF does not directly support medical research, the agency's investments are critical to medical science and related industries because of its leadership in the advancements in diagnostics, regenerative medicine, drug delivery, and the design and manufacturing of pharmaceuticals.

Ninety percent of NSF funding is allocated through merit-based competitive awards. Over a three-year period from FY 2005-2007, NSF received an average of 43,000 competitive proposals and made 10,600 competitive awards each year. In FY 2007, these awards went to approximately 1,900 colleges, universities, and other non-profit institutions. It is estimated that in FY 2009 nearly 212,000 people will be directly involved in NSF research and education programs. These include

approximately 61,000 senior researchers and other professionals, 73,000 postdoctoral, graduate and undergraduate students, and 77,000 K-12 teachers and students.

The agency does not operate its own laboratories, but does support national research centers, user facilities, oceanographic vessels and Antarctic research stations. NSF also supports university-industry research partnerships, U.S. participation in international scientific efforts, and efforts to improve science, math and engineering education at the K-12 level as well as at colleges and universities.

Agency Structure: NSF is an independent federal agency managed by a presidentially-appointed, Senate-confirmed director and deputy director. The agency's policy direction is established by the National Science Board, which consists of 24 scientists, mathematicians, engineers, top university officials, and industry leaders.

NSF has a staff of approximately 1,300 people and is divided into seven directorates. Six of the directorates are directly responsible for funding discipline-oriented basic and applied research: Biological Sciences (BIO); Computer and Information Science and Engineering (CISE); Engineering (ENG); Geosciences (GEO); Mathematical and Physical Sciences (MPS); and Social, Behavioral and Economic Sciences (SBE). The remaining directorate is responsible for overseeing NSF's Education and Human Resources (EHR) activity. The NSF also supports research activities through its Office of Polar Programs (OPP). Last year, NSF created a new office, the Office of Cyberinfrastructure, specifically to support cyberinfrastructure research activities previously supported by CISE. NSF's large scientific facilities and major research projects are funded in a separate account known as the Major Research Equipment and Facilities Construction (MREFC) account.

Recent NSF Funding History: For the most part, NSF has seen steady growth over the past several decades. After declines in the NSF budget in the mid-1990's which resulted from growing pressure to balance the federal budget, growth began again for NSF in 1998 peaking in FY 2004. Since then, the NSF budget has declined slightly after adjusting for inflation and has yet to surpass its FY 2004 funding level despite approval of various initiatives to double the agency's funding levels.

While the NSF has always enjoyed strong Congressional support, this support surged during the late 1990's as key leaders in both the House

and Senate began to speak in favor of doubling the NSF's budget over five years. The growing level of support for NSF was demonstrated in 2002 when Congress passed the NSF Authorization Act of 2002, a bill aimed at putting the NSF on a track to double its budget over five years. This Act (P.L. 107-368), signed into law in December 2002, increased authorized funding for NSF from its FY 2002 level of $4.8 billion to $9.8 billion in FY 2007.

Despite high hopes that passage of the NSF Authorization bill would result in significant funding increases for NSF, a dramatically changed federal fiscal environment—characterized by increasing budget deficits and costs associated with the war on terrorism—resulted in NSF funding well below the authorized levels. In FY 2004, the first year after the passage of the authorization bill, the NSF received $5.6 billion, a five percent increase, and in FY 2005 the NSF actually received a cut. This cut marked the first time in ten years the NSF did not see an increase overall and was the first time since FY 1986 that R&RA was cut in real terms. In FY 2006, the NSF budget increased by only two percent, still leaving its final short of where it had been two years earlier in FY 2004 when adjusted for inflation.

In 2005 a number of reports were issued by business, higher education and scientific organizations which sounded the alarm that the U.S. might be losing its global scientific and technological edge. The most notable of these was the National Academies' *Rising above the Gathering Storm* report. Concerns generated by these reports, combined with the release of New York Times journalist Thomas L. Friedman's book *The World is Flat*, led to the introduction of major bipartisan innovation and competitiveness legislation in the U.S. Congress which called for significant funding increases for the NSF and other federal agencies with a significant role in the support of basic physical sciences and engineering research.

In January 2006, President Bush announced the American Competitiveness Initiative (ACI) in his State of the Union address which called for doubling the NSF budget and the budgets for the Department of Energy's (DOE) Office of Science and core research programs at the National Institute of Standards and Technology (NIST) over ten years. The President's ACI announcement came on the heels of the House Democrats' release in November 2005 of their own "Innovation Agenda" which called for doubling NSF funding over a five-year period. And in August 2007, the Congress overwhelmingly passed and the President

signed the America COMPETES Act (P.L. 110-69) which authorized $22 billion to the National Science Foundation (NSF) over fiscal years 2008-2010, putting the agency on a path to double its funding in approximately seven years.

Despite the strong bipartisan support expressed for these competitiveness and innovation initiatives and the overwhelming support for the COMPETES Act, funding for NSF fell short of the doubling path in both the FY 2007 and FY 2008 appropriations cycles. Cumulatively, NSF was funded at $500 million below the amount originally proposed by the President in the ACI. Despite the various presidential and congressional initiatives aimed at doubling the NSF budget, when adjusted for inflation the NSF budget has yet to rebound to its peak funding level which came in FY 2004. While the "will" to support science appears to exist in both the White House and Congress, finding a "way" to actually fund these research programs appears to be much more difficult.

Indeed, the final funding levels for research approved by Congress and the White House for FY 2008 left many in the scientific community stunned, given that the President and the Democratic Congress both had touted major efforts to boost NSF funding. In what seemed to be a year when the White House and Congress all agreed that NSF deserved significant funding increases, how was it that these increases did not materialize?

In the end, the proposed funding increases for NSF fell victim to bickering between the White House and Congress over the total dollars available for domestic spending. Faced with threats from the President that appropriations bills would be vetoed for exceeding his overall domestic spending targets by $22 billion, Congress significantly pruned back its spending bills to gain presidential approval of an omnibus appropriations bill before the end of the calendar year. Included in these last-minute cuts was the proposed NSF funding increase.

The failure to achieve the proposed increase for NSF funding in the FY 2008 budget cycle does not bode well for realizing similar funding increases proposed by President Bush for NSF in the FY 2009 budget. Many are predicting a replay of last year's budget squabbles with a final resolution not coming until a new President is sworn into office next year.

RESEARCH AND RELATED ACTIVITIES (R&RA)

Research and Related Activities (R&RA) would receive $5.6 billion in the President's FY 2009 budget, an increase of $790 million or 16.4 percent above the FY 2008 estimate of $4.8 billion (see Table II-7 for R&RA details). Requests for specific R&RA directorates and offices are:

Biological Sciences (BIO): $675 million (up $63 million or 10.3 percent). BIO is the dominant federal supporter of basic research in the non-biomedical biological sciences at academic institutions, providing 67 percent of all support. BIO's contribution to a broad array of biological sciences is critically important, particularly in such areas as environmental biology, plant sciences, and agriculture. BIO-supported research is important to furthering the understanding of how living organisms function and interact with nonliving systems which, in turn, has significant relevance to issues of national importance relating to the environment, economy, agriculture, and human welfare. For FY 2009, enhanced support for disciplinary and interdisciplinary research across BIO's core programs is the highest priority for this directorate.

In FY 2009, the BIO directorate is requesting a realignment of two important activities: (1) the transfer of the Plant Genome Research program to the Integrative Organismal System subactivity and (2) the transfer of management and oversight of the National Ecological Observatory Network (NEON) to the Emerging Frontiers subactivity. In FY 2009, BIO expects to make 1,310 competitive awards and 975 research grants. The average award size would be $200,600 per year for an average duration of 3.0 years. (For more, see Chapter 17.)

Computer and Information Science and Engineering (CISE): $639 million (up $104 million, or 19.5 percent). CISE is the principal source of federal funding for university-based basic research in computer science, providing the vast majority (86 percent) of total federal support in this area. CISE provides academic researchers with advanced computing and networking capabilities and fundamental knowledge in computing science and engineering which, in turn, are essential to innovation and effectiveness in many areas, including advanced scientific research, medical care, national and homeland defense, organizational competitiveness, and governmental efficiency. In FY 2009, CISE expects to make 1,950 competitive awards and 1,550 research grants. The average award size is estimated to be $180,000 per year and an average duration of 3.0 years. (For more, see Chapter 22.)

Engineering (ENG): $759 million (up $122 million, or 19.2 percent). ENG is a major source of federal funding for university-based, fundamental engineering research, providing 40 percent of the total federal support in this area. ENG investments in engineering research and education build and strengthen our Nation's capacity to lead the world in innovation. These investments include such emerging technologies as sensors and sensor systems, nanotechnology, cyber-enabled engineering, metabolic engineering, bioengineering and manufacturing. Since establishing the National Nanotechnology Initiative in 2000, ENG has played a vital role in directing frontier engineering research in the U.S. In FY 2009, ENG expects to make 2,235 competitive awards and 1,590 research grants. The average award size is estimated to be $118,000 per year for an average of 3.0 years. (For more, see Chapters 24 and 25.)

Geosciences (GEO): $849 million (up $96 million, or 12.8 percent). GEO is the principal source of federal funding for university-based basic research in the geosciences, providing about 59 percent of total federal support in these areas. GEO plays a critical role in addressing the nation's need to understand, predict, and respond to environmental events and changes. Research supported by GEO also helps to determine the best use of Earth's resources. In FY 2009, GEO expects to make 1,600 competitive awards and 1,250 research grants. The average award would be $160,000 per year for 3.0 years. (For more, see Chapter 16.)

Mathematical and Physical Sciences (MPS): $1.4 billion (up $235 million, or 20.2 percent). MPS provides about 44 percent of federal funding for basic research at academic institutions in the mathematical and physical sciences and serves as the federal steward for ground-based astronomy. In FY 2009, MPS expects to make 2,850 competitive awards and 2,200 research grants. The average award size is estimated to be $145,000 per year and an average duration of 3.1 years. (For more on physics, see Chapter 13; on astronomy, see Chapter 14; and on chemistry, see Chapter 18.)

Social, Behavioral and Economic Sciences (SBE): $233 million (up $18 million, or 8.5 percent). SBE is a principal source of federal support for fundamental research on human cognition, behavior, social structures, and social interaction, as well as for research on the intellectual and social contexts that govern the development and use of science and technology. Overall, SBE accounts for about 61 percent of federal support for basic research in the social sciences at U.S. academic

institutions. In some fields, including anthropology, archaeology, political science, linguistics, non-medical sociology, and the social aspects of psychology, SBE is the predominant or exclusive source of federal basic research support. In FY 2009, SBE expects to make 1,277 competitive awards and 810 research grants. The average award size is estimated to be $117,810 per year and an average duration of 2.5 years. (For more, see Chapter 19.)

Office of Polar Programs (OPP): $491 million (up $48 million, or 10.9 percent). OPP supports research in the extreme environments and unique geography found at the earth's poles. Much of the research performed by the NSF in the Arctic and Antarctic is not feasible elsewhere. In FY 2009, OPP expects to make 402 competitive awards and 350 research grants. The research awards would have an average award size of $249,398 per year and an average duration of 3.0 years.

Office of Cyberinfrastructure (OCI): $220 million (up $35 million, or 18.8 percent). OCI was created in July 2005 in an organizational realignment that moved the CISE Division of Shared Cyberinfrastructure into the Office of the Director. OCI supports research, development, acquisition and operations of advanced shared and connecting cyberinfrastructure that enables advances in 21st century science and engineering research and education. In FY 2009, OCI expects to make 72 competitive awards and 55 research grants. The research awards would have an average award size of $440,000 per year and an average duration of 2.5 years.

Office of International Science and Engineering (OISE): $47 million (up $6 million, or 14.8 percent). OISE serves as the focal point, both inside and outside NSF, for international science and engineering activities. OISE supports U.S. scientists and engineers engaged in international research and education activities in all NSF-supported disciplines involving any region of the world. Bold exploration at the frontiers of science and engineering increasingly requires international partnerships. OISE is the lead office in helping to develop such partnerships on behalf of the NSF. In FY 2009 OISE expects to make 370 competitive awards and 100 research grants. The research awards would have an average award size of $175,000 per year and an average duration of 3.0 years.

Integrative Activities: $276 million (up $44 million or 18.8 percent). Integrative Activities (IA) was created in FY 1999 within R&RA to

support cross-disciplinary research efforts and major research instrumentation.

EDUCATION AND HUMAN RESOURCES (EHR)

NSF, in accordance with the NSF Act of 1950, is the principal federal agency charged with promoting science and engineering (S&E) education. In support of this mission, EHR promotes the development of a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians and educators and a well-informed citizenry who has access to the ideas and tools of science and engineering. The budget would fund EHR programs at $790 million in FY 2009, an increase of $65 million or 8.9 percent over FY 2008.

Division of Research on Learning in Formal and Informal Settings (DRL): It is the mission of DRL to integrate STEM education research, development, evaluation, and synthesis activities. As part of its mission, DRL will assume the leadership of two of EHR's five thematic priorities in FY 2009; public understanding of science, and advancing STEM literacy and promoting learning through research and evaluation. The FY 2009 budget requests $227 million for DRL, an increase of $13 million, or 5.8 percent over the FY 2008 level of $214 million.

Division of Undergraduate Education (DUE): DUE's objective is to increase the quantity and improved the quality of STEM undergraduate education. As part of its mission, DUE will assume a leadership role in the areas of teacher education and cyber-infrastructure for learning. The FY 2009 budget requests $220 million for DUE, an increase of $9 million, or 4.2 percent over the FY 2008 level of $211 million.

Division of Graduate Education (DGE): DGE supports graduate students and innovative graduate programs in science and engineering. The FY 2009 budget requests $191 million for DGE, an increase of $31 million or 19.1 percent over the FY 2008 level of $160 million.

Graduate fellowships and stipends: Within EHR, the budget would fund an estimated 3,075 fellows under the Graduate Research Fellowship, 950 Graduate Teaching Fellows in K-12 education, and 1,425 trainees under the Integrative Graduate Education and Research Traineeships. Approximately, 5,450 graduate fellowships and traineeships will be supported NSF-wide in FY 2009.

Math and Science Partnerships (MSP): The FY 2009 request for MSP is $51 million, an increase of $2.5 million over the FY 2008 level of $48.5 million. As part of this increase, $1.5 million is requested for the Innovation through Institutional Integration effort and $1 million is requested for the Teacher Education thematic priority. (For more on NSF's EHR programs, see Chapter 4.)

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION (MREFC)

The FY 2009 budget requests $148 million for MREFC, a decrease of $58 million or 28.2 percent below FY 2008. The reason for the steep decline in funding for MREFC is due to the completion of several major projects and the Administration's decision not to fund the Alaska Regional Research Vessel, NEON, and the Ocean Observatories Initiative in 2009. Despite these significant cuts in the MREFC account, the FY 2009 budget requests funding for several construction projects, including the Advanced Laser Interferometer Gravitational Wave Observatory ($51 million), the Atacama Large Millimeter Array ($82 million), the IceCube project ($11 million), and the Advanced Technology Solar Telescope ($2.5 million).

NSF INVESTMENTS

As in past years, the FY 2009 budget includes several cross-foundational investments and priorities aimed at strengthening and improving the science and engineering enterprise. These investments include increased funding for the following programs: Cyber-enabled Discovery and Innovation; Science and Engineering Beyond Moore's Law; Adaptive Systems Technology; and Dynamics of Water Processes in the Environment. The investments and priorities outlined in this year's budget seem to be very much in line with the Administration's American Competitiveness Initiative as well as the America COMPETES Act of 2007 aimed at increasing the nation's investment in the physical sciences and engineering.

As part of its overall mission, NSF continues its support for major National Science and Technology Council (NSTC) crosscutting initiatives in the FY 2009 budget. For example, the FY 2009 budget request for Climate Change Science Program is $220.6 million (up $15.4 million); the Networking and Information Technology R&D Initiative is slightly over $1 billion (up $159 million); and the National Nanotechnology Initiative is $397 million (up $8 million; see Table I-9.)