

**U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION**

HEARING CHARTER

Oversight of the National Science Foundation

Tuesday, February 26, 2007

10:00 a.m. - 12:00 p.m.

2318 Rayburn House Office Building

1. Purpose

On Tuesday, February 26, 2008, the Subcommittee on Research and Science Education of the House Committee on Science and Technology will hold a hearing to receive testimony from the Director of the National Science Foundation (NSF) and the Chair of the National Science Board (NSB) regarding NSF's fiscal year (FY) 2009 budget request and related policy issues.

2. Witnesses

- **Dr. Arden L. Bement, Jr.**, Director of the National Science Foundation.
- **Dr. Steven C. Beering**, Chairman of the National Science Board.

3. Overarching Questions

- How does the FY 2009 budget request address the NSF programs authorized in the America COMPETES Act, including math and science education activities? How is NSF responding to the policy directives in COMPETES, including those regarding mentoring and ethics training for young scientists?
- On what basis should NSF make decisions about how to allocate budgets across education programs, including K-12, undergraduate, and graduate programs? How will NSF's new teacher education initiative balance priorities across the programs that support K-12 education? Is there an appropriate balance among the different modes of support for graduate students (fellowships, traineeships, and research assistantships)?
- The *American Competitiveness Initiative* (ACI) set a 10-year doubling path for the physical sciences, engineering and computer sciences, which had been flat-funded for several years. What is NSF doing to ensure that the social, behavioral, economic and biological sciences are appropriately integrated and sufficiently funded under the often multidisciplinary research initiatives supported under ACI?

4. Summary of NSF FY 2009 Budget Request

The National Science Foundation is the primary source of federal funding for non-medical basic research conducted at colleges and universities and serves as a catalyst for science, technology, engineering, and mathematics (STEM) education reform at all levels. NSF is one of the research agencies that the President, in his 2006 State of the Union Address, proposed to double over ten years (beginning in FY 2007) as part of the *American Competitive Initiative* (ACI). The America COMPETES Act (P.L. 110-69) called for an even more rapid, seven-year doubling path for NSF and responded to a critical shortage of well-trained K-12 STEM teachers by increasing funding for two flagship NSF teacher education programs: The Noyce Teacher Scholarship Program and the Math and Science Partnerships Program (MSP).

Both ACI and COMPETES have yet to be realized. The FY 2007 Appropriations CR resulted in only a 4.2 percent increase for NSF in the first year of ACI – a ten year doubling requires approximately 7 percent/year growth. The FY 2008 omnibus appropriations bill provides \$6.032 billion¹, a 2.5 percent increase over FY 2007. The Administration's FY 2009 request for NSF is \$6.854 billion, \$822 million (13.6 percent) above the FY 2008 estimate, reflecting a determination to keep NSF on the 10-year doubling path proposed under ACI. (COMPETES authorized \$7.326 billion for FY 2009, \$472 million more than the request.) However, the Administration provided only a nominal increase for MSP and reduced the Noyce Program below the FY 2008 omnibus appropriations level.

Research and Related Activities (R&RA)

Scientific research programs and research facilities (which comprise the R&RA account) receive a \$773 million (16 percent) increase from FY 2008. In keeping with the Administration's emphasis on the mathematical and physical sciences, engineering and computer sciences under ACI, those directorates, in addition to cyberinfrastructure, each receive an approximately 20 percent increase over FY 2008, while the biological sciences (+10.3 percent) and social, behavioral and economic sciences (+8.5 percent) receive more modest increases. The COMPETES Act specifically called on NSF not to disinvest in the biological and social sciences over the long-term, but did not assume that all fields would receive equal increases each year.

NSF's contribution to the multi-agency National Nanotechnology Initiative (NNI) increases by only \$8 million (2.1 percent) to \$397 million, \$30.6 million of which is directed toward research on the environmental, health and safety aspects of nanotechnology. The Committee will be taking up a reauthorization of the NNI this spring. NSF's contribution to another multi-agency program, the Networking and Information Technology R&D Program (NITRD), increases by \$159 million (17 percent) to \$1.09 billion. The entire budgets of both the Computer Sciences and Cyberinfrastructure directorates are counted toward the NITRD total.

¹ The FY 2008 estimate is \$33 million below the appropriated level due to a rescission required by the Appropriators in the FY 2008 omnibus bill.

As part of the FY 2009 request, NSF is launching three new cross-Foundation initiatives: Science and Engineering Beyond Moore's Law (\$20 million), Adaptive Systems Technology (\$15 million) and Dynamics of Water Processes in the Environment (\$10 million). An initiative launched in FY 2008, Cyber-enabled Discovery and Innovation (CDI), will be doubled to \$100 million. All of these initiatives repackage existing research under new headings and it is unclear to what extent they create new research directions or provide more money for existing research. CDI and S&E Beyond Moore's Law are both captured within the NITRD portfolio.

The COMPETES Act put special emphasis on increasing support for young investigators, whose funding success rates sit about 10 percent lower than more established investigators. The Administration request includes \$182 million (+\$14 million) for CAREER grants, less than \$2 million below the amount authorized in COMPETES. The Act also created a new Pilot Program for Young Investigators to help provide seed funding to first time principal investigators who, despite being recognized as outstanding, are still disadvantaged by not having a track record of previous funding. Based on staff conversations with NSF officials, NSF is taking this new program seriously and is in the process of deciding how best to implement it.

Since FY 2006, under a Memorandum of Agreement, NSF has been responsible for reimbursing the U.S. Coast Guard for the costs of the icebreakers that support scientific research in the Polar regions. The request for FY 2009 is \$54 million, a reduction of \$3 million under a recent agreement in which NSF is no longer supporting the *Polar Star* in caretaker (i.e. mothballed) status. NSF will also continue to purchase back-up icebreaking services on the open market at a cost of approximately \$9 million in FY 2009.

Major Research Equipment and Facilities Construction (MREFC)

The MREFC activity funds the construction of large research facilities, such as telescopes and research ships. Funding for the design, operation and management of these major user facilities is included in the R&RA budget.

The fiscal year 2009 MREFC budget is down by 33 percent to \$147 million, in small part because of projects that were completed in FY 2008 and in much larger part because three design-stage projects: The Alaska Region Research Vessel (ARRV), the National Ecological Observatory Network (NEON) and the Ocean Observatories Initiative (OOI) are on hold pending the establishment of rigorous cost and schedule baselines. As recently as last year, NSF put place-holders for these projects in MREFC, but they have since established a "zero-tolerance" policy for cost-overruns. The only new project receiving funding in FY 2009 is the Advanced Technology Solar Telescope (ATST), which will receive \$2.5 million for late-stage design work. This is the first time that any design funds are requested from the MREFC Account, and NSF is reviewing the policy for funding preconstruction design work in general, as requested in COMPETES. In another break with prior practice, the MREFC budget request does not include out-year

funding estimates for ATST and the newly available 2008 Facility Plan² does not include any horizon or “readiness stage” projects.

Education and Human Resources (EHR)

EHR funds most of NSF’s activities that support K-12 STEM education and the majority of activities that support undergraduate STEM education. EHR also funds most of NSF’s graduate fellowship and traineeship programs. The FY 2009 request for EHR is \$790.41 million, an increase of \$64.81 million (8.9 percent) over FY 2008, but \$205 million short of the level authorized in COMPETES. The single biggest increase of \$28.6 million (32.5 percent) goes to the Graduate Research Fellowship program. Overall, programs that support K-12 education, including the Noyce Program, MSP, and Discovery Research K-12, increase by only 4.6 percent, half of the total increase for EHR. NSF programs to broaden participation, which includes programs in both R&RA and EHR, increase by only \$18.8 million (2.9 percent).

K-16 Programs

The Administration flat-funded or provided only meager increases for a number of K-16 education programs slated for increases in COMPETES, including the Noyce Program, MSP, the Advanced Technological Education Program (ATE), and the STEM Talent Expansion Program. Moreover, the Administration intends to fund the Noyce Program below the appropriated level of \$15 million in FY 2008. The rationale given for flat-funding these programs (with the exception of MSP) is that they have not yet undergone the rigorous evaluation required under the Administration’s Academic Competitiveness Council (ACC) process. (For background on ACC, see the charter from the June 6, 2007 Research Subcommittee hearing on Federal STEM Education Programs.) Discovery Research K-12, which supports applied research aimed at improving STEM education at the K-12 level, fares the best of the three K-12 programs, with an \$8.5 million (8.5 percent) increase.

Graduate Research and Education (R&RA and EHR)

The two major NSF programs that support graduate students, the Graduate Research Fellowships Program (GRF) and the Integrative Graduate Education and Research and Training Program (IGERT) take funds from both R&RA and EHR. Both of these programs received special attention in the COMPETES act for their role in nurturing the best and brightest science and engineering students. While GRF is important for the independence it affords graduate students to choose a research advisor who might not otherwise be able to support another student, IGERT is also an extremely well regarded and effective program that by design supports cutting-edge interdisciplinary science through its support for graduate students. In the FY 2009 request, NSF increases GRF by 30 percent to \$125 million while flat-funding IGERT at \$64 million. The reason for this unbalanced treatment of two equally important and effective graduate student programs is unclear. Another large program that NSF lists under graduate education is the Graduate Teaching Fellows in K-12 Education (GK-12).

² <http://www.nsf.gov/pubs/2008/nsf0824/nsf0824.pdf>

Broadening Participation

The single biggest increase for programs to broaden participation goes to the Centers of Research Excellence in Science and Technology Program (+ \$5.5 million or 22 percent), which supports research and education infrastructure at minority-serving institutions. Three other programs designed to increase participation by minority students, HBCU-UP, LSAMP and TCUP, will receive a combined \$3.5 million increase after having received a \$10.5 million increase to \$83.4 million in FY 2008. The ADVANCE program, which seeks to increase the numbers of tenure-track women faculty in science and engineering disciplines, will receive a 2.5 percent decrease to \$20.8 million after having received a 25 percent increase in FY 2008.

Agency Operations and Award Management

This NSF account funds the internal operations of NSF. The FY 2009 request provides an increase of \$23.3 million (8.3 percent) over FY 2008. AOAM was the one account that was nearly fully funded in the FY 2008 omnibus appropriations bill. Dr. Bement made it clear to Congress that AOAM was his number one priority for funding in FY 2008. The NSF workforce has been under increasing pressure as research budgets increased, and the electronic system used to receive and process grant applications is undergoing an upgrade in preparation for implementation across the federal research enterprise.

5. Additional Policy Issues Addressed in COMPETES

The COMPETES Act contained a number of policy directives and report requests not addressed in the FY 2009 budget request:

- Sec. 7007 requires an NSB report, due in August, evaluating the role of NSF in supporting interdisciplinary research. The key issues are whether NSF has a clear policy for the review of unsolicited interdisciplinary proposals, and whether the research community is sufficiently informed about where to submit such proposals.
- Sec. 7008 requires that all NSF grant applications that include funding to support postdoctoral researchers include a description of the mentoring activities that will be provided for such individuals.³
- Sec. 7009 requires universities funded by NSF to provide appropriate training and oversight in the responsible and ethical conduct of research to students and trainees at all levels, including postdoctoral researchers. The Manager's Statement accompanying COMPETES directed NSF to provide written guidelines to universities on what constitutes appropriate training.
- Sec. 7010 requires that NSF make summaries of research results publicly available in a timely manner. NSF was already moving in this direction before COMPETES.

³ The widespread problem being addressed through this provision is addressed in detail in a 2000 (but still relevant) report from the National Academies: *Enhancing the Postdoctoral Experience for Scientists and Engineers*. http://www.nap.edu/catalog.php?record_id=9831

- Sec. 7011 requires NSF to enforce its policy regarding the sharing of research results by making any researcher who fails to comply ineligible for future funding.
- Sec. 7013 required NSB to evaluate NSF's policy on cost-sharing. The Board has already responded with a report presented to NSF in February.⁴ In short, NSB recommended reinstating cost-sharing by industry for certain Centers programs with significant industry participation, as well as cost-sharing by states under the EPSCoR program. They also issued a series of recommendations regarding management and oversight of cost-shared grants. NSF is currently reviewing NSB's recommendations.
- Sec. 7014 required NSB to review NSF's policies for pre-construction funding and maintenance and operation costs of MREFC projects. The Board also completed this report in February (#NSB-08-15) and it should be online shortly. The gist of the recommendations is that NSB should be more integrated into the large facilities planning process and that MREFC funds should be available for late-stage design activities. NSF is currently reviewing the Board's recommendations.
- Sec. 7018 requires NSF to consider the degree to which grant proposals address critical national science and innovation needs.
- Sec. 7020 requires a plan, due this month, to ensure broadband access for all institutions of higher education participating in NSF programs that require high-speed networking.
- Sec. 7022 requires a report, due in August, on the impact and scope of the "Broader Impacts" grant review criterion used by NSF.
- Sec. 7032 requires a National Academies report, due in August, on barriers to and strategies for greater diversity in STEM fields.
- Sec. 7033 authorizes NSF to establish a Hispanic-Serving Institutions Undergraduate Program similar to a program for Historically Black Colleges and Universities.
- Sec. 7034 authorizes a new Professional Science Masters program at NSF.

6. Questions for Witnesses

Dr. Bement

- How does the FY 2009 budget request address the NSF programs authorized in the America COMPETES Act, including math and science education activities?
- How has the planning and budgeting process changed for major research facilities? Why doesn't the FY 2009 MREFC budget request contain any out-year budget requests for the FY 2009 new start, the Advanced Technology Solar Telescope? Furthermore, there are no horizon projects listed in the 2008 Facility Plan. Are there any projects in readiness stage for FY 2010? If not, when can we expect to see a proposal for FY 2010 new-starts?

⁴ http://www.nsf.gov/nsb/publications/2008/rprt_congress_cs_policy.pdf

- Please elaborate on the three new cross-Foundation initiatives for FY 2009: Science and Engineering Beyond Moore's Law, Adaptive Systems Technology, and Dynamics of Water Processes in the Environment. How did these initiatives come about? To what extent do they repackage existing efforts? What new research directions are being funded under these initiatives?
- What is the role of NSF in promoting international science cooperation? To what extent do you coordinate your international efforts with the Department of State or other federal agencies? In particular, what role do you have in promoting scientific exchange with scientists in countries whose research infrastructure lags behind that of United States?

Dr. Beering

- How has the planning and budgeting process changed for major research facilities? How will the role of the Board change in this process?
- What is the appropriate role of NSF in promoting international science cooperation? How should NSF coordinate its international efforts with the Department of State and other federal agencies? In particular, what role does or should NSF have in promoting scientific exchange with scientists in countries whose research infrastructure lags behind that of United States?
- Is the Board satisfied with the current funding level for the Foundation's education programs and with the priorities among categories of programs (K-12, undergraduate, and graduate)? On what basis should NSF make decisions about how to allocate budgets across education programs? In particular:
 - What are the highest priority NSF programs that address K-12 STEM education, and in particular, please comment on whether the Board has a view on the adequacy of the FY09 budget request for the Robert Noyce Teacher Scholarship Program and the Math and Science Partnerships?
 - Does the Board believe there is an appropriate balance among the different modes of support for graduate students (fellowships, traineeships, and research assistantships)?

National Science Foundation
 FY 2009 Budget Request (dollars in millions)
 (Source: Agency Budget Justification)

NSF Program Activity	FY 2007 Actual	FY 2008 Estimate	FY 2009 COMPETES Authorization	FY 2009 Request	Change over FY 2008	
					Amount	% Change
Research and Related Activities (R&RA)	4758	4821	5742	5594	772.5	16.0%
Biological Sciences	609	612		675	63.0	10.3%
Computer and Information Science and Engineering	527	535		639	104.2	19.5%
Engineering	630	637		759	122.5	19.2%
Geosciences	746	753		849	96.0	12.8%
Math & Physical Sciences	1151	1167		1403	235.4	20.2%
Social, Behavioral and Economic Sciences	215	215		233	18.4	8.5%
Cyberinfrastructure	182	185		220	34.8	18.8%
International S&E	40	41		47	6.1	14.8%
Polar Programs	438	443		491	48.4	10.9%
<i>Icebreakers</i>	53	57		54	-3.0	-5.3%
Integrative Activities	219	232		276	43.7	18.8%
<i>EPSCoR</i>	102	111*	133	114	2.4	2.2%
<i>Instrumentation (MRI)</i>	90	94	123	115	21.1	22.5%
US Arctic Research Comm.	1.45	1.47		1.53	0.06	4.1%
CAREER**	187.4	167.8	184	181.9	14.1	8.4%
Graduate Research and Education**	58.6	54.2	63	55.2	0.97	1.8%
<i>Graduate Research Fellowships (GRF)</i>	8.14	8.06	10.0	8.06	0.0	0.0%
<i>IGERT</i>	42.4	37.8	53	38.8	1.0	2.6%
<i>Teaching Fellows (GK-12)</i>	8.09	8.31		8.31	0.0	0.0%
Research Experiences for Undergraduates (REU)**	63.3	57.7	68	61.6	3.8	6.6%
Education and Human Resources (EHR)	696	726	995	790	64.8	8.9%
Research on Learning	209	214		227	12.5	5.8%
Noyce Scholarships	10.3	10.8*	115.0	11.6	0.8	7.4%
Math & Science Partnerships	46	49	111	51	2.5	5.2%
STEM Talent Expansion	29	30	50	30	0.0	0.0%
Advanced Tech Education	51	52	58	52	0.0	0.0%
Grad Research and Educ	156	160	137	191	30.6	19.1%
<i>GRF</i>	86	88	107	117	28.6	32.5%
<i>IGERT</i>	25	25	30	25	0.0	0.0%
<i>GK-12</i>	45	47		49	2.0	4.3%
Human Resources Develop.	126	140		153	12.9	9.2%
Major Research Equipment & Facilities Construction (MREFC)	166	221	262	148	-73.2	-33.2%
Agency Operations (AOAM)	248	282	310	305	23.3	8.3%
Inspector General (OIG)	11.9	11.4	12.8	13.1	1.7	14.6%
Nat. Science Board (NSB)	3.7	4.0	4.2	4.0	0.1	1.5%
AGENCY TOTAL	5884	6032	7326	6854	822.0	13.6%

Blank cells: The COMPETES Act was silent on several of the funding lines shown here.

* below the level appropriated in the omnibus (\$115m for EPSCoR and \$15m for Noyce)

** These programs cut across all of the research directorates.