Testimony before the
Senate Science, Technology and Space Subcommittee
Senate, Commerce, Science and Transportation Committee
by
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Introduction

Mr. Chairman, Senator Allen, members of the Subcommittee, thank you for this opportunity to testify before you today on the FY 2003 budget request for research and development (R&D). I represent the largest general scientific society in the world with over 130,000 members and 275 affiliated societies. Our members come from the entire range of science and technology disciplines.

From that unique perspective, I can tell you that our nation's science and technology enterprise continues its great productivity, and has had a tremendously successful year with an array of exciting advances that will yield benefits throughout society. Moreover, many of this past year's most important findings illustrate and emphasize that in the current age, major advances in any one specialty field are dependent on an integrated, interwoven set of processes that requires simultaneous progress throughout the broad science and technology enterprise. A few examples include:

- *Science* magazine's breakthrough of the year: nanotechnology. Scientists and engineers have created the first set of molecular-scale circuits that, when they are wired to computer chip architectures, will provide incredible computing power in tiny machines. This set of breakthroughs depends heavily on fundamental discoveries in condensed matter physics, chemistry, and materials science.
- Geologists and chemists have made tremendous progress in revealing the mechanisms of the breakdown of organic matter that can determine soil fertility and the dispersal of soil contaminants.
- Using animal models, scientists at an NSF-built science and technology center have worked out many of the molecular and neural mechanisms of the body's biological clock, including critical gene elements. Building on this work, clinical investigators have now shown direct application of these findings in human subjects who have many similar genes.

- Combining molecular biology and materials science, researchers have, basically, produced spider silk fibers from mammalian cells.
- Advanced optics developed for astronomical telescopes are now being used to help map the eye retina and may lead to improved optical surgery and corrective lenses.

Since I came to AAAS recently from the National Institute on Drug Abuse at NIH, I also want to emphasize that progress in all of the biomedical sciences is heavily dependent on the health of the entire array of scientific fields. You know, of course, about the application of fiber optics in medical scoping, and the use of lasers, developed by physicists and chemists, in surgery. In my own area of highest expertise – the brain mechanisms of addiction – advances in physics and their applications in imaging technology are directly responsible for our finally being able to look into the brains of living, awake humans during and following drug experiences, and those studies have revolutionized our understanding of this great social and health problem.

Over twenty federal agencies contribute to federal R&D, many of them under your subcommittee's jurisdiction. Each agency, according to its mission, plays a very important role in contributing to our nation's R&D productivity, and it is important that all agency science programs receive strong support. It is also important to note, however, that NSF has a specific mission to pursue basic research across the full-range of science and technology disciplines and therefore plays a very special and unique role.

Research and Development in the FY 2003 Budget Request

My testimony today is intended to examine R&D in the Administration's budget request, to highlight trends in federal support for R&D across disciplines, and to discuss university R&D. It reflects our belief that balanced and strong support across the entire science and technology enterprise is critical to the nation's future.

Overall Outlook

The request for total federal R&D in FY 2003 is a record $112 billion, $8.9 billion more than FY 2002 (see Table 1). However, the proposed increases of $5.2 billion for DOD and $3.7 billion for NIH make up the entire $8.9 billion increase, leaving all other R&D funding agencies combined with barely the same amount as in FY 2002.

- Nondefense R&D would increase 7.2 percent to $53.3 billion. NIH would make up almost half of the entire nondefense R&D portfolio, receiving the final installment of a plan to double the NIH budget in five years. Excluding NIH, nondefense R&D would fall by 0.2 percent to $26.8 billion.

- Basic research would increase $1.9 billion to an all-time high of $25.5 billion (see Table 2). For the past two years NIH has supported the majority of federal basic research, and in FY 2003 it would provide 56 percent of all federal support.
- The total federal investment in basic and applied research combined would increase 6.5 percent to $51.9 billion in FY 2003 (see Table 2), with a large increase for NIH (up 14.5 percent to $25.6 billion) responsible for most of the increase. Without NIH, total federal research would decline by 0.2 percent (or $48 million) to $26.3 billion.

R&D in NSF, NASA, NIST, and NOAA

The National Science Foundation (NSF) budget would total $5.0 billion in FY 2003, an increase of 5.0 percent. Excluding NSF's non-R&D education activities, NSF R&D would be $3.7 billion, a boost of 3.5 percent or $125 million. More than half of the increase, however, is due to proposed transfers to NSF -- of the National Sea Grant program from the Department of Commerce; hydrologic sciences from the Department of the Interior; and environmental education from the Environmental Protection Agency. These three proposed transfers account for $76 million of the $125 million increase to NSF R&D. I emphasize the term "proposed" because the program transfers must be authorized and appropriated with congressional oversight. Excluding the transfers, NSF R&D would only increase 1.4 percent, less than the rate of inflation.

The National Aeronautics and Space Administration (NASA) would see its total budget increase by 0.7 percent to $15.1 billion in FY 2003. NASA's R&D (two-thirds of the agency's budget) would climb 4.3 percent to $10.7 billion. While the much-delayed International Space Station would receive $1.5 billion for construction, down from $1.7 billion, most science programs would receive increases.

While last year's budget would have eliminated the Advanced Technology Program (ATP) at the National Institute of Standards and Technology (NIST), the FY 2003 budget would keep it alive, though at a greatly reduced level. NIST would instead redirect funds to intramural R&D in the NIST laboratories, which would receive a $70 million increase to $402 million, including funding to make the new Advanced Measurement Laboratory operational.

National Oceanic and Atmospheric Administration (NOAA) R&D would decline by 1.1 percent or $6 million because of the transfer of the $62 million (in FY 2002) National Sea Grant program from NOAA to NSF. Overall, other NOAA R&D programs would see increases.

Multi-agency Initiatives

Three major multi-agency initiatives that would receive increases in the FY 2003 budget merit special mention.

- Funding for the Nanoscale Science, Engineering, and Technology Initiative would climb another $106 million (or 17.5 percent) to $710 million in FY 2003. NSF's lead contribution to the initiative would rise by 11.1 percent to $221 million.
- NSF also continues its lead role in the Networking and Information Technology R&D initiative, which would see its budget edge up 2.5 percent to $1.9 billion.
- The longstanding U.S. Global Change Research Program would climb 2.6 percent to $1.7 billion. While NASA's Earth Science program continues to provide the bulk of funding ($1.1 billion), the increases in FY 2003 would go mostly to other agencies' contributions. There would also be $40 million in new funds for the Climate Change Research Initiative (CCRI) for fundamental research to fill key gaps in climate science knowledge.

R&D in Colleges and Universities

Despite their comparatively small share of overall federal R&D funding, colleges and universities serve as the primary site for the performance of basic research and the training of future scientists and engineers. On average, 58 percent of the R&D performed by colleges and universities is funded by the federal government, with most of the rest coming from the institutions' own funds (see Chart 1).

Trends in the R&D Portfolio

AAAS also analyzes the budget across all agencies, and that helps to understand trends characterizing the science and technology enterprise as a whole.

- Looking at trends in federal research by discipline between FY 1970-2000, one can see that engineering, physical sciences, environmental sciences, mathematics and computer sciences, social sciences, and psychology are relatively flat, or in some instances, show modest growth. At the same time, federal support for the life sciences has grown dramatically, from slightly more than $5 billion in FY 1970 (using constant dollars) to over $20 billion in FY 2001. (see Chart 2)
- Analyzing federal support for life sciences, physical sciences, and engineering research by agency, one can see how dependent the life sciences are on funding from

NIH. In contrast, most fields of physical science and engineering research are dependent on funds from many different agencies (see Charts 3 and 4).

Conclusion

The FY 2003 budget now moves to Congress, which must take on the task of establishing budget priorities. This task occurs in a Congress far different from last year, with some members criticizing the budget for too little funding on domestic programs, and others espousing that it spends too much.

For R&D, the Administration has clearly placed greater priority upon defense and medical research. The opportunities for R&D, however, are much more extensive. According to *Science* magazine's predictions for 2002, we should see significant advances in astronomy with the proposed launch of a second large telescope in Chile; more precise global positioning systems through the use of optical clocks that rely on visible light waves; and greater clarity of visualization systems through improved imaging technology and faster computers that will allow us to examine biological molecules and watch cell signaling as it occurs. These and other scientific opportunities face Congress as it prepares to decide how to allocate precious R&D resources.

Let me conclude by emphasizing again the need to maintain progress simultaneously across all of science and technology. In the 21st Century, science and engineering fields are so inter-dependent that lags in one field inevitably will delay progress in others. We cannot afford a "taking-turns" approach to science funding in this country. Our continued national security and improving quality of life depend on a uniformly healthy and rapidly growing science and technology enterprise.

APPENDIX

American Association for the Advancement of Science (AAAS)

Founded 150 years ago, AAAS is the world's largest federation of scientific and engineering societies, with nearly 275 affiliates. AAAS counts more than 130,000 individual scientists, engineers, science educators, policymakers, and interested citizens among its members, making it the largest general scientific organization in the world. Our mission is to advance science and innovation throughout the world for the benefit of all people. Our objectives in this mission are to foster communication among scientists, engineers and the public; enhance international cooperation in science and its applications; promote the responsible conduct and use of science and technology; foster education in science and technology for everyone; enhance the science and technology workforce and infrastructure; increase public understanding and appreciation of science and technology; and strengthen support for the science and technology enterprise.

Every year since 1976, AAAS has published an annual report analyzing research and development (R&D) in the proposed federal budget in order to make available to the scientific and engineering communities and to policymakers timely and objective information about the Administration's plans for the coming fiscal year. At the end of each congressional session, AAAS also publishes a report reviewing the impact of appropriations decisions on research and development. AAAS has also established a Web site for R&D data on which we now post regular updates on budget proposals, agency appropriations, and outyear projections for R&D, as well as numerous tables and charts. The address for the site is www.aaas.org/spp/R&D.

Alan I. Leshner
Dr. Leshner became Chief Executive Officer of the American Association for the Advancement of Science and Publisher of *Science* Magazine in December 2001.

Prior to coming to AAAS, Dr. Leshner was Director of the National Institute on Drug Abuse (NIDA). One of the scientific institutes of the U.S. National Institutes of Health, NIDA supports over 85% of the world's research on the health aspects of drug abuse and addiction. Prior to becoming Director of NIDA, Dr. Leshner had been the Deputy Director and Acting Director of the National Institute of Mental Health. He went to NIMH from the National Science Foundation (NSF), where he held a variety of senior positions, focusing on basic research in the biological, behavioral and social sciences, and on science education.

Dr. Leshner went to NSF after 10 years at Bucknell University, where he was Professor of Psychology. While on the faculty at Bucknell, he also held long-term appointments at the Postgraduate Medical School in Budapest, Hungary; at the Wisconsin Regional Primate Research Center; and as a Fulbright Scholar at the Weizmann Institute of Science in Israel. Dr. Leshner's research has focused on the biological bases of behavior. He is the author of a major textbook on the relationship between hormones and behavior, and numerous book chapters and papers in professional journals. He also has published extensively in the areas of science and technology policy and education.

Dr. Leshner received his undergraduate degree in psychology from Franklin and Marshall College, and M.S. and Ph.D. degrees in physiological psychology from Rutgers University. He also holds honorary Doctor of Science degrees from Franklin and Marshall College and the Pavlov Medical University in St. Petersburg, Russia. He has been elected a fellow of many professional societies, is a member of the Institute of Medicine of the National Academy of Sciences, and has received numerous awards from both professional and lay groups.

Table 1. R&D in the FY 2003 Budget by Agency
(budget authority in millions of dollars)

	FY 2001 Actual	FY 2002 Estimate	**FY 2003 Budget**	Change FY 02-03 Amount	Change FY 02-03 Percent
Total R&D (Conduct and Facilities)					
Defense (military)	42,740	49,639	**54,827**	5,188	10.5%
S&T (6.1-6.3 + medical)	*9,365*	*10,341*	***9,957***	*-384*	*-3.7%*
All Other DOD R&D	*33,375*	*39,298*	***44,870***	*5,572*	*14.2%*
Health and Human Services	21,045	24,141	**27,551**	3,410	14.1%
Nat'l Institutes of Health	*19,807*	*22,795*	***26,452***	*3,657*	*16.0%*
NASA	9,887	10,232	**10,676**	444	4.3%
Energy	7,733	8,361	**8,323**	-38	-0.5%
NNSA and other defense	*3,462*	*3,839*	***3,947***	*108*	*2.8%*
Energy and Science programs	*4,271*	*4,522*	***4,376***	*-146*	*-3.2%*
Nat'l Science Foundation	3,320	3,526	**3,651**	125	3.5%
Agriculture	2,181	2,334	**2,118**	-216	-9.3%
Commerce	1,030	1,096	**1,100**	4	0.3%
NOAA	*561*	*611*	***605***	*-6*	*-1.1%*
NIST	*413*	*460*	***483***	*23*	*5.0%*
Interior	621	660	**628**	-32	-4.8%
Transportation	718	778	**736**	-42	-5.4%
Environ. Protection Agency	574	592	**627**	35	5.9%
Veterans Affairs	719	761	**810**	49	6.5%
Education	264	268	**311**	43	16.0%
All Other	702	763	**689**	-74	-9.7%
Total R&D	91,534	103,150	**112,047**	8,897	8.6%
Defense R&D	46,202	53,478	**58,774**	5,297	9.9%
Nondefense R&D	45,332	49,672	**53,273**	3,601	7.2%
Nondefense R&D excluding NIH	*25,525*	*26,877*	***26,821***	*-56*	*-0.2%*
Basic Research	21,376	23,635	**25,499**	1,864	7.9%
Applied Research	22,451	25,050	**26,370**	1,320	5.3%
Development	42,959	49,390	**55,235**	5,845	11.8%
R&D Facilities and Equipment	4,749	5,075	**4,943**	-132	-2.6%

Source: AAAS, based on OMB data for R&D for FY 2003, agency budget justifications, and information from agency budget offices.
All years include homeland security and other emergency appropriations.
All years adjusted to include proposals to fully fund federal retiree costs.
March 5, 2002 - REVISED

Table 2. Research in the FY 2003 Budget
(budget authority in millions of dollars)

	FY 2001 Actual	FY 2002 Estimate	**FY 2003 Budget**	Change FY 02-03 Amount	Percent
BASIC RESEARCH					
Defense (military)	1,287	1,376	**1,365**	-11	-0.8%
Health and Human Services	11,642	13,193	**14,379**	1,185	9.0%
Nat'l Institutes of Health	*11,639*	*13,190*	***14,376***	*1,185*	*9.0%*
NASA	1,695	1,967	**2,361**	395	20.1%
Energy	2,390	2,424	**2,519**	94	3.9%
Nat'l Science Foundation	2,852	3,058	**3,205**	147	4.8%
Agriculture	801	860	**880**	20	2.3%
Commerce (NIST)	50	52	**73**	21	40.4%
Interior	56	58	**55**	-3	-4.4%
Transportation	17	13	**25**	12	92.6%
Environ. Protection Agency	104	107	**101**	-6	-5.3%
Smithsonian	108	111	**114**	3	2.7%
Veterans Affairs	289	329	**351**	23	6.9%
All Other	84	87	**70**	-17	-19.5%
Total Basic Research	21,376	23,635	**25,499**	1,864	7.9%
Basic research excluding NIH	*9,737*	*10,445*	***11,123***	*679*	*6.5%*
RESEARCH (basic + applied)					
Defense (military; incl. medical)	5,393	5,926	**5,213**	-713	-12.0%
Health and Human Services	20,735	23,610	**26,636**	3,027	12.8%
Nat'l Institutes of Health	*19,561*	*22,346*	***25,578***	*3,232*	*14.5%*
NASA	4,294	4,824	**5,549**	725	15.0%
Energy	4,697	5,155	**5,188**	32	0.6%
Nat'l Science Foundation	3,032	3,250	**3,404**	154	4.7%
Agriculture	1,845	1,846	**1,826**	-20	-1.1%
Commerce	825	887	**883**	-4	-0.4%
NOAA	*511*	*546*	***546***	*0*	*0.0%*
NIST	*306*	*334*	***328***	*-6*	*-1.8%*
Interior	590	628	**596**	-32	-5.1%
Transportation	461	517	**506**	-10	-2.0%
Environ. Protection Agency	474	489	**531**	41	8.5%
Veterans Affairs	704	745	**794**	48	6.5%
Education	174	180	**213**	33	18.3%
Agency for Int'l Develop.	249	268	**182**	-86	-32.1%
Smithsonian	108	111	**114**	3	2.7%
All Other	246	249	**235**	-14	-5.6%
Total Research	43,826	48,685	**51,869**	3,184	6.5%
Total research excluding NIH	*24,265*	*26,339*	***26,291***	*-48*	*-0.2%*

Source: AAAS, based on OMB data for R&D for FY 2003, agency budget justifications, and information from agency budget offices.
All years include homeland security and other emergency appropriations.
All years adjusted to include proposals to fully fund federal retiree costs.
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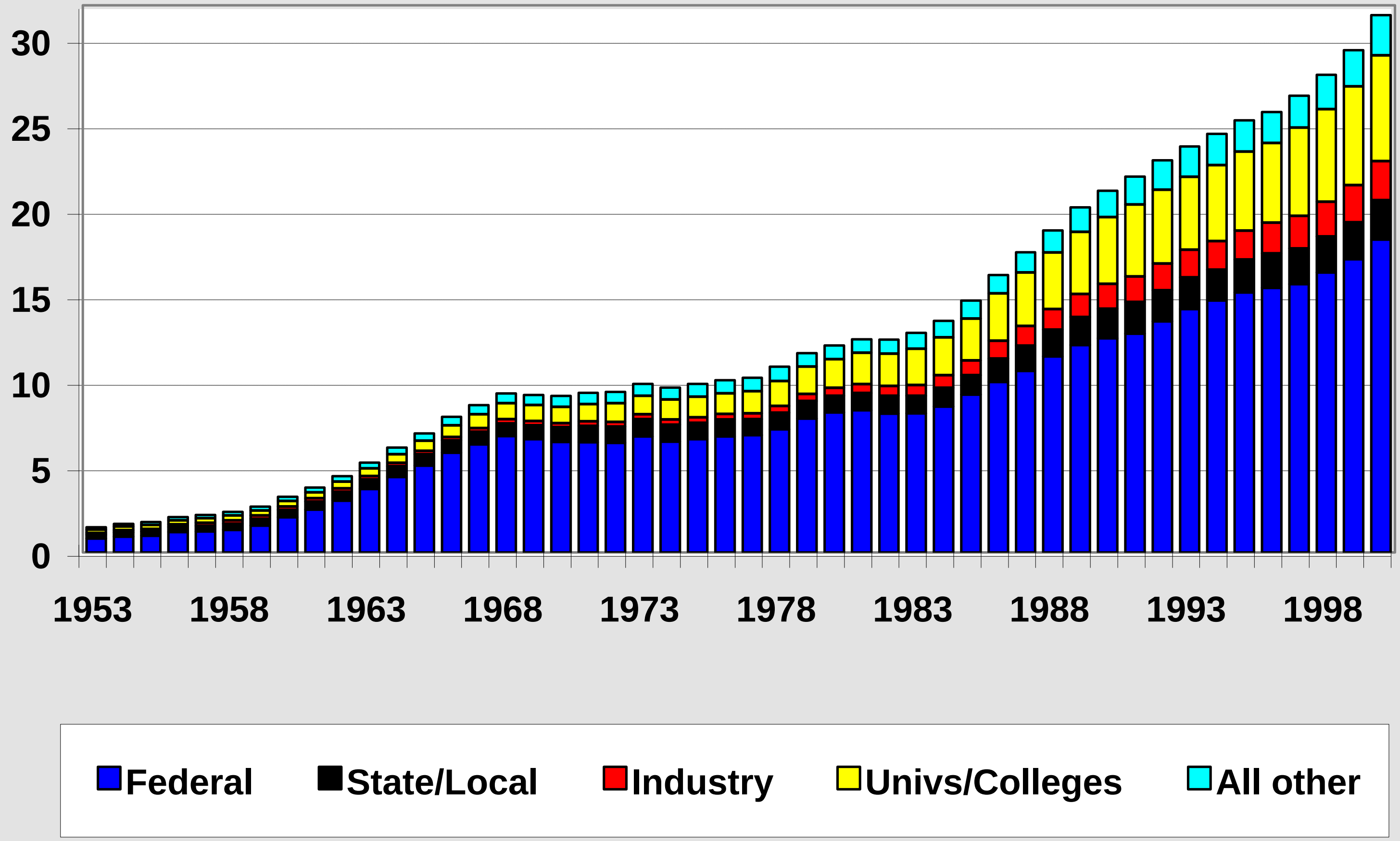
Chart 1. R&D at Colleges and Universities by Source of Funds

in billions of constant FY 2002 dollars, FY 1953-2000



Source: National Science Foundation, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 2000, 2001. Constant-dollar conversions based on OMB's GDP deflators.

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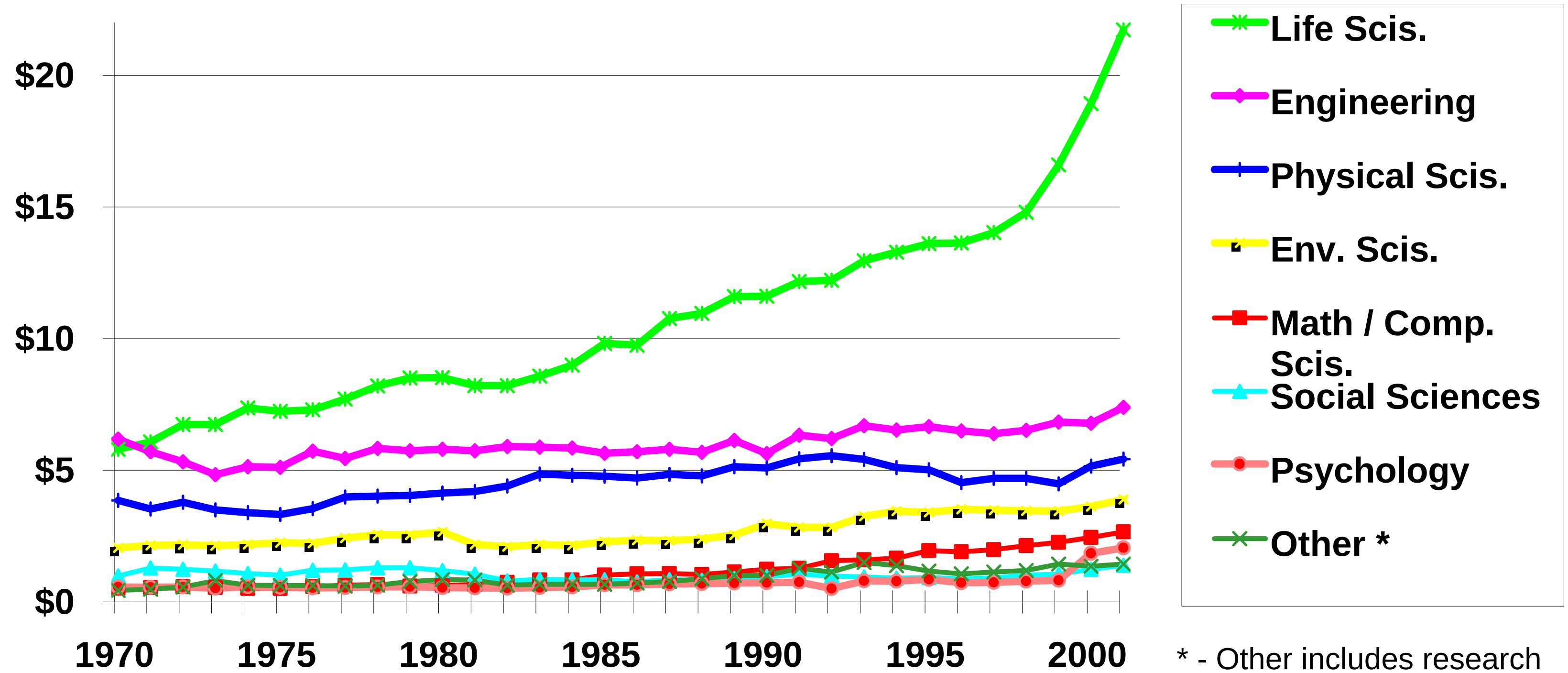
Chart 2. Trends in Federal Research by Discipline, FY 1970-2001

obligations in billions of constant FY 2002 dollars



* - Other includes research not classified (includes basic research and applied research; excludes development and R&D facilities)

Source: National Science Foundation, *Federal Funds for Research and Development FY 2000, 2001, and 2002,* 2002. FY 2001 data are preliminary. Constant-dollar conversions based on OMB's GDP deflators.

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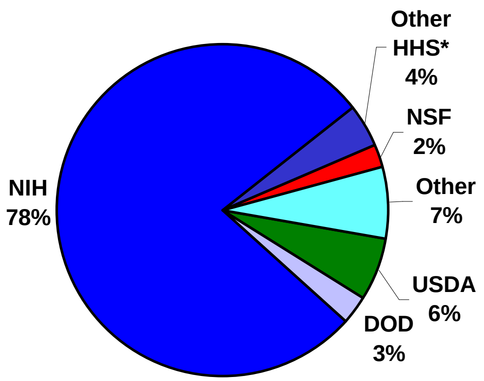
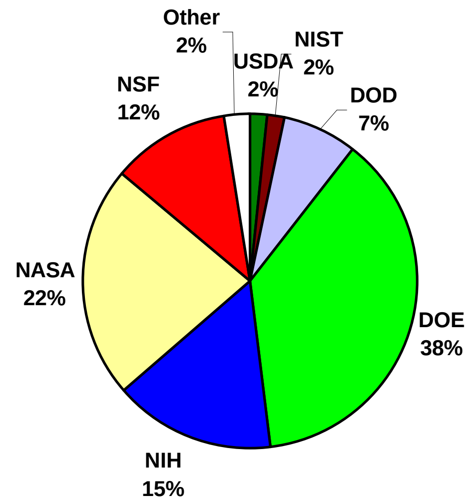
Chart 3. Federal Funding of Research By Agency and Discipline, FY 2002

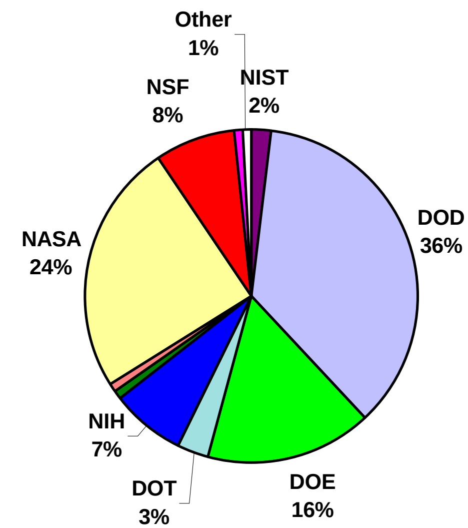
(preliminary obligations)



Life Sciences



Physical Sciences



Engineering Sciences

Source: National Science Foundation, *Federal Funds for Research and Development FY 2000, 2001, and 2002,* 2002. Data exclude engineering work classified as development and R&D facilities

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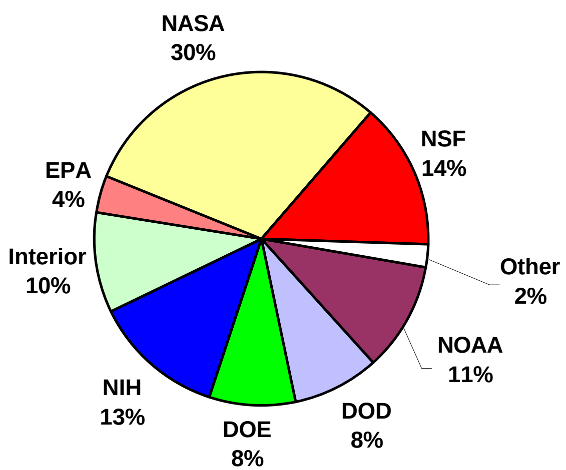
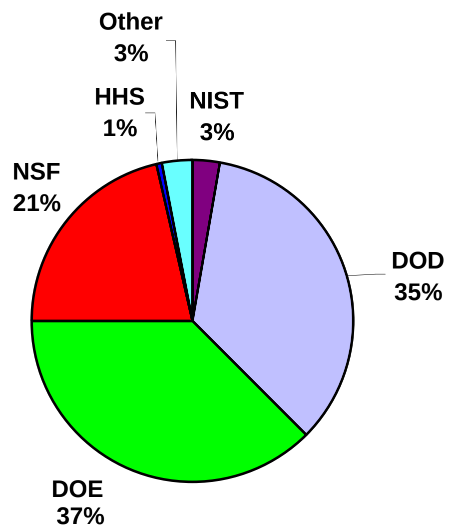
Chart 4. Federal Funding of Research By Agency and Discipline, FY 2002

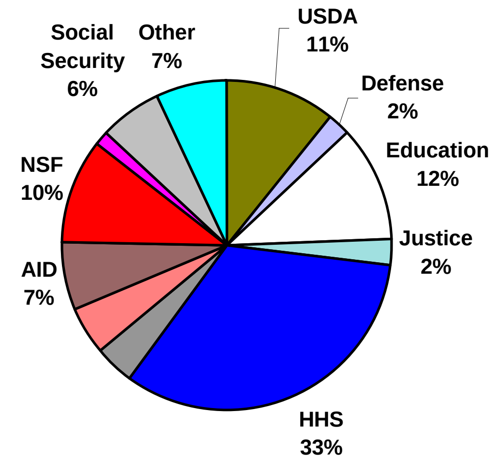
(preliminary obligations)



Environmental Sciences



Computer Sciences*



Social Sciences

Source: National Science Foundation, *Federal Funds for Research and Development FY 2000, 2001, and 2002,* 2002. Data exclude engineering work classified as development and R&D facilities. * - FY 2000 data.

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