

NSF Fiscal Year 1998 Budget Request

The Clinton Administration's budget request for fiscal year 1998 calls for an increase of 3%¹ for the National Science Foundation (NSF), slightly more than the 1.8% increase for federal funding for research and development overall. These lean figures reflect the parsimonious mood in Washington, where balancing the budget is the main priority. Funding for science enjoys strong bipartisan support in both houses of Congress, but generating enough momentum to overcome the budget-cutting mood is an uphill battle.

One of the main difficulties is that growth in entitlement programs, such as Medicare, are putting a squeeze on the entire federal budget. Individuals have a legal right to government funds through entitlement programs, so the government does not have much leeway in making decisions about those areas of the budget. By contrast, support for science comes entirely from discretionary funding—year-to-year appropriations whose size depends on what Congress decides to spend. As entitlement programs grow, the only place to trim the budget is in the discretionary pot.

As funding has become increasingly strained, the scientific community has become more vocal in pressing for increases for science. Leaders in the scientific community have been working hard to secure a 7% increase for the NSF, and this effort has garnered substantial support in Congress. Under the leadership of AMS President Arthur Jaffe, as well as the Committee on Science Policy and the Washington office, the AMS has been working with other science groups to try to make this increase a reality. Jaffe says that what is crucial now is grassroots support. "We need very strong support from the mathematics community for this movement," he said, suggesting that individual mathematicians call or write their Congressional representatives. Without a sustained push, he noted, the momentum could die out over the summer. At the time of this writing, the House of Representatives had just passed an authorization bill calling for a 7.2% increase for the NSF.

¹In Table I the increase is shown as 1.9%. The difference is due to the fact that the NSF carried over from fiscal 1996 to fiscal 1997 more than \$30 million, mostly in the Academic Research Infrastructure program. Because the funds are carried over rather than having been appropriated for fiscal 1997, the NSF does not include the carryover funds in its computation of its increase for fiscal 1998.

Whether this increase will survive through the appropriations process is unclear, but it is an optimistic sign.

Reports Analyze Budget Request

The scientific community has produced a number of reports analyzing support for science in the budget request. "The Federal Science & Technology Budget Request FY 1998", published by the National Academy of Sciences,² does its own categorizing of federal spending on science and technology rather than relying on the government's R&D groupings. Under this scenario the report finds that if the 1998 budget request is adopted, funding for science will have dropped 3.4% in constant dollars between 1994 and 1998. The report finds a 2% constant-dollar increase between 1997 and 1998, but this increase is caused by a one-time change in the way that certain facilities are funded by the Department of Energy. Without this change the budget would be flat between 1996 and 1998. For two agencies, the NSF and the National Institutes of Health, the picture has not been so dreary; these were the only two agencies receiving constant-dollar increases between 1994 and 1997. The report finds deep declines since 1994 in science and technology programs in many government departments, especially the Departments of Defense, Agriculture, and the Interior.

Another report, "AAAS Report XXII: Research and Development, FY 1998",³ prepared by the American Association for the Advancement of Science, sticks to the government's method of categorizing federal support of science. But its conclusion is no cheerier than that of the National Academy: funding for R&D will rise by 1.8% if the 1998 budget request is enacted. With inflation this means a cut of 0.8%. The AAAS report also contains a chapter on federal support of mathematics written by Lisa Thompson, Con-

²The report is available on the NAS Web site, <http://www.nas.edu/fsrd/fsrd.html>.

³For information about the AAAS report, consult the Web site <http://www.aaas.org/spp/dspp/rd/fy98.htm>. The chapter of the report devoted to mathematics will appear in the August issue of the Notices.

Table 1: National Science Foundation

millions of dollars

	1994 Actual	Change	1995 Actual	Change	1996 Actual	Change	1997 Plan	Change	1998 Request
(1) Mathematical Sciences Research Support	\$ 78.0	9.4%	\$ 85.3	2.8%	\$ 87.7	6.3%	\$ 93.2	4.1%	\$ 97.0
(2) Other Research Support (Note a)	2212.8	10.3%	2439.6	-2.4%	2381.0	2.9%	2450.8	2.1%	2502.7
(3) Education and Human Resources (Note b)	569.0	7.5%	611.9	-1.8%	601.2	3.0%	619.3	1.0%	625.5
(4) Salaries and Expenses (Note c)	127.4	4.8%	133.5	2.3%	136.5	2.2%	139.5	1.7%	141.8
(5) Totals	2987.2	9.5%	3270.3	-2.0%	3206.3	3.0%	3302.8	1.9%	3367.0
(6) (1) as a % of the sum of (1) and (2)	3.40%		3.38%		3.55%		3.66%		3.73%
(7) (1) as a % of (6)	2.61%		2.61%		2.74%		2.82%		2.88%

Note a: Support for research and related activities in areas other than the mathematical sciences. Includes scientific research facilities and instrumentation, Antarctic program, and certain research centers. Excludes Science and Technology Centers. **Note b:** The programs in this category provide support in all fields, including the mathematical sciences. **Note c:** Administrative expenses of operating the Foundation, including the Office of Inspector General.

Table 2: Directorate for Mathematical and Physical Sciences

millions of dollars

	1994		1995		1996		1997		1998	
	Actual	% of Total	Actual	% of Total	Actual	% of Total	Plan	% of Total	Request	% of Total
(1) Mathematical Sciences	\$ 78.0	(12.6%)	\$ 85.3	(13.2%)	\$ 87.7	(13.3%)	\$ 93.2	(13.4%)	\$ 97.0	(13.6%)
(2) Astronomical Sciences	101.5	(16.4%)	102.5	(16.0%)	108.7	(16.5%)	116.3	(16.7%)	118.8	(16.6%)
(3) Physics	127.4	(20.6%)	130.0	(20.1%)	131.9	(20.0%)	138.7	(19.9%)	148.2	(20.7%)
(4) Chemistry	114.9	(18.6%)	123.1	(19.1%)	127.7	(19.3%)	133.2	(19.1%)	135.4	(18.9%)
(5) Materials Research	167.2	(27.0%)	174.8	(27.1%)	175.1	(26.5%)	183.4	(26.4%)	186.3	(26.0%)
(6) Office of Multidisciplinary Activities	28.8	(4.7%)	29.5	(4.6%)	29.5	(4.5%)	31.0	(4.5%)	30.0	(4.2%)
(7) Totals	617.9		645.2		660.5		695.9		715.7	

Table 3: Compilation of the NSF Budget, 1993-1998

millions of dollars

	1993 Actual	1994 Actual	1995 Actual	1996 Actual	1997 Plan	1998 Request	1993-1996 Increase	1993-1998 Increase
(1) Mathematical Sciences Research Support	\$ 77.6	\$ 78.0	\$ 85.3	\$ 87.7	\$ 93.2	\$ 97.0	13.0%	25.0%
<i>Constant Dollars</i>	53.7	52.6	56.0	56.0			4.3%	
(2) Other Research Support	2052.5	2212.8	2439.6	2381.0	2450.8	2502.7	16.0%	21.9%
<i>Constant Dollars</i>	1420.4	1493.1	1600.8	1517.5			6.8%	
(3) Education and Human Resources	505.1	569.0	611.9	601.2	619.3	625.5	19.0%	23.8%
<i>Constant Dollars</i>	349.6	383.9	401.5	383.2			9.6%	
(4) Salaries and Expenses	114.5	127.4	133.5	136.5	139.5	141.8	19.2%	23.8%
<i>Constant Dollars</i>	79.2	86.0	87.6	87.0			9.9%	
(5) Totals	2749.7	2987.2	3270.3	3206.3	3302.8	3367.0	16.6%	22.5%
<i>Constant Dollars</i>	1902.9	2015.7	2145.9	2043.5			7.4%	

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

gressional liaison for the Joint Policy Board for Mathematics. Thompson's report states that the 1998 request would mean a 2.6% constant-dollar increase for federal funding of mathematics over the 1997 level. The mathematics programs at the science funding agencies of the Department of Defense would see a 5.8% constant-dollar increase overall, a figure that masks the fact that they suffered a precipitous 16.3% drop in constant dollars from 1995 to 1997. According to the report, the Division of Mathematical Sciences (DMS) at the NSF would see a constant-dollar increase of 1.4% with the 1998 budget request.

Although its budget is not increasing a great deal, the DMS will gain some flexibility in how it distributes its funds. The NSF is phasing out some of the Science and Technology Centers over the next couple of years, and one of those set for closure is the Geometry Center at the University of Minnesota. The Geometry Center's funding will drop from \$1.8 million in 1997 to \$0.9 million in 1998. The \$0.9 million cut from the Geometry Center will remain within the DMS and will for now be put toward principal investigator grants. In addition, the DMS has opened a new competition for the institutes it funds: the Mathematical Sciences Research Institute (MSRI) in Berkeley and the Institute for Mathematics and its Applications (IMA) at the University of Minnesota.⁴ Although the existing institutes are expected to be strong contenders in the new competition, the DMS is holding open a variety of possibilities, including institutes in the same mold as MSRI and IMA, conference centers, and "centers without walls". There is also the possibility that the DMS will fund no institutes, though this is considered unlikely. In July David Eisenbud of Brandeis University will replace William P. Thurston as director of MSRI; Thurston will move to the University of California, Davis.⁵

Initiative on Massive Data Sets

The DMS is closely involved in one of the NSF's main initiatives for 1998, called Knowledge and Distributed Intelligence (KDI); in fact, DMS director D. J. Lewis serves as the NSF-wide coordinator of the project. At the heart of the initiative is the multidisciplinary problem of managing massive data sets. "Mathematics should be able to play in all components of KDI," Lewis remarks, noting that some parts of it might be entirely devoted to mathematics. For example, one major problem in this area is

the development of algorithms to identify patterns in data sets. The DMS hosted a workshop on massive data sets last fall and will hold a tutorial on the topic in July. There was also a special session about it at the Joint Mathematics Meetings in San Diego last January. Another important mathematical aspect of KDI will be security and integrity of data. In this connection, the DMS held a workshop on cryptography and coding theory last April. Reports of these events will be posted on the DMS Web site, <http://www.nsf.gov/mps/dms/>. The NSF 1998 budget request calls for \$48 million for KDI for learning and intelligent systems (which was already begun this year), knowledge networking, and computational tools. In addition, \$10 million is requested for development of a faster "next generation" Internet.

Lewis expects that in all likelihood the Clinton budget proposal, which contains the NSF budget request, will be adopted. If this happens, then apart from any new funds for KDI the NSF's budget will remain flat. Under these circumstances Lewis is trying to take advantage of opportunities he finds at the NSF to increase funding for mathematics. His assessment of the climate at the NSF and in Washington is that one must argue for the crucial role mathematics plays in solving scientific problems that are important to society. "We are looking for ways to see where we can bring core mathematics into these activities so that we can grow the budget," he states. "What I foresee is that any growth in the NSF's budget in the next five years will be in interdisciplinary areas." And these areas require mathematics: "Without the input from core researchers," he points out, "the interdisciplinary areas will soon be stymied."

The strategy of trying to increase funding for mathematics through applications to scientific problems has sometimes provoked the reaction in the mathematical community that the DMS is neglecting core research. However, the fact that Lewis has pursued exactly that strategy has not undermined his support in the community. "I believe he is doing it with an understanding of all the parameters," says Peter Sarnak of Princeton University. "The community trusts him fully that he is working for mathematics as a whole," he commented. "I've only heard good things said about him." Sarnak also notes that Lewis is responsive to problems mathematicians are facing. For example, in the last two years Princeton has had great difficulties with funding for graduate students. As research grants have shrunk, fewer faculty have funding for students on their grants, and those who do can support at most one student. Sarnak speculated that other mathematics departments are experiencing the same problem. Lewis is now working on a pilot program that

⁴See "Recompetition of the NSF-Funded Mathematics Institutes", *Notices*, January 1997, pages 33-36.

⁵See the article about Eisenbud in this issue of the *Notices*, pages 688-689.

would provide grants to mathematics departments for integrated educational efforts, from the undergraduate through the postdoctoral level. The idea grew out of a call in a National Academy of Sciences report for a new mechanism for funding graduate students. Other areas were “uninclined” to change how they funded students, said Lewis, but he saw an opportunity for mathematics. In August a proposal to establish the program will be submitted for approval to the National Science Board, the NSF’s policymaking body.

Research Competing with Education?

As budgets for research have tightened, resentment has grown over the amount of NSF money devoted to education. At a time when many are finding fault with reform projects in calculus and school mathematics,⁶ some mathematicians are grumbling about the multimillion dollar grants going to educational projects. The difference in the sizes of mathematics research grants and mathematics education grants is indeed striking. For example, among the approximately 130 active grants in the Topology and Foundations program in DMS, the average is around \$40,000 per year, and the largest grant is under \$500,000 for three years (many of these grants support more than one investigator). By contrast, the average for the 35 active grants for K–12 mathematics education projects in the Instructional Materials and Curriculum Development program is more than \$500,000 per year, and the largest grant runs \$9.3 million over six years. “I wouldn’t want and don’t need a million-dollar grant, because I don’t want that responsibility,” says Ronald Fintushel of Michigan State University, “but it saddens me to see so many young researchers without grants while funds are poured into educational projects.”

In the early 1990s Congress appropriated large amounts of money for education at the NSF—much more, in fact, than the NSF itself had requested. The budget for the Education and Human Resources directorate more than doubled in constant dollars between 1990 and 1996. “There is so much money sloshing around that the existence of the money is driving decisions, rather than people deciding what is best for students,” remarks Henri Gillet of the University of Illinois at Chicago. Although he is generally supportive of mathematics education reform, he has “mixed feelings” about whether the reformers really need such large amounts of money from the NSF. Gillet has seen declines in the number and size of research grants in his own area of algebraic geometry, but he is unsure

that this phenomenon has a direct connection to large educational grants. Suppose Congress ended funding for mathematics education at the NSF and put the money up for grabs, Gillet says. “How effective would the mathematics community be at getting that money?... I’m skeptical it would come to us.”

At the same time researchers are asking questions about the NSF’s investment in education, the Foundation has been calling for greater integration of education and research. This has been a major theme in the tenure of NSF director Neal Lane. The NSF recently handed out special recognition awards of \$500,000 to institutions that have done a good job of integrating research and education. Lewis predicts that fairly soon the NSF will move from recognition awards to requirements. Of course, it is easier for, say, a chemist to give undergraduates a sense of some aspect of chemistry research than it is for a mathematician to do the same in mathematics. Nevertheless, Lewis says, mathematicians will have to figure out how to “make undergraduates aware of mathematical discovery.” The DMS is “going to have to address it more than we have been,” he says.

Gillet believes that the DMS is trying hard to do the best it can to support mathematics research in difficult times. But he confesses that when one talks of increasing funding for mathematics, there is one fact that nags him: There is a surfeit of people who want to do mathematics research. Last year his department advertised open positions and got 1,000 applications. The rather bleak outlook for funding for mathematics research has not driven people from the field. “When you have hordes of people trying to get into research,” he remarks, “it’s hard to promote the argument that you need more money for research.”

—Allyn Jackson

Information on the FY1998 budget request for NSF can be found at the NSF Web site, at <http://www.nsf.gov/bfa/bud/fy1998>.

⁶See the article “The Math Wars” in this issue of the Notices, pages 695-702.