AAAS October Update on R&D -

FY 2000 Begins Without Final Budgets; Federal R&D Funding Undecided

(This analysis is a progress report on FY 2000 appropriations as of the October 1 start of FY 2000, and summarizes the AAAS R&D Funding Updates released so far. The complete series of AAAS R&D Funding Updates, including continually updated analyses of R&D by agency in FY 2000 appropriations, is available on the AAAS R&D Web Site (http://www.aaas.org/spp/R&D) in the "R&D in FY 2000" or the "What's New" sections.)

The October 1 start of fiscal year (FY) 2000 has arrived, but Congress and the President are still a long way from completing FY 2000 appropriations for the federal government's discretionary programs, including federal support of R&D. Although they have given themselves another three weeks to complete work, final funding levels for most R&D programs are far from settled, and lawmakers may need even more time to resolve the numerous difficult choices standing in the way of final agreements on the FY 2000 budget. This update represents a progress report on where appropriations for R&D programs stand at this point in the budget process.

FY 2000 R&D in House and Senate Appropriations

Just last week, the House and the Senate finally managed to draft their respective versions of all 13 appropriations bills. The House and the Senate managed to resolve their differences over funding levels on only one of the nine bills (the Energy-Water bill) containing R&D funding before the October 1 start of FY 2000. As a result, Congress must still reconcile differences between House and Senate funding levels for nearly all R&D programs.[1] This update presents data on House and Senate funding levels for R&D in each chamber's appropriations bills.

The House and Senate differ widely in their treatment of R&D programs, leaving final funding levels for federal R&D very much in doubt. Because of tight budget caps within which defense spending would rise considerably, the House would make cuts to most non-biomedical research programs and would deny funds for several Clinton Administration initiatives. The Senate, working under the same budget caps, would provide increases for most R&D programs because it has made R&D a high priority and defense spending a lesser one. It remains to be seen whether the higher Senate funding levels, lower House funding levels, or something in between will prevail in final FY 2000 appropriations. (Note: All percentage changes below refer to current dollars and do not take account of inflation, projected at 2 percent for the coming year.)

- **The House would cut funding for most R&D funding agencies**. The House would provide $38.3 billion for **nondefense R&D** in FY 2000, a slight increase of 0.3 percent over FY 1999, but only because the House would provide a substantial increase to the National Institutes of Health (NIH; see Table 1A). **Nondefense R&D excluding NIH would fall 5.0 percent**, or more than $1.1 billion, to $22.0 billion in the House plan. Especially hard hit would be R&D in the National Aeronautics and Space Administration

[1] The Energy-Water bill, which funds most of the Department of Energy (DOE), was signed into law on September 30. This Update does not reflect House-Senate conference funding levels for Energy-Water programs, but rather the House-approved and Senate-approved funding levels. Final DOE funding levels for R&D can be found in a September 29 DOE R&D Funding Update. Conferences have also concluded on the Agriculture and Transportation bills. Funding levels for R&D programs in these bills can be found in forthcoming R&D Funding Updates on USDA and DOT, scheduled for release on October 5.

(NASA; down 7.0 percent to $9.0 billion); the Department of Commerce ($844 million, down 21.5 percent), and the Department of Energy (DOE; $6.8 billion, down 2.9 percent). Even the National Science Foundation (NSF), which received increases in previous years, would see its R&D decline by 2.7 percent to $2.6 billion. Gray bars in Figure 1 show how agencies would fare in House appropriations as compared to FY 1999.

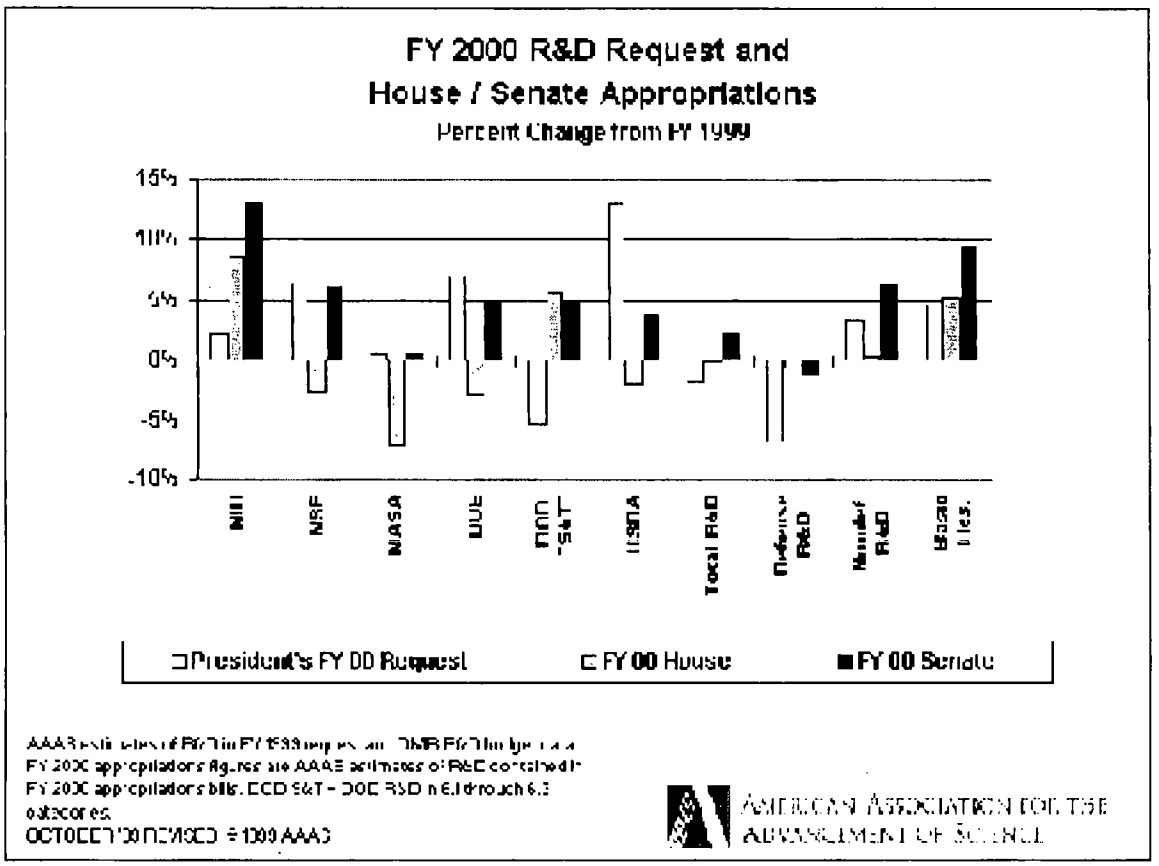


Figure 1.

- By contrast, **the Senate would provide increases for most R&D funding agencies**. The Senate would provide $40.5 billion for nondefense R&D in FY 2000, a boost of $2.4 billion or 6.2 percent over FY 1999 funding levels (see Table 1B). Although a majority of the increase would be due to a nearly 13 percent increase in NIH R&D, other agencies would also benefit from the Senate plan (see Figure 1). Nondefense R&D excluding NIH would rise a modest 1.9 percent to $23.6 billion. The Senate would boost NSF's R&D by 6.1 percent to $2.9 billion, just $10 million short of the Administration request, and would increase Department of Energy (DOE) R&D by 4.9 percent to $7.3 billion. The largest percentage increase would go to the Department of Commerce, with a 15.8 percent increase to $1.2 billion, for both the National Institute of Standards and Technology (NIST) and the National Oceanic and Atmospheric Administration (NOAA). Black bars in Figure 1 show how agencies would fare in Senate appropriations as compared to FY 1999.

- **Defense R&D** would receive favorable treatment in both the House and Senate. House appropriations for defense R&D in the Department of Defense (DOD) and DOE would total $40.9 billion, a cut of $304 million or 0.7 percent below FY 1999, but $2.4 billion more than the request (see Figure 1). The Senate would provide a similar appropriation of $40.7 billion, with less for DOD but more for DOE. Both chambers' cuts would be concentrated in DOD's development activities and would be partly offset by increases for basic and applied research. The **"Science and Technology" portion of DOD's budget**

(encompassing basic and applied research plus exploratory technology development) would increase by 5.6 percent to $8.2 billion in the House plan, including $250 million for congressionally designated medical research. The Senate would provide slightly less but also $8.2 billion, for an increase of 4.9 percent, including $300 million for medical research (see Figure 1). Figure 1 also shows that DOD itself requested a cut for S&T. If House or Senate funding levels prevail in conference, FY 2000 funding would begin to reverse years of decline in DOD S&T, which provides significant portions of total federal support for engineering and physical sciences research.

- **Basic research would rise significantly under both the House and Senate plans,** but the increases would go mostly to life sciences and medical research funded by NIH. House action on R&D would result in total basic research funding of $18.2 billion, an increase of nearly $900 million (or 5.2 percent), but over $700 million of the increase would go to an 8.5 percent increase in NIH basic research (see Table 2A). Although the total increase for basic research is similar to the request (see Figure 1), the President's request would have spread the increase more evenly among agencies. In the House plan, other agencies would see small increases, but NSF, the second-largest supporter of basic research and the largest supporter of most non-life sciences disciplines, would see its basic research decline by 0.7 percent to $2.3 billion. NASA basic research would increase by 7.1 percent to $2.3 billion, but mostly because of a reclassification of work from applied to basic research. DOD, the primary supporter of basic research in engineering, mathematics, and computer sciences, would see its basic research ("6.1") rise by 3.1 percent to $1.1 billion.

- **The Senate would boost basic research funding by 9.3 percent or $1.6 billion to $18.9 billion**, mostly because of a $1.1 billion or 12.9 percent increase for basic research in NIH (see Table 2B). Under both the House and Senate plans, NIH would account for the majority of federal basic research support for the first time. Although the Senate increases would go disproportionately to life sciences and medical basic research, the Senate would also boost funding for non-life sciences basic research, including a 7.9 percent increase for basic research at NSF, a 13.0 percent increase for NASA, and a 3.1 percent increase for DOD. Both the House and the Senate would provide flat to declining basic research funding for DOE, the primary supporter of physics research.

- As in FY 1999, the Clinton Administration presented a **"21st Century Research Fund"** in the FY 2000 request to highlight programs that it considers important to the nation's science and technology enterprise. The Fund includes both R&D and non-R&D items while excluding large parts of the nation's R&D portfolio (primarily in development). Tables 1A and 1B summarize appropriations for the Fund, which is intended to serve as one indicator of the health of the federal research enterprise in the budget process. House appropriations for the Fund total $37.7 billion, 2.1 percent above FY 1999 but $407 million below the Administration request. The House would cut the Administration's request for almost every nondefense R&D program, but would balance it by providing $1 billion more than the request for NIH. The Senate would provide $39.2 billion, $2.3 billion or 6.1 percent more than FY 1999 and $1.1 billion more than the request, again primarily because of NIH.

- Both the House and Senate would give a clear priority to **health-related R&D**, but would differ in their relative treatment of R&D for other **national missions**. The **House** would give an increase only to health-related R&D (mostly in NIH), with a $1.3 billion increase to $17.7 billion (see Table 3A). R&D for all other functional categories would decline. The House would reduce space R&D by 7.2 percent, and would slash commerce-related R&D by 38 percent to $296 million, mostly because of the elimination of NIST's Advanced Technology Program. The **Senate** would be more generous to a broad range of R&D programs. The Senate would boost health-related R&D by 11.8 percent to $18.3 billion (see Table 3B), but would provide increases for other national missions as well. Most civilian missions would see increases of at least the 2 percent expected inflation rate, except for cuts in transportation R&D (due to declining aeronautics R&D in NASA) and international R&D (based on an Administration-requested cut for R&D in the State Department).

R&D Appropriations for Key Agencies

(Full information on House and Senate appropriations for individual agencies can be found in the AAAS R&D Funding Updates on the AAAS R&D Web site. The Web versions of this document contain links from each agency listing to its most recent R&D Funding Update).

- The **National Aeronautics and Space Administration (NASA)** budget would decline steeply in the House plan, from $13.7 billion in FY 1999 to a proposed $12.7 billion, a cut of $1 billion or 7.4 percent. NASA's Science, Aeronautics and Technology (SAT) account, which funds most of NASA's R&D, would decline 12.0 percent to $5.0 billion because of deep cuts to the Earth Science and Space Science programs. The Senate, however, would provide the requested amount of $13.6 billion for the NASA budget, a cut of 0.6 percent from FY 1999, and a slight increase for NASA's R&D programs. Space Science would decline 2.0 percent in the Senate plan and 7.7 percent in the House plan. Because of the large differences between the House and the Senate, it is highly uncertain what NASA's final budget will look like.

- There are also large differences between the House and the Senate over the **National Science Foundation (NSF).** The House would cut NSF's budget by 2.0 percent to $3.6 billion. Most of the research directorates would receive level funding; NSF had requested increases between 2 to 5 percent. Cuts in facilities funding would result in a 2.7 percent decline in total NSF R&D. The House would dramatically scale back first-year funding for the Administration's proposed Information Technology for the Twenty-First Century (IT^2) initiative. NSF requested $146 million for its role in IT^2, but the House would provide only $35 million. The Senate, by contrast, would boost NSF's budget by $211 million or 5.7 percent to the requested level of $3.9 billion. NSF's R&D would climb 6.1 percent to $2.9 billion. While the Senate would deny most of the request for IT^2, it would increase funding for similar information technology research by almost 40 percent.

- The House and the Senate both propose substantial increases for the **National Institutes of Health (NIH)**. The House would provide $16.9 billion for NIH in FY 2000, $1.3 billion or 8.5 percent more than FY 1999. The Senate would be even more generous with an appropriation of $17.6 billion, exactly $2 billion above FY 1999 for an increase of 12.8 percent. Both these amounts are well above the request of $15.9 billion, which would have represented an increase of 2.1 percent. The Senate's generosity comes with a catch: $3 billion would be withheld until the next-to-last day of FY 2000. [2]

- The House would slash R&D in the **Department of Commerce** by nearly one fourth. The House would provide only $844 million for Commerce R&D, a reduction of $231 million or 21.5 percent from FY 1999 funding levels. The House would eliminate the Advanced Technology Program (ATP) and make cuts to most R&D programs in the National Oceanic and Atmospheric Administration (NOAA). Intramural research in the National Institute of Standards and Technology (NIST) would remain at the FY 1999 level. The Senate, in sharp contrast to the House, would provide generous increases to most Commerce R&D programs, including ATP, for a 15.8 percent increase in total Commerce R&D ($1.2 billion). Both NIST and NOAA would receive substantial increases.

- In the wake of growing congressional anger over security breaches and allegations of mismanagement at **Department of Energy (DOE)** weapons labs, Congress recently agreed to move DOE's weapons-related activities to a new semi-autonomous agency, the National Nuclear Security Administration

[2] (NIH's R&D as shown in the Tables is slightly less than the total NIH budget after subtracting overhead and research training costs.)

(NNSA). The new NNSA may come into existence as early as this week when the President signs its authorization into law. Tables 1A and 1B show House and Senate proposed budgets for DOE, but most of DOE's budget has already been signed into law. The final Energy-Water bill gives slight increases to DOE's Science programs, and substantial increases for DOE's support of magnetic fusion research and weapons-related R&D. The Spallation Neutron Source project receives $118 million, down from a requested $214 million, and DOE's share of IT^2 receives no money. The rest of DOE's budget is still in House-Senate conference.

- The House would boost **Department of Defense (DOD)** funding of basic and applied research above both the President's request and the FY 1999 funding level. DOD's basic research ("6.1") would total $1.1 billion, 3.1 percent above FY 1999, while applied research ("6.2") would total $3.4 billion, more than 7 percent above the current year funding level. The House would provide $60 million for DOD's role in the IT^2 initiative, down from the request of $100 million. The House would also create a separate $250 million appropriation for medical R&D, including $175 million for breast cancer research and $75 million for prostate cancer research. The Senate would provide similar increases for DOD "6.1", "6.2", and medical research accounts. The conference report for DOD (due to be completed this week) is expected to retain these increases.

- The **U.S. Department of Agriculture (USDA)** would receive $1.6 billion for its R&D, a cut of 2.1 percent, in the House plan. This would be far below the request of $1.85 billion because the House would block a new, non-appropriated competitive research grants program from spending a planned $120 million in FY 2000. (The Senate would allow the release of $50 million.) The Senate would be more generous with an appropriation of $1.7 billion for total USDA R&D (up 3.8 percent). The conference report on the Agriculture bill was completed late last week, but was not available as this update was being written.

- The **Environmental Protection Agency (EPA)** would receive $643 million for its R&D from the House and $646 million from the Senate, for declines of 3.5 percent and 3.4 percent, respectively, but these amounts would be close to the request of $645 million. Most research programs would be funded at FY 1999 levels.

Outlook for October and Beyond

As Congress struggles over final funding levels for R&D programs and other federal discretionary spending, the final status of FY 2000 R&D funding remains largely unsettled. Congress and the President have not even begun final negotiations on the shape of the FY 2000 budget because of the mistrust between them. All unsigned appropriations bills are covered by a **continuing resolution** (CR) providing temporary funding for all programs at FY 1999 levels through **October 21**, but few believe that even an extra three weeks will enable lawmakers to finish FY 2000 appropriations. In the interim, Congress is expected to complete as many appropriations bills as it can and send them individually to the President for his signature or veto. If the President vetoes bills, as he has threatened to with most of the bills containing R&D funding, there is no clear strategy in Congress on how to rewrite the bills to win his final approval.

Any appropriations bills not signed into law by October 21, which could be a majority of them, will likely be bundled into an omnibus appropriations bill, and funding levels will be hammered out in high-level negotiations between the Republican leadership and Administration officials behind closed doors.

The final negotiations are complicated by Congress' insistence on sticking to budget totals established in the FY 2000 budget resolution, which in turn were based on **discretionary spending caps** enacted in 1997. Under the caps, total FY 2000 discretionary spending must be cut more than $30 billion below the amount appropriated for FY 1999 to $538 billion. This goal proved unworkable, so then Congress switched to a dual game of sticking to the caps technically while spending $14 billion, the projected amount of the **non-Social Security surplus**, above the cap. In the past month, even this has proved impossible. In a further retreat,

Congress now plans to technically stay within the cap, designate up to $14 billion in spending above the caps as emergency spending (which is exempt from the caps), push as much spending as possible to FY 2001, and spend even more money to bring appropriations bills to acceptable funding levels by finding **revenue offsets** for any spending exceeding $562 billion ($538 billion cap plus the $14 billion non-Social Security surplus). All these budgetary maneuvers should enable Congress to exceed FY 1999 discretionary spending of $556 billion, preserve funding for domestic programs, award large increases for defense programs, and still keep its vehemently stated promise not to dip into the Social Security surplus.

Congress, however, is running into serious problems implementing this strategy. A recent Congressional Budget Office study estimated that current House and Senate spending plans would push discretionary spending well above $600 billion and dip into the Social Security surplus by up to $18 billion. Although the federal government has used Social Security surplus money every year for the past 40 years to finance government programs (including this year) and although such actions do not in any way reduce the Social Security Trust Fund's assets, both the President and Congress have vowed to stop this practice once and for all in FY 2000.

Congress has been engaged in a mad scramble to find offsets and budgetary tricks to enable it to keep its pledge. In addition to declaring farm aid, disaster assistance, veterans' medical care, and even the 2000 Census as emergency spending, in the Labor-HHS bill both the House and the Senate would push an unprecedented $20 billion in spending from FY 2000 into FY 2001, borrowing from next year to finance this year. Last week, defense appropriators decided to reclassify defense spending which had been regular appropriations as emergency spending. The House proposed to rescind $3 billion in funds promised to state governments as part of the 1996 welfare reform law, until an outcry from the nation's governors forced a retreat. Now, the House proposes to change payments of the Earned Income Tax Credit (EITC) from an annual payment to monthly payments. The EITC, a refundable tax credit for low-income working households, is currently paid out like other tax refunds in one payment in the spring after a tax return is filed. By shifting payment to a monthly schedule, more than half of the payments would take place in the next fiscal year. The federal surplus in the first year would increase (by an estimated $9 billion), allowing for more FY 2000 spending without touching the Social Security surplus, but the refunds would only be delayed, resulting in no long-term budget impact. For EITC recipients, however, EITC credits claimed on a 1999 tax return would not be fully paid out until spring 2001, while all other taxpayers would receive their full refunds in spring 2000. Although Republican Presidential candidate and front-runner George W. Bush criticized the idea, the House approved a Labor-HHS bill containing this offset in order to keep its spending within its target.

This scramble to make the numbers fit has resulted in remarkable exercises in creative budgeting that could unravel, adding an extra layer of uncertainty to the already uncertain exercise of reconciling House funding levels to Senate funding levels. Although R&D funding has fared relatively well in the Senate bills and less so in the House bills, these funding levels are made possible by budgetary maneuvers that could be insufficient to meet the targets and by offsetting budget cuts that may not be acceptable to the President. As the FY 2000 appropriations process drags on, lawmakers will have to wrestle with the caps, the non-Social Security surplus, proposed congressional offsets, proposed alternative offsets (such as the President's proposed increase in the tobacco tax), emergency spending, forward funding to FY 2001, and defense vs. nondefense spending, and resolve this maze of issues before coming to a final conclusion of funding for individual programs.

Funding Trends for R&D in House and Senate Plans

As the FY 2000 budget process heads into the home stretch, federal R&D hangs in the balance. Figure 2 shows how House appropriations for FY 2000 would affect recent funding trends in R&D. Figure 2 shows the percent change in agencies' R&D budgets from FY 1994 to the FY 2000 House-proposed funding level in real terms (after adjusting for inflation). FY 1994 is the starting point because it is the recent peak in funding

for most nondefense R&D agencies and because it is the year before sharp cuts in discretionary spending began to bring the federal budget to surplus.

The House plans for R&D would give most agencies less for R&D in FY 2000 than in FY 1994, sometimes far less. Only NIH and NSF would be immune from the trend. Although NIH would see its R&D budget climb by 40 percent over the six years, NSF would see its R&D budget up by only six percent, or an average of just 1 percent a year. Other agencies, such as NASA, DOE, Commerce, and DOD's S&T programs, would face R&D budgets more than 10 percent below FY 1994 funding levels. Although total nondefense R&D would be up slightly, this increase would be due entirely to NIH. The last column shows that nondefense R&D minus NIH, the sum total of federal civilian investments in non-life sciences, non-biomedical R&D, would be down more than 10 percent if the House plans are enacted. Defense investments in basic and applied research in engineering, mathematics, and computer sciences would also be down by more than 10 percent.

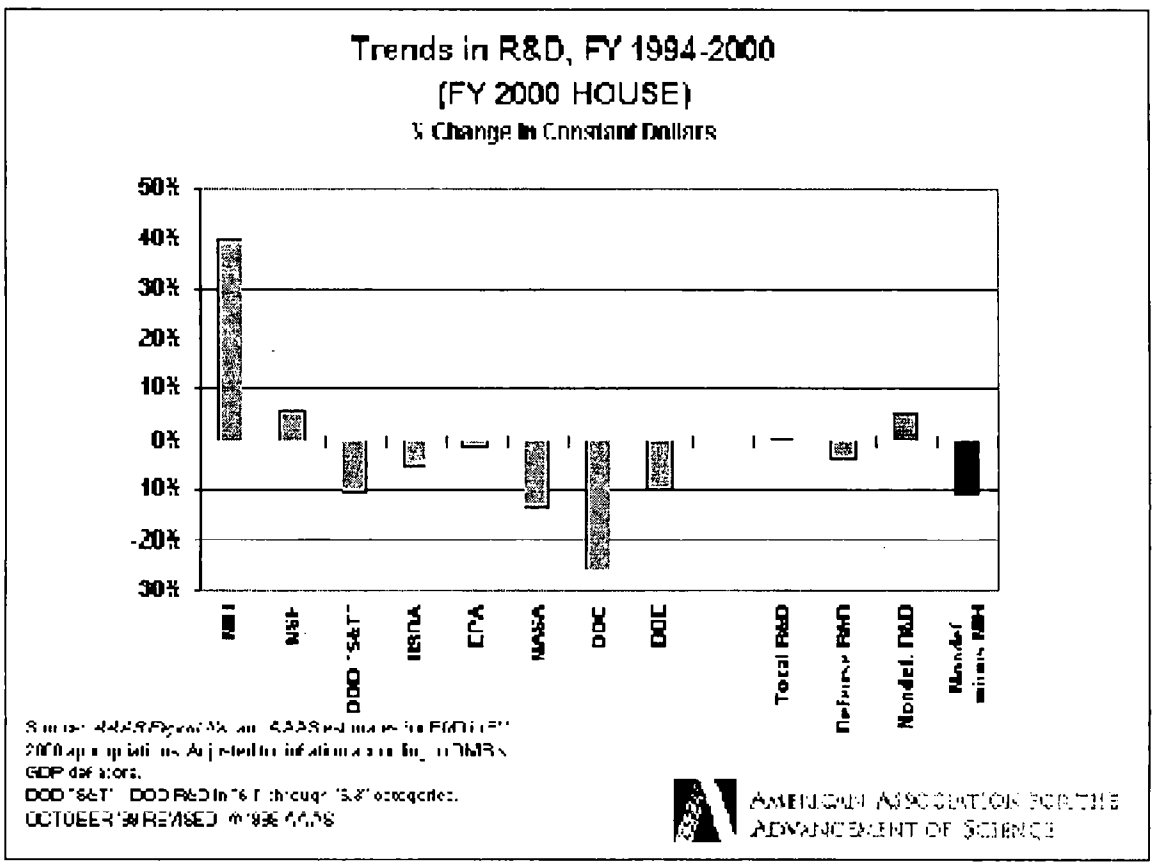


Figure 2.

Senate plans for R&D would be more favorable to R&D, especially in non-life sciences disciplines, as shown in Figure 3. NIH would be a big winner, as in the House plan, and would see its R&D budget increase by 45 percent compared to FY 1994. NSF, the primary supporter of non-life sciences research in most disciplines, would be well above the FY 1994 funding level, as would the Department of Commerce. Although other agencies would see flat or declining budgets over the time period, the decreases would be less than in the House-proposed budgets. Only DOD S&T would be more than 10 percent below the FY 1994 funding level. Total nondefense R&D would be up 11.1 percent from FY 1994 in the Senate plan. After subtracting NIH the cut between FY 1994 and FY 2000 would be 4.8 percent.

Lawmakers' debates in October and possibly November will determine which of the House or Senate scenarios, or what combination of the two, or even something entirely different, will ultimately prevail in FY

2000 appropriations. Congress and the President are well on their way to repeating last year's experience. In the FY 1999 budget process, both sides went into budget negotiations vowing to abide by the discretionary cap but ended up approving advance appropriations, emergency spending, and offsets to get around it. In order to finish appropriations, 8 of the 13 appropriations bills were bundled together in a 3,000-page omnibus appropriations bill cobbled together in frantic closed-door negotiations and rushed through Congress before most Members of Congress could even attempt to read it. It is looking increasingly likely that FY 2000 will be a repeat of the same situation. Although R&D fared well in the FY 1999 process, it is anyone's guess what will happen to R&D this time around.

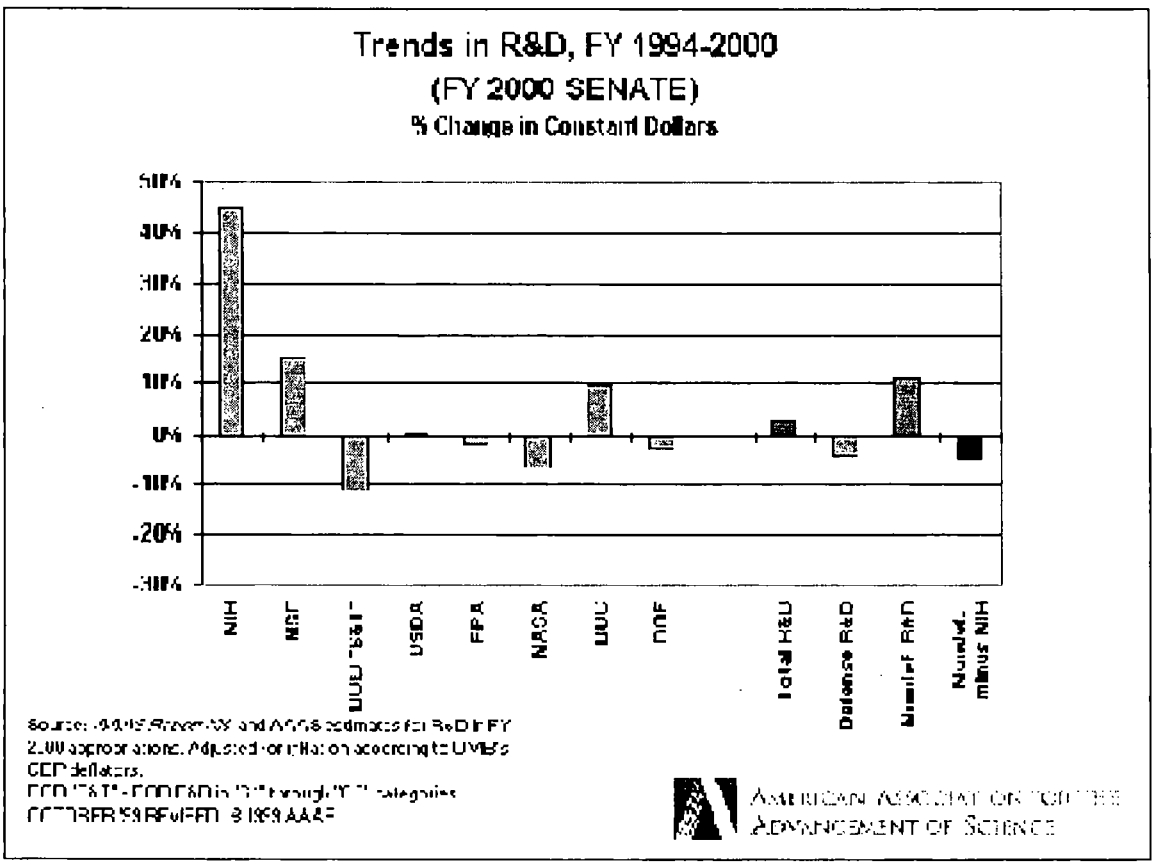


Figure 3.

(Further AAAS R&D Funding Updates on the AAAS R&D Web site will provide up-to-date information on R&D in FY 2000 appropriations, including final funding levels as they emerge from House-Senate conference.)

- October 4

AAAS R&D Budget and Policy Program
1200 New York Ave, NW
Washington, DC 20005
(202) 326-6607; -6600
fax (202) 289 4950
science_policy@aaas.org
www.aaas.org/spp/R&D

Table 1A. Total R&D by Agency
HOUSE Action on R&D in the FY 2000 Budget
(budget authority in millions of dollars)

			Action by House				
	FY 1999	FY 2000	**FY 2000**	Chg. from Request		Chg. from FY 1999	
	Est.	Request	**House**	Amount	Percent	Amount	Percent
Defense (military)	37,975	35,065	**37,788**	2,722	7.8%	-187	-0.5%
("S&T" 6.1,6.2,6.3 + Medical)	*7,791*	*7,386*	***8,229***	*843*	*11.4%*	*438*	*5.6%*
(All Other DOD R&D)	*30,184*	*27,679*	***29,558***	*1,879*	*6.8%*	*-625*	*-2.1%*
National Aeronautics & Space Admin.	9,715	9,770	**9,032**	-738	-7.6%	-683	-7.0%
Energy	6,974	7,467	**6,775**	-692	-9.3%	-199	-2.9%
Health and Human Services	15,750	16,047	**17,061**	1,014	6.3%	1,311	8.3%
(National Institutes of Health)	*14,971*	*15,289*	***16,251***	*962*	*6.3%*	*1,280*	*8.6%*
National Science Foundation	2,714	2,890	**2,641**	-249	-8.6%	-73	-2.7%
Agriculture	1,638	1,850	**1,604**	-246	-13.3%	-34	-2.1%
Interior	567	584	**558**	-26	-4.5%	-9	-1.6%
Transportation	603	836	**656**	-180	-21.5%	53	8.9%
Environmental Protection Agency	669	645	**645**	0	0.0%	-24	-3.5%
Commerce	1,075	1,172	**844**	-328	-28.0%	-231	-21.5%
(NOAA)	*600*	*600*	***547***	*-53*	*-8.8%*	*-53*	*-8.8%*
(NIST)	*468*	*565*	***290***	*-275*	*-48.7%*	*-178*	*-38.1%*
Education	224	276	**223**	-53	-19.0%	-1	-0.2%
Agency for Int'l Development	143	94	**140**	46	49.1%	-3	-2.0%
Department of Veterans Affairs	674	663	**673**	10	1.5%	-1	-0.1%
Nuclear Regulatory Commission	49	47	**46**	-1	-2.1%	-3	-6.1%
Smithsonian	138	146	**142**	-4	-2.6%	4	3.0%
All Other	443	353	**348**	-5	-1.3%	-95	-21.4%
Total R&D	79,350	77,904	**79,177**	1,272	1.6%	-174	-0.2%
Defense R&D	41,208	38,483	**40,904**	2,422	6.3%	-304	-0.7%
Nondefense R&D	38,142	39,422	**38,272**	-1,149	-2.9%	131	0.3%
Nondefense R&D minus NIH	*23,171*	*24,133*	***22,021***	*-2,111*	*-8.7%*	*-1,149*	*-5.0%*
Basic Research	17,276	18,101	**18,175**	74	0.4%	899	5.2%
Applied Research	16,640	16,642	**16,543**	-98	-0.6%	-97	-0.6%
Total Research	33,916	34,742	**34,718**	-24	-0.1%	802	2.4%
"21st Century Research Fund"	36,943	38,111	**37,704**	-407	-1.1%	761	2.1%
"FS&T"	48,326	49,404	**48,794**	-610	-1.2%	467	1.0%

AAAS estimates. Includes conduct of R&D and R&D facilities. Includes rescissions and emergency appropriations.
All figures are rounded to the nearest million. Changes calculated from unrounded figures.
FY 2000 House figures are AAAS estimates of R&D funding contained in FY 2000 House appropriations bills.
FY 2000 House figures represent House-approved or House Appropriations Committee-approved funding levels. House action only - Does not reflect House-Senate conference funding levels for Energy-Water, Transportation, and Agriculture bills.

Table 1B. Total R&D by Agency
SENATE Action on R&D in the FY 2000 Budget
(budget authority in millions of dollars)

			Action by Senate				
	FY 1999	FY 2000	**FY 2000**	Chg. from Request		Chg. from FY 1999	
	Est.	Request	**Senate**	Amount	Percent	Amount	Percent
Defense (military)	37,975	35,065	**37,223**	2,158	6.2%	-751	-2.0%
("S&T" 6.1,6.2,6.3 + Medical)	*7,791*	*7,386*	***8,172***	*786*	*10.6%*	*381*	*4.9%*
(All Other DOD R&D)	*30,184*	*27,679*	***29,051***	*1,372*	*5.0%*	*-1,132*	*-3.8%*
National Aeronautics & Space Admin.	9,715	9,770	**9,770**	0	0.0%	55	0.6%
Energy	6,974	7,467	**7,313**	-154	-2.1%	338	4.9%
Health and Human Services	15,750	16,047	**17,702**	1,654	10.3%	1,951	12.4%
(National Institutes of Health)	*14,971*	*15,289*	***16,902***	*1,613*	*10.5%*	*1,931*	*12.9%*
National Science Foundation	2,714	2,890	**2,880**	-10	-0.4%	165	6.1%
Agriculture	1,638	1,850	**1,700**	-149	-8.1%	63	3.8%
Interior	567	584	**577**	-8	-1.3%	9	1.6%
Transportation	603	836	**630**	-206	-24.6%	27	4.5%
Environmental Protection Agency	669	645	**644**	-1	-0.1%	-24	-3.6%
Commerce	1,075	1,172	**1,245**	73	6.2%	170	15.8%
(NOAA)	*600*	*600*	***675***	*75*	*12.4%*	*75*	*12.4%*
(NIST)	*468*	*565*	***563***	*-2*	*-0.3%*	*96*	*20.4%*
Education	224	276	**233**	-43	-15.7%	9	3.9%
Agency for Int'l Development	143	94	**93**	-1	-1.3%	-50	-35.1%
Department of Veterans Affairs	674	663	**663**	0	0.0%	-11	-1.6%
Nuclear Regulatory Commission	49	47	**47**	0	0.0%	-2	-4.1%
Smithsonian	138	146	**140**	-6	-4.2%	2	1.3%
All Other	443	353	**392**	39	11.0%	-51	-11.5%
Total Senate R&D	79,350	77,904	**81,250**	3,345	4.3%	1,900	2.4%
Defense R&D	41,208	38,483	**40,729**	2,246	5.8%	-480	-1.2%
Nondefense R&D	38,142	39,422	**40,521**	1,099	2.8%	2,379	6.2%
Nondefense R&D minus NIH	*23,171*	*24,133*	***23,619***	*-514*	*-2.1%*	*448*	*1.9%*
Basic Research	17,276	18,101	**18,879**	778	4.3%	1,603	9.3%
Applied Research	16,640	16,642	**17,255**	614	3.7%	615	3.7%
Total Research	33,916	34,742	**36,134**	1,392	4.0%	2,218	6.5%
"21st Century Research Fund"	36,943	38,111	**39,212**	1,101	2.9%	2,269	6.1%
"FS&T"	48,326	49,404	**51,360**	1,956	4.0%	3,033	6.3%

AAAS estimates. Includes conduct of R&D and R&D facilities. Includes rescissions and emergency appropriations.
All figures are rounded to the nearest million. Changes calculated from unrounded figures.
FY 2000 Senate figures are AAAS estimates of R&D funding contained in FY 2000 Senate appropriations bills.
Senate-approved or Senate Appropriations Committee-approved funding levels.
Senate action only - Does not reflect House-Senate conference funding levels for Energy-Water, Transportation, and Agriculture bills.

Table 2A. Estimated Research by Agency
HOUSE Action on R&D in the FY 2000 Budget
(budget authority in millions of dollars)

			Action by House				
	FY 1999	FY 2000	**FY 2000**	Chg. from Request		Chg. from FY 1999	
	Est.	Request	**House**	Amount	Percent	Amount	Percent
Basic Research:							
Health and Human Services	8,429	8,590	**9,146**	557	6.5%	717	8.5%
National Institutes of Health	*8,427*	*8,588*	***9,144***	556	6.5%	717	8.5%
National Science Foundation	2,333	2,514	**2,316**	-197	-7.8%	-16	-0.7%
Department of Defense	1,108	1,113	**1,142**	29	2.6%	34	3.1%
Department of Energy	2,225	2,281	**2,232**	-48	-2.1%	7	0.3%
National Aeronautics & Space Admin.	2,140	2,466	**2,292**	-174	-7.1%	151	7.1%
Department of Agriculture	677	776	**693**	-83	-10.7%	15	2.3%
Department of the Interior	51	53	**53**	0	-0.2%	2	3.4%
Smithsonian	128	136	**132**	-4	-2.8%	4	3.2%
Environmental Protection Agency	83	79	**79**	0	0.0%	-4	-4.8%
Department of Commerce	36	38	**37**	-1	-2.8%	1	3.5%
All Other	65	55	**52**	-3	-5.7%	-13	-19.7%
Total Basic Research	17,276	18,101	**18,175**	74	0.4%	899	5.2%
RESEARCH (basic and applied):							
Health and Human Services	13,657	13,899	**14,791**	892	6.4%	1,134	8.3%
National Institutes of Health	*12,915*	*13,171*	***14,017***	846	6.4%	1,102	8.5%
National Science Foundation	2,513	2,699	**2,487**	-212	-7.8%	-26	-1.0%
Department of Defense	4,259	4,072	**4,516**	443	10.9%	257	6.0%
Department of Energy	4,103	4,379	**4,023**	-356	-8.1%	-80	-2.0%
National Aeronautics & Space Admin.	4,468	4,424	**4,156**	-268	-6.1%	-312	-7.0%
Department of Agriculture	1,416	1,643	**1,455**	-187	-11.4%	39	2.8%
Department of the Interior	536	551	**532**	-19	-3.5%	-4	-0.7%
Environmental Protection Agency	470	447	**447**	0	0.0%	-23	-4.9%
Department of Commerce	846	878	**687**	-191	-21.7%	-159	-18.8%
NOAA	*544*	*543*	***495***	*-48*	*-8.8%*	*-49*	*-9.0%*
NIST	*296*	*329*	***187***	*-143*	*-43.4%*	*-110*	*-37.0%*
Department of Transportation	397	576	**452**	-124	-21.6%	55	13.7%
Department of Veterans Affairs	608	597	**606**	9	1.5%	-2	-0.3%
Department of Education	157	174	**141**	-33	-19.0%	-16	-10.3%
All Other	485	403	**425**	22	5.5%	-60	-12.4%
TOTAL RESEARCH	33,916	34,742	**34,718**	-24	-0.1%	802	2.4%

AAAS estimates. Includes conduct of R&D and R&D facilities.

All figures are rounded to the nearest million. Changes calculated from unrounded figures.

FY 2000 House figures are AAAS estimates of R&D funding contained in FY 2000 House appropriations bills.

House-approved or House Appropriations Committee-approved funding levels.

House action only - Does not reflect House-Senate conference funding levels for Energy-Water, Transportation, and Agriculture bills.

Table 2B. Estimated Research by Agency
SENATE Action on R&D in the FY 2000 Budget
(budget authority in millions of dollars)

			Action by Senate				
	FY 1999	FY 2000	**FY 2000**	Chg. from Request		Chg. from FY 1999	
	Est.	Request	**SENATE**	Amount	Percent	Amount	Percent
Basic Research:							
Health and Human Services	8,429	8,590	**9,515**	926	10.8%	1,086	12.9%
National Institutes of Health	*8,427*	*8,588*	***9,513***	*926*	*10.8%*	*1,086*	*12.9%*
National Science Foundation	2,333	2,514	**2,518**	4	0.2%	185	7.9%
Department of Defense	1,108	1,113	**1,142**	29	2.6%	35	3.1%
Department of Energy	2,225	2,281	**2,208**	-72	-3.2%	-17	-0.8%
National Aeronautics & Space Admin.	2,140	2,466	**2,419**	-47	-1.9%	279	13.0%
Department of Agriculture	677	776	**715**	-61	-7.9%	37	5.5%
Department of the Interior	51	53	**52**	-1	-2.0%	1	1.6%
Smithsonian	128	136	**130**	-6	-4.5%	2	1.5%
Environmental Protection Agency	83	79	**79**	0	-0.1%	-4	-4.9%
Department of Commerce	36	38	**38**	0	-0.5%	2	5.9%
All Other	65	55	**62**	6	11.0%	-4	-5.4%
Total Basic Research	17,276	18,101	**18,879**	778	4.3%	1,603	9.3%
RESEARCH (basic and applied):							
Health and Human Services	13,657	13,899	**15,352**	1,452	10.4%	1,694	12.4%
National Institutes of Health	*12,915*	*13,171*	***14,581***	*1,410*	*10.7%*	*1,666*	*12.9%*
National Science Foundation	2,513	2,699	**2,746**	47	1.8%	233	9.3%
Department of Defense	4,259	4,072	**4,314**	242	5.9%	55	1.3%
Department of Energy	4,103	4,379	**4,312**	-67	-1.5%	209	5.1%
National Aeronautics & Space Admin.	4,468	4,424	**4,408**	-16	-0.4%	-60	-1.4%
Department of Agriculture	1,416	1,643	**1,490**	-153	-9.3%	74	5.2%
Department of the Interior	536	551	**544**	-7	-1.3%	9	1.6%
Environmental Protection Agency	470	447	**446**	-1	-0.1%	-24	-5.0%
Department of Commerce	846	878	**945**	66	7.6%	99	11.6%
NOAA	*544*	*543*	***611***	*68*	*12.4%*	*67*	*12.2%*
NIST	*296*	*329*	***328***	*-1*	*-0.3%*	*32*	*10.8%*
Department of Transportation	397	576	**436**	-139	-24.2%	39	9.9%
Department of Veterans Affairs	608	597	**597**	0	0.0%	-11	-1.8%
Department of Education	157	174	**147**	-27	-15.7%	-10	-6.6%
All Other	485	403	**397**	-6	-1.5%	-88	-18.1%
TOTAL RESEARCH	33,916	34,742	**36,134**	1,392	4.0%	2,218	6.5%

AAAS estimates. Includes conduct of R&D and R&D facilities.

All figures are rounded to the nearest million. Changes calculated from unrounded figures.

FY 2000 Senate figures are AAAS estimates of R&D funding contained in FY 2000 Senate appropriations bills.

Senate-approved or Senate Appropriations Committee-approved funding levels.

Senate action only - Does not reflect House-Senate conference funding levels for Energy-Water, Transportation, and Agriculture bills.

Table 3A. Major Functional Categories of R&D
HOUSE Action on R&D in the FY 2000 Budget
(budget authority in millions of dollars)

			Action by House				
	FY 1999	FY 2000	**FY 2000**	Chg. from Request		Chg. from FY 1999	
	Est.	Request	**House**	Amount	Percent	Amount	Percent
Defense [1]	41,208	38,483	**40,904**	2,422	6.3%	-304	-0.7%
Nondefense [2]	38,142	39,422	**38,272**	-1,149	-2.9%	131	0.3%
Space	8,518	8,704	**7,905**	-799	-9.2%	-614	-7.2%
Health	16,379	16,664	**17,688**	1,024	6.1%	1,309	8.0%
Energy	1,173	1,353	**1,162**	-192	-14.2%	-12	-1.0%
General Science	5,365	5,668	**5,219**	-449	-7.9%	-146	-2.7%
Natural Resources & Environment	2,088	2,104	**1,994**	-110	-5.2%	-94	-4.5%
Agriculture	1,427	1,608	**1,393**	-215	-13.4%	-34	-2.4%
Transportation	1,799	1,902	**1,783**	-118	-6.2%	-16	-0.9%
Commerce	474	571	**296**	-275	-48.2%	-178	-37.6%
International	194	123	**169**	46	37.6%	-25	-12.8%
All Other	724	725	**664**	-61	-8.4%	-60	-8.3%
Total R&D	79,350	77,904	**79,177**	1,272	1.6%	-174	-0.2%

Table 3B. Major Functional Categories of R&D
SENATE Action on R&D in the FY 2000 Budget
(budget authority in millions of dollars)

			Action by Senate				
	FY 1999	FY 2000	**FY 2000**	Chg. from Request		Chg. from FY 1999	
	Est.	Request	**SENATE**	Amount	Percent	Amount	Percent
Defense [1]	41,208	38,483	**40,729**	2,246	5.8%	-480	-1.2%
Nondefense [2]	38,142	39,422	**40,521**	1,099	2.8%	2,379	6.2%
Space	8,518	8,704	**8,704**	0	0.0%	185	2.2%
Health	16,379	16,664	**18,319**	1,654	9.9%	1,939	11.8%
Energy	1,173	1,353	**1,217**	-137	-10.1%	43	3.7%
General Science	5,365	5,668	**5,552**	-116	-2.0%	187	3.5%
Natural Resources & Environment	2,088	2,104	**2,130**	26	1.2%	42	2.0%
Agriculture	1,427	1,608	**1,497**	-111	-6.9%	70	4.9%
Transportation	1,799	1,902	**1,696**	-206	-10.8%	-103	-5.8%
Commerce	474	571	**569**	-2	-0.3%	96	20.2%
International	194	123	**122**	-1	-1.0%	-72	-37.2%
All Other	724	725	**716**	-9	-1.2%	-8	-1.1%
Total R&D	79,350	77,904	**81,250**	3,345	4.3%	1,900	2.4%

AAAS estimates. Includes conduct of R&D and R&D facilities.

All figures are rounded to the nearest million. Changes calculated from unrounded figures.

Classifications generally follow the government's budget function categories except health (which here includes health R&D in HHS and VA).

[1] Includes DOD R&D and atomic energy defense R&D in DOE.

[2] Includes all R&D not in defense (domestic and international discretionary programs).

House-approved, Senate-approved, or Appropriations Committee-approved funding levels.

House or Senate action only - Does not reflect House-Senate conference funding levels for Energy-Water, Transportation, and Agriculture bills.

LANE
SMITH
GWIN
ADS
PORTER
MUSGRAVE
GIBSON

CHIEF OF STAFF JOHN PODESTA
REMARKS ON RESEARCH AND DEVELOPMENT FUNDING
NATIONAL PRESS CLUB
(As Prepared for Delivery)
September 1, 1999

cc: NSIA Staff

One afternoon in the spring of 1804, in a heavily loaded keelboat and two oversized canoes, nearly four dozen men crossed the Mississippi River and started up the Missouri, struggling against its thick, muddy current. At the behest of President Thomas Jefferson, and with the support of Congress, they were, at that time, on the most important expedition of American history – the United States' first official exploration into unknown spaces, and a glimpse into their young nation's future.

Lewis and Clark were America's foremost explorers, not only mapping out the contours of a continent, but also, in profound ways, the frontiers of our imagination. In that way, they are the forebears of those who have given us the recent Mars expedition, those who are building the international space station, those who are hunting for the mysteries of the human genome, those who are looking for answers to the challenge of global climate change.

A passion for discovery and a sense of adventure have always driven our nation forward. These deeply rooted American qualities spur our determination to explore new scientific frontiers and spark our can-do spirit of technological innovation. Continued leadership depends on our enduring commitment to science, to technology, to research, to learning.

In each of the last seven years, President Clinton and Vice President Gore have proposed increases in civilian research and development. Investments in their FY2000 budget will allow us to explore the solar system, keep America at the cutting-edge of the Information Revolution, and reduce the emission of greenhouse gases – all while getting our fiscal house in order and making key investments in education and training.

The Administration is deeply concerned that the Republican-led Congress – particularly the House – is proposing to make deep cuts in our funding for research and development in the new fiscal year. Republicans in both the House and the Senate are proposing a risky tax and budget cuts that will guarantee that federal funding of R&D is slashed in the future. This is the wrong direction for our country. One wonders whether this Congress would have zeroed out Jefferson's request for the Lewis and Clark Expedition.

This morning, I'd like to explain why we believe that continued federal investments in research and development are so important, and why we're so troubled by the Republican attack on our science and technology budgets. We should all be working toward bipartisan progress – not playing politics with an issue so fundamentally crucial to our nation's future.

Investments in science and technology – both public and private – have driven economic growth and improvements in the quality of life in America for the last 200 years.
Many of the products and services we have come to depend on for our way of life in America – from lasers to communications satellites to human insulin – are all the products of US policies to encourage investments in science and technology. In 1969, the same year scientific research landed the first American on the moon, the Defense Department began its work on the computer network that would lead to today's Internet. These discoveries have all contributed to advances in the economy, national security, the environment, transportation and medical care.

In the last fifty years alone, technological innovation has been responsible for as much as half of the nation's growth in productivity. The information technology sector alone has accounted for one-third of our economic growth – jobs in the IT sector are paying 80 percent above the private average wage.

More and more, firms are using information technology to compete and win in today's global markets. They are designing products that are tailored to the needs of an individual customer, selling their products on the Internet, and delivering "just-in-time" training to their employees over corporate networks. Technology advances are enabling small businesses to perform high-quality design and manufacturing work that previously required the resources of big corporations. At the same time, big businesses are able to achieve the speed, flexibility, and proximity to customers that were once the sole domain of smaller firms. Fed Chairman Alan Greenspan recently stated that rapid technological change has greatly contributed to eight years of record peacetime expansion, and is one of the forces producing what he called "America's sparkling economic performance."

But we all know that science and technology is not just about economic growth. It's also about:

- **Allowing Americans to longer and healthier lives.** Whether it was Ben Franklin's invention of bifocals, Jonas Salk's discovery of the Polio vaccine, or David Ho's pathbreaking AIDS treatment, America has always been a world leader in medical research and technology.

In the last century alone, average life expectancy in the United States has increased by nearly 30 years – from 47 to 76. But we're clearly just at the beginning of advances in biomedical research. According to scientists, advances in genomics – an understanding of the function of human genes – will allow us to begin to detect, prevent and cure many diseases for which there is no known cure. With this technology in hand, scientists will be able to develop personalized medicines that are tailored to our genetic makeup.

- **Growing the economy while protecting the environment.** Advances in environmental science and technology hold tremendous promise for the creation of a sustainable future – a future where environmental health, economic prosperity, and quality of life are mutually reinforcing. Manufacturing processes that emit zero waste, ultra-clean fuel cells, and cars that get 80 miles per gallon are well within our reach.

- **Maintaining a strong defense.** From B-17 Flying Fortress to stealth bombers to unmanned aerial vehicles, America's military strategy has relied heavily on technological superiority. Particularly

in the post-Cold War era, as we face new threats of cyber-terrorism as well as chemical and biological warfare, investments in research and development underlie our ability to succeed in high-priority missions ... to minimize causalities ... to mobilize our military services ... and to deter potential adversaries.

- **Investing in fundamental research.** As MIT President Chuck Vest has said, "one of the strongest justifications for supporting research is what we still don't know." President Vest is right. The potential growth in the fields of science and technology is limitless. We still don't know why cells age and die, how human beings learn and remember information, or whether there is life on other planets. But there's one thing we do know for certain: From medical research to national security advancements, continued progress in science and technology fundamentally relies on adequately funded research and development.

It seems logical that there would be strong bipartisan support for federal investments in science and technology. After all, thanks to farsighted, bipartisan investments, the United States today has an array of major scientific facilities and accomplishments that are the envy of the world. And economists of all ideological persuasions agree that the government has an important role to play – because individual companies can never capture all of the benefits of research.

But this year, the Republican-led Congress – to make room for their risky tax plan – is playing politics with science and technology funding. They have proposed deep cuts in many important research programs. And in so doing, they are threatening the potential progress of innovation in America.

1) So far, they have cut the President's request for civilian R&D by $1.8 billion, an 8 to 10 percent reduction.

2) They slashed funding for the Administration's information technology research initiative by 70 percent – a program that would sponsor a wave of innovations in the same way that the ARPANET led to today's Internet.

3) They blocked the Administration's proposed increase for the National Science Foundation – the only agency that has the responsibility of supporting research and education in all science and engineering disciplines.

4) They cut the NASA budget by $1 billion, threatening over 30 space missions. These cuts endanger future NASA missions like the Chandra Project – which recently beamed vivid images of exploding stars and black holes back to Earth.

5) They cut $580 million from the budget for environmental and energy research – dramatically undermining our efforts to increase our understanding of climate change, to reduce our dependence on foreign oil, and to improve the quality of the air we breathe.

6) They eliminated the Commerce Department's Advanced Technology Program – the only program that is explicitly designed to promote civilian technology in partnership with industry.

7) And by digging deep into the pork-barrel, they earmarked nearly $1 billion in R&D projects, undermining the discipline of competition and peer review, and slashing funding for higher priority projects. Although in 1994 Republicans pledged to cut wasteful spending, it's clear that they're more interested in larding up the budget than pursuing cutting-edge research.

8) **And as if this year's cuts weren't devastating enough, the Republican budget and tax plans could reduce discretionary domestic spending by roughly half in the coming decades – inevitably leading to even further cuts in research and development. This is a 19th century budget for a 21st century economy. It appears that these Republicans grew up watching too much Fred Flintstone and not enough Jetsons.**

These cuts are inconsistent with the Republican rhetoric on science and technology. Republican Senators have passed bipartisan legislation to double civilian R&D over an 11-year period. The Republican Chairman of the House Science Committee has introduced legislation that would authorize much of the Administration's information technology initiative.
But these lofty sentiments are nowhere to be seen in the House-passed appropriations bills, or in the Republican fiscal and tax proposals, which would devastate discretionary spending. We can't build a bridge to the 21st Century with press releases and empty promises.

Sustaining America's leadership in science and technology has been a cornerstone of the Clinton Administration. A key to the strategy President Clinton and Vice President Gore have embraced is investing in our people, investing in technology, and dramatically increasing our efforts in research and development. They know that S&T investments enable our nation to compete aggressively in the global marketplace, to protect our environment, to safeguard our national security, and to contribute to our economic prosperity and quality of life.

They also know that investing in research will help prepare the next generation of scientists, engineers, and entrepreneurs so that Americans will have 21st Century skills for 21st Century jobs. And that's why the President's balanced budget contains the largest increase in funding for higher education since the GI Bill – and why he sponsored the Hope Scholarship and the Lifelong Learning Tax Credits which help Americans pay for college.

But let's be clear about one thing: this shouldn't be a partisan issue. Instead, as it has in the past, it should unite and inspire us – not divide us. Just last week in the *Washington Post*, President Bush's Science Advisor Allan Bromley called this year's federal budget for science a disaster, noting "Congress has lost sight of the critical role science plays in America."

Technological leadership is vital to the national interests of the United States. Most of the Federal research and education investment portfolio enjoyed bipartisan support during the first term of the Clinton Administration. I would hope that we can continue to extend this partnership with the Congress across our entire science and technology agenda – and promote private sector investment in research and development by supporting the R&D tax credit.

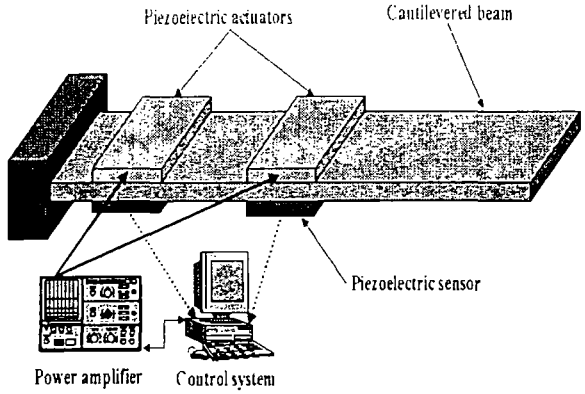
Such a partnership to stimulate scientific discovery and new technologies will take America into the new century well-equipped for the challenges and opportunities that lie ahead. A passionate interest in exploring new frontiers, a relentless quest for new knowledge, a fundamental belief in progress and in rising standards of living – are all at the core of the American character.

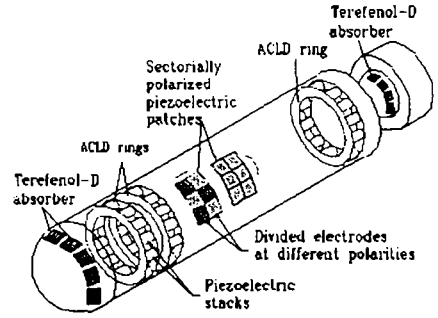
Although it is virtually impossible to predict specifically how today's basic research results will eventually improve our quality of life, or to imagine the new industries and markets that will emerge, there is no question that such improvements and industries will arise.
Just as we now reap the harvest from past discoveries, the work of researchers and scientists will transform our lives as we move into the 21st Century.

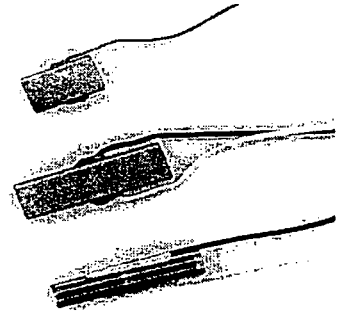
In the final year of the eighteenth century, President Jefferson wrote: "I am for encouraging the progress of science in all its branches...[and] for awing the human mind – not to go backwards instead of forwards to look for improvement."

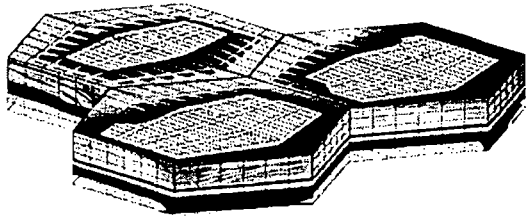
Thank you very much.

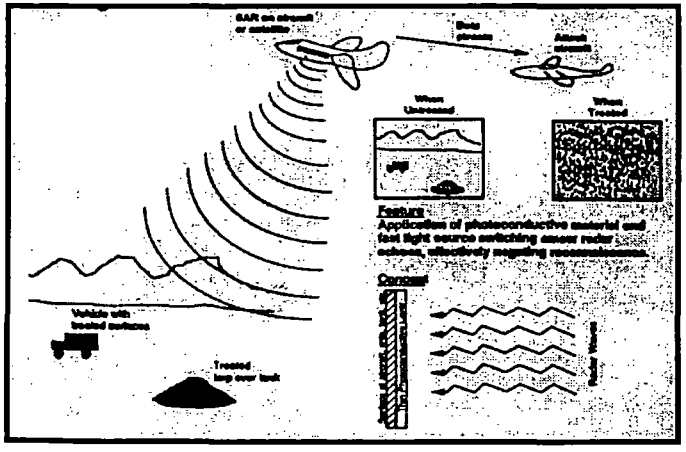
Smart Materials & Structures









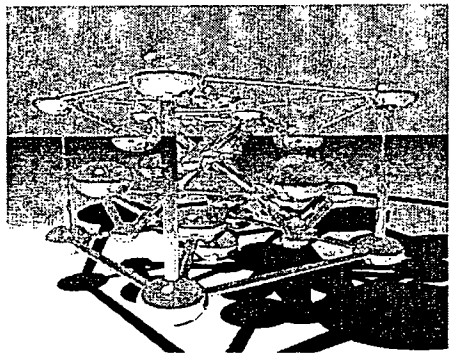


The Scientific investigation of materials and structures that can adapt to changes in the environment.

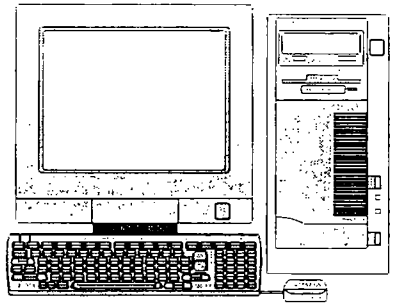
- *Elastic active materials*
- *Smart skins and coatings*
- *Distributed sensors and actuators*
- *Armor materials by design*
- *Adaptive structures*

DoD Applications: Ultraquiet submarines, adaptive flight control, vibrational control, advanced stealth, armor materials.

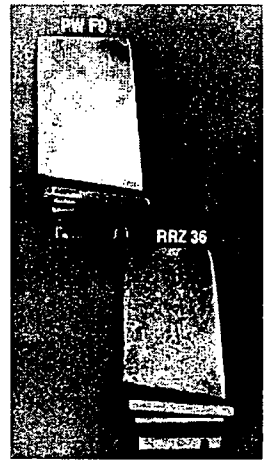
Computational Materials Science

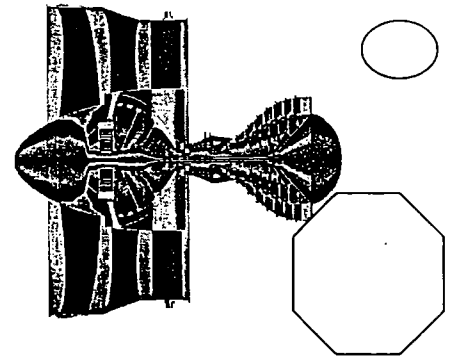


Atomic Structure



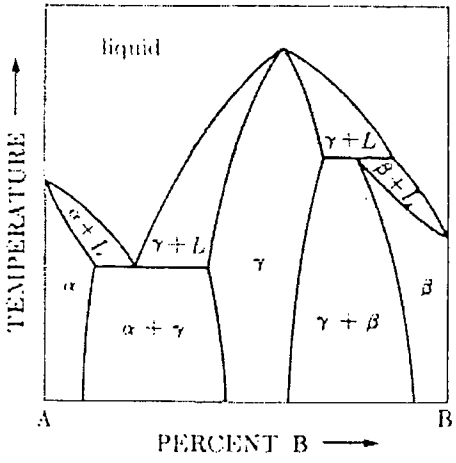
Modeling





Components → System Product

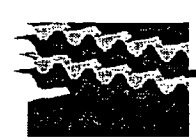
Phase Stability

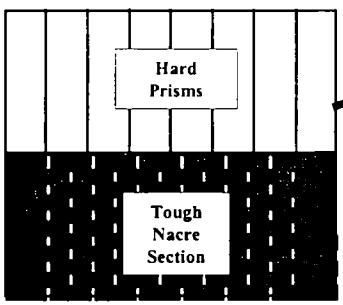


- Use modern molecular modeling and phase stability calculations to predict material microstructure.
- Based on microstructure, model physical, chemical, and mechanical properties in complex systems and environments.
- Iterate steps to optimize structure and reduce testing time and experimental trials.

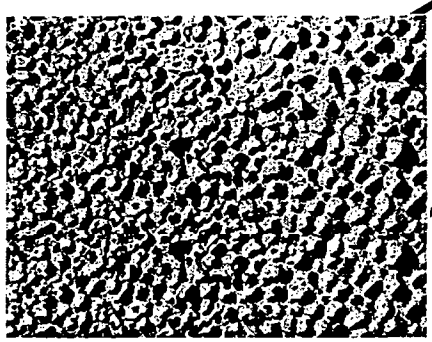
DoD Applications: Advanced High Temperature Alloys, High Quality Castings, Tailored Composites for Armor and High Performance Structures

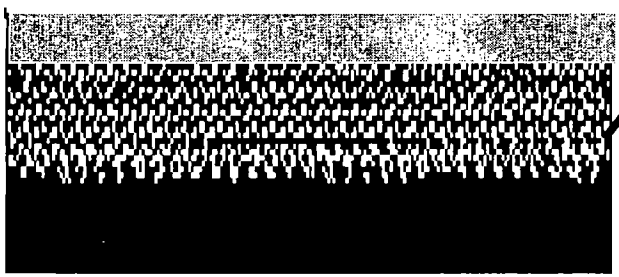
Multifunctional Materials



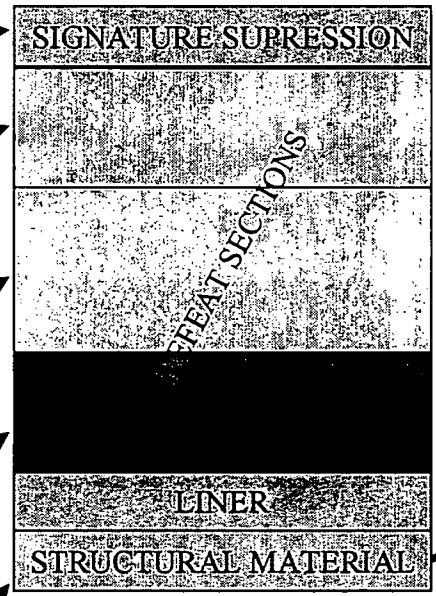


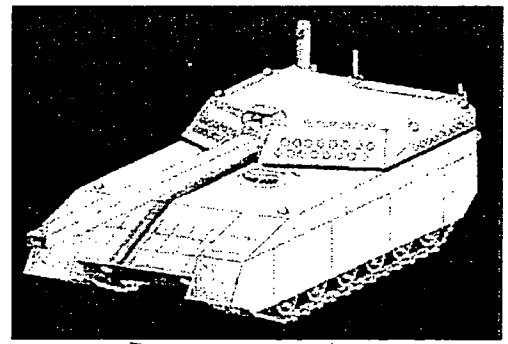
Biomimetic Material





Functionally Graded Composite

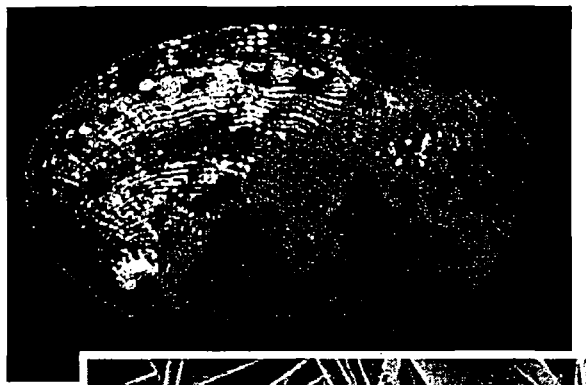


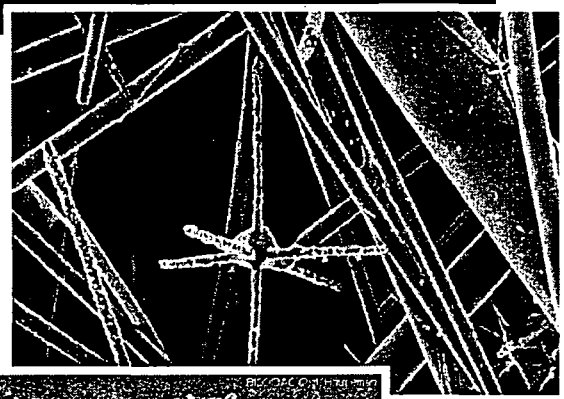


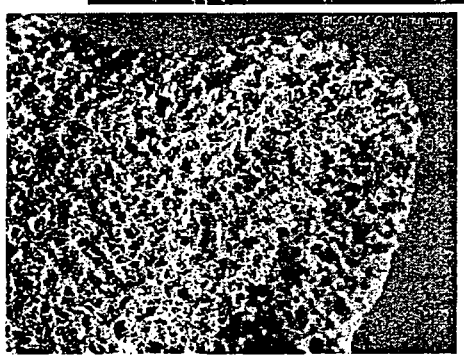
- Design multiple performance properties into materials systems such as vehicular outer structure.
- Saves weight and overall complexity by using most effective materials and synergy of materials interactions.

DoD Applications: Lightweight Armored Vehicles, Aircraft Passive Protection, Hardened Satellite Structure

Biomimetics

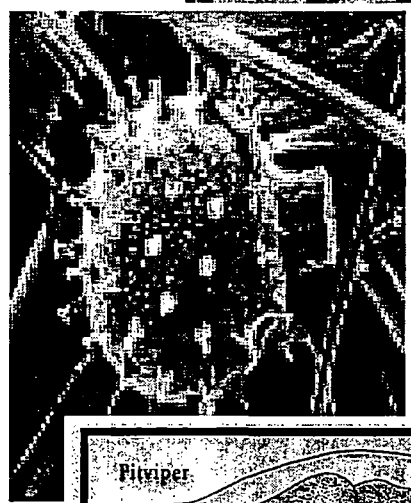


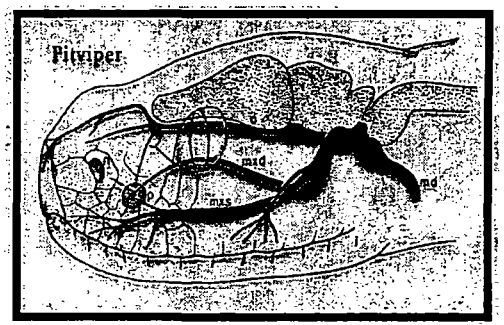




The science and technology of underlying design principles found in nature to enable the development of novel synthetic materials, processes, and sensors.

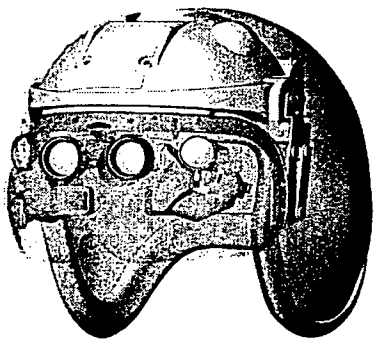
- **Biomaterials**
  - Bioceramics
  - Hybrid structures
- **Bioprocesses**
  - Vision systems
  - Auditory systems
  - Networks
  - Neural computation
- **Biosensors**
  - Artificial nose
  - Stochastic sensing
  - electronic eyes

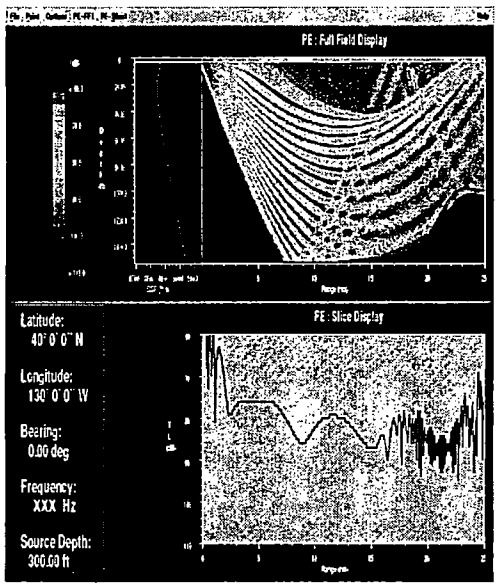




DoD Applications: Lightweight armors, Biochem sensors, smart sensors, bio-robotics

Human Systems for Warrior Performance



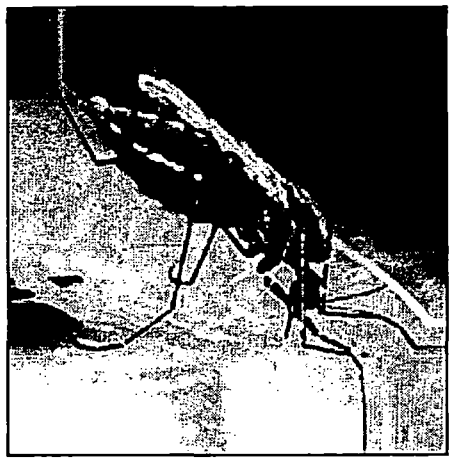


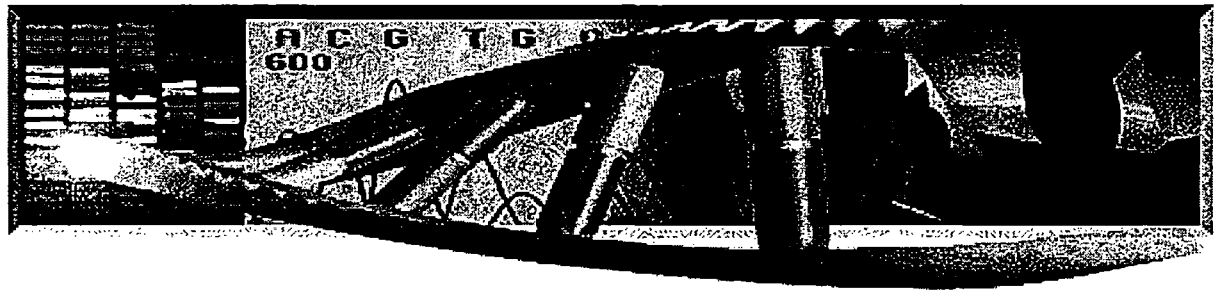
Technology to prepare and equip the military's most critical resource--its people.

- *Education and training for all military tasks*
- *Warfighter systems to expand capabilities*
- *Information displays to maintain advantage*

DoD Applications: Unit readiness, mission performance, prevention of injury.

Biomedical S&T for Deployment Health



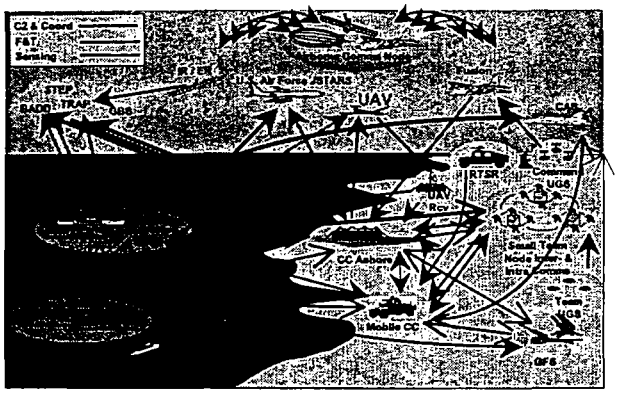


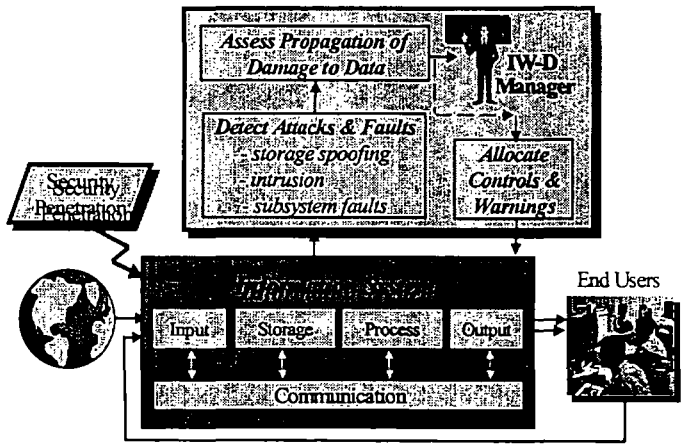
Technology to preserve combatants' health and mission capability despite battle and non-battle threats in varied deployments.

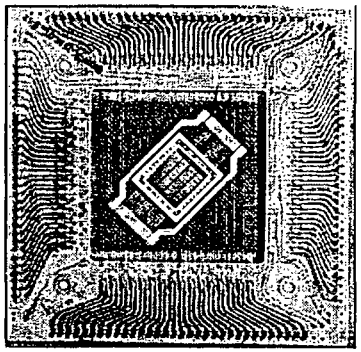
- Drugs and vaccines for health protection
- Operational medicine to minimize hazards
- Combat casualty care to treat trauma

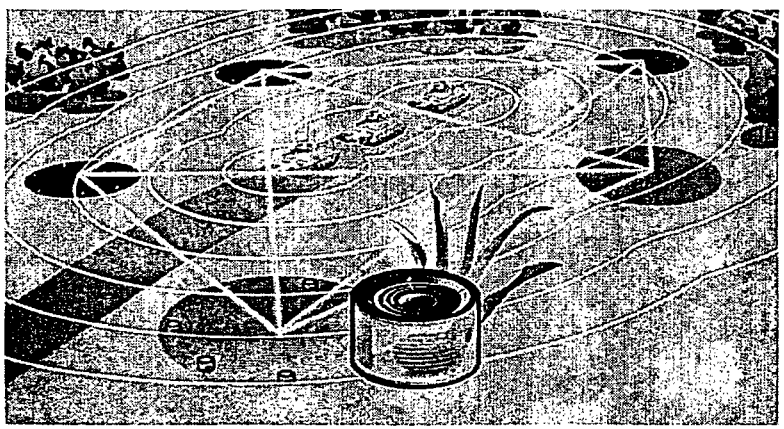
DoD Applications: Prevention and cure of disease, casualty reduction, sustainment of individual and unit readiness.

Information Technology







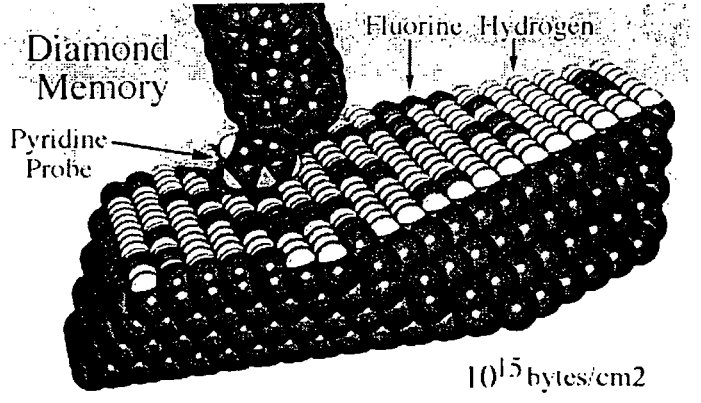


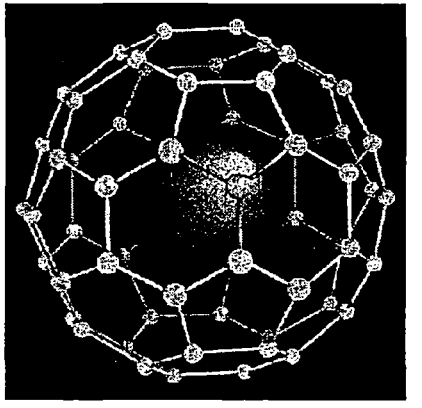
Basic science and engineering research on the fundamental principles and techniques of information acquisition, storage, processing, distribution, and display.

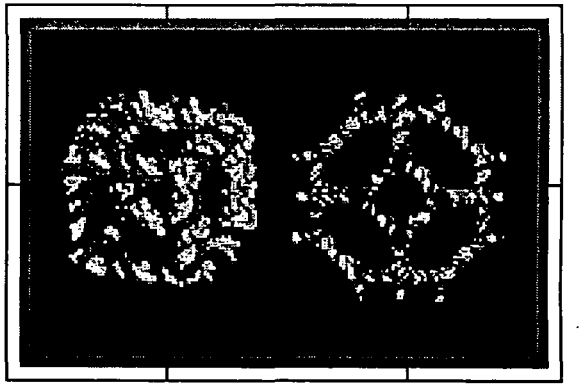
Computers, Communication, Networks, Information integration, displays, software.

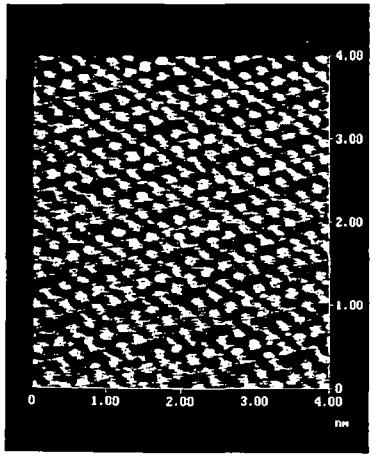
DoD Applications: C4ISR, Battle management, Surveillance, Sensors, Security, Information Assurance.

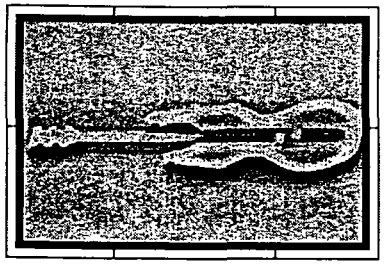
Nanoscience







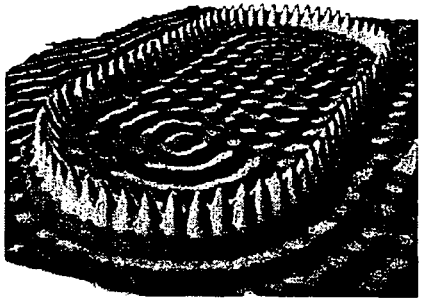


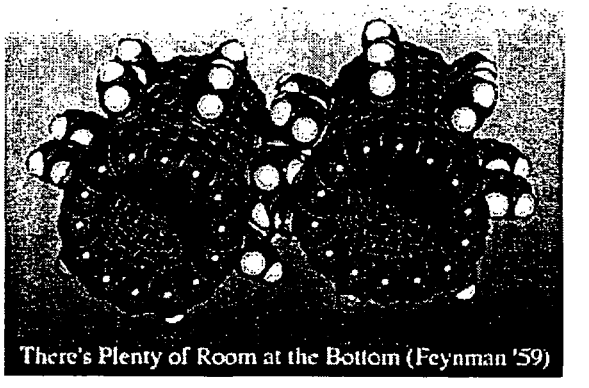


The science and technology of controlling and manipulating things at the atomic layer and nanometer (10^{-9} m) scale.

- Fabrication, synthesis, and processing of materials with predetermined properties
- Characterization, novel phenomenon, and properties for structural, electronic, and biological materials
- Nanoscale concepts and devices

DoD Applications: Electronics, computers, Biochem sensors





BUDGET OPTIONS
(TOM KALIL)
10/4/99

7.4 + inflation - $150
- $300

7.8 - 7.9 the FY2000 request + initiatives $300

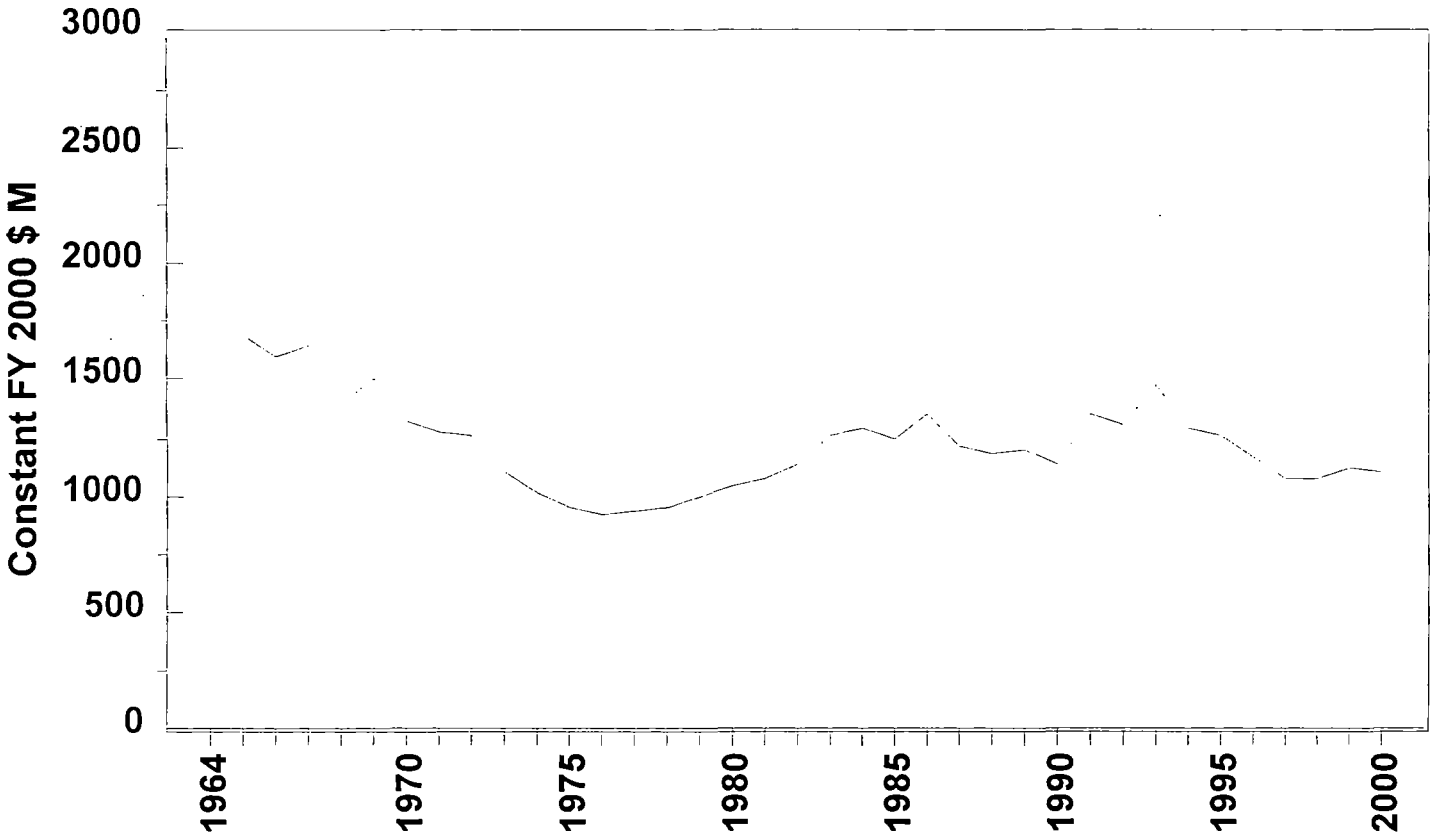
8.4 FY2000 as appropriated plus inflation

8.320 Defense Authorization.
2% real growth.

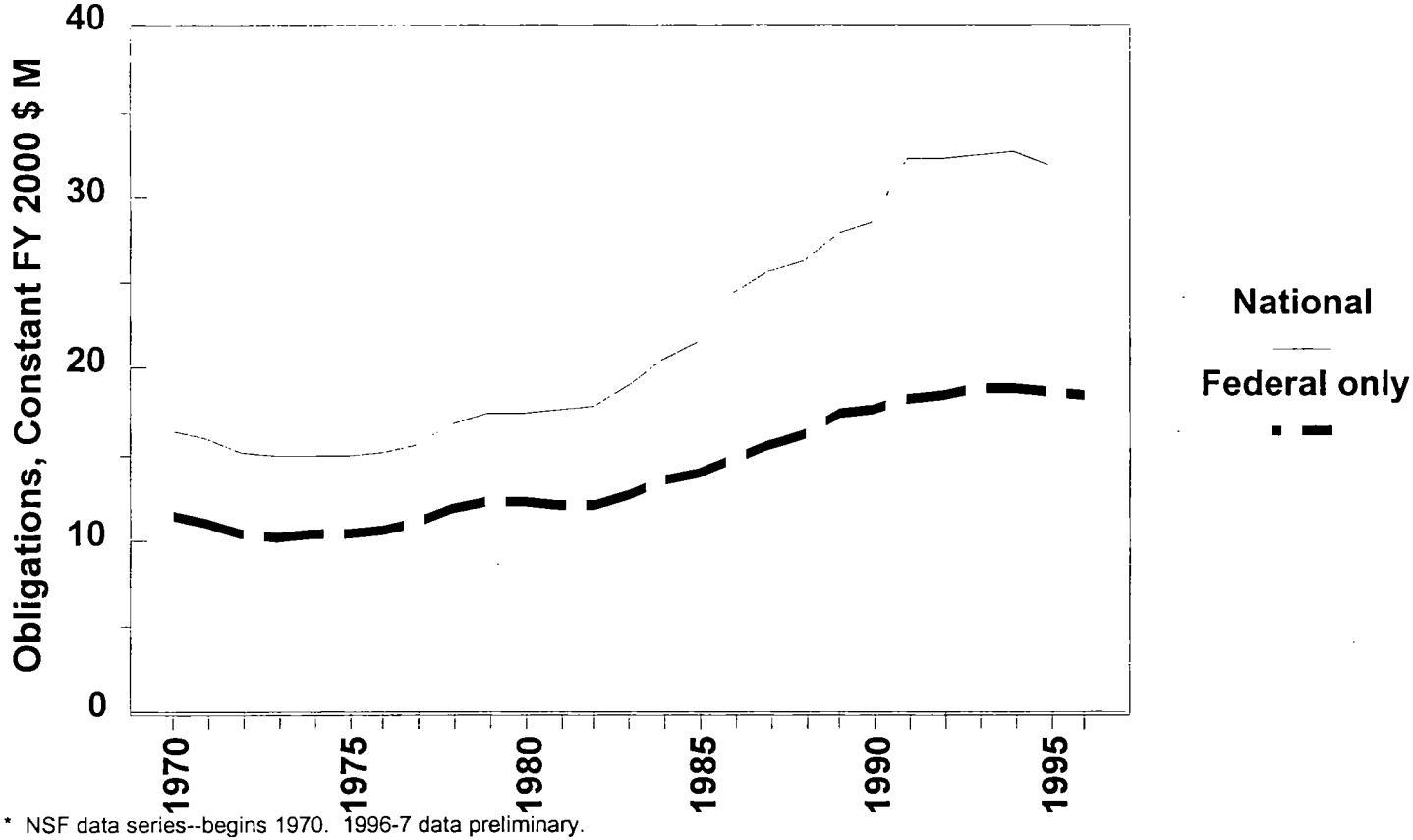
8.55 ~~As appropriated~~
5% real growth.

8 growth

DoD Basic Research in Context
FYs '64-'00

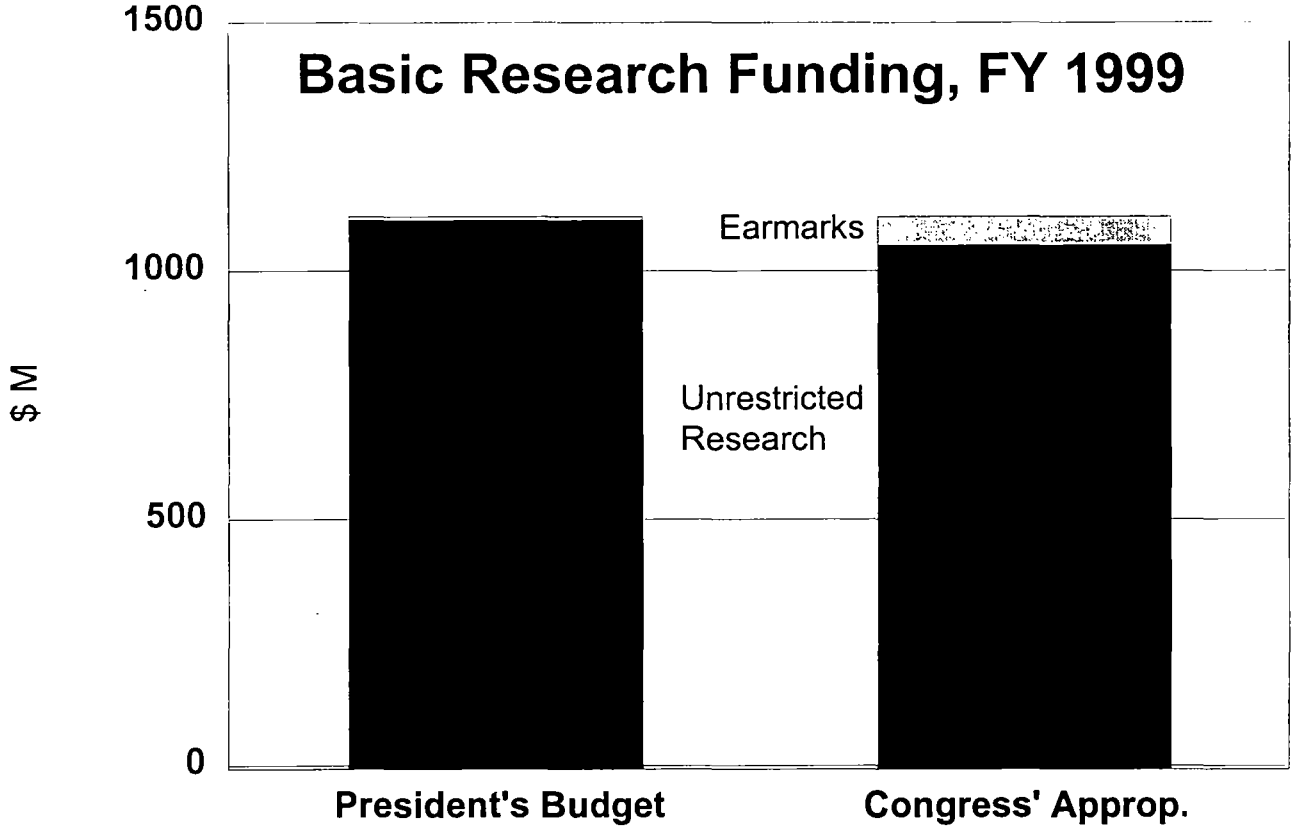


Total National Basic Research
FYs 1970-97*

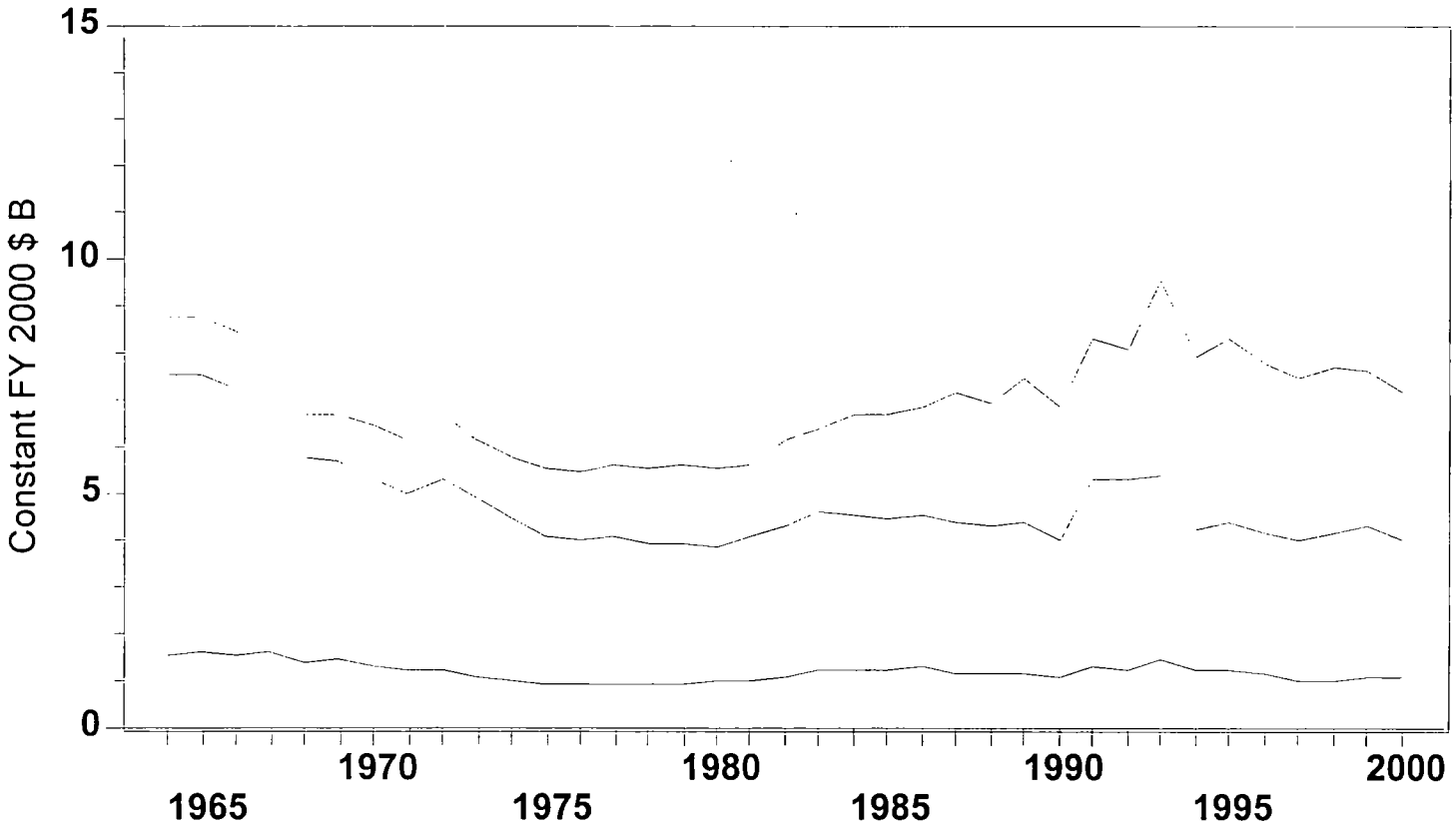


* NSF data series--begins 1970. 1996-7 data preliminary.

Evidence Lacking for Congress' Support of More Basic Research

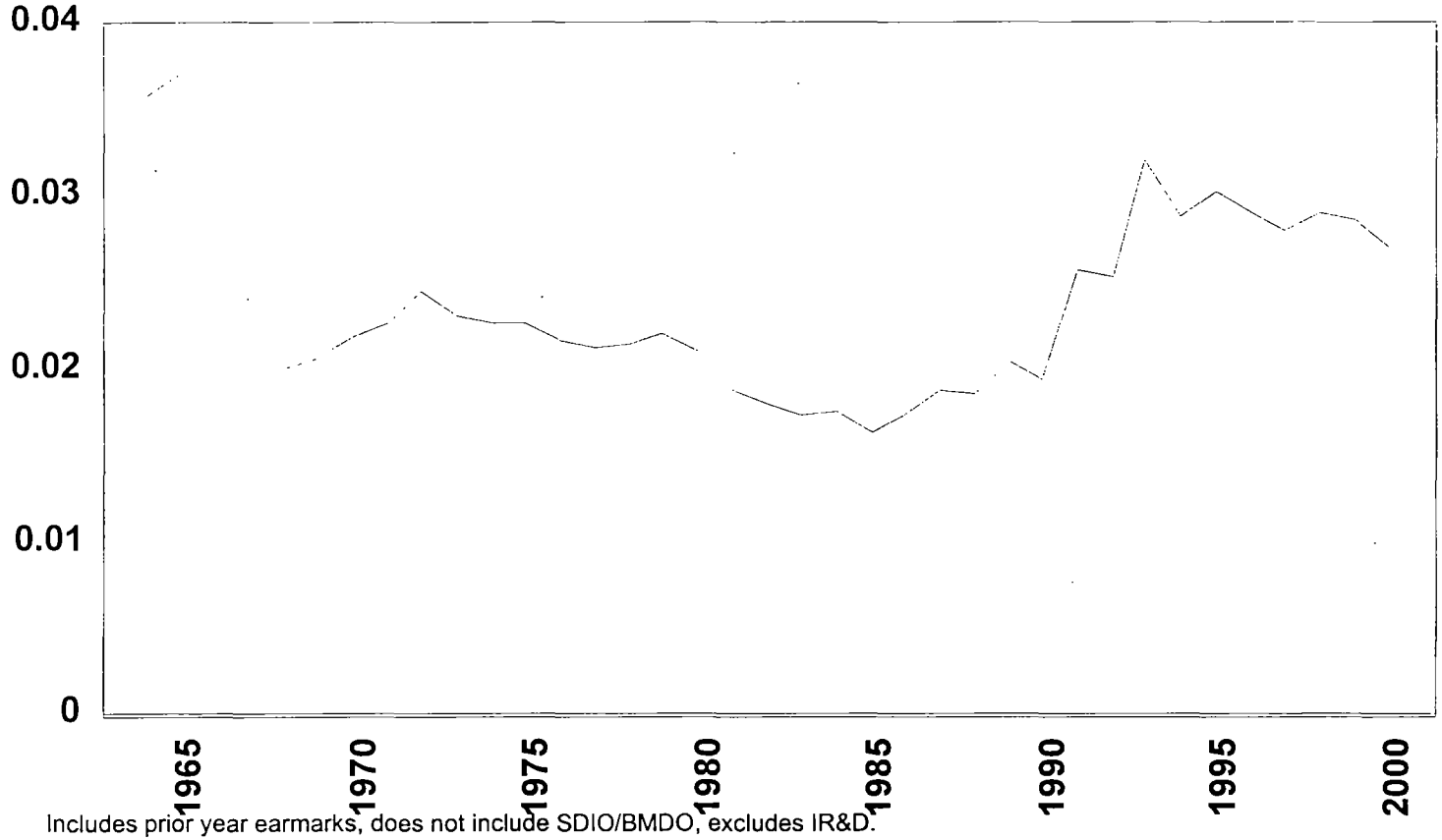


DoD Science & Technology* Funding History



* Excludes BMDO & SDIO funding for consistency across time

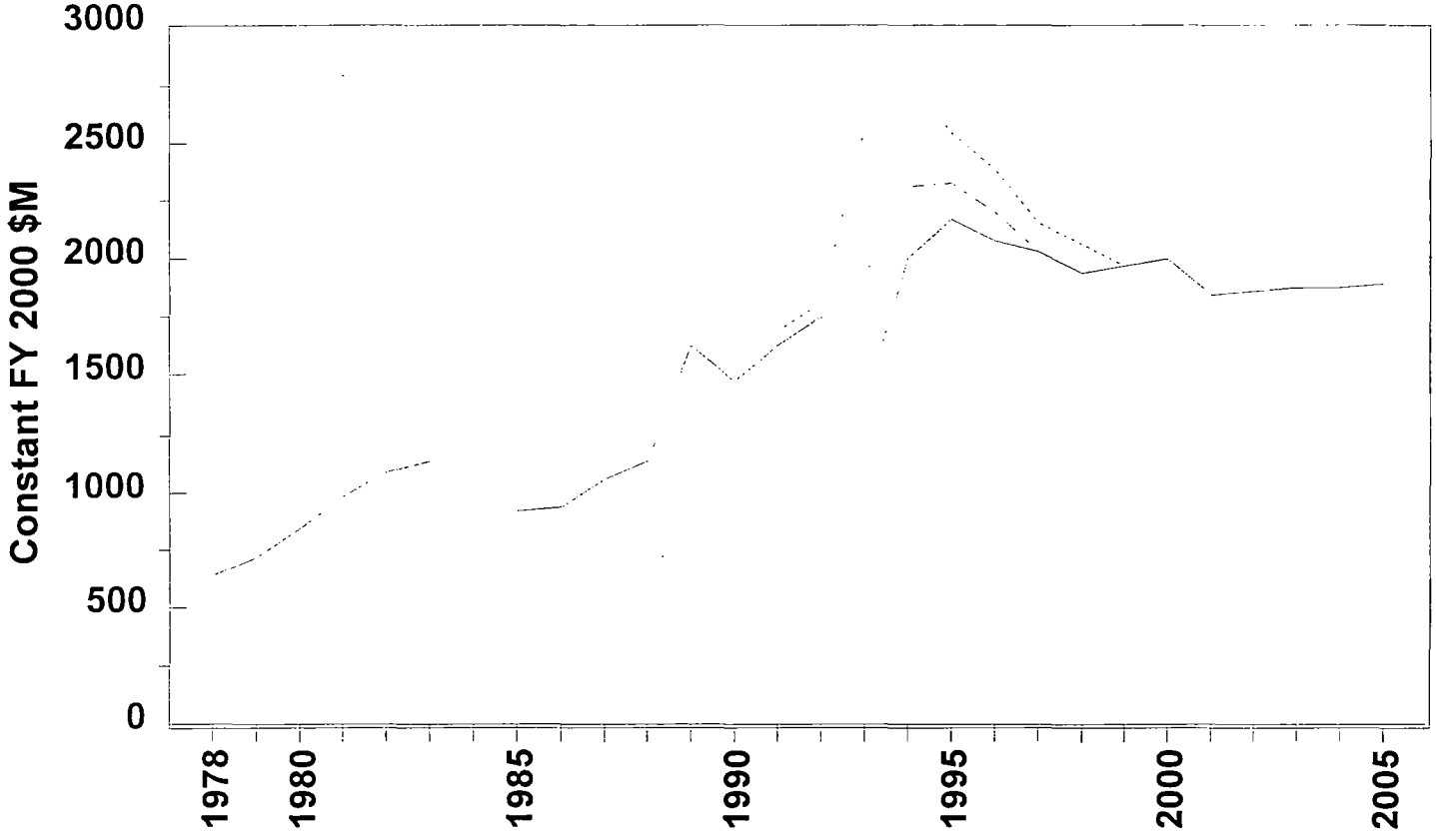
S&T* as Fraction of DoD Total



Includes prior year earmarks, does not include SDIO/BMDO, excludes IR&D.

DARPA Budget in Context

Excluding Transferred Program & Earmarks



BACKGROUND PAPER
DOD S&T FUNDING SITUATION, FY2000-FY2001

FY2000

- The authorization conference has completed its work; the results are summarized in the attached spreadsheets.

- The appropriations conference will likely not finish before the end of the fiscal year. Congress will probably pass a continuing resolution to cover the first two weeks of October while the appropriations conference concludes its work.

FY2001

- DDR&E believes that the overall S&T picture will not be as bad in FY2001 as during the previous two years. The Air Force probably will not present as large a reduction to its S&T funding as it did last year, in large part due to the pressure and bad publicity it received for its previously proposed S&T reductions. However, there are several worrisome trends.

- 6.1 funding. Our contacts in DDR&E perceive a gradual shift away from basic research within DOD.

  - The Navy and Army will maintain 6.1 funding levels in FY2001 with essentially no real growth from FY2000.
  - The Air Force plans to slowly decrease 6.1 funding from $209 million to approximately $200 million (then year dollars) by FY2005. Although the R&D office within the Secretary of the Air Force's staff has been fighting to maintain 6.1 funding (Dr. Don Daniel, SAF/AQR), there is pressure from the senior military leadership to reduce basic research in order to support near term requirements such as operations. The military leadership would like 6.1 funding to drop to the level supported by the Army ($180-190 million), if not below.
  - DARPA has been structurally shifting away from basic research. Although DARPA's 6.1 budgets have been on the order of $80 million per year, OMB and DDR&E now question whether DARPA's 6.1 funding truly supports basic research. The general feeling is that the 6.1 account leans more toward applied research or advanced technology development.
  - The Navy may go the same way as DARPA with its 6.1 funding. The service is restructuring its S&T portfolio to have "fewer walls" between 6.1, 6.2, and 6.3 programs—in other words, more blurring of the research accounts. Some Navy personnel have expressed their concerns that 6.1 funding will eventually shift toward applied research.

- Navy 6.2 and 6.3 funding. The Navy plans to decrease its 6.2 and 6.3 funding in the outyears. We do not have details on the magnitudes of the proposed decreases.

DEFENSE S&T BUDGET										
Figures in $ Millions (then year)										
Component	**Category**	**FY1998 Enacted**	**FY1999 Enacted**	**FY2000 Pres Bud**	**Authorizations**					
					House	**% Diff, Pres Bud**	**Senate**	**% Diff, Pres Bud**	**Conference**	**% Diff, Pres Bud**
Army	6.1		188.6	186.9	188.3	0.75%	201.9	8.03%	203.2	8.72%
	6.2		630.8	555.3	619.2	11.51%	577.9	4.07%	614.0	10.57%
	Tech Base	0.0	819.4	742.1	807.4	8.80%	779.7	5.07%	817.1	10.11%
	6.3		712.1	524.9	539.4	2.76%	541.9	3.24%	545.9	4.00%
	S&T	0.0	1,531.5	1,267.1	1,346.9	6.30%	1,321.7	4.31%	1,363.1	7.58%
	RDT&E			4,426.2	4,708.2	6.37%	4,671.2	5.54%	4,791.2	8.25%
Navy	6.1		362.7	376.7	376.7	0.00%	376.7	0.00%	376.7	0.00%
	6.2		570.7	523.8	554.3	5.82%	546.8	4.39%	576.3	10.02%
	Tech Base	0.0	933.4	900.6	931.1	3.39%	923.6	2.55%	953.1	5.83%
	6.3		580.8	519.5	549.7	5.81%	557.0	7.22%	555.8	6.99%
	S&T	0.0	1,514.2	1,420.1	1,480.8	4.27%	1,480.6	4.26%	1,508.9	6.25%
	RDT&E			7,984.0	8,358.5	4.69%	8,201.1	2.72%	8,362.5	4.74%
Air Force	6.1		210.4	209.5	209.5	0.00%	209.5	0.00%	209.5	0.00%
	6.2		605.6	507.6	537.6	5.91%	582.0	14.65%	583.4	14.93%
	Tech Base	0.0	816.0	717.1	747.1	4.18%	791.5	10.37%	792.9	10.57%
	6.3		423.5	465.7	493.2	5.91%	548.3	17.74%	533.2	14.49%
	S&T	0.0	1,239.5	1,182.8	1,240.3	4.86%	1,339.8	13.27%	1,326.1	12.11%
	RDT&E			13,077.8	13,212.7	1.03%	13,567.3	3.74%	13,630.1	4.22%
Services	6.1	0.0	761.7	773.1	774.5	0.18%	788.1	1.94%	789.4	2.11%
	6.2	0.0	1,807.1	1,586.7	1,711.1	7.84%	1,706.7	7.56%	1,773.7	11.78%
	Tech Base	0.0	2,568.8	2,359.9	2,485.7	5.33%	2,494.8	5.72%	2,563.1	8.61%
	6.3	0.0	1,716.4	1,510.1	1,582.3	4.78%	1,647.2	9.08%	1,634.9	8.26%
	S&T	0.0	4,285.2	3,870.0	4,068.0	5.12%	4,142.1	7.03%	4,198.1	8.48%
	RDT&E	0.0	0.0	25,488.0	26,279.4	3.10%	26,439.6	3.73%	26,783.8	5.08%

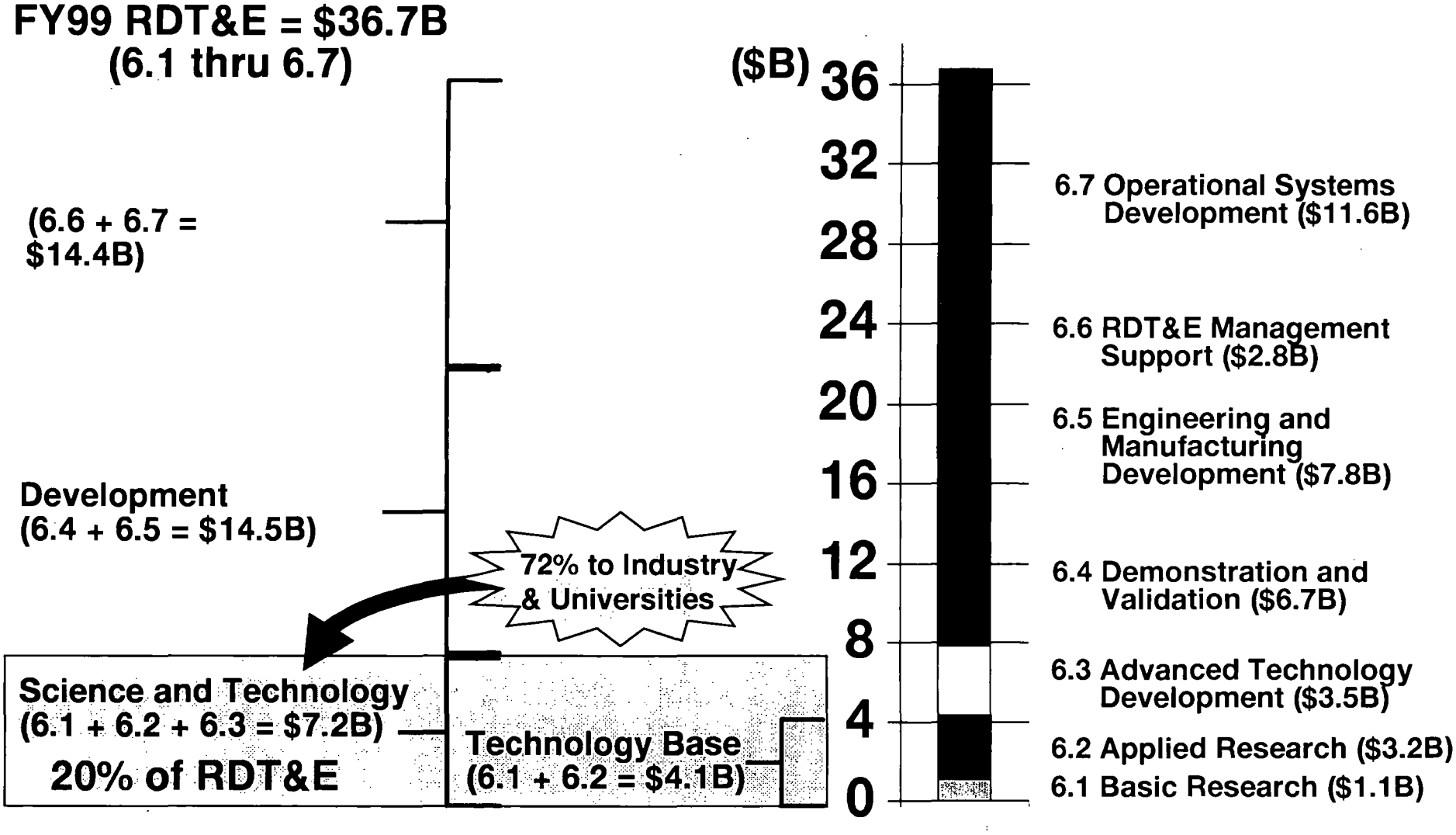
Component	Category	FY1998 Enacted	FY1999 Enacted	FY2000 Pres Bud	Authorizations					
					House	% Diff, Pres Bud	Senate	% Diff, Pres Bud	Conference	% Diff, Pres Bud
Defense Wide	6.1		346.3	340.0	346.0	1.76%	340.0	0.00%	345.5	1.62%
	6.2		1,343.9	1,372.3	1,416.8	3.24%	1,406.3	2.48%	1,392.8	1.49%
	Tech Base	0.0	1,690.2	1,712.3	1,762.8	2.95%	1,746.3	1.99%	1,738.3	1.52%
	6.3		1,816.6	1,804.0	1,815.6	0.64%	1,864.0	3.33%	1,895.9	5.09%
	S&T	0.0	3,506.8	3,516.3	3,578.4	1.77%	3,610.3	2.67%	3,634.1	3.35%
	RDT&E			8,609.3	9,278.4	7.77%	9,122.2	5.96%	9,210.8	6.99%
OT&E				24.4	24.4	0.00%	24.4	0.00%	24.4	0.00%
DT&E				253.5	253.5	0.00%	253.5	0.00%	253.5	0.00%
DOD Totals	6.1	0.0	1,108.0	1,113.2	1,120.6	0.66%	1,128.2	1.35%	1,135.0	1.96%
	6.2	0.0	3,151.0	2,959.0	3,127.9	5.71%	3,113.0	5.20%	3,166.5	7.01%
	Tech Base	0.0	4,259.0	4,072.2	4,248.5	4.33%	4,241.1	4.15%	4,301.4	5.63%
	6.3	0.0	3,533.0	3,314.1	3,397.9	2.53%	3,511.2	5.95%	3,530.8	6.54%
	S&T	0.0	7,792.0	7,386.3	7,646.4	3.52%	7,752.3	4.96%	7,832.2	6.04%
	RDT&E	0.0	0.0	34,375.2	35,835.7	4.25%	35,839.7	4.26%	36,272.5	5.52%

DEFENSE S&T BUDGET										
Figures in $ Millions (then year)										
Component	**Category**	**Appropriations**						**Enacted**	**% Diff, Pres Bud**	**% Diff, FY99 Enact**
		House	**% Diff, Pres Bud**	**Senate**	**% Diff, Pres Bud**	**Conference**	**% Diff, Pres Bud**			
Army	6.1	186.9	0.00%	210.2	12.47%					
	6.2	782.0	40.84%	635.1	14.37%					
	Tech Base	968.9	30.56%	845.2	13.89%	0.0		0.0		
	6.3	649.8	23.80%	587.4	11.91%					
	S&T	1,618.8	27.76%	1,432.7	13.07%	0.0		0.0		
	RDT&E	5,148.1	16.31%	4,900.8	10.72%					
Navy	6.1	376.7	0.00%	376.7	0.00%					
	6.2	597.2	14.01%	588.3	12.31%					
	Tech Base	974.0	8.15%	965.1	7.16%	0.0		0.0		
	6.3	721.8	38.94%	598.5	15.21%					
	S&T	1,695.8	19.41%	1,563.6	10.10%	0.0		0.0		
	RDT&E	9,080.6	13.73%	8,463.2	6.00%					
Air Force	6.1	216.5	3.34%	209.5	0.00%					
	6.2	613.0	20.76%	574.8	13.23%					
	Tech Base	829.5	15.67%	784.3	9.36%	0.0		0.0		
	6.3	526.4	13.04%	542.2	16.44%					
	S&T	1,355.9	14.64%	1,326.5	12.15%	0.0		0.0		
	RDT&E	13,709.2	4.83%	13,565.4	3.73%					
Services	6.1	780.1	0.91%	796.4	3.01%	0.0		0.0		
	6.2	1,992.3	25.56%	1,798.2	13.33%	0.0		0.0		
	Tech Base	2,772.4	17.48%	2,594.6	9.95%	0.0		0.0		
	6.3	1,898.1	25.69%	1,728.2	14.44%	0.0		0.0		
	S&T	4,670.5	20.69%	4,322.8	11.70%	0.0		0.0		
	RDT&E	27,937.9	9.61%	26,929.5	5.66%	0.0		0.0		

Component	Category	Appropriations						Enacted	% Diff, Pres Bud	% Diff, FY99 Enact
		House	% Diff, Pres Bud	Senate	% Diff, Pres Bud	Conference	% Diff, Pres Bud			
Defense Wide	6.1	366.5	7.79%	351.0	3.24%					
	6.2	1,389.3	1.24%	1,386.6	1.04%					
	Tech Base	1,755.8	2.54%	1,737.6	1.48%	0.0		0.0		
	6.3	1,830.4	1.47%	1,819.5	0.86%					
	S&T	3,586.2	1.99%	3,557.0	1.16%	0.0		0.0		
	RDT&E	8,930.1	3.73%	9,325.3	8.32%					
OT&E		29.4	20.46%	24.4	0.00%					
DT&E		272.0	7.30%	253.5	0.01%					
DOD Totals	6.1	1,146.7	3.01%	1,147.5	3.08%	0.0		0.0		
	6.2	3,381.6	14.28%	3,184.7	7.63%	0.0		0.0		
	Tech Base	4,528.2	11.20%	4,332.2	6.39%	0.0		0.0		
	6.3	3,728.5	12.50%	3,547.6	7.05%	0.0		0.0		
	S&T	8,256.7	11.78%	7,879.8	6.68%	0.0		0.0		
	RDT&E	37,169.4	8.13%	36,532.7	6.28%	0.0		0.0		

8.5

S&T is the Foundation of Modernization



DoD Percent of Federal Technology Base (6.1+6.2) Funding to Universities ($FY97)

Electrical Engineering	64%
Metallurgy & Materials	36%
Mathematics	21%
Mechanical Engineering	29%
All Engineering	55%
Computer Science	46%
Civil Engineering	35%

All Federal Funding	11%

Source: Federal Funds for R&D NSF Report #96-334

DoD is the Dominant Federal Investor in Critical Technology Base Fields - ($FY97, 6.1 + 6.2)

Electrical Engineering	69%
Metallurgy & Materials	55%
Mechanical Engineering	63%
Computer Science	56%
All Engineering	33%
Civil Engineering	23%
Mathematics	27%

All Funding	18%

Note - 6.1 & 6.2 Funding Only

Source: NSF Federal Funds for R&D Report #96-334

DoD funding for S&T

Briefing for John Podesta

July 8, 1999

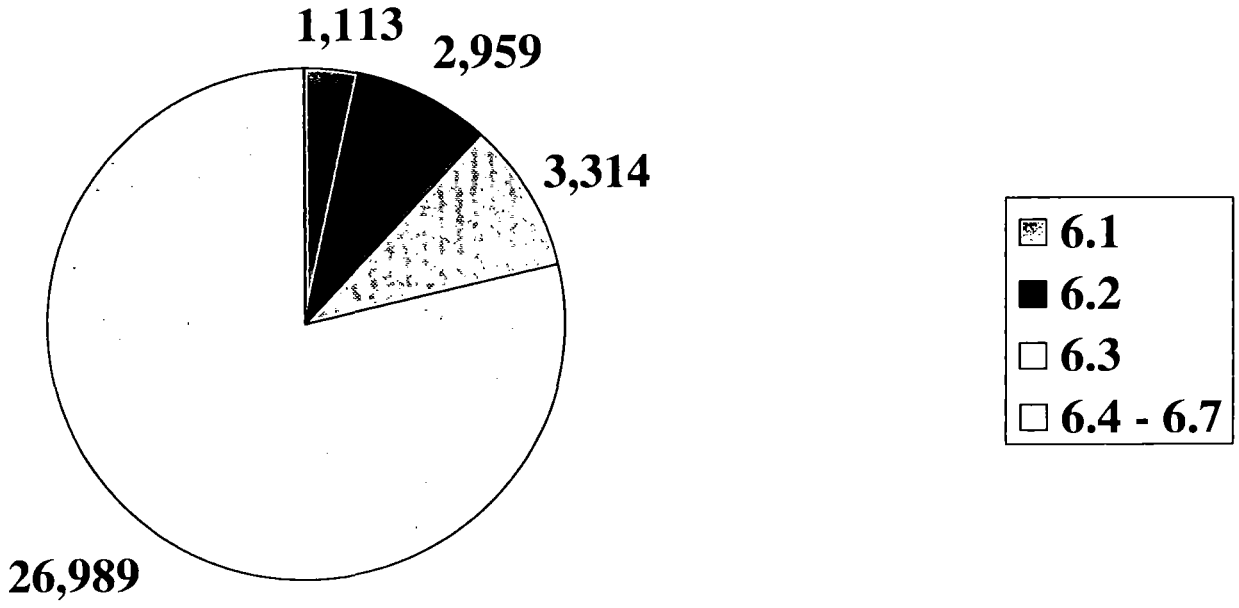
Overview

- DoD funding for S&T is declining
- DoD support for S&T very important in physical sciences,engineering
- Continued support for S&T needed for military superiority
- Congress, outside advisory committees are concerned

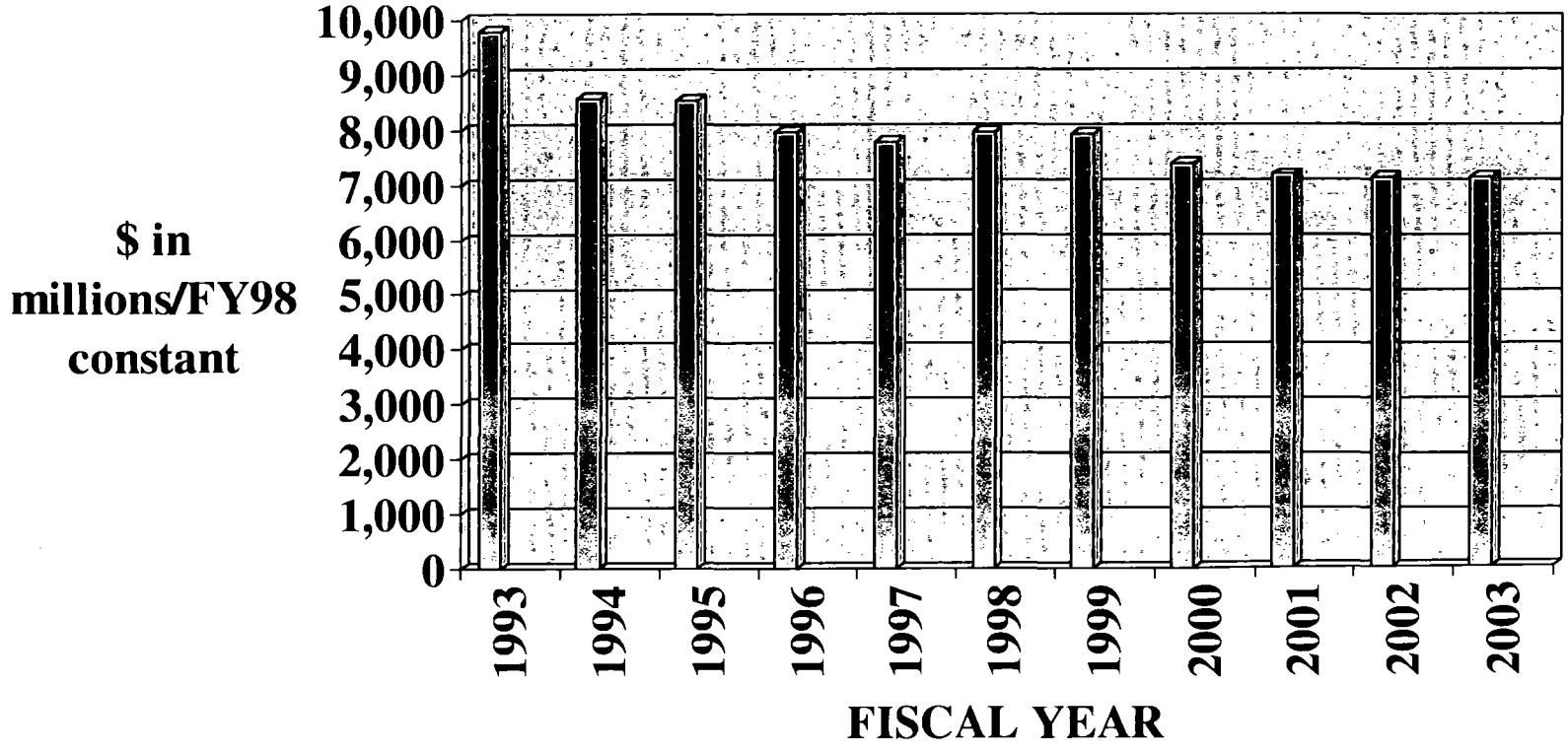
Defintions

- 6.1 Basic Research
- 6.2 Applied Research
- 6.3 Adv. Tech. Development
- 6.4 Demonstration & Validation
- 6.5 Eng. & Manufact Dev.
- 6.6 Management Support
- 6.7 Operational Sys. Dev.

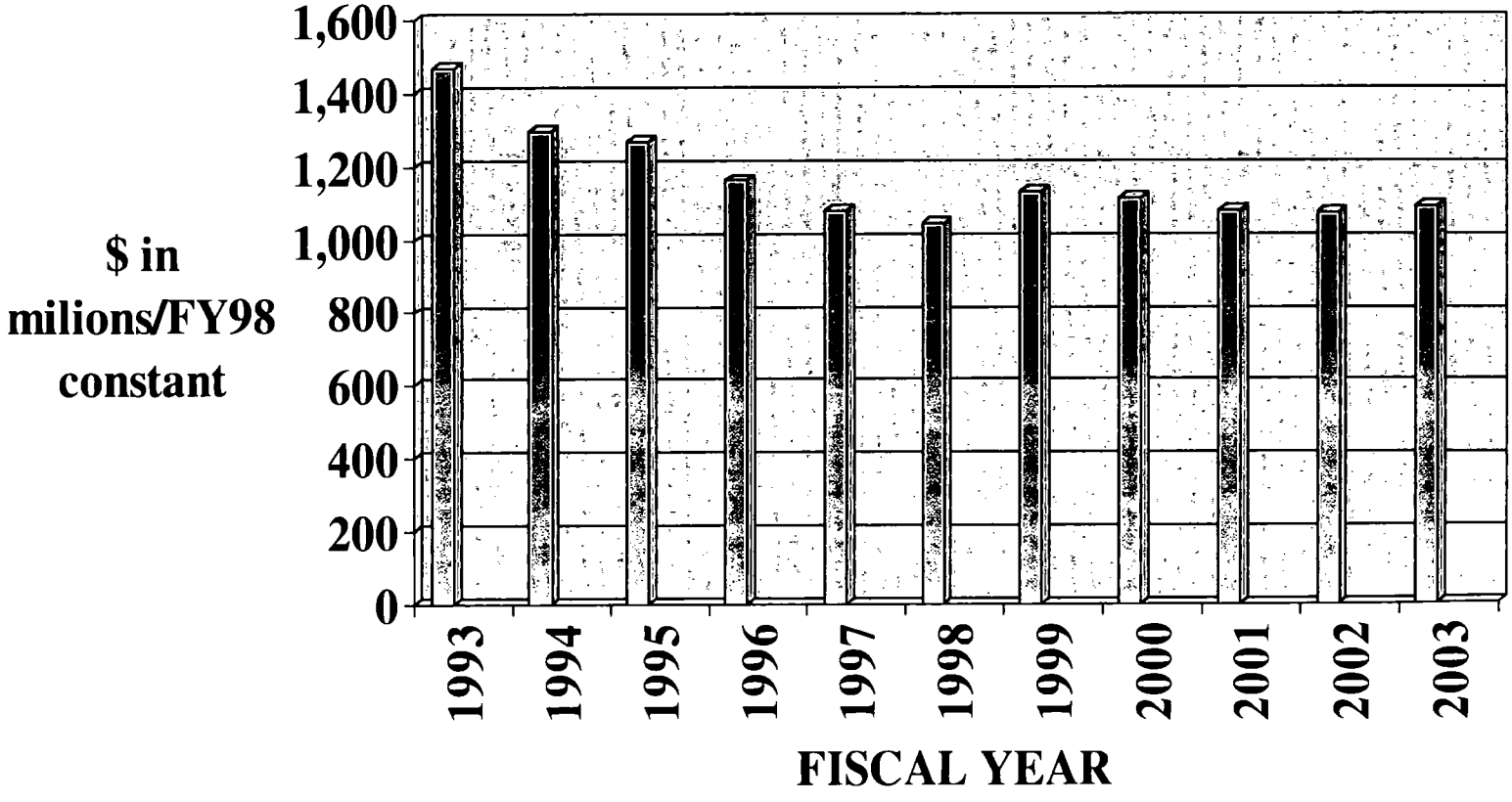
Total Defense R&D



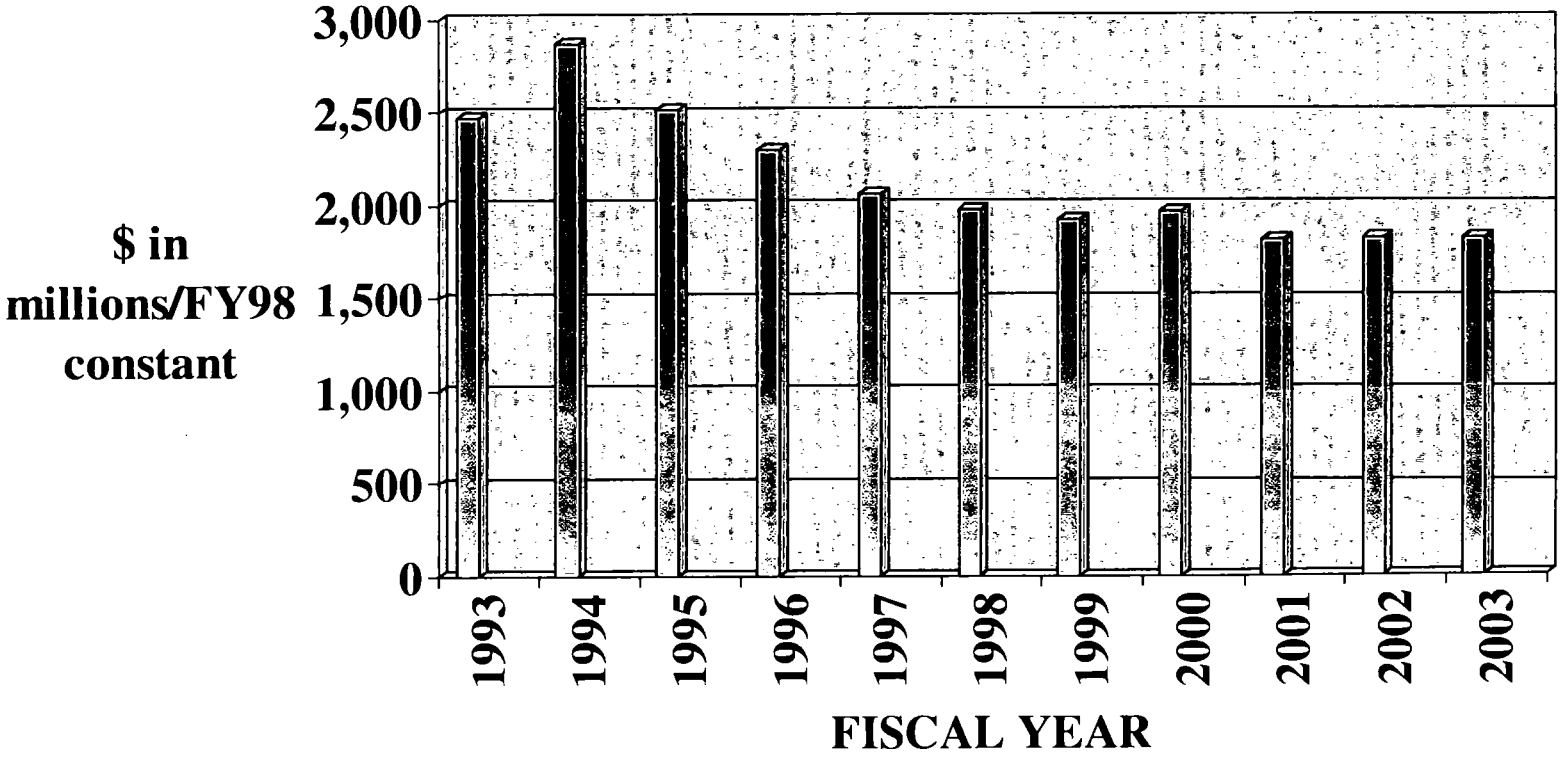
DOD S&T FUNDING (6.1 - 6.3)



DOD 6.1 FUNDING



DARPA BUDGET



DoD Percentage of Federal Research Funding to Universities

• Computer Science	60%
• Mathematics	27%
• All Engineering	38%
• Electrical Engineering	69%
• Mechanical Engineering	50%
• Materials Engineering	38%

Federal R&D trends

- **FY94 to FY2000 - change in constant $**
  - **DoD S&T: - 19.8 percent**
  - **Energy: - 0.9 percent**
  - **NASA - 6.6 percent**
  - **NSF + 15.8 percent**
  - **NIH + 31.2 percent**

Federal R&D trends

- **FY2000 request**
  - **DoD S&T -- $7.4 billion**
  - **NIH -- $15.3 billion**
  - **NASA - $9.77 billion**
  - **DoE - $7.46 billion**
  - **NSF - $2.89 billion**

University research

- FY93 - 97: constant dollars
  - 13.8% -- aeronautical engineering
  - 31.9% -- electrical engineering
  - 40.9% -- mechanical engineering
  - 21.8% -- physics
  - 10.8% -- chemistry
  - 14.0% -- mathematics

DoD research management (especially DARPA)

- Bigger grant size
- No entitled constituencies
- Excellent program managers
- Hard problems
- Merit review as opposed to peer review

Defense Science Board

- DoD S&T funding key to U.S. military superiority
- S&T funding should be increased to at least $8 billion (currently $7.4 billion)
- At least 1/3 of S&T spending should go to "revolutionary capabilities"
- E.g. nanotechnology, quantum computing, robotics, intelligent systems, chem-bio

Congressional concerns

- House - declining defense R&D "seriously threatens" U.S. technological superiority critical to ensuring U.S. military superiority
- Senate - "deeply concerned" that DoD S&T is lowest since 1986, questions DoD's ability to develop technologies necessary to "revolutionize military capabilities"

Defense payoff from S&T

- Stealth technology
- Night vision
- Unmanned aerial vehicles
- Precision guided munitions
- Moving target indicators
- Mine countermeasures

Options

- **Increase DoD S&T funding**
  - **As part of FY2001 budget process**
  - **Presidential Decision Directive on defense S&T**
  - **WH/DoD/Congressional meeting on defense S&T strategy**

Options

- **Increase support for physical sciences and engineering in civilian agencies**
  - **NSF**
  - **Department of Energy science**
  - **NASA**
  - **NIH -- biomedical engineering**