The Budget Vise Tightens: NSF Fiscal Year 2006 Budget Request

This article is the 33rd in a series of annual reports outlining the president's request to Congress for the budget of the National Science Foundation. Last year's report appeared in the June/July 2004 issue of the *Notices*, pages 651–55.

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Mathematicians taking a look at the fiscal year 2006 budget request for the National Science Foundation (NSF) will find their field highlighted as a "priority area". And yet when they get to the fine print and check the numbers, they will see that the NSF's Division of Mathematical Sciences (DMS) is slated for a zero increase.

This paradoxical state of affairs for mathematics is just one of many disappointments for the research community as the highly constrained budget process for 2006 gets under way. In February 2005 the Bush administration sent to Congress its budget request for fiscal year 2006, which begins on October 1, 2005. Tax cuts, an economy that has remained in low gear, and mounting bills for the war in Iraq and for national security have all combined to push the federal deficit to record proportions. As a result, many government activities are squeezed in the fiscal 2006 budget, and funding for research is no exception. Congress, which generally favors research, will rework the president's budget during the appropriations process, but the legislators do not have much wiggle room. The reality of too many priorities chasing too few dollars will not go away.

According to an analysis by the American Association for the Advancement of Science, under the terms of the fiscal 2006 request, total federal spending on research and development would rise $84 million for a total of $132.3 billion, a 0.1% increase over fiscal year 2005. Basic and applied research would decline by 1.4%, a decrease that comes on the heels of a small increase of just 1.4% the previous year. Against that backdrop the requested increase of 2.4% for the NSF looks at first glance to be pretty good. The outlook for, say, the Department of Energy's Office of Science, for which the Bush administration has requested a 4.5% cut, is far worse. But this relative good news for the NSF masks a troubling reality. The NSF absorbed a 3.2% cut last year, so if the new request is enacted, the foundation's budget for fiscal 2006 would actually fall below the level of fiscal 2004. This would amount to a substantial cut when attrition by inflation is taken into account.

As Table 1 shows, NSF funding for research activities, outside of the mathematical sciences, would grow by 4.5%. But again, a closer look at the numbers gives a bleaker picture. Out of the $189 million increase, $48 million will go toward covering costs associated with the management of the polar icebreaking fleet, a responsibility formerly held by the Coast Guard. According to congressional testimony by NSF director Arden Bement Jr., the reason for the transfer of responsibility is increased participation by the Coast Guard in homeland security. Some have questioned whether $48 million suffices, with some estimates holding that the true cost of the icebreaking activities could be as much as $75 million annually.

Another big part of the increase for NSF research activities comes in the "Major Research Equipment and Facilities Construction" account, which would receive an increase of 44%, or $76 million. While no new starts are planned, several construction projects that were put on hold will begin in fiscal 2006. If one sets aside the increases for the icebreaking fleet and for facilities construction,

the increase for the rest of the NSF's "Research and Related Activities" account would be just 1.5%.

But the hardest hit area within the NSF is the Education and Human Resources (EHR) directorate, which is slated for a 12.4% reduction. This cut comes on top of a 10.9% cut for EHR in fiscal 2005 (the administration actually requested an even larger cut of 17.9%). In recent years Congress has typically given EHR higher budgets than the administration has requested, so this proposed reduction might not become a reality. Indeed, some have speculated that the administration proposed a big cut for EHR anticipating that Congress would not let such a cut go through.

In past years the NSF appropriation was overseen by House and Senate subcommittees called Veterans' Affairs, Housing and Urban Development, and Independent Agencies. The NSF was one of the "independent agencies", as was the National Aeronautics and Space Administration (NASA). This year has seen a revamping of the appropriations subcommittees. Among the newly created subcommittees are Science, State, Justice, and Commerce and Related Agencies on the House side, and its counterpart Commerce, Justice, and Science on the Senate side. The NSF and NASA, along with the National Institute of Standards and Technology, are now under the jurisdiction of these subcommittees. While the NSF was not well placed in the VA-HUD subcommittees, it is not clear it will fare better in the new scenario. Sharing the appropriations pie with NASA may make for stiff competition. NASA is slated for a 4.6% increase in the 2006 request, as President Bush's initiative for increased space exploration gets under way.

From Priority Area to a Flat Budget

When the 3.2% cut hit the NSF in the current fiscal year, the DMS was protected, relatively speaking. As other divisions sustained reductions of up to 5%, the DMS received a tiny increase in fiscal 2005 to $200.38 million, up from $200.35 million. This

Table 1: National Science Foundation (Millions of Dollars)

	2002 Actual	Change	2003 Actual	Change	2004 Actual	Change	2005 Plan	Change	2006 Request
(1) Mathematical Sciences Research Support	$ 151.5	18.0%	$ 178.8	12.0%	$ 200.3	0.0%	$ 200.4	0.0%	$ 200.4
(2) Other Research Support (Note a)	3579.8	13.3%	4054.7	5.5%	4277.0	-1.9%	4193.8	4.5%	4383.1
(3) Education and Human Resources (Note b)	866.1	7.9%	934.9	1.0%	944.1	-10.9%	841.4	-12.4%	737.0
(4) Salaries and Expenses (Note c)	176.6	13.8%	201.0	14.7%	230.6	2.9%	237.2	19.9%	284.5
(5) Totals	$4774.1	12.5%	$5369.3	5.3%	$5652.0	-3.2%	$5472.8	2.4%	$5605.0
(6) (1) as a % of the sum of (1) and (2)	4.06%		4.22%		4.47%		4.56%		4.37%
(7) (1) as a % of (5)	3.17%		3.33%		3.54%		3.66%		3.57%

Tables prepared by Notices *staff.*
Note a: Support for research and related activities in areas other than the mathematical sciences. Includes scientific research facilities and instrumentation. **Note b:** Support for education in all fields, including the mathematical sciences. **Note c:** Administrative expenses of operating the NSF, including the National Science Board and the Office of the Inspector General.

Table 2: Directorate for Mathematical and Physical Sciences (Millions of Dollars)

	2002 Actual	% of Total	2003 Actual	% of Total	2004 Actual	% of Total	2005 Plan	% of Total	2006 Request	% of Total
(1) Mathematical Sciences	$151.5	16.5%	$ 178.8	17.2%	$ 200.3	18.3%	$ 200.4	18.7%	$ 200.4	18.4%
(2) Astronomical Sciences	166.0	18.0%	187.1	18.0%	196.6	18.0%	195.1	18.2%	198.6	18.3%
(3) Physics	195.9	21.3%	224.5	21.6%	227.8	20.9%	224.9	21.0%	230.1	21.2%
(4) Chemistry	162.8	17.7%	181.6	17.4%	185.1	17.0%	179.4	16.8%	181.4	16.7%
(5) Materials Research	219.4	23.8%	241.4	23.2%	250.6	23.0%	240.5	22.5%	245.7	22.6%
(6) Office of Multidisciplinary Activities	24.8	2.7%	27.3	2.6%	31.1	2.8%	29.5	2.8%	30.0	2.8%
(7) Totals	$920.4	100.0%	$1040.7	100.0%	$1091.6	100.0%	$1069.9	100.0%	$1086.2	100.0%

year it is the DMS's turn to take a hit: The other divisions within the Mathematical and Physical Sciences directorate are slated for increases of 1% or 2%, while the DMS is flat. Although the designation of the mathematical sciences as an NSF "priority area" did not help the DMS in the fiscal 2006 request, it did have a substantial impact on the division's budget in earlier years: As Table 3 shows, between 2000, when talk of a "priority area" first began, and 2004 the DMS budget rose 72% in constant dollars.

At the beginning of that period, when the economy was booming and government coffers were full, there was talk of even quadrupling the budget of the DMS—and of doubling that of the NSF as a whole. In late 2002 Congress passed a bill authorizing year-by-year increases, with the aim of doubling the NSF budget by 2007. But the bill was an authorization, not an appropriation, so as the fiscal condition of the government worsened, the bill's provisions fell by the wayside. In anticipation of large increases promised by the bill, some NSF divisions made commitments that are proving hard to keep with the current restricted budget. William Rundell, director of the DMS, said that his division managed to avoid becoming dangerously overcommitted. Nevertheless, he said, "We built programs that, frankly, we would never have done were it not for the prospect and likelihood that the budget would increase still further." As Rundell put it, "The mood around here certainly isn't what it was two years ago."

While this year the DMS has "tightened every belt imaginable," Rundell said, the division's main priority has been to protect core funding for research grants. In fact, in the current fiscal year the DMS increased slightly the funding for single-investigator grants "by clamping down on anything we can cut." Rundell said that the priority given to research grants will be the same in fiscal 2006. The AMS Committee on Science Policy (CSP) seems to be in tune with this strategy. At its meeting in April 2005 the CSP passed a resolution that states: "The AMS Committee on Science Policy recommends to DMS that it consider redirecting some NSF funds in order to increase the number of individual investigator grants, focused research grants and their equivalent." However, the constraints on the DMS may reach a point where this priority can be sustained only by cutting something fairly large out of the budget.

Last fall, rumors circulated that one of the five NSF-funded mathematics institutes might be eliminated. (These institutes are the Mathematical Sciences Research Institute in Berkeley, the Institute for Mathematics and its Applications at the University of Minnesota, the Institute for Pure and Applied Mathematics at the University of California at Los Angeles, the Mathematical Biosciences Institute at Ohio State University, and the Statistical and Applied Mathematical Sciences Institute at the Research Triangle Park. In addition, the School of Mathematics at the Institute for Advanced Study, the American Institute of Mathematics Research Conference Center in Palo Alto, and the Banff International Research Station in Banff, Canada, also receive institute funding from the NSF.) Asked if one of the institutes might be eliminated if the fiscal situation worsens, Rundell replied that this is a possibility: "Nothing is a given." Since the DMS has put top priority on research grants and since it received "priority area" designation in part by establishing work force programs like EMSW21 (Enhancing the Mathematical Sciences Workforce

Table 3: Compilation of NSF Budget, 2000–2006 (Millions of Dollars)

	2000 Actual	2001 Actual	2002 Actual	2003 Actual	2004 Actual	2005 Plan	2006 Request	2000–2004 Change	2000–2006 Change
(1) Mathematical Sciences Research Support	$ 106.0	$ 121.4	$ 151.5	$ 178.8	$ 200.3	$ 200.4	$ 200.4	89.0%	89.1%
Constant Dollars	*61.6*	*68.5*	*84.2*	*97.2*	*106.0*			*72.1%*	
(2) Other Research Support (Note a)	2978.9	3370.2	3579.8	4054.7	4277.0	4193.8	4383.1	43.6%	47.1%
Constant Dollars	*1729.9*	*1903.0*	*1989.9*	*2203.6*	*2264.2*			*30.9%*	
(3) Education and Human Resources (Note b)	683.6	795.4	866.1	934.9	944.1	841.4	737.0	38.1%	7.8%
Constant Dollars	*397.0*	*449.1*	*481.4*	*508.1*	*499.8*			*25.9%*	
(4) Salaries and Expenses (Note c)	154.9	172.9	176.6	201.0	230.6	237.2	284.5	48.9%	83.7%
Constant Dollars	*89.9*	*97.6*	*98.2*	*109.2*	*122.1*			*35.8%*	
(5) Totals	$3923.4	$4459.9	$4774.1	$5369.3	$5652.0	$5472.8	$5605.0	44.1%	42.9%
Constant Dollars	*2278.4*	*2518.3*	*2653.8*	*2918.1*	*2992.0*			*31.3%*	

Current dollars are converted to constant dollars using the Consumer Price Index (based on prices during 1982–84).

For Notes a, b, and c, see Table 1.

NSF Director Addresses Committee on Science Policy

On April 8, 2005, Arden Bement Jr., director of the National Science Foundation, spoke before a meeting of the AMS Committee on Science Policy. He began by noting that investments in research and education "contribute not only to economic growth and societal well-being but also to the increasing demands of national security." With this in mind, the NSF is developing a strategic plan that takes into account the constraints imposed by the federal budget. A key part of this plan will be to strengthen core research, since strong and healthy core disciplines lay the foundation on which quality interdisciplinary work is built. Bement said that increased funding in the past has also allowed the NSF to "improve the training of the future work force and to launch new, interdisciplinary programs." He pointed to the successes of programs like VIGRE (Vertical Integration of Research and Education in the Mathematical Sciences) in increasing the number of graduate students in mathematics and emphasizing mentoring and the preparation of students for research.

Bement said that "these are the success stories that resonate with policymakers and the public—people who want to know that their investments in research and education are worthwhile." Another sign that the investment has paid off is the emerging and unexpected applications of core research to interdisciplinary research. He pointed to several examples of how mathematical tools from topology and complex variables have had an impact on biomedical research. Partnerships between the mathematical sciences and the other sciences allow the NSF to demonstrate reasons for public support and also to leverage its resources in times of budget constraints. He pointed to opportunities not only in the biological sciences but also in the information sciences, where the ability to store, analyze, and visualize vast quantities of data is crucial to applications ranging from medical diagnosis to homeland security.

Bement finished his prepared remarks by emphasizing the need to continue to publicize research activities and engage in policy discussions. "To keep mathematics in the forefront of science and engineering and to sustain public support, we must clearly communicate both critical needs and brilliant results."

Bement then invited questions from the audience. When asked if there will be changes in the types of programs the NSF sponsors and in how they are administered, Bement lamented the erosion in the success rate of proposals and its demoralizing and counterproductive influence. He hopes to support more unsolicited single researcher proposals and narrow the focus on solicited proposals as well as cut back on some initiatives. In response to a question on the future of funding for mathematics education, Bement mentioned a bill that will be introduced in Congress to forgive interest on loans to students in science education programs in return for a two-year commitment to public service. Several people raised the question of whether it is better for mathematicians to push for support for basic science across the board or to emphasize mathematics. Bement cautioned that too narrow a strategy would minimize its effect and suggested that mathematicians need to help legislators understand how science works and its impact on society. A recurrent theme in many questions was the need to fund young researchers and active individual researchers and the concern that bigger grants, pluridisciplinary programs, and the review structure have had a negative impact on this need. Bement reiterated his desire to rebuild the core and increase the success rate.

—Michael F. Singer

Michael Singer is professor of mathematics at North Carolina State University and an AMS Council representative on the Committee on Science Policy.

The full text of Bement's prepared remarks may be found at `http://www.ams.org/ams/ArdenBement.PreparedRemarks.CSP2005.pdf`.

in the 21st Century), it is the other elements of the NSF portfolio that might end up on the chopping block—and the institutes are among them.

In the current restrained budget climate, one new idea the DMS may pursue is funding travel and workshops on a scale that is something between, say, a one-time $20,000 conference, and a $2-million-a-year institute. One model would be to establish research networks of the type that have developed in Europe with funding from the European Union. These networks—which sport clever acronyms like EAGER (European Algebraic Geometry Research Training Network) and EDGE (European Differential Geometry Endeavor)—link researchers at different institutions across several countries and are supported by multiyear grants on the order of $500,000 per year to fund meetings, research visits, postdoctoral researchers, and graduate students. If the DMS began funding such networks, a key aim would be to broaden participation by women, minorities, and those in nonelite institutions.

"There are no entitlements," Rundell said of the decisions the DMS will be making. "Everything is getting looked at very carefully. If something does not look first class, it may not be funded [in order] to make way for priorities."

Groundswell of Discontent

In the weeks and months after the release of the administration's fiscal 2006 budget request, many protested what they saw as inadequate increases for scientific research. During a February hearing of the House Science Committee, Vernon Ehlers (R-MI) summed up the general feeling: "I recognize the tough budget, I recognize tough times, I recognize the military necessities we have. But we seem to forget the important role that research and

education play in our national defense and also in our national prosperity." Many suggested that it is shortsighted for the U.S. to rein in its support for research just at a time when its competitors around the world—notably in Asia—are expanding theirs.

Discontent over the low increase for science is being heard not just from strong science supporters like Ehlers, who holds a Ph.D. in physics, and not just from the science community itself. Representatives of industry are also weighing in. Some of their concerns came out during a press briefing held in February 2005 by the Task Force on the Future of American Innovation, a coalition of high-tech companies, business associations, higher education groups, and scientific organizations (including the AMS). At the briefing, one of the speakers was Craig Barrett, president of Intel Corporation, who described how low investment in science in the U.S. has translated into a shortage of science and engineering talent. "This is the first time in a while that I have seen industry mobilized," remarked Samuel M. Rankin III, director of the AMS Washington office. "We've reached a point where people are beginning to worry," he continued. "In science, yes, they are concerned, but now it's starting to resonate with industry. The more we can get industry involved in preaching the value of basic research, the better chance we have to get an increase."

In March 2005 the Coalition for National Science Funding, an advocacy group that includes the AMS, issued a call for Congress to pass a $6-billion budget for the NSF. Not long afterward, supporters of science in Congress drafted a letter proposing just such a budget. Are these efforts likely to bear fruit? Rankin says he does not know. "But we are in a situation where we simply have to make the case that the NSF is important," he said. And it is especially important in mathematics. The NSF provides more than three-quarters of all federal funding for academic research in mathematics, a much higher percentage than in most other areas of science. What the last few years have shown is, while it is great to be dubbed a "priority area", what really makes a difference for mathematics funding is having a strong budget for the NSF overall. And for fiscal 2006, that is unlikely to happen.

—Allyn Jackson