

NSF Fiscal Year 2003 Budget Request

This article is the 30th 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 August 2001 issue of the *Notices*, pages 705-708.

Last fall, Congress passed the appropriations bill providing money for the National Science Foundation (NSF) for fiscal year 2002, which runs from October 2001 through September 2002. Buried in the conference report for the bill, amid discussions of funding for high-profile projects like telescopes and particle colliders, is this statement: "The conferees have also placed a high priority on mathematics research within the amounts provided for this activity." This small statement is having a big impact on the mathematical sciences, for it has translated into a \$30 million increase in NSF spending in this area.

Each year, on the first Monday in February, the federal budget cycle begins when the president sends his budget request to Congress for the next fiscal year, which starts the following October. The fiscal year 2002 request was delayed from February to April 2001, due to the change in administration. That request was not kind to science. The NSF stood to gain only a miserly 1 percent, although even in that lean budget the NSF's Division of Mathematical Sciences (DMS) was singled out for a substantial rise. As criticism came from many quarters about the paltry increases for science throughout the budget request, and as the events of September 11 underscored the need for scientific research to bolster the nation's defenses, Congress decided to put more money into science. As a result, the fiscal year 2002 federal budget, when it was finally enacted by Congress last fall, included an 8.4 percent increase for the NSF, and science budgets rose across the federal government. And the budget for the DMS surged past its requested level, climbing to \$151.5 million, an increase of 24.7 percent.

The increases for the DMS have resulted from a mathematical sciences initiative (now being called a "priority area"), which was approved in October 2000 by the National Science Board, the NSF's policymaking body. The influence of this initiative can also be seen in the fiscal year 2003 budget request, which was sent to Congress on February 4, 2002. Although the requested increase for the NSF overall is only 5 percent, the DMS would receive a \$30 million hike, amounting to a 20 percent rise for the

division and bringing its total budget to \$181 million for fiscal 2003. There has been "a recognition and an identification of the mathematical sciences as a priority area, with implications that 2003 is one increase in several to follow," said Philippe Tondeur, director of the DMS. "This may change the landscape of mathematical sciences funding by the NSF."

How did the mathematical sciences initiative come about? According to Samuel M. Rankin III, director of the AMS Washington Office, some of the groundwork was laid by Donald J. Lewis of the University of Michigan, when he was director of the DMS from 1995 to 1999. Lewis launched some innovative programs, such as VIGRE (Vertical Integration of Research and Education), that had a large impact in the mathematical sciences community and high visibility within the NSF. In addition, Rankin noted, then-AMS president Arthur Jaffe of Harvard University worked hard to convey the importance of the mathematical sciences to the upper echelons of the NSF. In September 1998, biologist Rita Colwell was named director of the NSF, and she has become an enthusiastic champion for the mathematical sciences. Jaffe invited her to speak at the May 1999 inauguration of the Clay Mathematics Institute, a philanthropic organization he heads. "From that time on, she really started talking a lot about mathematics," Rankin recalled. Then Tondeur came to the NSF in the summer of 1999 and aggressively began making the case for strong NSF support of the mathematical sciences. "On a daily basis, Tondeur is pushing mathematics, and he has done an excellent job working the system," Rankin said.

DMS Plans for Fiscal 2002

One way the DMS plans to use its fiscal year 2002 increase is in making three new awards for mathematical sciences institutes, bringing to six the total number of institutes funded by the DMS (the existing three are the Mathematical Sciences Research Institute in Berkeley, the Institute for Mathematics and its Applications at the University of Minnesota, and the Institute for Pure and Applied Mathematics at the University of California, Los Angeles). At the time of this writing, the awards

were still in the process of negotiation and the locations and natures of the new institutes had not been announced. During fiscal year 2002, the new institutes will receive start-up funding and will come to full funding only in fiscal 2003. The current plan for fiscal year 2002 calls for the DMS to spend \$12.8 million on institutes; the fiscal year 2003 request raises this amount to \$14.0 million. The DMS is also contributing to a mathematical sciences institute established last year in Canada, the Banff International Research Station (BIRS). However, the DMS contribution to BIRS is much less than for the U.S. institutes: \$1.3 million over four years. Primary funding for BIRS comes from the Canadian government and the province of Alberta.

In arguing for increases for mathematics, Tondeur has emphasized three themes—interdisciplinary research, fundamental research, and education—and these can be seen in the DMS plans for spending its \$30 million increase for fiscal year 2002. Under the banner of interdisciplinary research, the DMS has issued calls for proposals for “partnership” programs in three areas. The first is designed to stimulate work at the interface of mathematics and biology and is jointly funded by the DMS (which is contributing \$2 million) and the National Institute of General Medical Sciences (which is contributing \$4 million). The second partnership focuses on mathematics and the geosciences, with an initial emphasis on analyzing and modeling geosystems that contain a broad range of interacting scales. For this partnership, the DMS and the NSF’s Geosciences directorate will each contribute \$2 million. The third partnership is called CARGO (Computational and Algorithmic Representation of Geometric Objects) and has three sponsors: the DMS (\$1.5 million), the NSF’s Computer and Information Science and Engineering directorate (\$1.5 million), and the Defense Advanced Research Projects Agency (\$1 million).

Under the theme of fundamental research, the Focused Research Groups (FRGs) program will go from \$9 million in fiscal 2001 to \$12 million in fiscal 2002. The DMS has always funded group grants, but often the researchers on such grants have only loose collaborative ties. To be funded under the FRG program, a proposal must justify how the group can together achieve things that would not be possible with the individual researchers working alone. Tondeur pointed to the earlier effort to classify all finite simple groups as an example of a project that required intensive group work. In fiscal year 2001, the DMS funded ten FRGs, and Tondeur said the number will increase in fiscal year 2002. Some FRGs involve researchers from other disciplines and are jointly funded with other NSF divisions.

The heart of the DMS portfolio in fundamental research remains its disciplinary programs, which emphasize individual research grants: Algebra,

Number Theory, and Combinatorics; Analysis; Applied Mathematics; Computational Mathematics; Statistics and Probability; and Geometric Analysis, Topology, and Foundations. Tondeur said that in fiscal year 2002, increases for the disciplinary programs “will be bigger than ever before,” with all the programs receiving increases in the 9 to 16 percent range. Further increases are also projected for fiscal year 2003. These increases, he indicated, have come as a result of the diversification of the DMS portfolio. “The programs get better increases in a diversified strategy than in any other way,” he said. And, “the fact that we have diversified our portfolio has made us more attractive for increased investments.” He pointed out that opportunities for research support will also increase through the FRGs and the partnership grants, which fund researchers in much the same way as individual grants do. According to an NSF “fact sheet” about the mathematical sciences initiative, the fiscal year 2003 budget request would allow the DMS to support 2,000 individual investigators (including some working in teams), 300 postdoctoral scholars, and 1,300 graduate students.

Rankin noted that, when it comes to increases for individual grants, the NSF tends to emphasize upping grant size and duration, but rarely mentions raising the total number of grants. “Nobody ever tries to sell that,” he remarked. Now, though, the Coalition for National Science Funding (CNSF) has taken up the cause. The CNSF, which Rankin currently chairs, is an alliance of over ninety universities and scientific and professional societies that have banded together to support the goal of increasing the NSF budget. The CNSF has issued a statement outlining what it believes should be priorities for the fiscal year 2003 NSF budget. At the top of the priority list is an increase of \$220 million for funding for core programs in research and education. “Presently, 13 percent of highly rated proposals to NSF are not funded due to lack of funds,” the statement says. “The proposed increase would...enable more highly rated proposals to be funded, allowing NSF to meet unrealized opportunities in core research and education.”

The main showpiece for the DMS educational theme is the VIGRE program. VIGRE supports innovative projects in mathematical sciences departments, in which research and education are integrated through interactions among undergraduates, graduate students, postdoctoral fellows, and faculty. There are currently thirty-one VIGRE grants active. The DMS recently completed an assessment of the projects funded during the first year of VIGRE and has decided to terminate some of those grants and also to fund some new ones. In fiscal year 2002, the DMS will spend about \$16 million on VIGRE. The program will remain an important part of the DMS portfolio, but Tondeur said he cannot anticipate what the level of funding for fiscal year

2003 will be until the proposals come in for the next deadline for the program, which is in July 2002. As Tondeur put it, "there is no prescribed growth model for VIGRE."

The VIGRE program has brought a mixed reaction from the mathematical sciences community. At the Joint Mathematics Meetings in San Diego in January 2002, Rankin went to a VIGRE focus group attended by about twenty-five directors of graduate programs (or their representatives). Based on the reactions at the focus group, Rankin reported, it appears that some departments feel pressure to go after VIGRE grants simply in order to remain competitive with those departments that already have the grants. VIGRE provides good support for graduate students, and departments without the grants find they are at a disadvantage in attracting qualified students. At the same time, because students supported on VIGRE grants must be U.S. citizens, departments that have the grants find that the pool of well-qualified U.S. students is too small. VIGRE-supported students are not

permitted to teach, so some departments with VIGRE grants find they have to bring in graduate students from other disciplines to teach mathematics classes. As Rankin summed up the general reaction, "VIGRE presents as many dilemmas and problems as positive attributes."

Math a Priority in 2003

Scanning through the fiscal year 2003 request, one finds that the DMS stands out among the NSF divisions as having one of the highest requested increases. Within the Mathematical and Physical Sciences (MPS) directorate, the DMS is clearly the big winner: The request calls for cuts for all of the other disciplinary divisions in the MPS, and overall the directorate's budget would rise only 2.3 percent. Another big increase is seen in the Math and Science Partnerships program, begun in fiscal year 2002 in the Education and Human Resources directorate (this program is separate from the partnerships established in the DMS). The program's budget would rise from \$160 million to

Table 1: National Science Foundation (Millions of Dollars)

	1999 Actual	Change	2000 Actual	Change	2001 Actual	Change	2002 Plan	Change	2003 Request
(1) Mathematical Sciences Research Support	\$ 100.7	5.3%	\$ 106.0	14.5%	\$ 121.4	24.8%	\$ 151.5	20.1%	\$ 181.9
(2) Other Research Support (Note a)	2777.6	7.2%	2978.9	13.1%	3370.2	6.4%	3586.0	3.9%	3727.6
(3) Education and Human Resources (Note b)	662.5	3.2%	683.6	16.3%	795.4	10.0%	875.0	3.8%	908.1
(4) Salaries and Expenses (Note c)	149.5	3.6%	154.9	11.6%	172.9	6.1%	183.5	18.9%	218.2
(5) Totals	\$3690.3	6.3%	\$3923.4	13.7%	\$4459.9	7.5%	\$4795.9	5.0%	\$5035.8
(6) (1) as a % of the sum of (1) and (2)	3.50%		3.44%		3.48%		4.05%		4.65%
(7) (1) as a % of (5)	2.73%		2.70%		2.72%		3.16%		3.61%

Note a: Support for research and related activities in areas other than the mathematical sciences. Includes scientific research facilities and instrumentation and the Antarctic program. **Note b:** Support for education in all fields, including the mathematical sciences. Does not include funds collected through H1-B Nonimmigrant Petitioner receipts. **Note c:** Administrative expenses of operating the NSF, including the Office of the Inspector General.

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

	1999		2000		2001		2002		2003	
	Actual	% of Total	Actual	% of Total	Actual	% of Total	Plan	% of Total	Request	% of Total
(1) Mathematical Sciences	\$100.7	13.7%	\$106.0	14.0%	\$121.4	14.2%	\$151.5	16.5%	\$181.9	19.3%
(2) Astronomical Sciences	118.5	16.1%	122.5	16.2%	148.7	17.4%	165.9	18.0%	161.2	17.1%
(3) Physics	162.7	22.2%	168.3	22.3%	187.5	22.0%	195.9	21.3%	193.3	20.5%
(4) Chemistry	135.3	18.4%	138.6	18.3%	154.3	18.1%	162.9	17.7%	160.8	17.1%
(5) Materials Research	186.4	25.4%	190.5	25.2%	209.7	24.5%	219.5	23.8%	219.3	23.3%
(6) Office of Multidisciplinary Activities	29.9	4.1%	29.9	4.0%	32.4	3.8%	24.8	2.7%	25.0	2.7%
(7) Totals	\$733.6	100%	\$755.9	100%	\$854.1	100%	\$920.4	100%	\$941.6	100%

\$200 million in fiscal year 2003; plans call for funding for the program to reach about \$1 billion in five years. "The [Partnerships program] brings states and local school districts together with the science, engineering, mathematics and education departments of institutions of higher education to strengthen pre-K-12 math and science education," the budget request states. "The partnership also aims to increase the number, quality and diversity of pre-K-12 math and science teachers."

The request identifies six main "priority areas," one of them being the mathematical sciences initiative (the change in terminology from "initiative" to "priority area" is due to the new administration's decree that the government take on "no new initiatives"). The other five are Biocomplexity in the Environment; Information Technology Research; Nanoscale Science and Engineering; Learning for the Twenty-first Century; and Social, Behavioral, and Economic Sciences. Among these six, the mathematical sciences initiative has the largest percentage increase, though in dollar amount it is much smaller than some of the others. Funding for the mathematical sciences initiative would increase from \$30.0 million in fiscal year 2002 to \$60.09 million in fiscal year 2003. The budget request also outlines long-term funding for the initiative, which would reach \$109.5 million by 2007. However, given the realities of year-to-year budgeting by the government, such long-term plans are notoriously difficult to carry out.

How does the requested increase for the mathematical sciences initiative relate to the DMS budget? For fiscal year 2002, the entire \$30.0 million investment in the initiative went to the DMS, whereas the fiscal year 2003 investment of \$60.09 million would be spread across eight NSF directorates; for example, \$0.91 million would go

to the Biological Sciences directorate, and \$2.74 million would go to the Education and Human Resources directorate. Most of the increase, though, would be concentrated in the MPS, whose investment in the mathematical sciences initiative would increase by \$17.39 million and total \$47.39 million in fiscal year 2003. The entire \$17.39 million increase would go to the DMS. The total requested increase for the DMS for fiscal year 2003 is \$30.39 million. Therefore, the request provides for a \$13.0 million increase for the DMS apart from the mathematical sciences initiative.

New Opportunities Ahead

With the increase for the DMS for fiscal year 2002 and the likelihood of more such increases in coming years, Tondeur sees a bright future for support of the mathematical sciences. "I hope researchers will find it's a wonderful playing field and will do extraordinary things with these extraordinary opportunities," he said. "In particular, I hope the improved landscape will encourage young people to join this glorious profession."

Tondeur's tour of duty in the DMS ends on July 31, 2002, and, despite his clearly successful time there, he has vowed not to stay past that date. Right now the NSF is looking for a replacement. "During the three years of my tenure at the helm of DMS, the NSF leadership has been extremely supportive of the mathematical sciences, increasing the DMS budget requests by 70 percent over this period," he said. "I hope for a successor who will be able to build on this effort."

—Allyn Jackson

The NSF fiscal year 2003 budget request is available at the website <http://www.nsf.gov/bfa/bud/fy2003/start.htm>.

Table 3: Compilation of NSF Budget, 1997–2003 (Millions of Dollars)

	1997 Actual	1998 Actual	1999 Actual	2000 Actual	2001 Actual	2002 Plan	2003 Request	1997–2001 Change	1997–2003 Change
(1) Mathematical Sciences Research Support	\$ 92.9	\$ 93.6	\$ 100.7	\$ 106.0	\$ 121.4	\$ 151.5	\$ 181.9	30.7%	95.8%
<i>Constant Dollars</i>	57.9	57.4	60.4	61.6	68.5			18.3%	
(2) Other Research Support (Note a)	2447.2	2557.2	2777.6	2978.9	3370.2	3586.0	3727.6	37.7%	52.3%
<i>Constant Dollars</i>	1524.7	1568.8	1667.2	1729.9	1903.0			24.8%	
(3) Education and Human Resources (Note b)	619.1	633.2	662.5	683.6	795.4	875.0	908.1	28.5%	46.7%
<i>Constant Dollars</i>	385.7	388.5	397.7	397.0	449.1			16.4%	
(4) Salaries and Expenses (Note c)	139.6	141.7	149.5	154.9	172.9	183.5	218.2	23.8%	56.3%
<i>Constant Dollars</i>	87.0	86.9	89.7	89.9	97.6			12.2%	
(5) Totals	\$3298.8	\$3425.7	\$3690.3	\$3923.4	\$4459.9	\$4795.9	\$5035.8	35.2%	52.7%
<i>Constant Dollars</i>	2055.3	2101.7	2215.1	2278.4	2518.3			22.5%	

Current dollars are converted to constant dollars using the Consumer Price Index (based on prices during 1982–1984).

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