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ABSTRACT

The 29th in a series that covers Federal research and development (R&D) funding as it evolves from one budget cycle to the next, this report discusses agency R&D funding levels for fiscal year 1981. This analysis reports relative changes in broad R&D and basic research categories, 1981 compared with 1980, and also some agency changes as indicated in the 1982 budget, as revised by the new administration in March, 1981. Areas chosen for special consideration in this report are among those frequently connected with current issues in science and technology. (Author/CS)

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foreword

This report is the 29th in a series that covers Federal R&D funding as it evolves from one budget cycle to the next. The present report discusses agency R&D funding levels for fiscal year 1981, as requested in the revised 1981 budget presented in March 1980. It brings the analysis up to date for relative changes in broad R&D and basic research categories, 1981 compared with 1980, and also some agency changes as indicated in the 1982 budget, as revised by the new administration in March 1981.

Areas chosen for special consideration in this report are among those most frequently connected with current issues in science and technology. For example, a section of the analysis is concerned with R&D funding changes by budget functions (national defense, space, health, energy), as distinct from agency funding changes. Shifts in relative function shares over the last decade are shown and explanations given of the reasons behind the changing relationships.

Another section covers Federal R&D support to performers since 1955, the first year such data were collected. It focuses especially on Federal R&D support to universities and colleges and includes a subsection which deals specifically with basic research support to the academic sector.

John B. Slaughter
Director
National Science Foundation

March 1981

notes

The data for fiscal years 1979-81 shown in the detailed statistical tables, the text tables, and nearly all the charts were collected from Federal agencies in March through May 1980 and were based on agency budgets as incorporated in the President's 1981 budget message to Congress and later revised The data are actual for 1979 but reflect estimates, including March 1980 budget amendments, for 1981 Fiscal year 1980 data, representing obligations estimated in the second quarter of fiscal year 1980, reflect congressional appropriation actions through that period but do not reflect actions on proposed rescissions Significant changes in 1980 and 1981 program levels resulting from congressional and executive actions taken after the data were collected are noted in the text, where possible

Table and chart details may not add to totals because of rounding

To obtain accurate historical data, use only the latest detailed statistical tables for Federal Funds, Volume XXIX (NSF 80-318), and not data published earlier Agencies revise prior year data when important changes occur in program classification and only the latest tables incorporate such changes

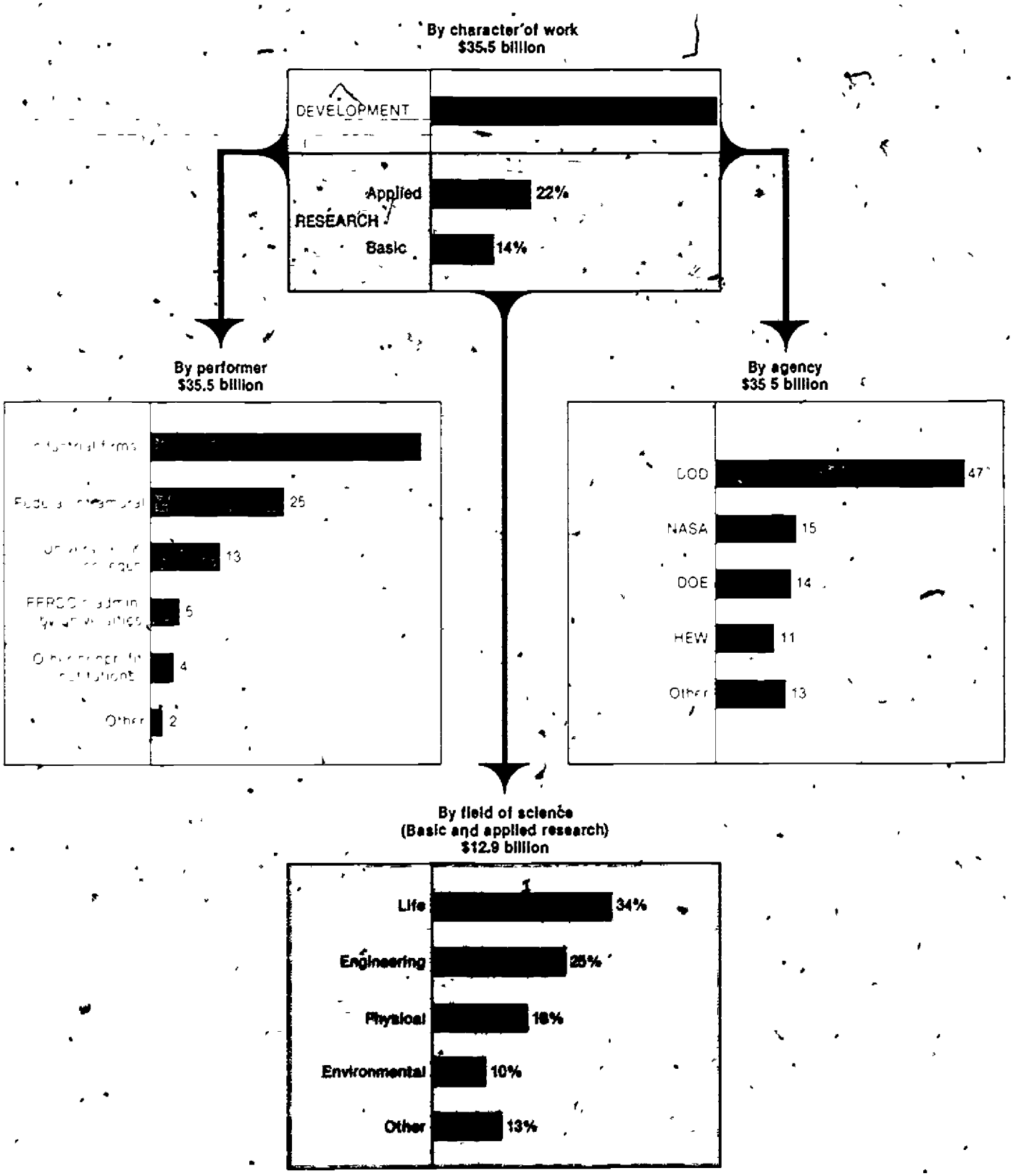
acknowledgments

This report was prepared in the Division of Science Resources Studies under the general guidance of Charles E Falk, Director, and William L. Stewart, Head, R&D Economic Studies Section. Benjamin L Olsen, Study Director, Government Studies Group, provided direction Eleanor Stoddard was responsible for organizing and writing portions of the text Ruth Siegel assisted in the analysis and wrote other portions of the text Dorothy K Ham prepared statistical materials and graphic illustrations.

contents

[1]See note on p. 29

Distribution of Federal obligations for research and development, FY 1981 (est.)*



*These data are based on the President's 1981 budget to Congress as revised in March 1980. They exclude R&D plant data.

bIncludes federally funded research and development centers (FFRDC's) administered by this sector.

SOURCE: National Science Foundation

highlights

- Federal R&D obligations (R&D plant excluded) were $35 5 billion in the President s revised 1981 budget request, or 11 per cent more than the total shown for fiscal year 1980 Four fifths of the increase was accounted for by proposed funding for the Department of Defense (DOD)

- The original January budget had shown an increase of 13 percent for all Federal R&D programs with real growth anticipated for basic research, applied research, and development. After the March 1980 revision, only development showed real growth [1] Although an administration statement in August pledged additional funds to maintain real growth of 3 percent in basic research as part of an economic revitalization plan, the timing proved to be unrealistic, and no add-on was requested for basic research in 1981

- As of March 1981 the net effect of all executive and legislative funding actions to date was an 11-percent increase in Federal R&D obligations for 1981 over 1980, the same relative increase as had been anticipated in the revised budget the previous March DOD still accounted for four-fifths of the increase

- Since 1975 R&D and R&D plant outlays within the relatively controllable portion of the Federal budget have maintained a 13-percent to 14-percent share An increase of 1 percentage point (to 14 percent) was shown for 1981, even after budget revisions

- In the March 1980 revision of the 1981 budget some new programs which had been scheduled for large increases in January were cut, among them the automotive basic research program, administered by the Department of Transportation (DOT); the industrial innovation program under the National Science Foundation (NSF) and the Department of Commerce, and the NSF university research facilities program Almost all the major support agencies showed lower relative overall R&D increases in 1981 after the budget revision than had been shown in January DOD, by contrast, received a 20-percent increase, the same relative increase scheduled for this agency in the January budget

- The amount provided in the March budget for developm $22 6 billion in 1981, was 12 percent higher than the 1980 l and was almost entirely derived from increases for weapons p grams of DOD One-third of the DOD increase in developm obligations was related for the M-X strategic missile

- After four successive years of real growth (an average increas 5 3 percent annually between 1976 and 1980), basic rese obligations in 1981 were expected to increase 9 percent in revised budget, or a 1 percent decline in constant dollars $4 9 billion total, however, was a current dollar high A l revision of basic research reporting by DOD, as well as cong sional appropriation actions for a number of programs, brou the total to more than $5 billion Even so, the relative gain basic research in 1981 remained 9 percent in current dollars s the 1980 base also increased

- Applied research support, scheduled to rise 10 percent to $ billion in 1981, showed only the same level of real effort a 1980, despite a sharp increase in DOD support

- The DOD increase in the 1981 budget was expected noticeably affect three performing sectors that derive their d Federal support from this agency The Federal intramural sec up an estimated 11 percent, the industrial sector (includ FFRDC's), up an estimated 13 percent, and FFRDC's ministered by nonprofit institutions, up an estimated 14 p cent

- By contrast, the university-and-college sector would receive o 8 percent more funds than in 1980, a decline in real Fede R&D support for the second consecutive year. The latest d now indicate that the 1981 relative increase will be closer t percent for this sector.

- Among major fields of science, three were scheduled for nota research funding increases in 1981 even after the budget r sion These were the physical sciences—up 14 perce mathematics and computer sciences—up 25 percent, psychology—up 12 percent

[1] The estimate used by the Office of Management and Budget (OMB) for inflation in fiscal year 1981 was 9 percent at the time the budget was revised and was reestimated in January 1981 at 10 percent, based on the GNP deflator

introduction

This report is one in a recurring series of National Science Foundation (NSF) reports that cover R&D activities within the various sectors of the national economy. The data cover Federal Government support of R&D programs and represent R&D obligational levels as reported by individual agencies to the *Federal Funds for Research and Development*, Volume XXIX survey, conducted by NSF in March through May 1980. The 95 Federal agency respondents were all those that sponsored R&D programs during the 1979-81 budget period.

Their responses were based on funding requests to Congress for fiscal year 1981, as contained in the President's 1981 budget, presented in January 1980 and later revised in March. The data incorporated the revisions to both 1980 and 1981 program levels. The survey contained a more detailed breakdown of Federal R&D programs than that required by the Office of Management and Budget (OMB) for its budget analysis[1] and also included some of the smaller R&D support agencies not covered in the OMB analysis.

The *Federal Funds* categories, as shown in this report and in the appendix tables that were released earlier in a separate document, cover Federal R&D data by agency, character of work (basic research, applied research, and development), performer, and field of science for the 1979-81 period, and by State distribution for 1979. The appendix tables provide the data in considerable detail and include historical data for the 1971-81 period.

Data for fiscal years 1971 through 1979 are actual, but data for the next two years are tentative. Fiscal year 1980 data reflect obligations estimated in the second quarter of fiscal year 1980, including obligations carried over from prior-year appropriations, as reported by the agencies at that time. they also include rescissions to program levels proposed by the administration in March 1980. Fiscal year 1981 data are based on amounts requested in the President's 1981 budget, and later revised as a counterinflationary measure.[3] While 1981 data for many agencies include estimates for carryovers, they do not reflect subsequent appropriations by the Congress or changes made by executive apportionment.

The text tables and charts in this report are based on survey data, i.e., on the 1981 Federal (revised) budget proposals. The analysis, however, includes not only a discussion of R&D program levels as set forth in the 1981 budget but also the effects of subsequent congressional and executive actions. Programs are analyzed on both an agency and a functional basis with an indication of funding changes from 1980 to 1981 before and after these actions. E so, all data for 1980 remain estimates in t report, they will not be "actual" until 1982 budget. Likewise, all data for 1981 estimates and will not be actual until 1983 budget.

While the statistics in the *Federal Fu* survey do not reflect the precision used accounting purposes, they are compara from one year to the next and provid useful measure of trends. Classificat problems exist in that some R&D progra are not clearly defined as such. Most age R&D programs have to be separated agency respondents from other, larger p grams because they are not identified budget line items. Once identified, R programs must then be further subdivi into the survey categories. Basic resear applied research, development, perform sectors, and fields. They must also be sho in terms of distribution to States. Si agency records are often kept by catego other than those requested in the surv judgment in reporting data must be used the respondents.

The respondents, however, have gai considerable experience in meeting survey requirements, and their efforts report accurately, according to establish definitions, have continued to improve reliability of the data. When reexaminat of reporting systems has resulted reclassification of data by character of wo fields of science, or any other catego agencies have cooperated in revising pr year data to maintain consistency.

[1] See Office of Management and Budget, *Special Analyses, Budget of the United States Government, Fiscal Year '98*, "Special Analysis K, Research and Development" (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office), 1980, p. 303.

[2] See National Science Foundation, *Federal Funds for Research and Development, Fiscal Years 1979, 1980, and 1981, Volume XXIX* (Detailed Statistical Tables) (NSF 80-318) (Washington, D.C., 1980.) These are obtainable gratis from NSF.

[3] See Office of Management and Budget, Research and Development Revisions to the Fiscal Year 1981 Budget, April 17, 1980.

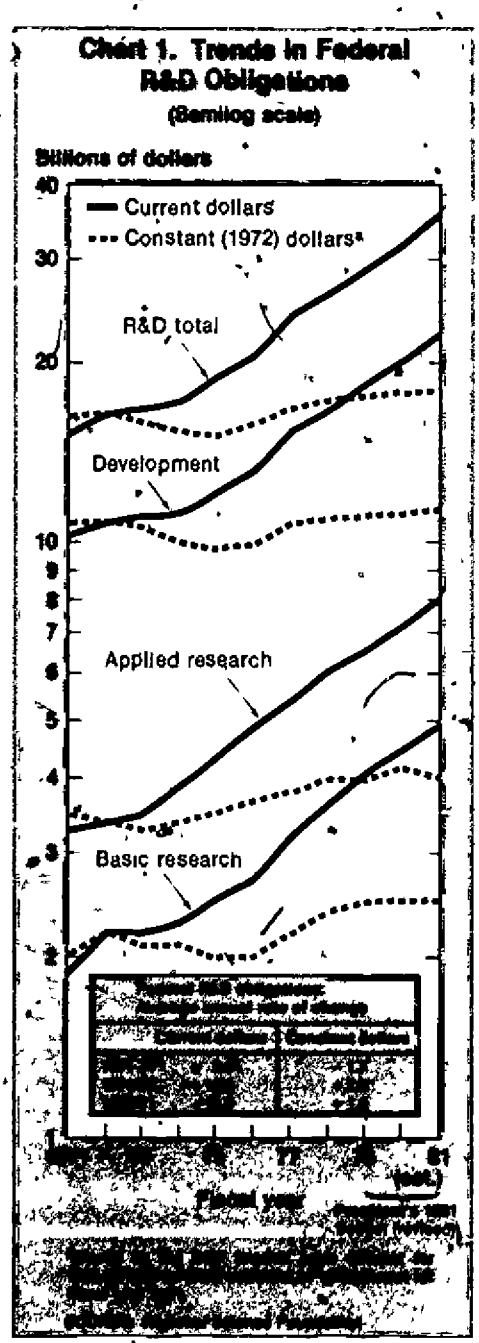
section 1.

federal r&d perspectives

The 1981 Federal budget, as presented in January 1980, represented the cumulative effects of three years of evolution of Federal R&D policies on the part of the Carter administration. It included a 13-percent increase in the R&D funding level, enough to ensure real growth for overall R&D support and for basic research. A revision of the budget in March reduced the R&D portion to $35.5 billion in obligations (R&D plant excluded), which provided an 11 percent increase over 1980, an amount sufficient to match estimated inflation and allow for slight real growth (chart 1).[1,2] Basic research funding at $4.9 billion, however, no longer exceeded anticipated inflation.

The continued real growth for Federal R&D programs was almost entirely dependent on the increase planned for DOD. In the original 1981 budget R&D obligations for DOD showed a 20-percent gain over 1980, and after revision the DOD increase was still 20 percent. Despite cuts for both 1980 and 1981 in a number of individual R&D programs of DOD, further revisions covering the rising costs of fuel and other items, plus increases for a few R&D programs resulted in only small net changes in the DOD R&D totals for the two years. Defense was part of the larger budget dilemma—even with selective cuts for 1980 and 1981 on the part of all the larger Federal agencies, the overall budget totals changed little in view of the fact that between January and March further allowance for inflation had to be made, increasing many programs that were retained.

Chart 1. Trends in Federal R&D Obligations
(Semilog scale)



broad effects of the budget revision

It was decided to revise the 1981 budget shortly after it was issued in January 1980. The rate of inflation accelerated at that time, and the administration responsed by using a broadly based anti-inflation strategy, including a widespread reduction in Federal expenditures. The administration stated, however, that care had been taken to preserve the "guiding philosophy that research and development (programs) represent an important investment in the Nation's future," and the R&D portion of the budget was, in fact, less impaired than the relatively controllable portion of the budget as a whole.

The relatively controllable area within which outlays for R&D activities are found consists of programs that are subject to annual authorization and appropriation actions in the form of new legislation, as distinct from the relatively uncontrollable area where program outlays are of a fixed cost or open ended nature under trust funds or other arrangements and are largely mandated by existing statutes although some appropriations are made for administrative

[1] The estimate used by the Office of Management and Budget (OMB) for inflation in fiscal year 1981 was 9 percent at the time the budget was revised and was reestimated in January 1981 at 10 percent based on the GNP deflator.

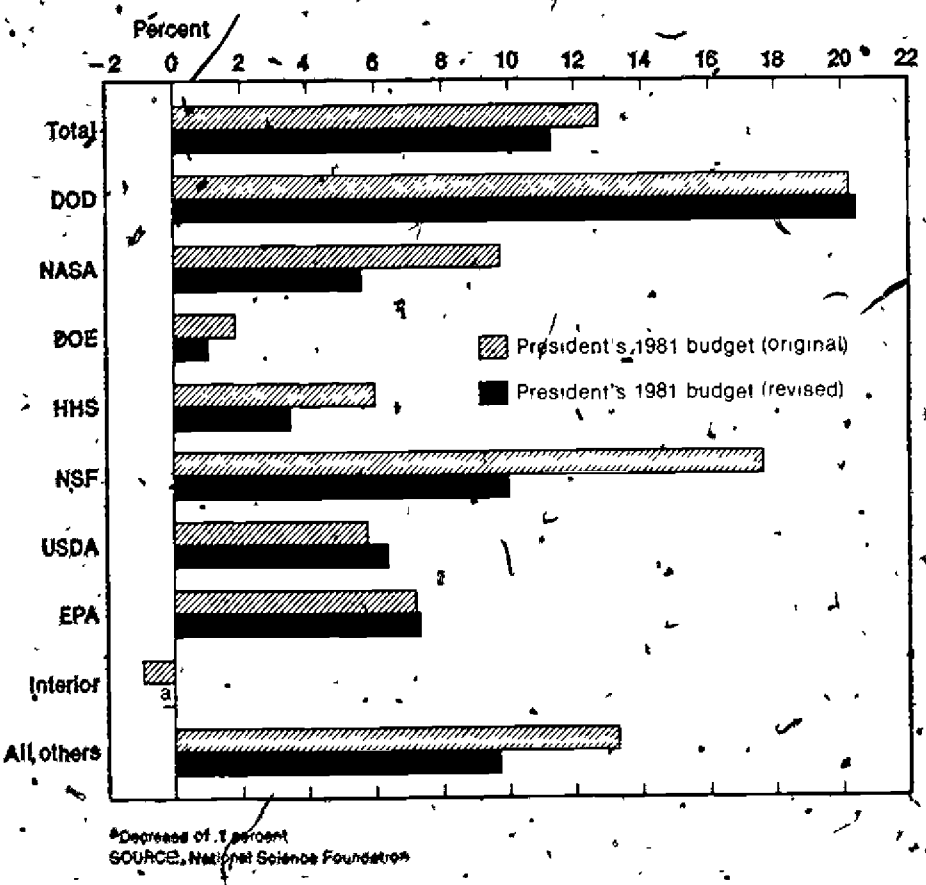
[2] If R&D and R&D plant obligations are considered the change from 1980 to 1981 was 10 percent compared with 14 percent before the budget revision.

and other program costs[3] The relatively controllable area was the portion of the budget where most reductions were made at the time of the budget revisions (about two-thirds of the cutback occurred in this area) Whereas the relatively controllable outlay total for 1981 declined by 8 percent after revision, the R&D portion of this total declined only 2 percent

The disparity between defense and all other R&D programs was, however, widened by the budget cuts (chart 2) In the January budget R&D programs other than those for DOD were scheduled to increase, collectively, by 7 percent But among the larger support agencies only the National Aeronautics and Space Administration (NASA), NSF, the Nuclear Regulatory Commission (NRC), and the Department of Labor matched or exceeded anticipated inflation in their 1981 totals After the budget revision, the overall increase for the non-DOD programs was only 3 percent, and the NASA increase now represented a decrease in real terms

The budget revision, as noted, also produced a real decrease for basic research After four consecutive years of constant-dollar growth, which resulted from an established Federal policy, basic research obligations in the revised 1981 budget amounted to an increase of 9 percent, compared with 12 percent originally The largest cuts were imposed on NASA and NSF, since every major Federal agency was required under the budget revision policy to make substantial reductions, those agencies whose programs were almost entirely research and development had no choice but to cut such programs, including basic research

Chart 2. FY 1980 to FY 1981 percent change in R&D obligation levels, by leading R&D support agency, before and after 1981 budget revision



[3]Relatively uncontrollable outlays cover payments to individuals under such programs as social security health insurance veterans benefits public assistance and nutrition assistance plus interest on the public debt general revenue sharing and other fixed-cost and open ended programs OMB also considers as relatively uncontrollable the carryover outlays from prior year contracts and obligations that are excluded from open-ended programs and fixed costs See *The Budget of the United States Government Fiscal Year 1981* (Washington D C Supt of Documents U S Government Printing Office 1980 pp 398 9 and *Fiscal Year 1981 Budget Revisions March 1980* (Washington D C Executive Office of the President Office of Management and Budget 1980) Such carryover outlays include R&D funds that NSF classifies within the relatively controllable portion of the budget along with R&D funds not carried over

agency-program changes

Despite the maintenance of some overa R&D growth in the 1981 budget, severa administration R&D initiatives wer blunted or eliminated An industry government cooperative program i automotive basic research, administered b the Department of Transportation (DOT originally scheduled for Federal funding i 1981 at a $20 million level, was cut to $1 million The industrial innovation pro gram, to be jointly sponsored by NSF an the Department of Commerce, originall funded at $50 million, was cut to $3 million This program included th establishment of generic technology cente for basic science and engineering The na tional oceanic satellite system (NOSS), to b developed jointly by DOD, NASA, an Commerce, with $24 million in obligatio in 1981, remained unchanged But withi NSF the university research facilities im provement program, a new $14 million pro gram in 1981, was completely eliminated

Several earlier administration initiative were retained These included the com petitive research grants program within th Department of Agriculture (USDA), the in dustry/university cooperative research pro gram within NSF, the interagency clima program, centered in the National Ocean and Atmospheric Administration (NOAA within Commerce, with principal researc funding from NSF, NOAA, and DOE, an the AgRISTARS program, consisting agriculture and resources inventory surve through aerospace remote sensing spon sored by four agencies (NASA the Agenc for International Development (AID USDA, Commerce and Interior) The NS industry/university cooperative researc program was reduced in the March revisio and slight reductions were made in the in teragency climate program The other pro grams were not affected

The increase in funding for biomedic research within the National Institutes Health (NIH) of the Department of Heal and Human Services (HHS) was only 6 pe cent in the revised budget The administr tion requested support, however, for 5,0 competing research project grants for 198

to be stabilized at this level in future years with the goal of achieving a balance within NIH between noncompeting and competing awards.

In August 1980 the administration announced as part of an economic revitalization program a planned increase of $600 million during fiscal years 1981 and 1982 "to maintain real growth of 3 percent in basic research and development and to support a range of new projects that will promote cooperative research by government, industry, and universities." By the following January, however, the plan for additional requests for 1981 had been given up and the relative increase for basic research was still 9 percent, or a 1-percent decline in real terms.

agency totals

When R&D totals are considered by agency, DOD stood out in the 1981 budget as the only one still scheduled for significant real growth. Despite cuts in some DOD R&D programs, the overall increase between 1980 and 1981 remained at 20 percent for an estimated real gain of 10 percent (table 1). NASA, the next agency in amount of R&D support, reflected a 6-percent current-dollar increase in 1981 after revisions, compared with a 10-percent increase in the January budget. The Department of Energy (DOE) showed a 1-percent increase in the revised budget, compared with a 2-percent increase initially. HHS, fourth in amount of R&D support, was scheduled for a 3-percent increase, compared with 6 percent in January. NSF was the only one of the six leading support agencies to maintain an increase that would approximately match inflation—10 percent, compared with 18 percent in January. The increase for USDA was only 6 percent.

Among all the other agencies reporting as much as $100 million in R&D activities, only three had funding levels indicating a sustained effort in 1981—Commerce, NRC, and the International Development Cooperation Agency (IDCA), which included the Agency for International Development (AID). For one agency, however, the Department of Labor, the projected increase still exceeded inflation.[4]

Congress acted on a number of 1981 budget requests before the next budget for 1982 was formulated. This budget, presented in January 1981, reflected congressional actions to date and showed the effects of public deliberation. Congress had slightly reduced the DOD R&D request, slightly increased the NASA request, added to DOE programs in solar technology, magnetic fusion, and fossil fuels programs, and increased funds for NIH biomedical research. A minimal reduction was given to NSF programs.

Thereafter, the new administration, as part of a major budget-cutting program to counter inflation, made rescissions in the 1981 R&D programs of all the agencies except DOD. Increases were given DOD programs under a policy of deliberate emphasis of the military area. The net results of the changes were apparent in the revised 1981 budget presented in March 1981. The budget showed an increase in defense R&D obligations of 21 percent for 1981 over 1980, an increase of 6 percent for NASA (the same as had been anticipated in the previous budget, as revised), an increase of 4 percent for DOE, and an increase of 4 percent for HHS. The NSF increase in 1981 was now 6 percent, and the increase for USDA 12 percent.

Table 1. Federal R&D obligations by agency

[Dollars in millions]

Agency	Actual			Estimated			
	1971	1979	Average annual percent change 1971-79	1980	Percent change 1979-80	1981	Percent change 1980-81
Total	$15,543	$28,978	8.1%	$31,878	10.0%	$35,492	11.3%
Department of Defense	7,509	12,506	6.6	13,788	10.2	16,604	20.4
National Aeronautics and Space Administration	3,258	4,411	3.9	5,114	15.9	5,398	5.6
Department of Energy	1,303	4,639	7.2	4,950	6.7	4,995	0.9
Department of Health and Human Services	[2]1,344	3,505	12.7	3,777	7.8	3,908	3.5
National Science Foundation	337	808	11.6	904	11.9	995	10.0
Department of Agriculture	305	663	10.2	732	10.4	778	6.3
Environmental Protection Agency	137	410	14.8	415	1.1	445	7.3
Department of the Interior	192	406	9.8	426	4.9	425	−.1
Department of Transportation	497	370	−3.7	362	−2.1	378	4.5
Department of Commerce	144	309	10.1	338	9.4	373	10.1
Nuclear Regulatory Commission	—	149	—	196	32.0	218	11.0
Department of Labor	23	137	25.1	164	19.7	193	17.6
Department of Education	[3]132	166	3.0	153	−7.9	164	7.2
Veterans Administration	63	127	9.2	131	2.9	134	2.2
International Development Cooperation Agency	[4]30	106	7.3	119	11.7	131	10.5
Other agencies	270	266	−.2	310	16.7	355	14.4

[1]Atomic Energy Commission including functions of the Nuclear Regulatory Commission
[2]Department of Health, Education, and Welfare minus the Office of Education
[3]Office of Education
[4]Agency for International Development

Note: Data for 1979-81 are based on the President's 1981 budget (revised).

SOURCE: National Science Foundation

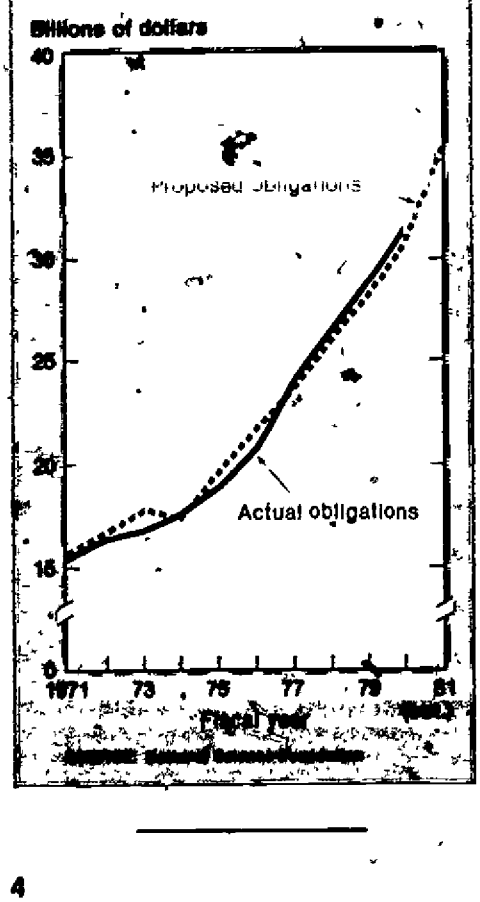
[4]For a further discussion of specific programs emphasized or cut back in 1981, see section 2, "Federal R&D Funding by Budget Function."

variations in budget estimates

In the 1971 80 period the variation of the "actual year" Federal R&D total from the R&D total contained in the original budget for a given year was 4 percent or less with the exception of one year—1973 for which the actual year Federal R&D total was almost 6 percent lower than the R&D total requested in the 1973 budget (chart 3)

From 1971 through 1976 the actual year R&D totals were *lower* than R&D totals that represented budget proposals with the exception of 1974 In this period congressional appropriations, on an overall basis, did not exceed budget proposals From 1977 through 1980 the trend was reversed, with ultimate totals *higher* than those originally requested. In the case of those four successive budgets, the Congress repeatedly added to funds requested for health, energy, and agriculture R&D programs The administration also added supplemental requests (not part of the original budget) for the space shuttle and for certain defense R&D programs, notably in fiscal years 1979 and 1980, these were granted, in whole or in part. For 1981, however, an interruption of the trend may have taken place by the time the data become final Congressional appropriations, thus far, have been closer to requested amounts than in recent years, and preliminary data, based on the second version of the 1982 budget, indicate a 1981 R&D total lower than that requested in the March 1980 budget revision. The attainment of a higher level would be dependent on congressional increases that appear unlikely to be made

Chart 3. Comparison of estimated Federal R&D obligations as originally proposed for Federal budget years with Federal R&D funds actually obligated for those years: FY 1971-81



relationship to broader indicators

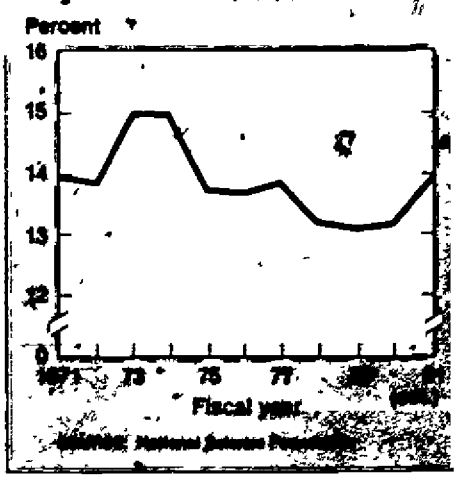
Placed against larger perspectives Federal R&D funding reflects some contrasts The R&D share of the Federal budget has stablized and the Federal R&D share of the gross [illegible] product (GNP) has shown signs [illegible] whereas the share of Federal R&D funding within the national R&D total has been declining for a number of years.

the federal budget

The share of R&D and R&D plant outlays within the overall Federal budget has remained virtually constant since 1976. That year the ratio was 5.7 percent, and in the revised 1981 budget the share was again 5.7 percent (table 2). From 1965 to 1975 a steady decline in share took place while social and other budget programs were growing at a faster rate than R&D programs The stability of the ratio in the years since 1975 can be largely ascribed to a resurgence of growth in Federal development programs, related to energy, defense and space undertakings, that have produced growth in the Federal R&D total. Even though a Federal policy existed from the 1977 budget to the 1980 budget to fund basic research at levels that would allow for real growth, the amounts involved have been considerably smaller than in the case of development.

During the second half of the seventies R&D and R&D plant outlays within the relatively controllable portion of the Federal budget have also maintained a stable share—between 13 percent and 14 percent (chart 4) [1] The gain in 1981 of almost a percentage point (to 14 percent) reflects the fact that reductions in R&D programs in the budget revision were not as great, proportionately, as reductions in other relatively controllable programs

Chart 4. Federal R&D and R&D plant outlays as a share of the relatively controllable portion of the Federal budget: FY 1971-81



the gross national product

Federal and industrial R&D outlays are sometimes examined as shares of the gross national product (GNP) to provide a starting point for analysis of the effects of research and development on economic growth and productivity Although the

[1] No R&D budget exists as such R&D programs for the most part are not acted upon as separate budget line items but are subsumed in larger appropriations The ratio of R&D outlays to relatively controllable (or total) Federal outlays is calculated for purposes of analysis only and is not used in the budget decision process

Table 2. Federal overall budget outlays and R&D obligations and outlays: fiscal years 1960-81

[Dollars in millions]

Fiscal year	Total budget outlays[1]	Research, development, and R&D plant		R&D &R&D plant outlays as a percent of total budget outlays
		Obligations	Outlays	
1960	$ 92,223	$ 8,080	$ 7,744	8 4
1961	97,795	9,607	9,287	9 5
1962	106,813	11,069	10,387	9 7
1963	111,311	13,663	12,012	10 8
1964	118,584	15,324	14,707	12 4
1965	118,430	15,746	14,889	12 6
1966	134,652	16,179	16,018	11 9
1967	158,254	17,149	16,859	10 7
1968	178,833	16,525	17,049	9 5
1969	184,548	16,310	16,348	8 9
1970	196,588	15,864	15,735	8 0
1971	211,425	16,154	15,971	7 6
1972	232,021	17,098	16,727	7 2
1973	247,074	17,575	17,489	7 1
1974	269,620	18,177	18,297	6 8
1975	326,185	19,860	19,551	6 0
1976	366,439	21,617	21,021	5 7
1977	402,725	25,351	23,380	5 8
1978	450,836	27,684	25,680	5 7
1979	493,673	30,454	27,843	5 6
1980 (est.)[2]	568,900	33,903	31,661	5 6
1981 (est.)[2]	611,500	37,470	34,892	5 7

[1]Outlays include expenditures plus net lending

[2]These estimates are based on amounts shown in *Fiscal Year 1981 Budget Revisions March 1980* (Executive Office of the President Office of Management and Budget)

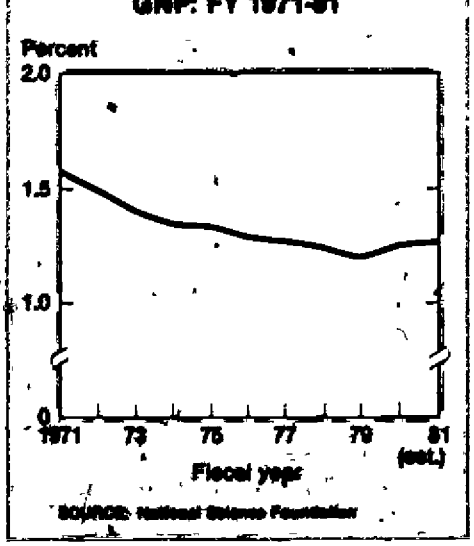
SOURCES Office of Management and Budget and Bureau of the Budget *The Budget of the United States Government Fiscal Years 1962 through 1981* National Science Foundation annual surveys of R&D Programs of Federal agencies

effects can be ascertained only by investigation of a complex set of interactions, a broad measure of the R&D component is provided by trends in the size of the R&D/GNP ratio

In 1971 the Federal R&D and R&D plant outlay share of GNP was 1 57 percent, and this share declined without interruption until 1979, although always remaining above 1 percent (chart 5). The estimate for 1980 shows an upturn, which is sustained in 1981 The increase in 1980 is largely attributable to growth in spending for DOD and DOE programs, and the increase in 1981 to growth in anticipated spending for DOD and NASA programs. It should be noted that Federal outlay data lag behind obligation data and this is why NASA would be an important factor along with DOD in 1981 outlays

Even though the Federal R&D/GNP ratio appears to be turning upward to the 1977 level of 1.27 percent, the effects of this relationship on the economy are not likely to be the same as in the earlier period since the relative importance of various agency programs within the Federal R&D total has changed. Over the 1977 81 period an increase is seen in DOD and DOE activities relative to NASA and HHS activities, with corresponding implications for impacts on performers and fields

Chart 5. Federal R&D and R&D plant outlays as a share of GNP: FY 1971-81



the national r&d tota

Starting in the midsixties the share federally supported R&D activities with the national R&D total began a stea decline, which lasted until 1974. It mained level for the next three years, a then declined further. In 1964 (the pe year) the Federal share was 66 percent, b the ratio had fallen to 51 percent by 197 and in 1981 will be an estimated 48 p cent.[6] During this period the indust supported share has been rising, with dustry accounting for nearly all the rest national R&D support

In the seventies the emphasis within t Federal R&D total shifted toward resea while at the same time development co tinued to predominate In the late sixt and early seventies defense, space, a defense-related atomic energy progra were in phases of minimal growth or act decline even through funding for progra in health, general science, and agricultu research was expanding. After 1973 renewal of support on the part of all t leading support agencies occurred with t main emphases placed on biomedic energy-related, space-related, and defen related *research* Now, as Federal R& growth continues, even while the Fede share of the national total declines, the e phasis may shift toward *development* DOD weapons programs produce the im impetus toward R&D expansion

character of work

In 1971 Federal R&D funding began nse steadily, after several years of decli with an upward trend becoming marked 1975 Funding for all three character work components fell in current doll before the start of the seventies, but as

[6]See National Science Foundation, *National Patterns Science and Technology Resources*, 1980 (NSF 80 (Washington D C Supt of Documents U S Governm Printing Office, 1980) In compiling data for national R totals, calculations cannot be made for R&D plant since dustry does not report such data

decade began, funding for each area once again moved higher, although at varying rates of increase (table 3).

Table 3. Federal obligations for research and development by character of work: fiscal years 1971-81

[Dollars in millions]

Fiscal year	Research			
	Total	Basic	Applied	Development
1971	$15,543	$1,946	$3,303	$10,294
1972	16,496	2,165	3,426	10,905
1973	16,800	2,193	3,454	11,154
1974	17,411	2,339	3,877	11,195
1975	19,039	2,536	4,305	12,198
1976	20,780	2,700	4,915	13,165
1977	23,984	3,191	5,413	15,380
1978	26,388	3,619	6,105	16 663
1979	28,978	4,097	6,576	18 305
1980 (est)'	31,878	4,509	7,295	20,075
1981 (est)'	35,492	4,902	8,006	22,584

'Data are based on the President s 1981 budget (rev sed)

Note Detail may not add to totals because of rounding

SOURCE National Science Foundation

In 1975 and the years since then, however, the rate of inflation increased enough to largely cancel out R&D gains (chart 1) Since 1975 real growth each year has ranged between 1 percent and 3 percent with the exception of 1977 when an 8-percent increase occurred The estimated constant-dollar value of the Federal R&D total in 1981 is still only 10 percent higher than in 1971, despite the fact that funding has more than doubled in that period in current dollars

From 1971 until 1976 applied research was the only area in which some real growth took place. Basic research and development funding actually declined in real terms between 1971 and 1976, but funding for each of these components began to rise the next year From 1976 to 1981 the most rapid rates of growth have been shown by basic research and development, especially by basic research, which has benefited from a deliberate support policy on the part of two successive administrations. Only in 1981 was this policy reversed in the March budget revisions, a constant-dollar decrease of 1 percent was indicated for basic research This appears to remain the case for basic research funding in 1981 after later congressional and administrative actions.

Development funding has grown rapidly since 1976 as a result of the growth of a number of DOE, NASA, and DOD programs In the revised 1981 budget the development component was the only one to show some real growth—an estimated 2 percent. Applied research funding was virtually unchanged in real terms. Thus, the broad impact of R&D policy for the 1981 budget would be less to advance science than to advance the technological products of science, especially those related to DOD weapons systems

performers

The heavy emphasis on defense R&I support in the 1981 budget will have reper cussions on performers As seen in table 4 three performing sectors showed growt ahead of anticipated inflation in the budge year These were the Federal intramural sec

Table 4. Federal obligations for research and development by performer: fiscal years 1971 and 1979-81

[Dollars in millions]

Performer	Actual			Estimated			
	1971	1979	Average annual percent change 1971 79	1980	Percent change 1979-80	1981	Percent change 1980-81
Total	$15,543	$28,978	8 1	$31,878	10 0	$35,492	11 3
Federal intramural	4,205	7,497	7 5	8,052	7 4	8,965	11 3
Industrial firms	7,608	12,900	6 8	14,558	12 8	16,642	14 3
FFRDC's' administered by industrial firms	480	1,318	13 5	1,389	5 4	1,445	4 0
Universities and colleges	1,644	3,888	11 4	4,207	8 2	4,556	8 3
FFRDC's' administered by universities	729	1,511	9 5	1,822	7 3	1,734	6 9
Other nonprofit institutions	463	1,031	10 5	1,061	2 9	1,085	2 3
FFRDC's' administered by other nonprofit institutions	210	369	7 3	418	13 4	475	13 5
State and local governments	141	310	10 3	386	24 4	407	5 5
Foreign	63	155	11 9	186	20 1	183	−1 5

'Federally funded research and development centers

Note Data for 1979-81 are based on the President s 1981 budget (revised)

SOURCE National Science Foundation

Between 1971 and 1981 the average annual rate of increase for basic research is an estimated 1 9 percent in constant dollars, for applied research, 1.5 percent, and for development, 0 5 percent Despite the momentum of recent years, the real level of development funding (strongly tied to trends in DOD development support) is still well below the 1967 high point, whereas basic research and applied research funding attained new record levels by 1978

In 1981 the share of development within the Federal R&D total is an estimated 64 percent, applied research, an estimated 22 percent, and basic research, an estimated 14 percent

tor, up an estimated 11 percent in 1981 th industrial sector, including federally funde research and development center (FFRDC's), up an estimated 13 percen and FFRDC's administered by other nor profit institutions, up an estimated 14 pe cent The strong growth anticipated fo each of these areas would be almost entirel engendered by DOD programs DOD is th leading agency sponsor of R&D perform ance by these sectors

The university and college sector showe an increase of 8 percent in the 1981 budge somewhat less than anticipated inflation I this case HHS is the leading support agenc by far, and the small relative increase

support that was expected to be provided by HHS tended to override an exceptionally high (19 percent) increase in planned R&D support to the university-and-college sector on the part of DOD. The second agency in size of support is NSF, followed by DOD. The NSF projected 1981 increase was 10 percent as a result of the budget revisions, considerably less than the increase in 1980. Even with some additions to NIH and NSF funding by the Congress, the university-and-college sector was still expected to receive increased R&D support at a rate less than inflation in 1981. Later data, based on the revised 1982 budget, make this expectation a virtual certainty.

As in many years of the previous decade, Federal intramural performance in the 1981 budget accounted for an estimated 15 percent of total Federal R&D support and extramural performance for the rest. Intramural performance includes not only direct R&D activities in Federal laboratories but also the costs of administering those and extramural R&D activities. Industry (including FFRDC's) continued to account for approximately 50 percent of total Federal R&D performance. Universities and colleges accounted for 13 percent of the total, compared with 11 percent in 1971.[1]

fields of science

Federal obligations for research were scheduled to reach a total of $12.9 billion in 1981, an estimated 9 percent increase, the same rate as the average annual increase for the 1971-80 period (9.4 percent). The total subsumes seven major fields of science plus a "not elsewhere classified" area, covering multidisciplinary projects within a broad field and single-discipline projects for which a separate field is not specified in the *Federal Funds* reporting system. Rates of growth for individual fields of science vary considerably from overall growth rates.

The life sciences have been the leading field in terms of Federal research funding since 1971 and accounted for an estimated 34 percent of the Federal research total in the 1981 budget (chart 6). The average annual rate of growth between 1971 and 1980 was 11.5 percent, the highest of any major field, but the increase anticipated in the 1981 budget was only 6 percent. This increase reflected, chiefly, the small increase allotted to NIH biomedical research programs.

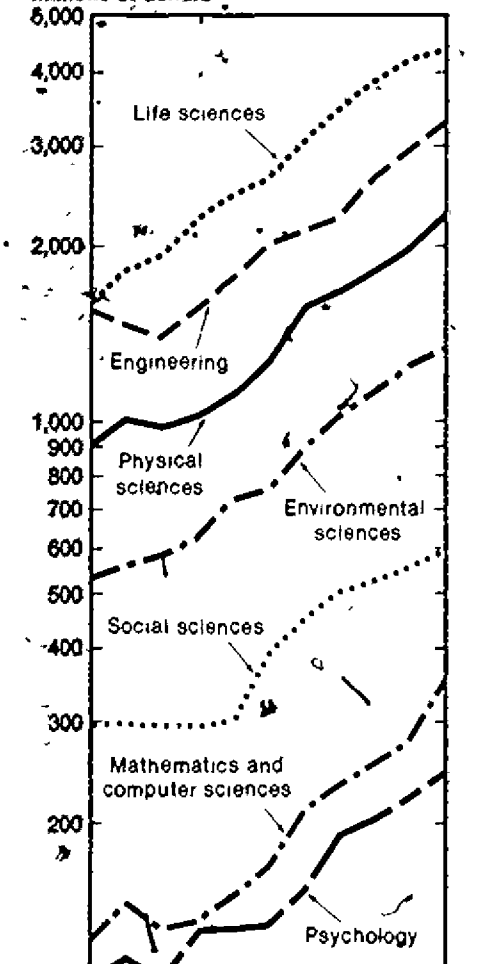
Engineering, now 25 percent of the Federal research total, grew at an average annual rate of only 7.3 percent in the 1971-80 period but was expected to show an increase of 10 percent in the 1981 budget. Nearly all of this gain would result from DOD programs (scheduled for an 18-percent rise). DOD contributes the largest share of research support to this fie followed by NASA, DOE, and NRC. 1981 NASA support is expected to decl and DOE support to increase only slightly.

The physical sciences represent 18 p cent of all Federal research support in 19 After registering average annual growth 8.7 percent between 1971 and 1980, th were scheduled for a 14-percent gain in 1981 budget, a relative increase greater th for all the other major fields exc mathematics and computer sciences. T projected growth reflected an announc administration policy of special attention basic research in the physical sciences make up for a long-term contraction in su port. The largest increase for physics w shown by DOD, second only to DOE amount of support to physics increases support by DOE and NSF were a substantial. As for the two other physi sciences, chemistry and astronomy, moderate increase was seen in chemis support in the 1981 budget, mostly spurr by NSF, and only a slight increase astronomy, reflecting the budget cutba for NASA, the leading support agency.

The environmental sciences—atm spheric, geological, and oceanographic make up 10 percent of the Federal resear total in 1981. The broad field grew at average annual rate of 9.8 percent betwe 1971 and 1980, second only to the l sciences. The planned increase in 198 however, was just 6 percent. Since NASA the leading agency sponsor of environme tal sciences research and since NASA ceived notable basic research cutbacks in t March budget revision, the relatively sm increase for the environmental field as whole can be tied largely to that ever NASA support is centered in the atm spheric and geological subfields. Ocean graphy, however, is funded principally NSF and DOD, and these agencies' pr jected 1981 increases that would allow some real growth.

The social sciences, now 5 percent of t Federal research total, showed the slow growth of any major field in the 1971-timespan—7.0 percent. A 7-percent i crease was also projected for 1981. In t past 10 years annual funding for the soc sciences has declined in real terms. T social sciences field is chiefly supported HHS through programs in health ca financing, human development, and me tal health, followed by USDA with a stro concentration in economics.

Chart 6. Trends in Federal obligations for research by field of science: FY 1971-81
(Semilog scale)



SOURCE: National Science Foundation

[1] For a fuller discussion of Federal R&D performers, see section 3, Federal R&D Support to Performers.

Mathematics and computer sciences, now 3 percent of the Federal research total, grew relatively rapidly in funding in the 1971-80 period—at an average annual rate of 9 3 percent—and in the 1981 budget was scheduled for a 25-percent increase, by far the largest relative increase of any field At present, DOD accounts for the chief support to this field, with NSF next A 30-percent increase for DOD in 1981, mostly in computer sciences, cut across all major DOD subdivisions A 16-percent increase for NSF was related to increased basic research support to both computer sciences and mathematics

Psychology, the smallest of the major fields in terms of funds provided (2 percent of the 1981 Federal research total), showed a 12 percent increase in the 1981 budget This compared with an average annual growth rate of 8 3 percent in the 1971-80 timespan After slow growth in most years of the seventies, significant growth was indicated for both 1980 and 1981 The largest support to research in psychology is provided by HHS, followed by DOD In 1981 the chief impetus to growth stems from DOD

section 2.

federal r&d funding by budget function

For the past decade NSF has classified Federal R&D programs on a functional basis to obtain a view of leading areas of R&D effort, their relative weights in the total picture, and their changes over selected periods of time. For the 1980 and 1981 budgets the function classification system has followed that of the overall Federal budget with only one adjustment. Of the 15 budget functions with R&D components, one, *general science, space, and technology*, has been divided into two functions *Space research and technology* and *general science*. All the other functions used for the R&D analysis are synonymous with budget functions.

On this basis, the areas that have grown most rapidly in the 1971-81 period are *energy, general science, health,* and *natural resources, and environment*, among the eight major functions (chart 7).[8] Energy and general science each increased more than six times in terms of R&D funding, and health and natural resources increased almost three times (table 5). The shares of these four functions also grew within the Federal R&D total.[9]

Moderate growth has been shown in *agriculture* and *national defense*. R&D funding for each of these areas more than doubled in current dollars between 1971 and 1981. The share of agriculture within the Federal R&D total, however, increased only slightly while that for national defense was still lower in the 1981 budget than in the years from 1971 through 1974 (table 6).

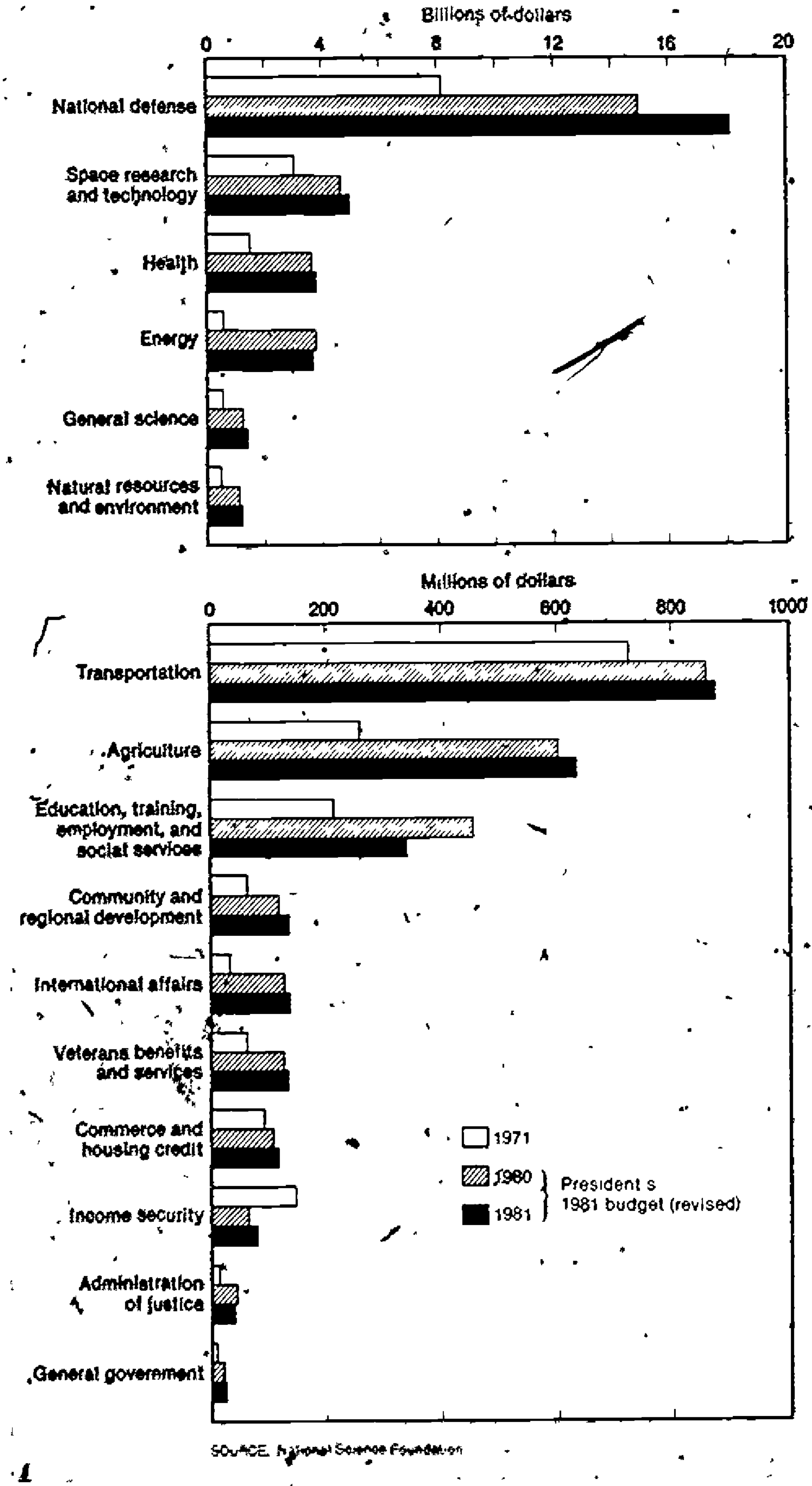
Slow growth in the 10-year period was recorded by *space research and technology* and *transportation*, and the shares of each of these functions within the Federal R&D total fell.

The analysis that follows is confined to these eight major functions since they have accounted for at least 96 percent of all Federal R&D support in each year of the 1971-81 timespan. They contain virtually all Federal development programs, which usually entail the highest costs. The research programs within these functions cut across all fields of science whereas the research programs sponsored within the smaller

[8] Major functions are defined as those with R&D funding levels of more than $500 million in the 1981 budget (revised).

[9] R&D data by budget functions for fiscal years 1978-81 are shown in budget authority dollars rather than obligations or outlays since budget authority is the basis for congressional funding decisions. The two most recent NSF function reports have therefore been based on budget authority. Sources of data for the 1979-81 function study were information provided by the agencies for Special Analysis K, Research and Development, in the 1981 budget; further detailed program information in agency budget justification documents, *Fiscal Year 1981 Budget Revision, March 1980*; and a paper, Research and Development Revisions to the Fiscal Year 1981 Budget, dated April 17, 1980, the last two issued by the Office of Management and Budget (OMB), and budget amendment justifications issued by the agencies. See National Science Foundation, *Federal R&D Funding by Budget Function, Fiscal Years 1979-81* (available on request). Program data based on obligations for the years 1971-77 were taken from earlier records and arranged according to the budget function system. It should be noted that dollar amounts and percent changes shown in this section for the most recent budget period will differ slightly from those shown for the Federal totals and agency programs in section 1, which are based on obligations.

Chart 7. Federal R&D funding by budget function: FY 1971, 1980 (est.) and 1981 (est.)



SOURCE National Science Foundation

[illegible] share of total Federal basic research within the minor functions is less than one half of 1 percent

the 1981 budget

When the original budget for 1981 was revised downward in March, the chief dollar reductions in R&D programs were made in the space and energy functional areas (table 5) [10] Next were health, general science, and transportation Reductions for defense natural resources and environment and agriculture were minimal While all major functions revealed smaller *relative* increases between 1980 and 1981 than had originally been planned (except energy, which showed a decrease) the change for overall defense R&D programs was negligible with the result that the divergence between the defense area and all other areas became greater

Defense, with a 21-percent anticipated R&D increase in 1981, was the only area to exceed the projected rate of inflation (chart 8) General science, with a 10-percent anticipated increase, just matched the probable inflation rate Every other major function (except energy) showed an increase that amounted to a decline in real terms Space research and technology, which had originally been expected to receive 11 percent more funds in 1981, thereby keeping pace with inflation, was reduced to a 7 percent increase after revisions

[9] The education training employment and social science function was actually reduced the most—from an original R&D [illegible] million [illegible] revised $ [illegible] million [illegible] function category

20

Table 5. Federal R&D funding by budget function: fiscal years 1971-81

[Dollars in millions]

Function	Actual									Estimates					
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980			1981		
										January	March reduction	Revised request	January	March reduction	Revised request
Total	$15 543	$16 496	$16,800	$17 411	$19 039	$20 780	$23 964	$26 517	$29 040	$32 050	- $205	$31 845	$36 397	- $868	$35,528
National defense	8 110	8,902	9 002	9,016	9 679	10 430	11,864	12,899	13,791	15 002	- 43	14 959	18 135	- 19	18,117
Space research and technology	3 048	2,932	2,824	2,702	2 764	3 130	3,365	3 461	3 969	4 606	—	4 606	5 119	- 201	4,918
Health	1,288	1 547	1,585	2,069	2,170	2,351	2,629	2,968	3 401	3 682	- 32	3 650	3 887	- 94	3 792
Energy	556	574	630	759	1 363	1 649	2 562	3 134	3,461	3 834	- 69	3 765	3 799	- 124	3 675
General science	513	625	658	749	813	858	974	1 050	1,119	1,246	—	1 246	1,435	- 64	1,371
Natural resources and environment	416	479	564	516	624	683	753	904	1,010	1,090	—	1 090	1 144	- 4	1,140
Transportation	728	559	572	694	635	631	709	768	799	871	- 12	860	917	- 41	876
Agriculture	259	294	308	313	342	383	457	501	552	604	- 3	602	640	- 6	634
Education training employment, and social services	215	235	290	236	239	255	230	345	354	497	- 39	457	639	- 299	341
Community and regional development	65	66	78	82	93	109	102	92	127	126	- 8	118	143	- 6	137
International affairs	32	29	28	24	29	42	66	57	117	127	—	127	135	—	135
Veterans benefits and services	63	69	74	85	95	98	107	111	123	126	—	126	135	- 5	130
Commerce and housing credit	90	50	50	51	65	69	71	77	92	107	—	107	119	- 5	114
Income security	145	106	106	71	72	48	55	67	57	63	—	63	86	—	80
Administration of justice	10	23	33	35	44	35	30	44	47	48	—	48	46	—	46
General government	7	8	7	9	12	12	13	18	23	21	—	21	23	—	23

Listed in descending order of 1981 budget authority. Data for 1971-77 are shown in obligations; data for 1978-81 are shown in budget authority.

Note: Detail may not add to totals because of rounding.

SOURCE: National Science Foundation.

Table 6. Percent distribution of Federal R&D funding by budget function: fiscal year 1971-81

Function	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980 est	1981
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100
National defense	52.2	54.0	53.6	51.8	50.8	50.2	49.5	48.6	47.5	47.0	51.0
Space research and technology	19.6	17.8	16.8	15.5	14.5	15.1	14.0	13.1	13.7	14.5	13.8
Health	8.3	9.4	9.4	11.9	11.4	11.3	11.0	11.2	11.7	11.5	10.7
Energy	3.6	3.5	3.7	4.4	7.2	7.9	10.7	11.8	11.9	11.8	10.3
General science	3.3	3.8	3.9	4.3	4.3	4.1	4.1	4.0	3.9	3.9	3.9
Natural resources and environment	2.7	2.9	3.8	3.0	3.3	3.3	3.1	3.4	3.5	3.4	3.2
Transportation	4.7	3.4	3.4	4.0	3.3	3.0	3.0	2.9	2.8	2.7	2.5
Agriculture	1.7	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.8
Education training employment and social services	1.4	1.4	1.7	1.4	1.3	1.2	1.0	1.3	1.2	1.4	1.0
Community and regional development	.4	.4	.5	.5	.5	.5	.4	.3	.4	.4	.4
International affairs	.2	.2	.2	.1	.2	.2	.3	.2	.4	.4	.4
Veterans benefits and services	.4	.4	.4	.5	.5	.5	.4	.4	.4	.4	.4
Commerce and housing credit	.6	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
Income security*	.9	.6	.6	.4	.4	.2	.2	.2	.2	.2	.2
Administration of justice	.1	.1	.2	.2	.2	.2	.1	.2	.2	.2	.1
General government	(2)	(2)	(2)	.1	.1	.1	.1	.1	.1	.1	.1

Listed in descending order of budget authority amounts in the 1981 budget (revised).

*Less than .05 percent.

Note: Detail may not add to totals because of rounding.

SOURCE: National Science Foundation.

national defense

In the 1981 revised budget national defense R&D programs, amounting to $18.1 billion, made up 51 percent of the Federal R&D total, compared with 47 percent in 1980. National defense is made up of all the programs of DOD (except civil programs of the Army Corps of Engineers) and the defense-related programs of DOE.

In the first half of the seventies growth in Federal R&D programs was slight, and in fact, nonexistent in constant-dollar terms. Nonetheless, the share of the defense function within the Federal R&D total was higher than at present, although it began to decline after 1972 (table 7). In the early seventies, even though space programs were reflecting annual decreases, the R&D funding within most other functions was growing enough to more than offset the space decline and thus prevent growth in the defense share.

Not until 1976 did R&D funding for national defense begin to rise in real terms; this pattern continued for two more years and then real declines occurred in 1979 and 1980. Changes in funding for defense in the second half of the seventies were small enough to amount to virtually level funding in almost every year. The projected 10-percent real growth for national defense R&D programs in the revised 1981 budget reflected the evolution of a new Federal policy toward defense support as a whole.

In the 1980 budget the President had announced a plan for 3 percent real growth in defense outlays in order to meet NATO commitments, but this plan did not devolve on R&D programs sufficiently to permit real increase that year. In the 1981 budg this underlying objective had reached e pression in the R&D area in the form significant increases in most defense R& mission areas. Even though reductions we made in March in some DOD programs, t rising cost of fuel and other items and t increases given to some other DOD R& programs offset the reductions.

[illegible]

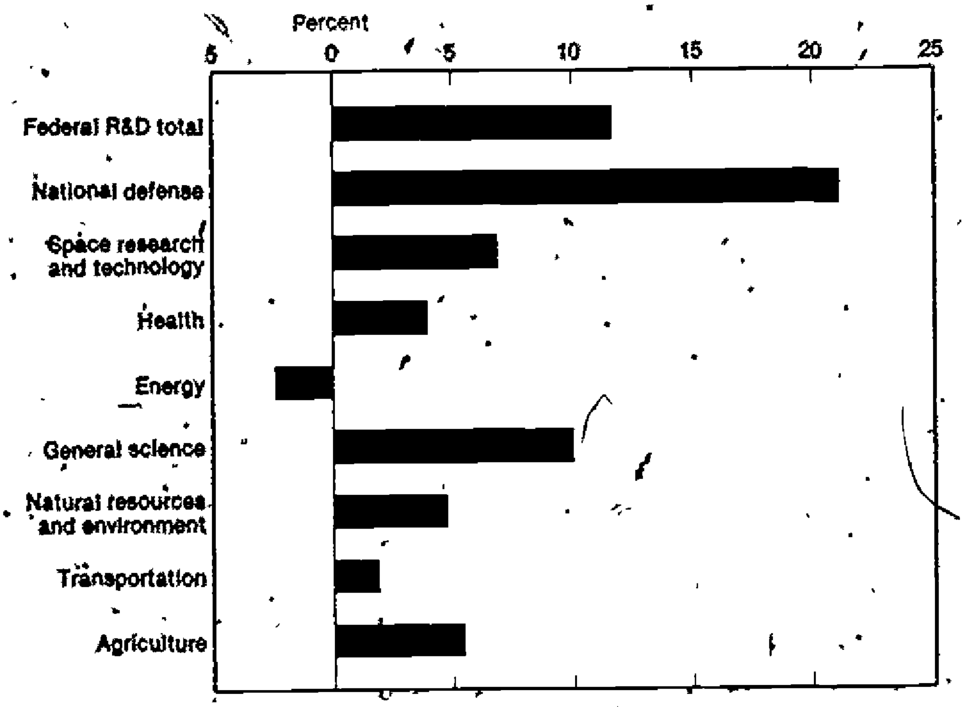
[illegible] percent for basic research, a decrease of [illegible] percent for *advanced technology* programs to less than $600 million, an increase of 54 percent in *strategic* R&D programs, mostly caused by an $881 million increase for development of the M X intercontinental ballistic missile, an increase of 10 percent to $5 7 billion, in *tactical* R&D programs, which are all directed to development of combat systems for general purpose forces, and an increase of 35 percent, to $1 6 billion, in *intelligence and communications* R&D programs The largest share of the increase for overall DOD programs in 1981 was found in the strategic program area, strategic and tactical programs together accounted for more than one-half of the increase

DOE *atomic energy defense activities* (amounting to 7 percent of the national defense total) were scheduled to grow 14 percent [illegible] $[illegible] billion after [illegible] budget [illegible] March The weapons R&D and testing activity, more than one half of the defense atomic energy R&D total, was expected to grow by 13 percent Naval reactors development, next in size, was expected to increase only 4 percent Inertial confinement fusion showed proposed growth of 39 percent and defense waste management, proposed growth of 29 percent

space research and technology

Space research and technology, which amounted to $4 9 billion, or an estimated 14 percent of total Federal R&D budget authority in the 1981 budget, is an area that declined in absolute funding between 1971 and 1974 and thereafter has traced a steady rise, largely as a result of activities related to the space shuttle program (table 7) The shuttle, which is moving from a developmental to an operational phase, was scheduled for a manned orbital test flight in 1981 At almost $2 billion in projected funding, it is the largest single Federal R&D program

Chart 8. Percent change, FY 1980-81, in R&D funding for major functions* in the 1981 Federal budget (revised)



*Shown in descending order of 1981 R&D budget authority

SOURCE: National Science Foundation

All activities assigned to the budget function of space are conducted by NASA and all NASA programs are R&D-related NASA, unlike other agencies, had no choice in the March budget revisions but to cut R&D programs Since the shuttle program was a stated administration commitment, reductions had to be made by NASA in other programs, although some of them were shuttle-related For example, within the broad *space transportation systems* (STS) area both the operations capabil development progam and the operatio program were reduced in line with a plan ed delay in the launch of the internation solar polar mission to 1985 instead of 198

Within the *space science* area the phys and astronomy program was considerat reduced in 1981 as a result of the solar po mission delay The reductions included stretch-out of mission development as w as shuttle/spacelab payload developme

Table 7. Federal R&D funding by major budget functions:[1] Average annual percent change in selected periods

Function	Actual		Estimated[2]	
	1971 74	1974 79	1979-80	1980-8
Total	3 9%	10 8%	9 7%	11 6
National defense	3 6	8 9	8 5	21 1
Space research and technology	−3 9	8 0	16 1	6 8
Health	17 1	10 5	7 3	3 9
Energy	11 0	35 5	8 8	−2 4
General science	13 5	8 4	11 3	10 1
Natural resources and environment	7 5	14 4	8 0	4 6
Transportation	−1 6	2 9	7 6	1 9
Agriculture	6 5	12 0	9 1	5 4
All others	−1 8	9 6	13 9	−6 0

[1]Listed in descending order of 1981 budget authority

[2]Based on the President's 1981 budget (revised)

Note Calculations are based on obligational data for the 1971 77 period and on budget authority data for all subsequent year

SOURCE National Science Foundation

and mission management The planetary exploration part of space science showed a 20 percent reduction (which mostly preceded the March revision) because the Galileo mission to Jupiter was divided into separate launches for the orbiter and probe spacecraft in 1984 (originally planned to be launched as a single spacecraft in 1982)

Within *space and terrestrial applications* the largest single program is the Landsat D, which received increased funds in the March budget revisions to cover unanticipated development costs The largest program reduction was applied to the operational land observing system The next largest reduction was proposed for the earth radiation budget experiment No setback occurred, however, in plans for a doubling of funds for the agricultural remote sensing (AgRISTARS) program The space communications program was scheduled for a 26 percent increase, no cutback occurred

Space research and technology, designed to provide a technology base for current and future activities, showed almost level funding in the 1981 budget *Supporting activities* (tracking and data acquisition) likewise showed little change in funding

health

As can be seen in table 7, funding for R&D programs within the health function expanded more rapidly in the 1971-74 period than those within all other major functions During these years the health share of the Federal R&D total rose from 8 percent to 12 percent But from 1974 to 1979, health funding grew at the same pace as overall Federal R&D funding and three other major functions exceeded the rate of growth for health In 1980 and 1981 the estimated increases for health research were insufficient to offset inflation and the share of health among all Federal R&D programs declined to 11 percent in the 1981 budget

Almost all the programs within this function are sponsored by HHS Of the health R&D total of $3 8 billion in 1981, the biomedical research activities of the National Institutes of Health (NIH) within HHS accounted for approximately 85 percent The Alcohol, Drug Abuse and Mental Health Administration (ADAMHA), another subdivision of HHS, accounted for the next largest share

Budget authority for health R&D programs showed an increase of 4 percent in the 1981 revised budget, compared with 6 percent originally Most of the NIH institutes were given small relative increases, or none, in the 1981 proposals, as part of a "no growth" policy Work on cancer was scheduled for a slight decline, and heart research was expected to increase by only 3 percent The exceptions to this policy were environmental health research, up 13 percent, and arthritis, metabolism, and digestive diseases research, up 9 percent The institutes concerned with cancer and heart research together were expected to account for 44 percent of the NIH total in 1981, compared with 51 percent in 1976 when their combined share was highest

An increase of 11 percent was given to R&D programs in the mental health area, representing the second annual increment of funding to implement the recommendations of the President s Commission on Mental Health

energy

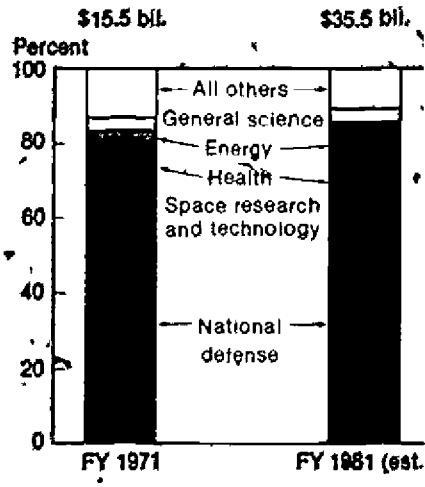
Energy was the only major function to show a decrease in overall R&D budget authority in 1981 Funding dropped 2 percent in the March budget to a net total of $3 7 billion, compared with a 1-percent decrease in the original budget Most energy programs are sponsored by DOE, the rest by the Nuclear Regulatory Commission (NRC), the Environmental Protection Agency (EPA), and the Energy Security Trust Fund (ESTF) Energy represented 10 percent of all Federal R&D budget authority in the 1981 budget, compared with 4 percent in 1971 (chart 9)

In the early seventies energy R&D funding grew moderately, mostly as a result of investment in the breeder reactor program Between 1971 and 1974 the energy function grew at an average annual rate of 1 50 percent, which was still slower than growth for the health and general science functions By 1975, however, the effect of the 1973 OPEC oil embargo was seen in a precipitous increase in funding for energy R&D programs, especially in fossil fuels, although all other areas—nuclear, solar, geothermal, conservation, and basic energy sciences—showed notable growth Between 1974 and 1979 the average annual increase of 35 5 percent in funding for energy R&D programs far surpassed growth rates other functional areas

In 1980, however, the rate of incre dropped sharply as almost all energy p grams—except those related to basic en sciences, safety, and energy-related vironmental research—showed mar slowdowns in funding A more mat phase of energy program development been reached at the same time that a po of budget austerity was announced

In the 1981 budget the administrat plan to halve funding for breeder rea systems, including termination of Clinch River demonstration project, c tributed to the slight net decrease in bud authority for overall energy R&D progra Significant increases were still planned basic energy sciences, geothermal, magn fusion, and solar energy programs Fu from the newly established Energy Secu Trust Fund were allocated to coal R&D p grams to aid in development of technol for large-scale production of synfuels 1981 the mix of energy programs h evolved to a point at which nuclear p grams, both fission and fusion, represen 35 percent of the energy R&D total, co pared with 51 percent in 1971

Chart 9. Share of leading functions in the Federal R&D total



SOURCE. National Science Foundation

general science

The general science function showed increase of 10 percent, to $1 4 billion,

R&D budget authority in the revised 1981 budget, compared with a 15-percent increase in the original January budget. Programs subsumed within this function are viewed as contributing to the Nation's scientific base in the broadest sense. All the R&D programs of NSF and the three basic sciences programs of DOE are included General science programs made up an estimated 4 percent of the 1981 Federal R&D total The comparable share in 1971 was 3 percent

In the 1971-74 period funding for general science R&D programs grew at an average annual rate of 13 5 percent, second only to health R&D programs In this period NSF research support was expanding, partly through acquisition of a number of DOD basic research programs that were transferred as a result of the Mansfield Amendment and partly as a result of a new NSF program of research applied to national needs, by which basic research findings could move more rapidly into practical applications In the 1974-79 period the growth of the general science function was slowed despite a boost in basic research support in 1977 and subsequent years that was part of administration policy

While nearly all the programs within the general science function are basic research in nature, most basic research—74 percent of the Federal total in 1981—is subsumed under other budget functions in support of other national needs, such as defense, health, or space exploration

In 1980 and 1981 the general science area reflected somewhat higher growth than in the 1974-79 period because of the administration policy of providing real increases in basic research support Not only NSF programs but also DOE high-energy physics, nuclear physics, and life sciences programs benefited from this policy Before the March budget revisions general science programs would have grown by several percentage points in constant dollars, and after the revision they were at least not expected to decline

As reflected in the revised budget, NSF programs were expected to grow 10 percent in 1981 A significant gain was indicated in mathematical and physical sciences, and high relative increases were still given to cross-directorate and ocean drilling programs despite budget amendments. An increase of 10 percent was proposed for DOE basic sciences programs, including a $22 million increase for high-energy physics

natural resources and environment

R&D programs within the natural resources and environment function grew fairly rapidly throughout the seventies, they were third in rate of growth after energy and health R&D programs In the 1971-81 period the natural resources and environment share within the Federal R&D total increased from slightly less to slightly more than 3 percent, and the dollar total in the 1981 budget was $1 1 billion

This function is made up of all the R&D programs of EPA except the energy-related environment program that is subsumed under the energy function, eight broad programs of the Department of the Interior concerned with water resources, land management, mining, geological surveys, fish and wildlife, and recreation, USDA forest research, the entire R&D effort of the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce, and the civil R&D programs of the Army Corps of Engineers

The growth of EPA programs has played an important part in the growth of the whole function, followed by expansion of NOAA and Geological Survey R&D programs These programs, which picked up momentum in the second half of the seventies, embodied efforts toward the attainment of a more healthy natural environment, improvement of weather and earthquake prediction and management, and better development and use of the Nation's mineral resources.

In 1980 and 1981 the growth rates for natural resources and environment slowed and were running behind estimated inflation. Budget revisions for 1981 were minimal, however, and did not change the increase, projected at 5 percent The conservation and land management area showed growth of 10 percent, covering expanded programs of the Forest Service within USDA. The pollution control and abatement area, entirely made up of EPA programs, showed an increase of 7 percent, including strong emphasis on solid waste and toxic substances research. Most other programs, such as those of NOAA within Commerce and the Geological Survey and the Bureau of Mines within Interior, showed almost level funding

transportation

Transportation R&D programs have reflected the slowest growth of those within any major functional area, and in the 1981 budget were scheduled for only a 2-percent increase, to $876 million Between 1971 and 1981 the share of this function within the Federal R&D total fell from 5 percent to an estimated 2 percent

Programs within the transportation function consist of all the R&D activities of the various subdivisions of the Department of Transportation (DOT), the aeronautical research and technology program of NASA and the R&D programs of the Maritime Administration within Commerce

At present the NASA program accounts for more than one-half the transportation R&D total, and the Federal Aviation Administration (FAA) programs within DOT for more than one-tenth After 1971, funding was terminated for work on the civil supersonic aircraft under FAA, and R&D funding for the transportation function was reduced accordingly Despite almost steady growth in the seventies in the NASA aeronautical research and technology program, the R&D total for transportation did not exceed the 1971 level until 1978 Growth for this program continued, and in the 1980 budget the only R&D program that showed a gain equal to inflation was the NASA aeronautical research and technology effort

Air transportation R&D funding was expected to decline in 1981, however, as a result of decreasing funds for the NASA aeronautical research and technology program, largely reflecting the phasing down of work on aircraft energy efficiency

In the revised 1981 budget, *ground transportation* R&D programs increased 1 percent because of the cooperative automotive research program (CARP), for which $12 million was added in 1981 after an $8 million reduction from the $2 million originally budgeted This program, planned as a joint Government-industry effort, was to be administered by DOT with

other agencies participating Agency financing was to be provided by the Energy Security Trust Fund The next administration cancelled the program

agriculture

. The agriculture function has maintained a steady 2-percent share of the Federal R&D total in the 1971-81 period Each year has registered some funding growth, and in the 1974-79 period the growth accelerated in accord with a public perception that the food demands of an expanding world population called for a greater focus on agricultural research The 1980 budget increase of 9 percent, however, did not quite meet estimated inflation

In the 1981 revised budget the overall increase for agriculture programs, to $634 million, was 5 percent Within that total, however, basic research in agriculture was scheduled for a 12-percent increase The competitive research grants program an administration initiative now in its third year, was scheduled for an increase of 56 percent This program is entirely basic research

The agriculture function consists exclusively of USDA programs, of which the Agricultural Research (AR) program area, almost entirely made up of in-house work, is the largest and the Cooperative Research (CR) program area, covering work at agricultural experiment stations located in all the States, is next in size A relatively small amount of R&D funding was assigned to the Economics, Statistics, and Cooperatives Services (ESCS), within the agricultural function in the 1981 budget

other functions

The remaining eight functions together made up 3 percent of total Federal R&D budget authority in the 1981 budget. Among these, the largest was *education, training, employment, and social services*, with $341 million in funding, or 1 percent of the Federal R&D total This function is made up of the education programs of the Department of Education, the human development programs of HHS, and all the R&D programs of the various Department of Labor subdivisions. In the 1981 budget revision the largest R&D program reduction for any function was made in a Labor program to develop and test models for the jobs portion of the administration's welfare reform proposal Since this program was the largest within the function, the overall function reflected a funding decrease of 25 percent from the 1980 level

basic research by function

In the January budget the increase in budget authority for basic research was 12 percent, sufficient for real growth, thus continuing a Presidential policy initiated in the 1977 budget After the March reductions the relative increase became 8 percent, or less than the rate of inflation and the f real decline in five years. Total budg authority for basic research in 1981 estimated at $4 9 billion (table 8) A subs quent administration decision to provi additional funds for basic research to assu real growth in 1981 was found to unrealistic in view of the timing and the a vent of a new administration. Thus, t basic research total in 1981 was an estimat $5 0 billion, 6 3 percent above 1980, or estimated real decline of 3 percent budget authority dollars (These data we taken from the 1982 budget as revised the new administration and before subs quent actions of the Congress)

The chief areas to receive funding redu tions in March 1980 were space, gene science, and health The largest cuts in ba research were for agencies whose progra are primarily research and/or developmen i e , NASA and NSF While most leadi functional areas still showed real increases funding for basic research after the re sions, the constant-dollar decrease f health, the leading area, and the decrea

Table 8. Budget authority for basic research by function: fiscal years 1979-81

[Dollars in millions]

Function	1979 actual	1980 January estimate	1980 Proposed reduction	1980 Revised estimate	1981 January estimate	1981 Proposed reduction	1981 Revise estima
Total	$4,408	$4,527	– $16	$4,511	$5,068	– $192	$4,876
Health	1,579	1,724	– 13	1,711	1,831	– 36	1,795
General science	1,026	1,138	—	1,138	1,309	– 49	1,259
National defense	365	441	– 2	439	533	– 15	518
Space research and technology	440	454	—	454	490	– 61	429
Agriculture	222	245	– 1	244	277	– 3	274
Energy	172	198	—	198	236	– 7	229
Natural resources and environment	131	139	—	139	152	—	152
Transportation	75	85	—	85	113	– 8	105
Education, training employment, and social services	59	62	—	62	73	– 8	65
Commerce and housing credit	10	12	—	12	20	– 5	15
Community and regional development	8	8	—	8	13	—	13
Veterans benefits and services	10	10	—	10	11	—	11
Administration of justice	10	10	—	10	10	—	10
Income security	1	1	—	1	1	—	1
General government	(1)	(1)	—	(1)	(1)	—	(1)
International affairs	—	—	—	—	—	—	—

[1] Less than $500 000

Note Detail may not add to totals because of rounding

SOURCE National Science Foundation

for space. Even in current dollars, strongly influenced the overall Federal support level for 1981 (chart 10).

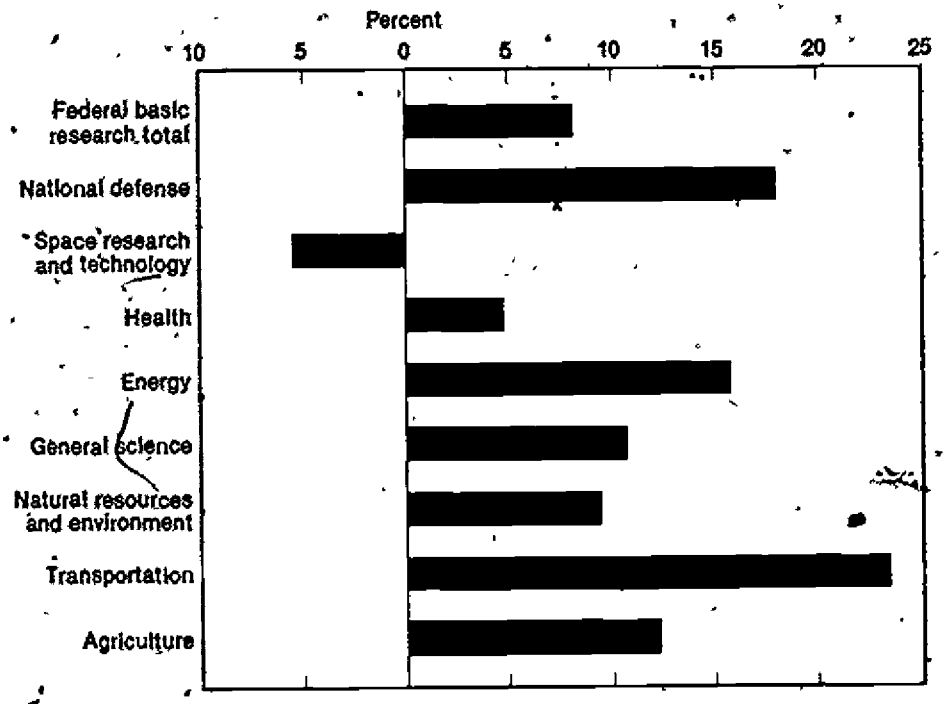
Health represented almost two fifths of all Federal basic research support, and general science represented one-fourth. National defense, the third functional area in amount of basic research support in 1981, accounted for slightly more than one-tenth. Recent growth in defense support has been part of an established DOD policy to provide substantial real growth in technology base programs in order to maintain a lead in U.S. military technology. The defense area showed an increase of 18 percent in basic research funding in the revised budget.

Space, which had fallen from third to fourth place in amount of 1981 support even before the revision, was expected to show an absolute decline (6 percent) in basic research funding—the only functional area with a lower funding level in 1981 than 1980. The most important cuts in space were related to the postponement of the solar polar mission and shuttle spacelab activities.

Five of the eight leading support areas continued to show growth equal to or ahead of anticipated inflation in the 1981 budget. Aside from space, the exceptions to real growth were health (up 7 percent) and natural resources and environment (up 9 percent). An unusually large relative increase—24 percent—was shown for basic research within transportation, even after the budget revision. Most of this increase was related to the proposed automotive basic research program.

Congress increased 1981 funds for some R&D programs in health through a continuing resolution for NIH, but this action was followed by a proposed rescission of $50 million for NIH on the part of the outgoing administration. Congressional actions have also included the restoration of some funds for NASA space sciences and the granting of the DOE basic science request and the requests of NSF and USDA. Subsequent actions of the new administration included rescissions in 1981 total basic research amounts for all leading support agencies except DOE and DOD, with the largest cuts directed to NSF. The net effect was to produce an estimated increase in 1981 over 1980 basic research budget authority of percent—one-half of the increase planned in the original 1981 budget. In real terms, anticipated growth was converted to decline.

Chart 10. Percent change, FY 1980-81, in basic research funding for major functions* in the 1981 Federal budget (revised)



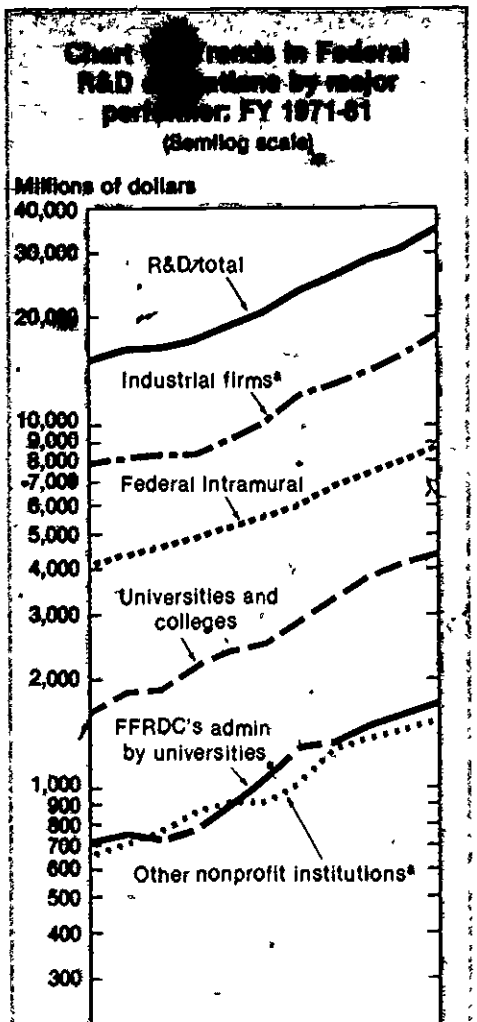
*Shown in descending order of 1981 R&D budget authority.
SOURCE: National Science Foundation

federal r&d support to performers

In the 1981 budget an estimated $26.5 billion, or three-fourths of the Federal R&D total, was expected to be directed to extramural performance through contracts and grants, and an estimated $9.0 billion was expected to be directed to intramural performance, including the conduct of direct R&D activities as well as the administration of both extramural and intramural R&D activities.

Throughout the seventies, the industrial sector led among all performer groups, followed by the Federal intramural sector, and the university-and-college sector. University-administered FFRDC's are currently fourth in size of effort, although in some years they have fallen behind the other nonprofit institution group (chart 11).

While the relative positions of these major performing sectors have remained almost constant since 1953 (when performer data were first collected by NSF), the proportion of work performed by each has shifted. Industrial support moved from 51 percent of the Federal R&D total in 1953 to a high of 65 percent in 1961, largely because of the growth in NASA programs, and then fell to a low of 48 percent in 1974 and 1975 when both DOD and NASA programs were in low-growth phases. Similar fluctuations occurred in the case of intramural R&D support. While funding for intramural work has increased steadily over the years, the intramural share of Federal R&D total was 36 percent in 1 but fell to a low of 18 percent in 1963 by 1968 was 23 percent. Throughout 1971-81 period it has ranged between percent and 28 percent. Universities colleges have shown almost continu funding growth since 1953, when they counted for 6 percent of all Federal rese and development, and their share has tended to grow. In 1980 they accounted 13 percent of the total, but in 1981 t share was expected to decrease to 13 per mostly as a result of the large increase p. ned for industrial performance of D programs combined with the relati small increase for HHS (NIH) programs



FFRDC's administered by universities were funded at almost the same level as the academic sector in 1955 but thereafter grew far more slowly, never accounting for more than 5 percent of the Federal R&D total. Three-quarters of their support has been provided by DOE and its predecessor agencies.

Nonprofit institutions (including FFRDC's) have consistently performed somewhat over 3 percent of the Federal R&D total. For many years these have been most heavily supported by HHS and DOD.

sectors and agency missions

The use of sectors bears a relationship to the character of work to be performed (chart 12) While every sector possesses the capability for all types of R&D performance, development is largely performed by industry and basic research by universities and colleges Applied research on the other hand, is fairly evenly shared by the Federal intramural, industrial, and academic sectors. The differing missions of the individual agencies determine the character of work to be performed, and this, in turn, influences the degree of reliance the agencies place on different performing sectors

DOD, NASA, and DOE have always supported the largest development programs, and for all three agencies two-thirds or more of their current development requirements are met through industrial performance In the late sixties and the first few years of the seventies, Federal industrial support waned both absolutely and in comparison with other performing sectors This was a period of decline for DOD and NASA R&D programs, following earlier cycles of rapid buildup. In 1975, however, development funding began to rise significantly for the first time in eight years, spurred by a surge of investment by DOD and DOE especially DOD Thereafter steady increases in development funding have been shown for both agencies (with the exception of DOE in 1981) and steady but relatively smaller increases for NASA and industry support has grown accordingly

Approximately one-half of the Federal basic research effort is performed on university and college campuses where specialized research talent and laboratories are concentrated Not surprisingly, the agencies that lead in support to basic research also lead in support to the academic sector

HHS and NSF are chiefly responsible for support of basic research in 1981—providing 37 percent and 19 percent of the Federal total, respectively. DOE, NASA, and DOD together accounted for another 33 percent of the Federal basic research total in the 1981 budget. HHS, NSF, DOD, and DOE are the four leading agencies in sponsorship of academic R&D performance

In the 1981 budget as in earlier years the Federal intramural performance sector was characterized by an emphasis on development and applied research Even though this sector ranks second in Federal basic research performance after universities and colleges, the comparative amount of basic research is small and its share of all Federal intramural work was only 13 percent in 1981 The leading agencies in support to development—DOD and NASA—are leaders in R&D support to the intramural sector, as are the leading agencies in support to applied research (DOD, HHS, and NASA) It should be noted that DOE, a leader in support of both development and applied research, relies more on FFRDC's than other agencies and supports relatively little intramural work

In the 1981 budget the effect of DOD funding on performers was pronounced For example, the 20-percent increase in defense R&D obligations was reflected in estimated increases in Federal industrial performance of 13 percent (including FFRDC's) and intramural performance of 11 percent

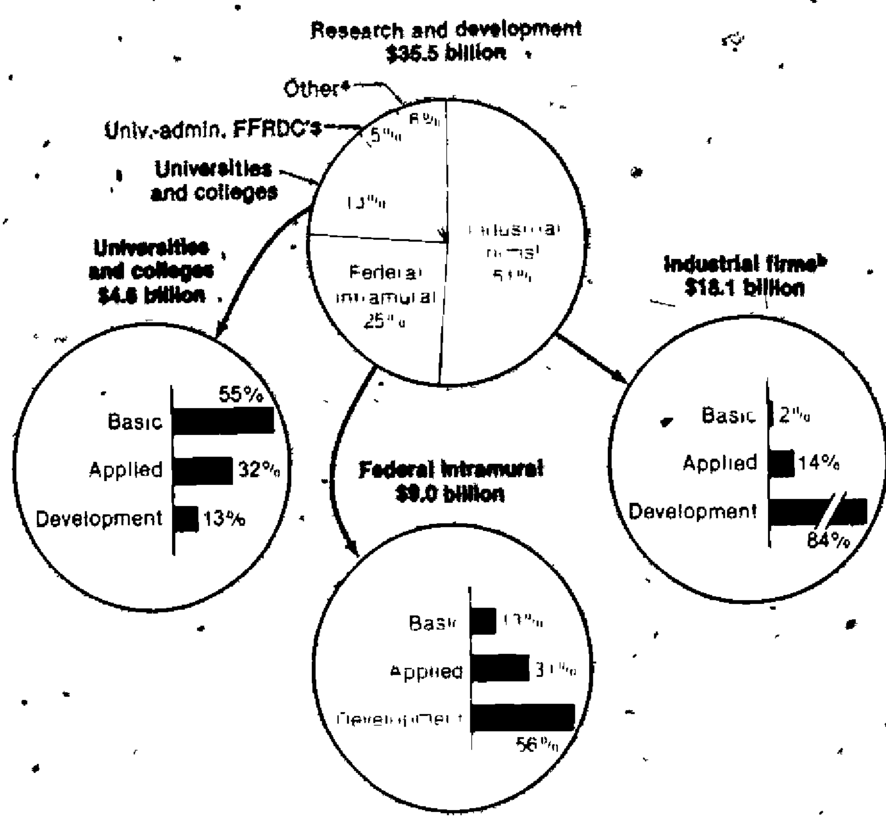
universities and colleges

Since 1961 at least two-thirds of the funds for university and college R&D performance have been provided by the Federal Government[1] Institutions of higher learning have become increasingly dependent on Federal research grants and other funding mechanisms as an aid in the education of graduate students and support for science research staff and as a source of funds required to administer and maintain high quality R&D capabilities. Graduate students in the sciences develop knowledge and skills in their specialties through performance of research under the guidance of men and women working at the frontiers of their fields.

The groundwork for Federal use of universities and colleges for needed research was put in place during World War II and in the years immediately thereafter. Policies were then established for agency relationships with universities in the use and administration of research grants, and mor

[1]National Science Foundation, *National Patterns of Science and Technology Resources: 1980* op cit

Chart 12. Federal obligations for research and development by performer and character of work: FY 1981 (est.)



*Includes other nonprofit institutions, FFRDC's administered by nonprofit institutions, State and local governments, and foreign performers.

[b]Includes federally funded research and development centers (FFRDC's) administered by this sector

SOURCE: National Science Foundation

agencies have come to use academic performers and to use them in more extended capacities

At present, universities and colleges are responsible for approximately 10 percent of the research and development performed nationally In 1955 universities and colleges performed only 5 percent of all research and development, and 54 percent of their support was provided by the Federal Government In the sixties, because of large increases in support from Federal agencies, university-and-college performance grew to 9 percent of national R&D performance and increasing portions of support were derived from the Federal Government This growth, needless to say, has not been supported uniformly by the agencies In 1955 DOD supported 47 percent of the university-and-college total, HHS (then the Department of Health, Education, and Welfare), 19 percent, USDA, 14 percent, and DOE (then the Atomic Energy Commission), 13 percent By 1964, HEW had become the lead agency, with 39 percent of the total, followed by DOD with 26 percent, NSF with 12 percent, and NASA with 10 percent

In the 1955-64 period much of this change was related to the launching of the Sputnik satellite by the USSR in 1957, which stimulated a response in the form of accelerated R&D activities on the part of the agencies of the United States Government Growth in Federal funding to universities and colleges occurred at an average annual rate of 25 0 percent between 1955 and 1964 NASA was established in 1958 to pursue the Nation's exploration of space, and although several years passed before the NASA contribution became noteworthy, the effect of the Russian achievement on DOD and NSF was immediate R&D support of the university-and-college sector by these two agencies grew significantly and continuously At the same time, rapid funding growth (especially for NIH biomedical research) occurred within HEW because of public faith in science as a source of solutions to national health and aging

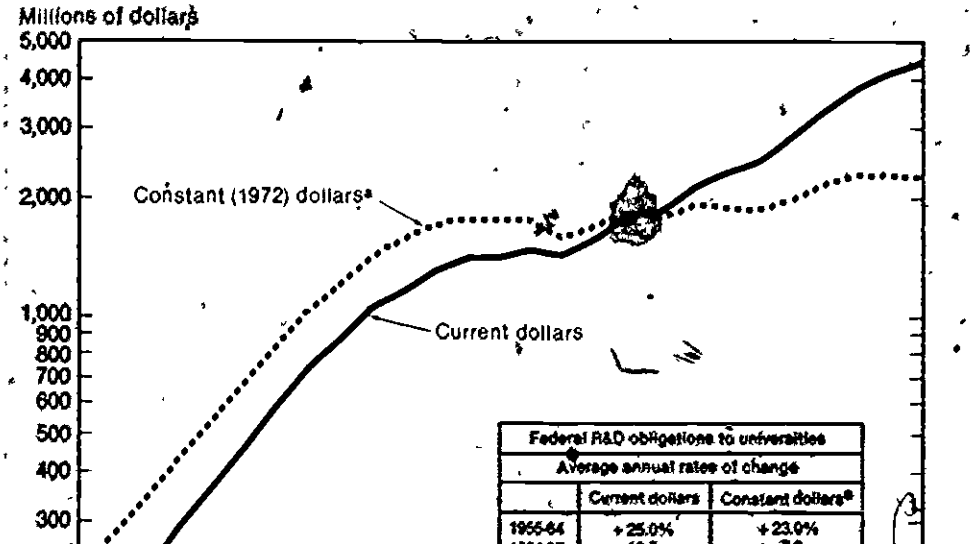
[illegible] partly related to the Vietnam war buildup Less attention was paid to basic research and hence to universities because of more pressing military needs of a short-range nature During this period a number of DOD development programs were in advanced stages thus the industrial and intramural sectors tended to receive more funds than the academic sector Large increases in support to universities and colleges by HEW and NSF during this period helped to offset the decline in DOD funding

While at this time Federal support was not growing very rapidly, the need for strengthening the academic sector was recognized In September 1965 the President of the United States directed all Federal agencies to administer their research grant and contract programs [illegible] among those of the highest quality In 196[illegible] NIH initiated its Health Sciences Advancement Awards, mostly at the graduate school level, to institutions which had already demonstrated some accomplishment [illegible] 1967, DOD started project THEMIS "[illegible] strengthen the scientific and engineering capabilities of selected academic institutions throughout the country " NASA awarded funds for training and research through [illegible] Sustaining University Grants Program

From 1967 to 1970, despite these programs to improve academic capabilities, [illegible] deceleration of Federal support to universities and colleges took place—an average annual increase of only a fraction of 1 percent, or a decline in real terms DOD and HEW were the chief agencies responsible for this situation

By 1971, however, Federal R&D funding to universities and colleges began to increase, and the next period of support (1970-75) reflected an average annual rate of growth of 10 3 percent in current dollars (or 3 6 percent in constant dollars) At the start of the seventies, HEW accounted [illegible] 46 percent of the university-and-colle[illegible]

Chart 13. Trends in Federal R&D obligations to universities and colleges: FY 1955-81



Federal R&D obligations to universities — Average annual rates of change		
	Current dollars	Constant dollars[a]
1955-64	+25.0%	+23.0%
1964-67	+10.5	+ 7.8
1967-70	+ .4	- 4.0
1970-75	+10.3	+ 3.8
1975-79	+12.7	+ 5.0
1979-80	+ 8.2	- .8
1980-81	+ 8.3	- 1.8

[a]Based on the GNP implicit price deflator with an estimate for inflation of 10.0 percent in fiscal year 1981.
SOURCE: National Science Foundation

total, and by 1979 this share had risen to an estimated 53 percent. Large sums invested by NIH in biomedical research, especially for cancer and heart disease, tended to be directed to university medical schools. HEW funding, more than that of any other agency, affected university and college R&D gains in this period.

Further increases in funds to the academic sector were provided by the predecessor agencies of DOE. Increases in investment (especially between 1973 and 1975) were related to the energy crisis that was exacerbated by the OPEC oil embargo in the fall of 1973. NSF support to universities also continued to be strong during the 1970-75 period. Although the Foundation's support encompassed a wide range of fields, the physical and environmental sciences, the life sciences, and engineering received the largest amounts of support. DOD support to universities, by contrast, showed no growth in the first half of the seventies.

Between 1975 and 1979, the acceleration in support to universities and colleges continued at an average annual rate of 12.7 percent in current dollars, or 5.0 percent in constant dollars. Growth in agency support during this period was most significant for DOD (12.9 percent on the average annually), DOE (10.4 percent), and USDA (8.6 percent). HEW and NSF support continued to grow, but at slower rates. A turnabout in DOD support from earlier years,

sponsored technology base work with ... intramural performers with the aim of ... ing the overall DOD intramural share of ... R&D performance to 30 percent by 19... Thus, as obligations for resea... (technology base) have grown in rec... years, more of the research funds have b... obligated to extramural performers, v... universities the leading choice for b... research.

The 1981 budget showed a decreas... rate of Federal support to universities ... colleges. In current dollars an estimated ... percent increase was shown for all Feds... agencies between 1979 and 1980, ... another 8-percent increase between 1... and 1981 (table 9). In constant dollars ... decrease of a fraction of 1 percent ... shown in 1980 and a decrease of 2 perc... in 1981 (chart 14). Agencies with the larg... increases between 1979 and 1980 were N... (up 14 percent) and NASA (up 13 percen... Between 1980 and 1981 DOD was ... pected to increase university-and-coll... R&D support by 19 percent, NSF, by ... percent, and DOE by 10 percent. A sma... (3 percent) increase on the part of HHS, ... leading support agency, tended to dil... the overall effet of these gains. The ... decline in overall R&D support resul... from the March attempt to balance ... budget. In the original budget the ove... 1980 and 1981 levels of R&D funding ... academia had been even with the rate of ... flation.

Table 9. Federal obligations for research and development to universities and colleges by agency: fiscal years 1971 and 1979-81

[Dollars in millions]

Agency	Actual			Estimates			
	1971	1979	Average annual percent change, 1971-79	1980	Percent change 1979-80	1981	Percent change 1980-81
Total	$1,644	$3,888	11.4%	$4,208	8.2%	$4,556	8.3%
Department of Health and Human Services	1629	1,942	15.1	2,091	7.7	2,206	5.4
National Science Foundation	267	617	11.0	702	13.8	776	10.5
Department of Defense	210	432	9.4	457	5.8	543	18.8
Department of Energy	94	260	13.6	272	4.6	298	9.5
Department of Agriculture	72	200	13.6	214	7.2	226	5.8
National Aeronautics and Space Administration	134	144	8	163	13.2	167	2.5
All others	196	294	13.6	309	5.1	340	10.7

[1]Data have been adjusted to reflect only health and human services programs (without education).
[2]Atomic Energy Commission data.

SOURCE: National Science Foundation

basic research at universities and colleges

Between 1971 and 1979, the average annual rate of growth for federally supported basic research at universities and colleges was 11 4 percent (table 10). During this period there were large increases in NSF and HHS support and a decline in DOD support Notable growth in NSF funding occurred in 1971 and 1972 when the Foundation assumed a number of projects support for which had been dropped by DOD and other mission-oriented agencies as a result of the Mansfield Amendment to the 1970 military procurement authorization This amendment restricted DOD to the support of research projects that had a "direct and apparent" relationship to specific military functions and operations. NSF budget requests for fiscal years 1971 and 1972 included sums to accommodate these additional research projects funds which became part of the NSF budget base In 1977 a second instance of sharp upward growth for NSF basic research occurred when the administration placed special emphasis on basic research as part of budget strategy In the two subsequent budgets, although the emphasis on basic research continued, greater responsibility for support was placed on mission agencies and NSF increases were slowed

In the past decade NIH has assumed an increasing share of all research supported by HHS, now accounting for approximately four-fifths of the HHS total The two institutes within NIH concerned with cancer and heart research have always been the largest, and their growth from 1971 through 1977 was far more rapid than that of any other institute except the one concerned with the environmental health sciences. A national crusade to conquer cancer was initiated in 1971, and a similar attack on heart disease was initiated in 1972 In 1978 and 1979, however, relative gains in research support for almost all the other NIH areas surpassed cancer and heart research although by this time the two concerned institutes accounted for one-half of research funding for all the NIH institutes The growth in research support to these two institutes was responsible for most of the rise in HHS basic research obligations in the years between 1970 and 1977.

Table 10. Federal obligations for basic research to universities and colleges by agency: fiscal years 1971 and 1979-81

[Dollars in millions]

Agency	Actual			Estimates			
	1971	1979	Average annual percent change 1971-79	1980	Percent change 1979-80	1981	Percent change 1980-81
Total	$ 873	$2,066	11 4%	$2,288	10 8%	$2,522	10 2%
Department of Health and Human Services	[1]358	1,021	14 1	1,103	8 1	1,177	6 7
National Science Foundation ...	220	574	12.7	653	13 8	727	11 2
Department of Defense .	120	163	4 0	190	16 5	239	25 4
Department of Energy	[2] 73	97	3 7	114	17 5	130	13 6
Department of Aeronautics and Space Administration	50	97	8 6	108	11 6	111	2.8
Department of Agriculture	28	84	14 5	90	7 7	103	14 0
All others .	19	29	5 8	29	- 8	36	22.1

[1]Data have been adjusted to reflect only health and human services programs (without education).
[2]Atomic Energy Commission data.

SOURCE. National Science Foundation

Between 1979 and 1980 Federal basic research support to universities and colleges increased by 11 percent, and the increase in the 1981 budget was an estimated 10 percent, or no more than the rate of inflation Lesser increases were allocated to applied research (table 11) A special effort was being made to invest in areas that would strengthen the technology base for defense and energy programs. Whereas DOD basic research support to academia increased only 4.0 percent on an annual average between 1971 and 1979, the increase between 1979 and 1980 was 16 percent, and between 1980 and 1981 the projected increase was 25 percent DOE shows a similar pattern. T comparable increase between 1971 a 1979, was 3.6 percent, followed by increas of 18 percent and 14 percent in 1980 a 1981, respectively By comparison, the r of growth in HHS basic research support academia has been slowing, from 1971 1979 the average annual increase was 1 percent, but in 1980 it was 8 percent and 1981, an estimated 7 percent NS however, has shown in these perio growths of 12 7 percent, 12 percent, and percent, respectively—a stable suppo record

Table 11. Federal obligations for applied research to universities and colleges by agency: fiscal years 1971 and 1979-81

[Dollars in millions]

Agency	Actual			Estimates			
	1971	1979	Average annual percent change 1971-79	1980	Percent change 1979-80	1981	Percent change 1980-81
Total	$ 558	$1,275	10 9%	$1,379	8 1%	$1,468	6.5%
Department of Health and Human Services	[1]252	688	13.3	752	9 6	788	4.9
Department of Defense	65	115	7 4	118	2 6	131	11 2
Department of Energy	[2] 17	107	26 0	111	3 8	127	14 6
Department of Agriculture	43	114	12.8	122	6 8	122	- .2
All others	125	253	9.3	277	9 2	300	8 6

[1]Data have been adjusted to reflect only health and human services programs (without education).
[2]Atomic Energy Commission data.

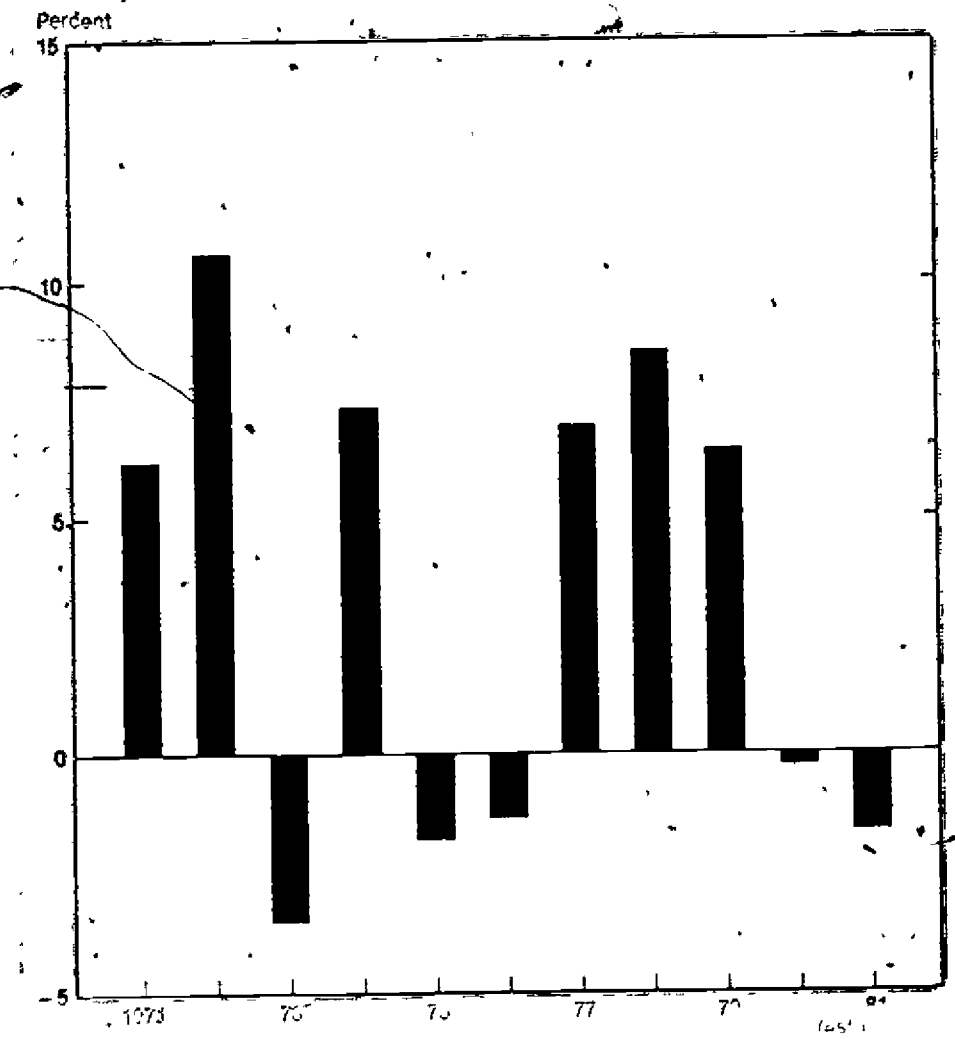
SOURCE. National Science Foundation

nual rate of growth in Federal R&D support to the academic sector was 2 1 percent in constant dollars, and between 1976 and 1979 this rate increased to 7 2 percent, only to be followed by estimated real declines in both 1980 and 1981 (chart 14) At present, university managers are experiencing rapidly increasing research costs, and they recognize that they may have to turn to new sources of support if growth in research is to continue The relatively controllable portion of the Federal budget (where R&D programs are found) is the most vulnerable area for cost-cutting measures, such as those intended to counter inflation Federal research support that devolves on universities and colleges is unlikely to be exempt from the stresses and strains in other Federal budget areas, and the possibility of continuing real declines in such support is strong

In 1980 an estimated 68 percent of university and college R&D funds was provided by the Federal Government, 21 percent by universities' own sources, 7 percent by nonprofit organizations, and 3 percent by industry [12] Of these sectors, industry, despite its small share, appears to have the greatest potential as a future source of support And, at the same time, industry appears to be the sector that could best benefit

Chart 14. Annual percent change in Federal R&D obligations to universities and colleges

In constant (1972) dollars*



markets, as well as at home

Before World War II academia and industry enjoyed a productive relationship in which each helped support the other s mission In the ensuing years the links between the two sectors weakened, and barriers developed that many feel must now be overcome if the innovation process is to be productive [13].

Efforts have already been made in this direction to build ties between industry and universities, both with and without Government assistance Several Federal agencies, including NASA, DOD, Commerce, DOE, and NSF are trying to facilitate the process NASA and DOD have formed university research consortia to direct academic capabilities towards the solution of specific technical problems with industrial ramifications

To encourage innovation, Commerce has administered a program to narrow the gap between universities and industry with respect to the introduction and application of technologies that might improve international competitiveness Funding from Commerce has been provided to universities for analysis of the structure and operations of "trade-impacted" industries Working with business experts, universities have formulated detailed plans for industries, process initiated in the apparel, consume electronics, steel, and footwear industries The new administration decided t eliminate this Commerce innovation pro gram as part of the 1982 budget revision and it will be phased out at the end of 198

The NSF Industry-University Cooperativ Research Program, started in 1978, sponso two types of program to encourage interse toral cooperation The first encourages joi university-industry cooperative researc centers. NSF provides seed money for the centers and gradually, over a 3- to 5-ye period, Federal funds are replaced wi private funds. The second involves discre university-industry projects, in which t

[12] *Ibid*

[13] Denis J Prager and Gilbert S Omenn Research Innovation and University Industry Linkages," *Science* Vol 207 January 25 1980

university portion is supported by the Federal Government and the industrial portion is cost-shared with industry These activities, while continuing, were not expanded in the 1982 budget.

Joint projects established without Federal support, such as the Monsanto-Harvard and Exxon-MIT projects, appear to be on the rise In some cases industries have discovered that universities can be effective suppliers of basic research Bell Laboratories, for example, maintains a number of individual scientific and technical arrangements with universities across the Nation The California Institute of Technology conducts several industrial associates programs, providing regular contacts between university scientists and industrial executives

Efforts to encourage further university-industry relationships in science and engineering have recently been mad through the issuance of joint researc guidelines by the Department of Justi Antitrust Division and by legislativ changes in the patent law that allow univer sities, small companies, and nonprof organizations greater control over the resul of research As further efforts are made reduce institutional barriers, industry m provide an increasing share of universi R&D support

section 4.

geographic distribution, 1979

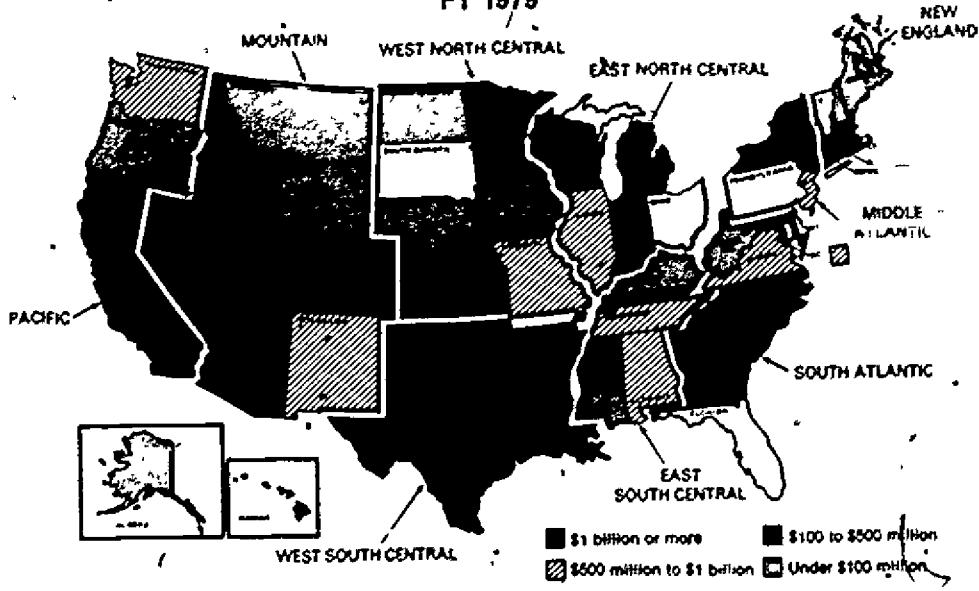
In 1979 the 10 agencies participating in the geographic portion of the survey reported a total of $27 9 billion in R&D obligations, more than 96 percent of the Federal R&D total in that year [14] These agencies also reported $1 4 billion in R&D plant obligations

Data were reported on a prime contract basis, although additional data were obtained from NASA on the effects of first-tier subcontracting in 1979 [15] The NASA data indicate that when subcontracting is taken into account, most States show an increase in share of the R&D total as a result of funds subcontracted out of California, the largest recipient State. Some change in ranking occurs, but the same States remain in the leader group

synopsis

- In 1979 every State and the District of Columbia received Federal R&D support [16] California received the largest amount—$6 8 billion. South Dakota the smallest amount—$10 2 million
- Eight States—California, Maryland, Massachusetts, New York, Texas, Pennsylvania, Ohio, and Florida—each showed more than $1 billion in Federal R&D obligations (chart 15) The same situation prevailed for the first four of these States in 1974, 1975, 1976, and 1977, and for the first five in 1978
- Nine States, including the District of Columbia, were recipients of Federal R&D funds in the $500 million to $1 billion category in 1978
- Nineteen States reflected support levels between $100 million and $500 million
- Fifteen States received less than $100 million in funds for Federal R&D performance
- In 1979 a total of 36 States each received more than $100 million in Federal R&D support, and 19 States each accounted for more than 1 percent of the Federal R&D total Whereas dollar amounts to the States tend to increase, the number of States receiving 1 percent or more tends to remain the same

Chart 15. Distribution of total Federal R&D obligations by State: FY 1979



SOURCE: National Science Foundation

[14] The Departments of Agriculture, Commerce, Defense, Energy, the Interior, Transportation, and Health and Human Services, the Environmental Protection Agency, the National Aeronautics and Space Administration, and the National Science Foundation

[15] See National Aeronautics and Space Administration, Office of Procurement, *Annual Procurement Report, Fiscal Year 1979* (Washington, D C 1980)

[16] For purposes of this analysis the District of Columbia is considered a State

trends in state support

Over the 17-year period that data have been collected on the distribution of Federal R&D obligations to the various States, one-half the States have accounted for approximately 95 percent of the total. Each year, between 16 and 18 States have each accounted for 2 percent or more of the Federal R&D total, and these States, with few exceptions, have been the same ones, year after year, even though their rank order has changed (table 12) They are the States that offer established industrial R&D capabilities and skills and/or contain Federal intramural facilities and university research complexes where the most advanced scientific work is undertaken They are the States most useful to analyze for their R&D capabilities as well as for the impact of Federal support on their institutions and economies.

Throughout the period for which data have been collected (1963-79) California has been, by a wide margin, the dominant recipient State for Federal R&D grants, contracts, and direct payments. From 35 percent of the Federal R&D total in 1963 the share of California dropped steadily to a low of 21 percent in 1972, but rose thereafter to the present level of 24 percent. The period of decline coincided generally with a decline in funding for NASA programs and either declines or very slight increases in funding for DOD R&D programs

Together, these two agencies accounted for more than 90 percent of the California total in 1963, but by 1972 their combined share was much closer to 80 percent. The interim period covered the phaseout of the NASA Apollo program and the culmination of a number of DOD development programs, including the B-1 advanced strategic bomber and the Minuteman ballistic missile system. Since 1972, however, both NASA and DOD have expanded their R&D activities in California in connection with such programs as the space shuttle, the Trident I missile system, and ballistic missile site defense (chart 16 and table 13).

Maryland, which has been the second recipient State since 1971, has increased in share-of-total since 1963, when the share was less than 6 percent, to more than 8 percent in 1979 This trend is largely explained by the numerous and growing Federal R&D installations in this State, typified by the National Institutes of Health (HHS), the Naval Air Test Center (DOD), the Army Edgewood Arsenal Laboratories (DOD), the National Bureau of Standards (Commerce), the Goddard Space Flight Center (NASA), and the Agricultural Research Center (USDA). In 1979 two-thirds of the Federal R&D effort in Maryland was carried out by intramural performers.

Since 1973 Massachusetts has been the third State in Federal R&D support, the Massachusetts share rose from 4 percent of the total in 1963 to more than 7 percent in 1979. Throughout this period DOD provided the largest amount of support—two-thirds of all Federal R&D obligations directed to the State in 1979 DOD and DOE have been responsible for most of the increase in funds to Massachusetts in the past several years, and the increases from these agencies in 1979 were substantial The largest amounts are directed to industrial performers with universities and colleges next. HHS and DOD also make extensive use of university skills in Massachusetts

New York, fourth in amount of Federal R&D support, reflects a decline in share of total from nearly 8 percent in 1963 to 5 percent in 1979 DOD, HHS, and DOE accounted for nearly 90 percent of the New York total in 1979. Almost one half of Federal support was directed to industrial firms and one fourth to universities and colleges. The primary reason for the decline in Federal R&D funds to New York in the 1968 73 period was the drop in NASA support to performers in the State combined with some decline in DOD support In recent years funds to New York have shown a rising trend, largely from DOD, HHS, and DOE programs

Since 1974, Federal R&D obligations to Texas have increased, having previously fallen from a 1968 high point At that time the Texas share of total was 6 percent, compared with 4 percent in 1979 DOD and NASA have always been the chief agency sponsors of R&D performance in this State and most of their support has been directed to industrial firms

Table 12. Distribution of Federal R&D obligations to the 20 States leading such support in FY 1979 for selected years

[Dollars in millions]

State /	1963	1969	1973	1978	19
Total, all States	$12,251	$15,355	$16,486	$25,620	$27,
	Percent distribution				
California	35 1%	27 9%	23 3%	24 0%	24
Maryland	5 5	6 3	8 7	8 3	8
Massachusetts	4 2	5 0	5 8	6 6	7
New York	7 7	7 2	5 7	5 0	4
Texas	3 2	4 5	3 9	4.2	4.
Pennsylvania	3 6	4 0	3 8	3 9	3
Ohio	2 5	2 8	2 9	3 3	3
Florida	2 8	5 8	5 8	3 7	3
New Mexico	2 8	2 8	2 8	3 9	3
Virginia	1 3	1 9	3 4	3 4	3
Washington	2.7	2.5	3 4	3 4	3
Missouri	1 9	9	4.2	3 2	2.
District of Columbia	3 3	2 9	2 8	3 1	2
New Jersey	3 3	4 6	4 7	2 0	2.
Tennessee	1 2	1.2	1 2	2 5	2.
Alabama	2.0	2 3	2 2	1 9	2.
Illinois	1.7	1 6	1 8	2 2	2.
Colorado	2 0	1 7	2 3	1 5	1.
Connecticut	1 1	1 5	1 0	1 2	1.
Michigan	1 3	1 1	1 1	1 4	
All other States'	10 8	11 5	9 9	11 3	11

'Includes outlying areas and offices abroad

SOURCE National Science Foundation

Table 13. Federal R&D obligations by geographic division and State for selected years

[Dollars in millions]

Division and State	1969	1978	Average annual percent change 1969-78	1979	Percent change 1978-79
Total, all States	$15,354 6	$25,619 8	5 9%	$27,916 8	9 0%
Pacific	4,813.5	7,208.1	4 6	7,855.6	9 0
Alaska	68 6	48 7	-3.8	45 9	-5 7
California	4,289.8	6,141 1	4 1	6,804 0	10 8
Hawaii	37 7	44 6	1 9	40.8	-8 6
Oregon	36 1	95.3	11 4	100 1	5 1
Washington	361.2	878.3	9 7	864.8	-1 5
South Atlantic	2,961 3	5,288 7	6 7	5,726 9	6 3
Delaware	16 1	11 1	-4.3	14 4	30 1
District of Columbia	444 3	792.3	6 6	768 4	-3 0
Florida	884 5	947 6	0 8	1,017.3	7 4
Georgia	276.8	155 7	-6.2	184 4	18.4
Maryland	961.8	2,126 0	9 2	2,359.8	11 0
North Carolina	58 5	192 3	14 1	220 9	14,9
South Carolina	17 1	118.3	24 0	114 3	-3 4
Virginia	266 3	872 1	13.2	940 3	7 8
West Virginia	16 0	73 3	18 5	107.2	46 2
Middle Atlantic	2,436 1	2,802.2	1 6	3,112.3	11 1
New Jersey	708.9	522 5	-3 3	649 3	24 3
New York	1,107 0	1,284 1	1 7	1,363 1	6.2
Pennsylvania	620 3	995 7	5 4	1,099 9	10 5
New England	1,085 7	2,231 1	8 3	2,685 1	20 4
Connecticut	223 6	299 8	3 3	328 4	9 5
Maine	14.3	25 4	6 6	23 1	-9 0
Massachusetts	775 0	1,693 3	9 1	2,082 3	21 8
New Hampshire	31 0	68 7	9 2	94 1	37 0
Rhode Island	32 8	120 3	15 5	140 7	16 9
Vermont	9 0	23 7	11 3	36.5	54 3
Mountain	1,136 7	2,077 9	6 9	2,262.7	8 9
Arizona	79.2	163.4	8 4	201.4	23.3
Colorado	264 4	393.2	4 5	442.2	12 5
Idaho	69 6	107 0	4 9	147 1	37 4
Montana	8.3	27.5	14.2	41 6	51 5
Nevada	23 3	19 7	-1 9	222 1	12 9
New Mexico	426.3	967 4	9.8	955.5	-3 2
Utah	49.8	161.8	14 0	211 6	30.8
Wyoming	6.8	40 6	22 1	41 0	.5
East North Central	1,044.3	2,010 4	7 5	2,097.8	4 4
Illinois	251.2	564.3	9 4	547.2	-3 0
Indiana	106.8	108.1	-0 1	122.0	12 9
Michigan	167 4	367.8	9 1	264 4	-28 1
Ohio	432.6	858 3	7 9	1,053.2	22 7
Wisconsin	84.2	111 9	3.2	111 0	- .8
West South Central	894.3	1,389 0	5 0	1,454.2	4 7
Arkansas	7 4	42.4	21.5	37.3	-12 0
Louisiana	171.8	162.7	-0 6	209 1	28.5
Oklahoma	20.1	105 0	20.2	70 1	-33.2
Texas	695.0	1,078.9	5 0	1,137 7	5.5
East South Central	597.5	1,277 1	8.8	1,347.3	5 5
Alabama	358 4	483 7	3 4	559 6	15 7
Kentucky	21 4	62.1	12.5	43 0	-30 7
Mississippi	26 0	87 1	14 4	100.7	15 5
Tennessee	191 6	644.3	14 4	644 1	(1)
West North Central	328.5	1,250 7	16 0	1,277.8	2 2
Iowa	34.2	68.3	8 0	84 9	24 3
Kansas	39.6	108 6	11.8	138.3	27 9
Minnesota	89.3	177 7	7.9	202.8	14 1
Missouri	141.9	827.3	21 6	778 9	-5 8
Nebraska	11 3	33.5	12 9	31 3	-6 6
North Dakota	6.8	28 3	17 2	33 4	18 0
South Dakota	5 4	9 1	6.0	10 2	12 0
Outlying areas	11 6	38 7	14.3	39 4	1 7
Office abroad	45.1	45 9	0 2	57 7	25 6

'Less than .05 percent

SOURCE. National Science Foundation

While the same States remain among the 15 to 20 leaders year after year, their rank order changes. The leading four remained in the same rank order in the 1974–79 period while the States that received less than these four shifted their positions. Those that were among the leading 10 in this period were Texas, Florida, Pennsylvania, New Mexico, Ohio, Washington, and Virginia. Included among the leading 20 were the District of Columbia, New Jersey, Missouri, Alabama, and Tennessee.

distribution of funds by performer

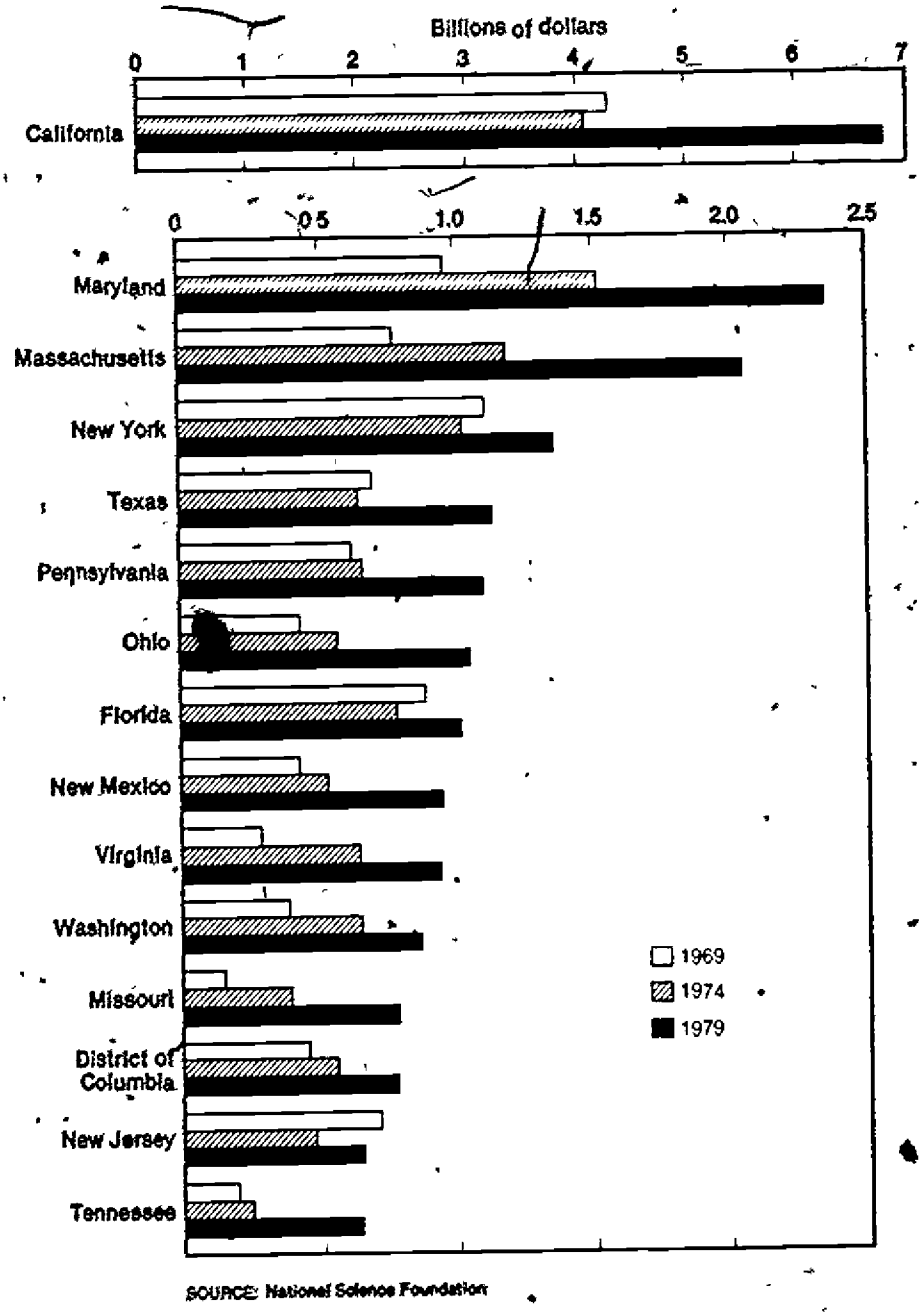
Because of the size of their R&D programs, DOD, NASA, DOE, and HHS have had the chief influence on the distribution of R&D funds to the various States. Among the 15 leading States in 1979, twelve received more Federal R&D funds from DOD than from any other agency, two (New Mexico and Tennessee) received chief support from DOE, and one (Texas) from NASA. Second-place roles were assumed by DOE in six of these States, by NASA in three, and by HHS in two of them. HHS was the third-largest support agency in 10 of them.

The States with R&D performance capabilities most adaptable to the needs of these agencies tend to lead in R&D support. These States contain aircraft, aerospace, and electronics industries, concentrations of university research talent, including modern medical research teams, and geographic areas safe and suitable for testing of missiles, aircraft, spacecraft, and explosives. Many of the leading States are located on seacoasts.

When States are compared on the basis of performing sectors, it can be seen that those that remain among the four or five leaders in receipt of Federal R&D funds year after year contain a strong balance of capabilities. Thus, in 1979 California led in R&D obligations directed to industrial firms, to universities and their associated FFRDC's, and to other nonprofit institutions (table 14).

Maryland led in Federal intramural support, and California was second. Maryland was also a leader in Federal R&D support to industry and universities and colleges.

Chart 16.- Federal R&D support to the 15 States leading in such support in 1979 for selected years



SOURCE: National Science Foundation

Massachusetts was second after California in support to industry, universities and colleges, and other nonprofit institutions.

New York was among the leading 10 States in Federal R&D support to industry, to universities and associated FFRDC's, and to other nonprofit institutions.

Florida and Texas were among the leading 10 States to receive Federal R&D obligations for intramural and industrial work.

Concentrations of Federal R&D funds tend to follow patterns of performer distribution. For example, the number of universities and colleges performing research for Federal agencies is relatively large, and thus, the 10 leading States in Federal R&D support to the academic sector made up just 62 percent of all Federal support to that sector in 1979.

By contrast, university-administered FFRDC's are far less numerous and the leading 10 States in their use by Federal agencies accounted for 98 percent of the total in 1979. Other nonprofit institutions (including FFRDC's), are also less abundant, and the leading 10 States accounted for 81 percent of their use by Federal agencies.

Table 14. Federal R&D obligations to each performing sector in the 10 States leading in support to that sector: FY 1979

[Dollars in millions]

Federal intramural	
Total	$ 7,196
Maryland	1,511
California	946
District of Columbia	527
Ohio	478
Virginia	465
Alabama	370
Florida	366
Texas	247
Massachusetts	242
New Jersey	232
All other States[2]	1,812
Industrial firms[1]	
Total	$14,042
California	4,473
Massachusetts	1,121
Texas	681
Missouri	647
Washington	636
Pennsylvania	633
New York	624
Maryland	610
Florida	567
Tennessee	528
All other States[2]	3,522
Universities and colleges	
Total	$ 3,740
California	518
New York	378
Massachusetts	351
Maryland	212
Pennsylvania	194
Texas	183
Illinois	154
Ohio	120
North Carolina	106
Michigan	100
All other States[2]	1,424
FFRDC's administered by universities	
Total	$ 1,486
California	582
New Mexico	286
Illinois	252
New York	118
Massachusetts	93
New Jersey	50
Colorado	27
Idaho	23
West Virginia	18
Arizona	14
All other States[2]	23
Other nonprofit institutions[1]	
Total	$ 1,219
California	259
Massachusetts	248
New York	93
Colorado	85
Washington	81
Pennsylvania	56
District of Columbia	48
Ohio	40
Illinois	39
Virginia	34
All other States[2]	237

[1]Includes federally funded research and development centers administered by this sector
[2]Includes outlying areas and offices abroad

SOURCE: National Science Foundation

ties. In the case of industrial firms (including FFRDC s) and intramural installations the comparable ratios were 75 percent for each sector

r&d plant

- Among the 10 States leading in Federal support to R&D plant in 1979, 6 were among the leading 10, and 9 were among the leading 15, in receipt of Federal R&D obligations

- Three agencies—DOE, DOD, and NASA—accounted for 90 percent of all R&D plant obligations, DOE for 60 percent In the case of DOD and NASA, data for R&D plant are underreported since much of the cost of R&D plant is included within R&D costs that are reported for extramural performers without plant separately broken ou Thus, in most States for which R& plant data are shown, the leading agen is DOE (table 15)

- In 1979 California received the most su port for R&D plant for the ninth su cessive year, with most obligations fro DOE but fairly large amounts fro DOD and NASA Most of the DO energy-related work supported by R& plant at the E O Lawrence Livermo Laboratory was defense-related and th supported by R&D plant at the E O Lawrence Berkeley Laboratory rang from solar energy to high-energy physi New Mexico and Washington al reflected R&D plant obligations fro DOE continuation of work on the Cor bustion Research Facility at the Sand Laboratory, N M , work on the hig intensity Neutron Source Facility at L Alamos, N M , and work on the hig performance Fuel Laboratory, Fu Storage Facility, and Fast Flux Te Facility, at the Hanford Engineerin Development Laboratory in Richlan Washington

Table 15. Federal obligations for R&D plant in the 10 States leading in such support by agency: FY 1979

[Dollars in millions]

	Total	DOE	DOD	NASA	HHS	NSF	USDA	DOT	Othe
Total	$1,394	$837	$270	$148	$53	$30	$23	$23	$10
California	400	234	95	53	4	5	2	7	—
New Mexico	139	126	11	(*)	—	—	(*)	—	(*)
Washington	87	86	(*)	—	(*)	—	(*)	—	(*)
New York	69	57	1	—	3	6	1	—	1
New Jersey	65	54	1	—	—	(*)	—	10	(*)
Maryland	64	(*)	11	9	40	(*)	2	—	1
Illinois	62	60	(*)	—	(*)	—	1	—	(*)
Tennessee	56	43	12	—	1	(*)	(*)	—	—
Pennsylvania	47	40	4	—	(*)	—	1	(*)	(*)
Florida	46	—	24	17	—	3	(*)	—	1
All other States[2]	360	136	110	68	5	15	14	5	6

[1]Includes the Departments of Commerce and the Interior and the Environmental Protection Agency
*Less than $500,000
[2]Includes outlying areas and offices abroad

SOURCE: National Science Foundation

appendixes

a. technical notes
b. federally funded research and development centers
c. statistical tables

Note

The detailed statistical tables for this volume have been published separately under one cover (NSF 80-318). Included on pp. 43-48 in this volume are detailed statistical tables C 1, C 2, and C 3, as well as a complete listing of all the tables.

Detailed statistical tables may be obtained gratis from the National Science Foundation, Washington, D.C. 20550.

appendix a

technical notes

scope and method

During the March-May 1980 period a total of 39 Federal agencies and their subdivisions—95 individual respondents—submitted data in response to the *Annual Survey of Federal Funds for Research and Development, Volume XXIX*, developed by the National Science Foundation (NSF) and distributed in January 1980. In nearly all cases the data received from the agencies were in terms of obligations and outlays incurred, or expected to be incurred, regardless of when the funds were appropriated or whether they were identified in the respondents' budgets specifically for R&D activities. The exception was the National Aeronautics and Space Administration (NASA), for which the same kinds of transactions were reported in terms of budget plan, which approximates obligations.

Federal agencies provided R&D data earlier to the Office of Management and Budget (OMB) for inclusion in "Special Analysis K, Research and Development" in *The Budget of the United States Government, Fiscal Year 1981*, which was part of the budget document presented to the Congress in January 1980. The administration later reduced a number of programs with the goal of producing a budget surplus as a counterinflationary measure. OMB issued a paper, "Research and Development Revisions to the Fiscal Year 1981 Budget," dated April 17, 1980, summarizing proposed rescissions in fiscal year 1980 R&D programs and budget amendments to fiscal year 1981 R&D programs for leading R&D support agencies. The agencies, in reporting to the *Federal Funds* survey for fiscal years 1979, 1980, and 1981, incorporated these revisions. The R&D data in the OMB documents and in the *Federal Funds* survey were based on the same definitions and are reconcilable, but the data in the *Federal Funds* survey cover smaller R&D support agencies not covered by OMB and are classified in greater detail.

definitions

The definitions are essentially unchanged from prior *Federal Funds* surveys.

1 research, development, and r&d plant

This heading includes all direct, indirect, incidental, or related costs resulting from or necessary to research

development, and R&D plant, regardless of whether the research and development are performed by a Federal agency (intramurally) or performed by private individuals and organizations under grant or contract (extramurally) Research and development exclude routine product testing, quality control, mapping and surveys, collection of general-purpose statistics, experimental production, and the training of scientific personnel.

a **Research** is systematic study directed toward fuller scientific knowledge or understanding of the subject studied. Research is classified as either basic or applied according to the objectives of the sponsoring agency

In **basic research** the objective of the sponsoring agency is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind

In **applied research** the objective of the sponsoring agency is to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.

b **Development** is systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes It excludes quality control, routine product testing and production

c **R&D plant** (R&D facilities and fixed equipment, such as reactors, wind tunnels, and radio telescopes) includes acquisition of, construction of, major repairs to, or alterations in structures, works, equipment, facilities, or land, for use in R&D activities at Federal or non-Federal installations. Excluded from the R&D plant category are expendable equipment and office furniture and equipment Obligations for foreign R&D plant are limited to Federal funds for facilities located abroad and used in support of foreign research and development.

2. obligations and outlays

a. **Obligations** represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when the funds were appropriated and when future payment of money is required.

b **Outlays** represent the amounts for checks issued and cash payments made during a given period, regardless of when the funds were appropriated

The obligations and outlays reported cover all transactions from all funds available to an agency from direct appropriations, trust funds, or special account receipts, corporate income, or other sources, including funds appropriated by the President, that the agency has received or expects to receive The amounts reported for each year reflect obligations and outlays for that year regardless of when the funds were originally authorized or received and regardless of whether they were appropriated, received, or identified in the agency's budget specifically for research, development, or R&D plant

An agency making a transfer of funds to another agency includes such transfers in its report of obligations and outlays. The receiving agency does not report, for purposes of this survey, funds transferred to it from another agency Similarly, a subdivision of an agency that transfers funds to another subdivision within that agency reports such obligations or outlays as its own

Obligations and outlays for work performed in foreign countries include funds directly available to Federal agencies and special foreign currencies separately appropriated. The latter currencies are derived largely from provisions of Public Law 480, 1954, as amended

3. cost coverage

Funds reported for research and development reflect full costs In addition to costs of specific R&D projects, the applicable overhead costs are also included The amounts reported include the costs of planning and administering R&D programs laboratory overhead, pay of military personnel, and departmental administration

4. fiscal year

The fiscal year in the Federal Government accounting period begins October 1 of a given year and ends September 30 of the following year, thus, fiscal year 1979 began on October 1, 1978 and ended September 30, 1979

5. agency

An agency is an organization of the Federal Government whose principal executive officer reports to the President The only exception is the Library of Congress also included in the survey, whose executive officer reports to the Congress The term subdivision refers to any major organizational unit of a reporting agency, such as a bureau, division, office, or service

6. performers

Performers are either *intramural* organizations accomplishing operating functions or *extramural* organizations or persons receiving support or providing services under a contract or grant

a **Intramural performers:** Agencies of the Federal Government. Their work is carried on directly by their own personnel. Obligations reported under this category are for activities performed directly by a reporting agency, or they represent funds that the agency transfers to another Federal agency for performance of work The ultimate performer must be a Federal agency If the ultimate performer is not a Federal agency, the funds so transferred are reported by the transferring agency under the appropriate extramural performer category (industrial firms, universities and colleges, other nonprofit institutions) Intramural performance includes the costs of supplies and equipment, essentially of an "off the shelf" nature, that are procured for use in intramural research and development

Also included as part of the intramural performance total are the expenses of Federal personnel engaged in planning and administering intramural and extramural R&D programs.

b **Extramural performers:** All organizations outside the Federal sector that perform with Federal funds under contract or grant. Only those costs associated with actual extramural R&D performance are reported, but these would include costs of materials and supplies to carry out R&D activities. Note that costs of "off-the-shelf" supplies and equipment procured from extramural suppliers and required to support intramural research and development should be considered as part of the costs of intramural performance and not as part of the costs of extramural performance Extramural performers are identified as follows

i. **Industrial firms:** Those organizations that may legally distribute net earnings to individuals or to other organizations.

ii **Universities and colleges:** Institutions engaged primarily in providing resident and/or accredited instruction for at least a 2-year program above the secondary school level Included are colleges of liberal arts, schools of arts and sciences, professional schools, as in engineering and medicine, including affiliated hospitals, associated research institutes, and agricultural experiment stations

iii **Other nonprofit institutions:** Private organizations other than educational institutions no part of whose net earnings inure to the benefit of a private stockholder or individual and other private organizations organized for the exclusive purpose of turning over their entire net earnings to such nonprofit institutions

iv. **Federally funded research and development centers. (FFRDC s),** R&D-performing organizations exclusively or substantially financed by the Federal Government that are supported by the Federal Government either to meet a particular R&D objective or, in some instances, to provide major facilities at universities for research and associated training purposes. Each center is administered by one of the above types of extramural performer

In general, all of the following criteria are met by an institutional unit before it is included in the federally funded research and development center category (1) Its primary activities include one or more of the following Basic research, applied research, development, or management of research and development (specifically excluded are organizations engaged primarily in routine quality control and testing, routine service activities, production, mapping and surveys, and information dissemination); (2) it is a separate operational unit within the parent organization or is organized as a separately incorporated organization, (3) it performs actual research and development or R&D management either upon direct request of the Federal Government or under a broad charter from the Federal Government, but in either case under the direct monitorship of the Federal Government; (4) it receives its major financial support (70 percent or more) from the Federal Government, usually from one agency; (5) it has, or is expected to have, a long-term relationship with its sponsoring agency (about five years or more), as evidenced by specific obligations assumed by it and the agency, (6) most or all of its facilities are owned or are funded under contract with the Federal Government; and (7) it has an average annual budget (operating and capital equipment) of at least $500,000

v. **State and local governments:** State and local government agencies, excluding State and local universities and colleges, agricultural experiment stations, medical schools, and affiliated hospitals (Federal R&D funds obligated directly to such State and local educational institutions are included under the universities and colleges category in this survey) Research and development under the State and local government category are performed either directly by State or local agencies or by other organizations under grants or contracts from such agencies. Regardless of the ultimate performer, Federal R&D funds directed to State and local governments are reported under the State and local government category and no other

vi. **Foreign performers:** Foreign citizens, organizations, or governments, as well as international organizations, such as NATO, UNESCO, WHO, performing work abroad nanced by the Federal Governme Excluded are payments to U.S. agencies, organizations, or citizens performing research and developme abroad for the Federal Governme the survey does not seek informati on "offshore" payments. Also e cluded are payments to foreign s entists performing in the Unit States.

vii. **Private individuals:** Individuals receiving a Federal R&D grant contract award directly, in this ca obligations are reported under "dustrial firms."

7. fields of science

The fields of science in this surv are divided into eight broad field c egories, each of them consisting of number of detailed fields. The bro fields are life sciences, psycholog physical sciences, environmental s ences, mathematics and computer s ences, engineering, social sciences, a other sciences not elsewhere classifie The following listing presents the fiel grouped under each of the broad field together with illustrative disciplines.

a. **Life sciences** consist of five d tailed fields, biological (excluding e vironmental), environmental biolog agricultural, medical, and life scienc not elsewhere classified. The illustr tive disciplines provided below und each of these detailed fields are not i tended to be sharp definitions, th represent examples of disciplines ge erally classified under a given detail field A discipline, however, may classified under another detailed fie when the major emphasis is elsewhe Research in biochemistry could be r ported as biological, agricultural, medical, depending on the orientati of the project Human biochemist would be classified under biologic but animal biochemistry or plant b chemistry would be under agricultur

Examples of disciplines under each of the detailed fields are as follows

Biological (excluding environmental): anatomy; biochemistry; biology; biometry and biostatistics, biophysics, botany, cell biology, entomology and parasitology, genetics, microbiology, neuroscience (biological), nutrition, physiology, zoology, other biological, n.e.c.[4]

Environmental biology, ecosystem sciences, evolutionary biology, limnology; physiological ecology, population biology, population and biotic community ecology, systematics; other environmental biology, n.e.c.[4]

Agricultural agronomy animal sciences food science and technology fish and wildlife forestry horticulture plant sciences, soils and soil science phytopathology phytoproduction agriculture, general other agriculture n.e.c.[4]

Medical internal medicine neurology, obstetrics and gynecology ophthalmology, otolaryngology pediatrics preventive medicine pathology pharmacology; psychiatry; radiology, surgery, dentistry, pharmacy, veterinary medicine, other medical, n.e.c.[4]

Life sciences, n.e.c.[4]

b. **Psychology** deals with behavior, mental processes, and individual and group characteristics and abilities. Psychology is divided into three categories biological aspects, social aspects, and psychological sciences not elsewhere classified. Examples of disciplines under each of these fields are as follows.

Biological aspects experimental psychology, animal behavior, clinical psychology, comparative psychology, ethology

Social aspects social psychology, educational, personnel, vocational psychology, and testing, industrial and engineering psychology; development and personality.

Psychological sciences, n.e.c.[4]

c. **Physical sciences** are concerned with understanding of the material universe and its phenomena. They comprise the fields of astronomy, chemistry, physics, and physical sciences not elsewhere classified. Examples of disciplines under each of these fields are as follows:

Astronomy laboratory astrophysics, optical astronomy, radio astronomy, theoretical astrophysics, X-ray, Gamma-ray, neutrino astronomy.

Chemistry, inorganic, organo-metallic, organic, physical.

Physics acoustics, atomic and molecular, condensed matter, elementary particle, nuclear structure, optics, plasma

Physical sciences, n.e.c.[4]

d. **Environmental sciences** (terrestrial and extraterrestrial) are concerned (with one exception) with the gross nonbiological properties of the areas of the solar system that directly or indirectly affect man's survival and welfare; they comprise the fields of atmospheric sciences, geological sciences, oceanography, and environmental sciences not elsewhere classified. The one exception is that obligations for studies pertaining to life in the sea, or other bodies of water, are reported as support of oceanography and not biology. Examples of disciplines under each of these fields are as follows

Atmospheric sciences aeronomy, solar, weather modification, extraterrestrial atmospheres, meteorology

Geological sciences engineering geophysics, general geology, geodesy and gravity, geomagnetism, hydrology, inorganic geochemistry, isotopic geochemistry, organic geochemistry, laboratory geophysics, paleomagnetism, paleontology, physical geography and cartography; seismology, soil sciences

Oceanography: biological oceanography, chemical oceanography physical oceanography, marine geophysics

Environmental sciences, n.e.c.[4]

e. **Mathematics and computer sciences** employ logical reasoning with the aid of symbols and are concerned with the development of methods of operation employing such symbols, and in the case of computer sciences, with the application of such methods to automated information systems. Examples of disciplines under each of these fields are as follows.

Mathematics algebra; analysis; applied mathematics, foundations and logic, geometry, numerical analysis; statistics; topology

Computer sciences programming languages; computer and information sciences (general); design development, and application of computer capabilities to data storage and manipulation, information sciences and systems, systems analysis.

Mathematics and computer sciences, n.e.c.[4]

f. **Engineering** is concerned with studies directed toward developing engineering principles or toward making specific scientific principles usable in engineering practice. Engineering is divided into eight fields, aeronautical, astronautical, chemical, civil, electrical, mechanical, metallurgy and materials, and engineering not elsewhere classified. Examples of disciplines under each of these fields are as follows

Aeronautical aerodynamics

Astronautical aerospace, space technology

Chemical, petroleum, petroleum refining, process.

Civil, architectural, hydraulic, hydrologic, marine, sanitary and environmental, structural, transportation

Electrical, communication, electronic, power.

Mechanical engineering mechanics.

Metallurgy and materials, ceramic, mining, textile, welding.

Engineering, n.e.c.[4] agricultural, industrial and management, nuclear, ocean engineering systems.

g. **Social sciences** are directed toward an understanding of the behavior of social institutions and groups and of individuals as members of a group. These sciences include anthropology, economics, political science, sociology, and social sciences not elsewhere classified. Examples of disciplines under each of these fields are as follows:

Anthropology archaeology cultural and personality, social and ethnology applied anthropology

Economics, econometrics and economic statistics, history of economic thought, international economics, industrial, labor, and agricultural economics, macroeconomics, microeconomics, public finance and fiscal policy, theory, economic systems and development.

Political science area or regional studies, comparative government, history of political ideas, international relations and law; national political and legal systems, political theory; public administration.

Sociology comparative and historical, complex organizations, culture and social structure, demography, group interactions, social problems and social welfare, sociological theory

Social sciences, n.e.c.[1] linguistics, research in education, research in history, socioeconomic geography, research in law, e.g., attempts to assess the impact on society of legal systems and practices

h Other sciences not elsewhere classified includes multidisciplinary and interdisciplinary projects that cannot be classified within one of the broad fields of science

8. geographic distribution of 1979 r&d obligations

a Ten agencies participated in the survey covering the geographic distribution of obligations for research and development and R&D plant These 10 agencies accounted for 97 percent of total Federal R&D and R&D plant obligations in 1979. The respondents were the Departments of Agriculture, Commerce, Defense, Energy, Health and Human Services, the Interior, and Transportation, the Environmental Protection Agency, the National Aeronautics and Space Administration, and the National Science Foundation

b. Data were requested for the actual year 1979 in terms of the principal location (State or outlying area) where the work was performed by the prime contractor, grantee, or intramural organization. Where this information was not available in their records, the respondents were asked to assign the obligations to the State, outlying area, or office abroad where the U S prime contractor, grantee, or intramural organization was located.

c Obligations were reported for research and development as a combined amount

d Specifically omitted from the geographic survey were R&D obligations to foreign performers and obligations for R&D plant used in support of foreign performers Foreign performer data, by country, are reported in another part of the *Federal Funds* survey

changes in reporting

Responses from the agencies in this survey, as in the previous ones, reflect revisions of estimates for the latest two years of the previous report Such revision is part of the budgetary cycle From time to time responses also reflect reappraisals and revisions in classification of various aspects of agencies' R&D programs When this occurs, NSF requires the agencies to provide revised prior-year data to maintain consistency and comparability with the most recent concepts.

limitations of the data

Funds for research and development are reported on a 3-year basis comparable with the 1981 budget, upon which the data are based. The respondents have reconciled the data reported here with amounts for research and development provided to OMB for the 1981 budget and later revised. The amounts reported for each year, as already stated, are the obligations or outlays incurred in that year, regardless of when the funds were authorized or received by an agency and regardless of whether or not the funds were identified in the agency a budget specifically for research, development, and/or R&D pl

Data submitted by the Federal ag cies for 1979 are considered to be act since they represent virtually co pleted transactions. Amounts repor for 1980 and 1981 are estimates in t they are subject to further approp tion, apportionment, or allocation cisions The effects of those and oth later actions on 1980 and 1981 outl and obligations will be reflected in next report

It should be noted that respond judgment is often necessary in cla fying the data Most agency R&D p grams must be separated by age respondents from other, larger p grams because they are not identif as budget line items R&D progra once identified, must then be furt subdivided into the survey categor Basic research, applied research, velopment, performers, and fields science The participating agenc however, have over the years de oped increasing skill and consiste in meeting the survey requireme When changes have been made agency reporting concepts, revisi have been incorporated into the his ical data to improve the comparabi and consistency of the statistical ser

Some agencies have not been able report the full cost of research and velopment. For example, the headqu ters costs of planning and adminis ing R&D programs of the Departmen Defense (DOD) (estimated at a fract of 1 percent of the DOD R&D total) not included because this agency stated that identification of the amou is impracticable

R&D plant data are also to some tent underreported because of the ficulty encountered by some agenc particularly DOD and NASA, in id tifying and reporting these data. Wh DOD reports obligations for R&D pl under the construction appropriati DOD is able to identify only a sm portion of the R&D plant support wit R&D contracts funded from the RDT appropriation NASA cannot separat identify those portions of indust R&D contracts applicable to R&D pl but subsumes R&D plant data in R&D data covering industrial per mance, although R&D plant data other performing sectors are reporte

[1] Not elsewhere classified Includes multidisciplinary projects within a broad field and single-discipline projects for which a separate field has not been assigned

relation to other reports

1. federal support to universities and colleges

NSF conducts a separate survey covering Federal support to individual colleges and universities. This survey is based on data provided by the Federal agencies under the reporting system established by the Committee on Academic Science and Engineering (CASE) of the Federal Council for Science and Technology. The reports resulting from these surveys are entitled *Federal Support to Universities, Colleges, and Selected Nonprofit Institutions* and often are referred to as the CASE reports.

Both the CASE and *Federal Funds* reports provide data on Federal obligations for research and development and R&D plant to universities and colleges and to university-administered federally funded research and development centers (FFRDC's). The CASE report, however, is based on obligations of Federal agencies to each individual academic institution, while the *Federal Funds* report is concerned with obligations to universities and colleges as a performer group. The CASE report additionally includes funds for non-R&D activities, such as science education and nonscience support. Further, the CASE survey is based on reports of only 14 agencies (the Departments of Agriculture, Commerce, Defense, Energy; Health and Human Services; Housing and Urban Development; the Interior, Labor, and Transportation, the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Agency for International Development, and the Nuclear Regulatory Commission) while the *Federal Funds* survey is composed of obligations of all agencies. The 14 respondents to CASE, however, account for more than 99 percent of total Federal R&D support to universities and colleges and all obligations to university-administered FFRDC's.

The different reporting procedures have led to the reporting of different totals to the CASE and *Federal Funds* surveys, as follows:

a. The obligations for research and developoment to universities and colleges reported for *Federal Funds* in 1979 amounted to $3,888 million, or $72 million more than the amount reported for CASE. Most of this difference can be attributed to variations in the amounts reported by the National Institutes of Health (NIH). The *Federal Funds* R&D total for NIH included funds for General Research Support grants, whereas for the CASE survey these were placed under the category of general support for science, which is a non-R&D area under the CASE definition. Other, smaller differences were found in the amounts reported by NSF, the Department of Agriculture, and the Department of the Interior.

b. The R&D obligation total for university-administered FFRDC's, as reported to *Federal Funds*, was $1,511 million in 1979 or $87 million less than reported for CASE. For *Federal Funds* $120 million subcontracted by the NASA university-administered Jet Propulsion Laboratory was included in ultimate-performer categories, while for CASE the subcontracted amount was included in the R&D obligations to FFRDC s administered by universities

c. Total R&D plant obligations to universities and colleges reported to the *Federal Funds* survey were $42 million in 1979, or $10 million more than the amount reported to the CASE survey.

d. Total R&D plant obligations to university-administered FFRDC's, as reported to *Federal Funds*, were $414 million in 1979, or $83 million more than reported to CASE.

The following factors should also be considered in comparing the data appearing in the two reports:

For *Federal Funds* each agency includes as part of its obligations the amounts transferred to other agencies for R&D activities. A receiving agency does not report funds transferred from another agency. In the CASE survey, by contrast, the data are reported by the agency that makes the *final* distribution of the funds to a given institution. Thus, for the CASE survey, agencies include funds received from other agencies and exclude funds transferred to other agencies, the reverse of the *Federal Funds* process. While such transfers should balance each other out with no resulting changes in total R&D obligations, these reverse reporting practices add to the possibility of differences between the two reports.

The CASE responses are in many cases prepared by different operating units within each agency from those that prepare the *Federal Funds* responses. The CASE data are also collected several months earlier than the *Federal Fund* data. In theory, although these conditions should not add to reporting differences, in practice differences can arise.

2. special analyses, budget of the united states

In a section of *Special Analyses, Budget of the United States Government*, OMB publishes estimates of obligations and outlays for research, development, and R&D plant These data, as shown in "Special Analysis K, Research and Development" in the 1981 budget do not provide as much detail on character of work and performers as *Federal Funds* data, and they do not include information on fields of science or geographic distribution.

"Special Analysis K" and *Federal Funds* utilize the same definitions for research and development and for R&D plant. The estimates for research and development published in the two reports are comparable, even though minor differences exist The comparison between the two reports is as follows

Total Federal R&D obligations
[Billions of dollars]

	FY 1979	FY 1980	FY 1981
Federal Funds	$ 29 0	$ 31 9	$ 35 5
Special Analysis K (revised)	29 0	31 9	35 4

3. federal r&d funding by budget function: fiscal years 1979-81

NSF published a special report under the above title, providing an analysis of Federal R&D programs by budget function categories. *Federal Funds, Volume XXIX*, by contrast, reports on R&D funding by agencies rather than functional categories. The *Federal Funds* report provides obligational data rather than budget authority data, which formed the basis for the function report. The R&D budget authority data for 1979-81 in the function report were based on information provided to OMB by the agencies as background for Special Analysis K in the 1981 budget, plus revised data, submitted later, embodying budget changes. Further program information was based on budget and budget amendment justification documents of the leading R&D support agencies and information provided directly to NSF by some of the smaller agencies.

4. other reports

a. Agencies may classify their R&D programs for purposes other than those for which the *Federal Funds* survey is conducted. Definitions and guidelines that are suitable to these other purposes may result in information that is not comparable with the data transmitted to NSF for *Federal Funds*.

b. *The Budget of the United States Government, Fiscal Year 1981* is the source of data on outlays, but the NSF definition of relatively uncontrollable outlays differs from that of OMB in that OMB designates outlays from prior-year contracts and obligations as relatively uncontrollable, whereas NSF considers this category of outlays to be initially controllable and therefore different in concept from fixed cost and open-ended programs like social security, veterans compensation and pensions, and interest on the national debt, which make up the rest of budget uncontrollable outlays.

The latter class of outlays are uncontrollable in that their disbursements fluctuate with the provisions of ongoing laws rather than with yearly authorizations a appropriations. All outlays that require propriation decisions by the Congress considered by NSF to be relatively co trollable, such outlays cover all R&D p gtams. See *The Budget, 1981*, p. 598.

sources

Data on R&D funds in this report years prior to 1952 were compiled by Bureau of the Budget, and subsequent d were based on NSF surveys. These data h been published in previous issues of t series, but certain adjustments have b made to achieve comparability with latest reporting concepts evolved by agencies.

Supplementing the statistical data c lected through the NSF survey of Fede agencies, a variety of sources were used the text of this report, including the n rative statements submitted by the agen in the NSF survey, published records testimony presented by agencies to comm tees of the Senate and the House, the *Budget Appendix*, and personal cont with agency respondents.

appendix b

federally funded research and development centers, fiscal years 1979-81

department of defense

office of the secretary of defense

Administered by other nonprofit institutions:

Institute for Defense Analyses (IDA), Arlington, VA

department of the navy

Administered by universities and colleges:

Center for Naval Analyses (University of Rochester), Arlington, VA

department of the air force

Administered by universities and colleges:

Lincoln Laboratory (Massachusetts Institute of Technology), Lexington, MA

Administered by other nonprofit institutions:

Aerospace Corporation, El Segundo, CA

C³ Division, MITRE Corporation, Bedford, MA

Project Air Force RAND Corporation, Santa Monica, CA

department of health and human services

national institutes of health

Administered by industrial firms:

Frederick Cancer Research Center (Litton Bionetics, Inc. Litton Industries), Frederick, MD

department of energy

Administered by industrial firms:

Bettis Atomic Power Laboratory (Westinghouse Electric Corp.), Pittsburgh, PA

Hanford Engineering Development Laboratory (Westinghouse-Hanford Corp.), Richland, WA

Idaho National Engineering Laboratory (EG & G Idaho, Inc.), Idaho Falls, ID

Knolls Atomic Power Laboratory (General Electric Company), Schenectady, NY

Liquid Metal Engineering Center (Rockwell International Corporation), Santa Susana, CA

Mound Laboratory (Monsanto Research Corp.), Miamisburg, OH

Oak Ridge National Laboratory (Union Carbide Corp.), Oak Ridge, TN

Sandia Laboratory (Western Electric Co., Inc.-Sandia Corp.), Albuquerque, NM

Savannah River Laboratory (E.I. duPont de Nemours & Co., Inc.), Aiken, SC

Administered by universities and colleges:

Ames Laboratory (Iowa State University of Science and Technology), Ames, IO

Argonne National Laboratory (University of Chicago and Argonne Universities Assn.), Argonne, IL

Brookhaven National Laboratory (Associated Universities, Inc.), Upton, Long Island, NY

E. O. Lawrence Berkeley Laboratory (University of California), Berkeley, CA

E. O. Lawrence Livermore Laboratory (University of California), Livermore, CA

Fermilab (Universities Research Association, Inc.), Batavia, IL

Los Alamos Scientific Laboratory (University of California), Los Alamos, NM

Oak Ridge Institute of Nuclear Studies (Oak Ridge Associated Universities), Oak Ridge, TN

Plasma Physics Laboratory (Princeton University), Princeton, NJ

Stanford Linear Accelerator Center (Stanford University), Stanford, CA

Administered by other nonprofit institutions:

Pacific Northwest Laboratory (Battelle Memorial Institute), Richland, WA

Solar Energy Research Institute (Midwest Research Institute), Golden, CO

national aeronautics and space administration

Administered by universities and colleges:

Jet Propulsion Laboratory (California Institute of Technology), Pasadena, C

national science foundation

Administered by universities and colleges:

Cerro Tololo Inter-American Observatory (Association of Universities for Research in Astronomy, Inc.), La Serena, Chile

Kitt Peak National Observatory (Association of Universities for Research in Astronomy, Inc.), Tucson, AZ

National Astronomy and Ionosphere Center (Cornell University), Arecibo, PR

National Center for Atmospheric Research (University Corporation for Atmospheric Research), Boulder, CO

National Radio Astronomy Observatory (Associated Universities, Inc.), Green Bank, WV

Sacramento Peak Observatory (Association of Universities for Research in Astronomy, Inc.), Sunspot, NM

appendix c

detailed statistical tables

Research, Development, and R&D Plant

Research and Development—Agency, Character of Work, and Performer

Total Research—Agency, Performer, and Field of Science

Basic Research—Agency, Performer, and Field of Science

Applied Research—Agency, Performer, and Field of Science

Development—Agency and Performer

R&D Plant

Total Research Performed at Universities and Colleges—Agency and Field of Science

Basic Research Performed at Universities and Colleges—Agency and Field of Science

Applied Research Performed at Universities and Colleges—Agency and Field of Science

Foreign Performers—Research a Development

Foreign Performers—Basic Resea

Special Foreign Currency Progra

Geographic Distribution—Resear and Development and R&D Plan

Federal Intramural Personnel Co

Historical Data

notes

- Estimates for 1981 are based on the Budget of the United States Government, Fiscal Year 1981 and on Fiscal Year 1981 Budget Revisions, as submitted to Congress by the administration, and do not reflect subsequent appropriations and apportionment actions
- Details may not add to totals because of rounding
- Asterisks appearing in lieu of figures indicate that the amounts are less than $50,000 or less than .05 percent
- The abbreviation "FFRDC's" appearing in statistical tables refers to federally funded research and development centers.
- In tables showing extramural performers, obligations of the Department of Agriculture to agricultural experiment stations are included within obligations to universities and colleges.
- Defense Agencies within the Department of Defense include the Defense Advanced Research Projects Agency, the Defense Nuclear Agency, the Defense Communications Agency, the Defense Mapping Agency, the Defense Logistics Agency, the Uniformed Services University of the Health Sciences, and technical support, Joint Chiefs of Staff
- R&D data reported by the National Aeronautics and Space Administration are in terms of budget plan rather than obligations
- The Department of Health and Human Services and the Department of Education replace the former Department of Health, Education, and Welfare.
- Within the Department of the Interior, the Water and Power Resources Service replaces the former Bureau of Reclamation
- Within the Department of Justice, the Federal Prison System replaces the former Bureau of Prisons and the Office of Justice Assistance, Research, and Statistics replaces the former Law Enforcement Assistance Administration
- The International Development operation Agency, a new agency, cludes the Agency for Internatio Development, formerly under Department of State.
- The Federal Emergency Man ment Agency encompasses the U Fire Administration, formerly ur the Department of Commerce, the Defense Civil Preparedn Agency, formerly under the Dep ment of Defense
- The appendix tables (Volume X providing data on R&D totals 1971 through 1978 are not com rable with totals for those years appendix tables issued to acc pany earlier Federal Funds repo Agencies have made some revisi in prior year data

NOTE. For trend comparisons, use these tables, appendix C, for Volu XXIX. Do not use earlier tables.

TABLE C-1. SUMMARY OF FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT: FISCAL YEARS 1979, 1980, AND 1981

(MILLIONS OF DOLLARS)

ITEM	ACTUAL 1979	ESTIMATES 1980	% CHG 1979-1980	1981	% CHG 1980-1981
TOTAL OUTLAYS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT	27,842.8	31,661.1	13.7%	34,891.6	10.2%
RESEARCH AND DEVELOPMENT	26,640.0	29,953.0	12.4	33,099.7	10.5
R&D PLANT	1,202.8	1,708.1	42.0	1,791.9	4.9
TOTAL OBLIGATIONS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT	30,453.8	33,902.9	11.3	37,469.7	10.5
RESEARCH AND DEVELOPMENT	28,978.4	31,878.2	10.0	35,492.1	11.3
PERFORMERS:					
FEDERAL INTRAMURAL 1/	7,496.6	8,051.7	7.4	8,965.2	11.3
INDUSTRIAL FIRMS	12,900.3	14,557.8	12.8	16,641.9	14.3
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	1,318.1	1,388.8	5.4	1,444.9	4.0
UNIVERSITIES AND COLLEGES	3,888.1	4,207.5	8.2	4,555.7	8.3
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	1,511.0	1,621.9	7.3	1,734.4	6.9
OTHER NONPROFIT INSTITUTIONS	1,030.8	1,060.7	2.9	1,085.4	2.3
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	368.7	418.3	13.4	474.9	13.5
STATE AND LOCAL GOVERNMENTS	310.1	385.8	24.4	406.8	5.5
FOREIGN	154.7	185.7	20.1	182.8	-1.5
RESEARCH	10,673.2	11,803.1	10.6	12,908.3	9.4
PERFORMERS:					
FEDERAL INTRAMURAL 1/	3,450.9	3,712.6	7.6	3,977.7	7.1
INDUSTRIAL FIRMS	1,927.2	2,225.7	15.5	2,545.0	14.3
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	245.0	315.9	28.9	348.1	10.2
UNIVERSITIES AND COLLEGES	3,340.4	3,666.8	9.8	3,989.6	8.8
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	800.6	882.7	10.3	987.1	11.8
OTHER NONPROFIT INSTITUTIONS	618.9	653.9	5.7	685.1	4.8
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	73.4	84.9	15.8	95.2	12.2
STATE AND LOCAL GOVERNMENTS	139.5	168.7	21.0	177.5	5.2
FOREIGN	77.4	91.9	18.8	103.0	12.0
FIELDS OF SCIENCE:					
LIFE SCIENCES	3,850.5	4,186.6	8.7	4,432.0	5.9
PSYCHOLOGY	202.3	221.7	9.6	248.3	12.0
PHYSICAL SCIENCES	1,821.5	1,980.4	8.7	2,262.5	14.2
ENVIRONMENTAL SCIENCES	1,103.4	1,249.9	13.3	1,328.5	6.3
MATHEMATICS AND COMPUTER SCIENCES	257.3	282.3	9.7	353.4	25.1
ENGINEERING	2,622.9	2,963.3	13.0	3,245.8	9.5
SOCIAL SCIENCES	527.9	560.2	6.1	601.7	7.4
OTHER SCIENCES, NEC	287.4	358.8	24.8	436.1	21.5
BASIC RESEARCH	4,097.3	4,508.6	10.0	4,901.9	8.7
PERFORMERS:					
FEDERAL INTRAMURAL 1/	1,026.2	1,096.4	6.8	1,172.4	6.9
INDUSTRIAL FIRMS	266.7	294.3	10.4	316.1	7.4
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	66.6	77.4	16.1	86.9	12.3
UNIVERSITIES AND COLLEGES	2,065.7	2,288.2	10.8	2,521.5	10.2
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	393.6	444.5	12.9	480.1	8.0
OTHER NONPROFIT INSTITUTIONS	232.5	250.0	7.5	262.3	4.9
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	6.7	7.3	8.5	7.4	2.0
STATE AND LOCAL GOVERNMENTS	19.8	21.8	10.1	23.5	7.8
FOREIGN	19.5	28.7	47.0	31.7	10.4
FIELDS OF SCIENCE:					
LIFE SCIENCES	1,870.6	2,035.3	8.8	2,176.0	6.9
PSYCHOLOGY	71.1	77.5	9.0	85.8	10.7
PHYSICAL SCIENCES	1,021.5	1,122.7	9.9	1,226.6	9.3
ENVIRONMENTAL SCIENCES	463.3	509.2	9.9	530.5	4.2
MATHEMATICS AND COMPUTER SCIENCES	96.1	108.4	12.8	129.9	19.8
ENGINEERING	395.1	443.5	12.2	520.7	17.4
SOCIAL SCIENCES	129.5	142.1	9.7	154.9	9.0
OTHER SCIENCES, NEC	50.0	69.8	39.6	77.5	11.0
APPLIED RESEARCH	6,575.9	7,294.5	10.9	8,006.4	9.8
PERFORMERS:					
FEDERAL INTRAMURAL 1/	2,424.7	2,616.2	7.9	2,805.3	7.2
INDUSTRIAL FIRMS	1,660.5	1,931.3	16.3	2,228.9	15.4
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	178.3	238.5	33.7	261.2	9.5
UNIVERSITIES AND COLLEGES	1,274.8	1,378.6	8.1	1,468.1	6.5
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	407.0	438.2	7.7	507.0	15.7
OTHER NONPROFIT INSTITUTIONS	386.4	403.9	4.5	422.8	4.7
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	66.7	77.6	16.5	87.8	13.1
STATE AND LOCAL GOVERNMENTS	119.7	147.0	22.8	154.1	4.8
FOREIGN	57.9	63.2	9.2	71.3	12.7
FIELDS OF SCIENCE:					
LIFE SCIENCES	1,979.8	2,151.2	8.7	2,256.0	4.9
PSYCHOLOGY	131.2	144.2	9.9	162.4	12.7
PHYSICAL SCIENCES	800.0	857.7	7.2	1,035.9	20.8
ENVIRONMENTAL SCIENCES	640.1	740.7	15.7	798.0	7.7
MATHEMATICS AND COMPUTER SCIENCES	161.2	173.9	7.9	223.4	28.5
ENGINEERING	2,222.8	2,519.8	13.1	2,725.1	8.1
SOCIAL SCIENCES	398.3	418.1	5.0	446.9	6.9
OTHER SCIENCES, NEC	237.4	289.0	21.7	358.6	24.1

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TABLE C-1. SUMMARY OF FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT
FISCAL YEARS 1979, 1980, AND 1981

(MILLIONS OF DOLLARS)

- CONTINUED

ITEM	ACTUAL, 1979	ESTIMATES 1980	% CHG 1979-1980	1981	% CHG 1980-1981
DEVELOPMENT	18,309.2	20,079.1	9.7%	22,583.8	12.5%
PERFORMERS:					
FEDERAL INTRAMURAL 1/	4,049.7	4,339.2	7.3	4,987.5	14.9
INDUSTRIAL FIRMS	10,973.0	12,332.1	12.4	14,096.9	14.3
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	1,073.1	1,073.0	*	1,096.9	2.2
UNIVERSITIES AND COLLEGES	947.7	940.7	-1.3	966.1	4.7
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	710.4	739.2	4.1	947.3	1.1
OTHER NONPROFIT INSTITUTIONS	411.9	406.8	-1.3	400.3	-1.6
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	295.4	333.4	12.9	379.7	13.9
STATE AND LOCAL GOVERNMENTS	170.7	217.0	27.2	229.3	5.7
FOREIGN	77.3	93.8	21.4	79.9	-14.8
R&D PLANT	1,479.5	2,024.7	37.2	1,977.6	-2.3
PERFORMERS SUPPORTED:					
FEDERAL INTRAMURAL	544.8	674.1	23.7	682.4	1.2
INDUSTRIAL FIRMS	214.4	556.6	159.6	611.9	9.9
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	224.4	277.4	23.6	252.1	-9.1
UNIVERSITIES AND COLLEGES	42.0	49.0	16.5	37.9	-22.5
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	414.1	431.6	4.2	362.8	-15.9
OTHER NONPROFIT INSTITUTIONS	9.2	6.4	-31.2	5.6	-11.2
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	17.7	22.1	24.8	14.5	-34.4
STATE AND LOCAL GOVERNMENTS	.3	-	-100.0	-	N/A
FOREIGN	8.4	7.6	-9.6	10.3	35.9

1/ COSTS ASSOCIATED WITH THE ADMINISTRATION OF INTRAMURAL AND EXTRAMURAL PROGRAMS ARE COVERED AS WELL AS ACTUAL INTRAMURAL PERFORMANCE.

* INDICATES PERCENT CHANGE LESS THAN .05.

SOURCE: NATIONAL SCIENCE FOUNDATION

TABLE C-2. FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT, BY AGENCY: FISCAL YEARS 1979, 1980, AND 1981

(MILLIONS OF DOLLARS)

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	1979	ESTIMATES 1980	1981	1979	ESTIMATES 1980	1981
TOTAL, ALL AGENCIES	26,453.8	33,902.9	37,469.7	27,842.8	31,661.1	34,391.6
DEPARTMENTS						
DEPARTMENT OF AGRICULTURE, TOTAL	685.7	773.9	814.9	693.5	892.9	795.2
AGRICULTURAL MARKETING SERVICE	1.0	1.3	1.3	.9	1.3	1.3
ECONOMICS, STATISTICS & COOPERATIVES SERVICE	35.5	42.1	44.6	35.6	42.1	44.5
FOREST SERVICE	111.0	115.7	124.3	105.7	115.2	119.3
OFFICE OF INTERNATIONAL COOPERATION AND DEVELOPMENT	-	-	8.6	-	-	8.6
OFFICE OF TRANSPORTATION	.7	.8	.9	.5	.8	.9
SCIENCE & EDUCATION ADMINISTRATION	537.5	613.1	635.3	487.8	531.3	531.6
AGRICULTURAL RESEARCH	365.0	427.0	435.7	331.2	341.1	341.3
COOPERATIVE RESEARCH	172.6	186.1	199.6	156.6	184.2	190.2
DEPARTMENT OF COMMERCE, TOTAL	311.8	343.0	373.9	317.1	349.4	363.3
BUREAU OF THE CENSUS	3.1	3.2	3.3	2.7	3.2	3.2
ECONOMIC DEVELOPMENT ADMINISTRATION	43.1	38.5	42.0	26.7	33.5	29.3
MARITIME ADMINISTRATION	20.5	20.5	17.8	18.7	17.8	17.5
NATIONAL BUREAU OF STANDARDS	69.3	76.4	79.7	64.8	74.5	82.0
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION	171.2	194.1	220.9	190.1	215.9	229.9
NATIONAL TELECOMMUNICATIONS & INFORMATION ADMIN	4.1	9.3	10.1	3.3	4.0	4.1
OFFICE OF THE SECRETARY	.1	.4	-	.3	.1	-
PATENT AND TRADEMARK OFFICE	.5	.6	1.1	.5	.6	1.1
DEPARTMENT OF DEFENSE, TOTAL	12,776.4	14,156.4	17,049.5	11,733.1	13,175.0	15,627.7
DEPARTMENT OF THE ARMY	2,772.5	2,969.2	3,380.4	2,536.2	2,809.9	3,148.1
MILITARY FUNCTIONS	2,746.9	2,939.5	3,348.1	2,510.6	2,780.2	3,115.8
MILITARY CONSTRUCTION	2.6	15.1	14.5	1.0	2.7	9.8
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	100.8	116.1	125.6	100.8	116.1	125.6
R&D&E APPROPRIATION	2,642.5	2,808.2	3,208.0	2,408.9	2,661.4	2,980.4
CIVIL FUNCTIONS (CORPS OF ENGINEERS)	25.6	29.7	32.3	25.6	29.7	32.3
DEPARTMENT OF THE NAVY	4,403.1	4,881.4	4,984.6	3,926.4	4,404.7	4,811.4
MILITARY CONSTRUCTION	18.3	7.5	17.3	7.3	9.2	9.6
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	86.6	101.1	107.8	86.6	101.1	107.8
R&D&E APPROPRIATION	3,293.3	3,766.6	3,851.8	3,826.4	4,289.0	4,686.7
SPECIAL FOREIGN CURRENCY PROGRAM	4.9	6.0	7.7	6.1	5.5	7.3
DEPARTMENT OF THE AIR FORCE	4,693.1	5,277.6	7,347.4	4,428.0	4,968.8	6,454.3
MILITARY CONSTRUCTION	98.5	192.0	211.4	100.0	122.9	174.9
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	248.2	284.8	290.8	248.2	284.8	290.8
R&D&E APPROPRIATION	4,346.4	4,820.9	6,845.2	4,079.8	4,561.1	5,988.6
DEFENSE AGENCIES	878.4	995.8	1,294.9	814.2	959.6	1,175.9
MILITARY CONSTRUCTION	6.3	-	-	5.4	.9	-
R&D&E APPROPRIATION	872.1	995.8	1,294.9	808.8	958.7	1,175.9
DIRECTOR OF TEST & EVALUATION, DEFENSE	29.3	32.6	42.2	28.3	32.0	38.0
DEPARTMENT OF EDUCATION	166.3	153.1	164.1	136.5	145.5	147.2
DEPARTMENT OF ENERGY	5,483.2	6,234.0	6,707.2	4,956.8	5,776.2	5,904.4
DEPARTMENT OF HEALTH AND HUMAN SERVICES, TOTAL	3,558.4	3,818.7	3,961.9	3,172.7	3,468.5	3,649.3
ALCOHOL, DRUG ABUSE & MENTAL HEALTH ADMINISTRATION	214.4	237.0	267.5	184.7	201.3	222.4
CENTER FOR DISEASE CONTROL	76.3	94.5	97.2	72.4	74.7	83.6
FOOD & DRUG ADMINISTRATION	66.7	84.9	92.8	60.6	69.0	63.0
HEALTH CARE FINANCING ADMINISTRATION	31.8	46.8	52.4	19.5	37.1	48.7
HEALTH RESOURCES ADMINISTRATION	4.9	.3	-	3.2	2.7	1.6
HEALTH SERVICES ADMINISTRATION	28.7	30.9	14.8	23.1	21.7	17.5
NATIONAL INSTITUTES OF HEALTH	3,000.8	3,201.9	3,295.3	2,713.4	2,948.2	3,083.1
OFFICE OF ASSISTANT SECRETARY FOR HEALTH	34.6	35.1	40.7	14.7	25.8	29.1
OFFICE OF HUMAN DEVELOPMENT SERVICES	57.1	60.5	54.0	57.1	60.5	54.0
OFFICE OF THE SECRETARY	24.7	24.0	24.0	26.5	26.5	24.6
SOCIAL SECURITY ADMINISTRATION	18.3	22.8	23.4	17.4	21.0	21.6
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	67.9	61.5	64.1	74.3	66.1	64.2
DEPARTMENT OF THE INTERIOR, TOTAL	410.8	436.8	439.2	404.3	413.9	432.8
BUREAU OF LAND MANAGEMENT	1.3	1.7	1.6	1.3	1.7	1.6
BUREAU OF MINES	121.3	118.9	109.0	121.4	108.0	111.4
GEOLOGICAL SURVEY	145.6	153.2	151.5	144.2	146.6	151.7
NATIONAL PARK SERVICE	8.9	9.0	11.3	8.9	9.0	11.3
OFFICE OF THE SECRETARY	1.4	4.1	2.4	1.5	2.4	3.2
OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT	5.0	8.4	8.3	5.0	8.4	8.3
OFFICE OF WATER RESEARCH & TECHNOLOGY	28.0	31.0	33.4	23.8	25.3	28.6
UNITED STATES FISH AND WILDLIFE SERVICE	87.1	96.4	103.1	87.3	96.8	103.2
WATER AND POWER RESOURCES SERVICE	12.2	14.2	13.6	11.0	15.7	13.7

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TABLE C-2. FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND RED PLANT, BY AGENCY: FISCAL YEARS 1979, 1980, AND 1981

(MILLIONS OF DOLLARS)

CONTINUED

AGENCY AND SUBDIVISION	OBLIGATIONS 1979	OBLIGATIONS ESTIMATES 1980	OBLIGATIONS ESTIMATES 1981	OUTLAYS 1979	OUTLAYS ESTIMATES 1980	OUTLAYS ESTIMATES 1981
DEPARTMENT OF JUSTICE, TOTAL	43.0	47.6	42.6	45.9	48.1	60.0
DRUG ENFORCEMENT ADMINISTRATION	2.4	4.4	3.1	2.7	4.0	3.2
FEDERAL BUREAU OF INVESTIGATION	3.1	2.2	.3	2.5	2.3	1.7
FEDERAL PRISON SYSTEM	3.4	4.1	4.2	3.3	4.3	4.0
IMMIGRATION AND NATURALIZATION SERVICE	.2	.8	.4	.3	1.3	.5
OFFICE OF THE ATTORNEY GENERAL	1.7	1.7	2.2	1.6	1.7	1.3
OFFICE OF JUSTICE ASSISTANCE, RESEARCH, AND STATISTICS	32.2	34.4	32.5	35.5	35.8	49.2
DEPARTMENT OF LABOR, TOTAL	137.0	166.0	192.8	149.2	167.7	216.9
BUREAU OF LABOR STATISTICS	.9	.9	1.1	.9	.9	1.1
EMPLOYMENT STANDARDS ADMINISTRATION	5.3	6.3	6.5	5.1	6.2	6.3
EMPLOYMENT AND TRAINING ADMINISTRATION	120.8	145.4	169.9	93.0	149.4	194.2
LABOR-MANAGEMENT SERVICES ADMINISTRATION	3.2	3.2	3.3	3.5	3.1	3.2
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	5.1	6.5	10.3	5.1	6.5	10.3
OFFICE OF THE SECRETARY	1.6	1.6	1.8	1.6	1.6	1.8
DEPARTMENT OF STATE, TOTAL	3.2	2.8	2.7	3.2	2.8	2.7
DEPARTMENTAL FUNDS	3.2	2.8	2.7	3.2	2.8	2.7
DEPARTMENT OF TRANSPORTATION, TOTAL	392.7	388.0	396.3	372.4	364.7	359.0
COAST GUARD	21.1	22.0	24.0	20.5	20.0	22.0
FEDERAL AVIATION ADMINISTRATION	120.4	111.5	121.7	111.4	106.4	112.3
FEDERAL HIGHWAY ADMINISTRATION	53.5	62.2	56.1	48.9	61.6	55.4
FEDERAL RAILROAD ADMINISTRATION	56.1	58.3	56.3	58.0	50.0	45.2
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION	56.8	59.2	62.7	53.6	54.2	59.2
OFFICE OF THE SECRETARY	11.7	12.5	12.0	16.7	17.0	14.5
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION	15.0	14.4	14.6	12.8	12.5	12.8
URBAN MASS TRANSPORTATION ADMINISTRATION	58.0	47.9	48.9	50.5	43.0	37.6
DEPARTMENT OF THE TREASURY, TOTAL	9.6	12.5	11.9	9.6	12.5	11.9
BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS	2.5	1.6	.8	2.5	1.6	.8
BUREAU OF ENGRAVING AND PRINTING	2.1	3.7	4.0	2.1	3.7	4.0
CUSTOMS SERVICE	1.4	3.7	3.2	1.4	3.7	3.2
INTERNAL REVENUE SERVICE	3.6	3.6	3.9	3.6	3.6	3.9
OTHER AGENCIES						
ACTION	1.6	1.6	2.6	1.6	1.6	2.6
ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS	1.7	1.7	1.8	1.7	2.1	1.8
APPALACHIAN REGIONAL COMMISSION	.9	.8	.8	.9	.8	.8
CIVIL AERONAUTICS BOARD	.6	.7	.6	.6	.7	.6
COMMUNITY SERVICES ADMINISTRATION	26.7	25.0	24.0	19.5	21.5	22.3
CONSUMER PRODUCT SAFETY COMMISSION	6.6	6.2	7.6	5.8	6.3	7.3
ENVIRONMENTAL PROTECTION AGENCY	412.5	416.8	447.4	388.9	435.1	465.2
EXECUTIVE OFFICE (ENERGY SECURITY TRUST FUND)	-	15.0	39.0	-	15.0	33.0
FEDERAL COMMUNICATIONS COMMISSION	2.9	3.9	3.3	1.9	3.6	3.5
FEDERAL EMERGENCY MANAGEMENT AGENCY	12.6	11.8	14.2	12.0	11.2	13.5
FEDERAL HOME LOAN BANK BOARD	.9	1.2	1.3	.9	1.2	1.3
FEDERAL TRADE COMMISSION	1.5	1.3	1.5	1.5	1.3	1.5
GENERAL SERVICES ADMINISTRATION	.5	.3	.6	.5	.3	.4
INTERNATIONAL COMMUNICATION AGENCY	.1	.2	.1	.1	.2	.1
INTERNATIONAL DEVELOPMENT COOPERATION AGENCY	112.9	126.3	141.6	80.3	112.5	123.5
AGENCY FOR INTERNATIONAL DEVELOPMENT	112.9	64.2	80.4	80.3	64.8	72.2
INST FOR SCIENTIFIC & TECHNOLOGICAL COOPERATION	-	62.1	61.1	-	47.8	51.2
INTERSTATE COMMERCE COMMISSION	.2	.2	.2	.2	.2	.2
LIBRARY OF CONGRESS	5.9	5.3	5.2	5.4	5.9	5.2
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	4,558.5	5,269.8	5,517.7	4,196.5	5,002.6	5,215.7
NATIONAL SCIENCE FOUNDATION	838.1	923.6	1,011.7	804.6	870.0	940.6
NUCLEAR REGULATORY COMMISSION	157.4	204.1	228.2	145.4	188.6	210.9
OFFICE OF PERSONNEL MANAGEMENT	6.0	6.7	8.1	6.0	6.8	8.1
SMITHSONIAN INSTITUTION	37.9	42.1	45.3	37.8	40.8	45.0
TENNESSEE VALLEY AUTHORITY	89.2	98.4	92.3	45.4	110.5	93.4
UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY	3.5	3.8	3.9	3.5	4.2	3.9
UNITED STATES INTERNATIONAL TRADE COMMISSION	3.4	2.7	4.1	3.4	2.7	4.1
VETERANS ADMINISTRATION	132.1	141.7	150.5	123.1	134.1	142.4

SOURCE: NATIONAL SCIENCE FOUNDATION

TABLE C-3. FEDERAL FUNDS FOR TOTAL RESEARCH AND DEVELOPMENT, BY AGENCY: FISCAL YEARS 1979, 1980, AND 1981

(MILLIONS OF DOLLARS)

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	1979	ESTIMATES 1980	ESTIMATES 1981	1979	ESTIMATES 1980	ESTIMATES 1981
TOTAL, ALL AGENCIES	28,978.4	31,878.2	35,492.1	25,643.0	29,953.0	33,399.7
DEPARTMENTS						
DEPARTMENT OF AGRICULTURE, TOTAL	668.0	731.2	777.5	668.7	692.9	664.5
AGRICULTURAL MARKETING SERVICE	1.0	1.3	1.3	.9	1.3	1.3
ECONOMICS, STATISICS & COOPERATIVES SERVICE	35.5	42.1	44.6	35.6	42.1	44.5
FOREST SERVICE	107.5	112.1	124.1	102.2	111.6	118.3
OFFICE OF INTERNATIONAL COOPERATION AND DEVELOPMENT	-	-	8.6	-	-	8.6
OFFICE OF TRANSPORTATION	.7	.8	.9	.5	.8	.9
SCIENCE & EDUCATION ADMINISTRATION	518.4	575.4	598.0	469.5	497.9	490.9
AGRICULTURAL RESEARCH	345.8	389.3	403.3	312.9	312.9	300.7
COOPERATIVE RESEARCH	172.6	186.1	194.6	156.6	184.2	190.2
DEPARTMENT OF COMMERCE, TOTAL	309.4	338.3	372.8	309.2	344.7	362.0
BUREAU OF THE CENSUS	3.1	3.2	3.3	2.7	3.2	3.2
ECONOMIC DEVELOPMENT ADMINISTRATION	43.1	38.5	42.0	26.7	33.5	29.3
MARITIME ADMINISTRATION	19.6	20.0	17.3	18.2	17.3	17.3
NATIONAL BUREAU OF STANDARDS	67.8	76.1	79.1	63.4	74.1	81.5
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION	171.2	190.2	219.7	190.1	212.0	225.6
NATIONAL TELECOMMUNICATIONS & INFORMATION ADMIN	4.1	9.3	10.1	3.3	4.0	4.1
OFFICE OF THE SECRETARY	.1	.4	-	.3	.1	-
PATENT AND TRADEMARK OFFICE	.5	.6	1.1	.5	.6	1.1
DEPARTMENT OF DEFENSE, TOTAL	12,506.2	13,787.7	16,604.4	11,497.3	12,869.4	15,244.3
DEPARTMENT OF THE ARMY	2,768.7	2,951.9	3,363.9	2,534.1	2,805.1	3,136.5
MILITARY FUNCTIONS	2,743.1	2,922.2	3,331.6	2,508.5	2,775.4	3,104.2
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	100.8	116.1	125.6	100.8	116.1	125.6
ROTEE APPROPRIATION	2,642.3	2,806.0	3,206.0	2,407.8	2,659.3	2,978.6
CIVIL FUNCTIONS (CORPS OF ENGINEERS)	25.6	29.7	32.3	25.6	29.7	32.3
DEPARTMENT OF THE NAVY	4,335.0	4,809.6	4,891.3	3,873.5	4,333.5	4,726.8
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	86.6	101.1	107.8	86.6	101.1	107.8
ROTEE APPROPRIATION	4,243.5	4,702.6	4,775.8	3,780.8	4,227.0	4,611.7
SPECIAL FOREIGN CURRENCY PROGRAM	4.9	6.0	7.7	6.1	5.5	7.3
DEPARTMENT OF THE AIR FORCE	4,525.6	5,021.8	7,059.9	4,263.1	4,760.7	6,202.1
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	248.2	284.8	290.8	248.2	284.8	290.8
ROTEE APPROPRIATION	4,277.4	4,737.1	6,769.1	4,014.9	4,475.9	5,911.3
DEFENSE AGENCIES	847.6	971.7	1,247.1	798.3	938.1	1,140.9
ROTEE APPROPRIATION	847.6	971.7	1,247.1	798.3	938.1	1,140.9
DIRECTOR OF TEST & EVALUATION, DEFENSE	29.3	32.6	42.2	28.3	32.0	38.0
DEPARTMENT OF EDUCATION	166.3	153.1	164.1	136.5	145.5	147.2
DEPARTMENT OF ENERGY	4,638.8	4,949.7	4,994.8	4,303.3	4,767.6	4,829.2
DEPARTMENT OF HEALTH AND HUMAN SERVICES, TOTAL	3,504.9	3,776.9	3,907.5	3,099.3	3,403.5	3,609.1
ALCOHOL, DRUG ABUSE & MENTAL HEALTH ADMINISTRATION	214.3	236.2	262.1	184.4	201.2	221.2
CENTER FOR DISEASE CONTROL	76.3	94.5	97.2	72.4	74.7	83.6
FOOD & DRUG ADMINISTRATION	61.0	64.2	66.2	40.0	47.1	58.3
HEALTH CARE FINANCING ADMINISTRATION	31.8	46.8	52.4	19.5	37.1	48.7
HEALTH RESOURCES ADMINISTRATION	4.9	.3	-	3.2	2.7	1.6
HEALTH SERVICES ADMINISTRATION	28.7	30.9	14.8	23.1	21.7	17.5
NATIONAL INSTITUTES OF HEALTH	2,993.1	3,161.6	3,272.9	2,641.0	2,885.1	3,049.6
OFFICE OF ASSISTANT SECRETARY FOR HEALTH	34.6	35.1	40.7	14.7	25.8	29.1
OFFICE OF HUMAN DEVELOPMENT SERVICES	57.1	60.5	54.0	57.1	60.5	54.0
OFFICE OF THE SECRETARY	24.7	24.0	24.0	26.5	26.5	24.6
SOCIAL SECURITY ADMINISTRATION	18.3	22.8	23.4	17.4	21.0	21.6
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	67.9	61.5	64.1	74.3	66.1	64.2
DEPARTMENT OF THE INTERIOR, TOTAL	405.8	429.6	429.0	395.3	402.1	422.6
BUREAU OF LAND MANAGEMENT	1.3	1.7	1.6	1.3	1.7	1.6
BUREAU OF MINES	121.0	116.7	109.0	117.1	105.0	109.4
GEOLOGICAL SURVEY	149.6	153.2	151.5	144.2	146.6	151.7
NATIONAL PARK SERVICE	8.9	9.0	11.3	8.9	9.0	11.3
OFFICE OF THE SECRETARY	1.4	4.1	2.4	1.5	2.4	3.2
OFFICE OF SURFACE-MINING RECLAMATION AND ENFORCEMENT	5.0	7.3	7.3	5.0	7.3	7.3
OFFICE OF WATER RESEARCH & TECHNOLOGY	24.3	30.3	32.2	23.1	24.6	27.8
UNITED STATES FISH AND WILDLIFE SERVICE	83.1	89.1	96.1	83.2	89.8	96.7
WATER AND POWER RESOURCES SERVICE	12.2	14.2	13.6	11.0	15.7	13.7

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TABLE C-3. FEDERAL FUNDS FOR TOTAL RESEARCH AND DEVELOPMENT, BY AGENCY: FISCAL YEARS 1979, 1980, AND 1981

(MILLIONS OF DOLLARS)

- CONTINUED

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	1979	ESTIMATES 1980	ESTIMATES 1981	1979	ESTIMATES 1980	ESTIMATES 1981
DEPARTMENT OF JUSTICE, TOTAL	43.0	47.6	42.6	45.9	48.1	60.3
DRUG ENFORCEMENT ADMINISTRATION	2.8	4.4	3.1	2.7	4.3	3.2
FEDERAL BUREAU OF INVESTIGATION	3.1	2.2	.3	2.5	2.3	1.7
FEDERAL PRISON SYSTEM	3.4	4.1	4.2	3.3	4.0	4.3
IMMIGRATION AND NATURALIZATION SERVICE	.2	.8	.4	.3	1.0	.5
OFFICE OF THE ATTORNEY GENERAL	1.7	1.7	2.2	1.6	1.0	1.3
OFFICE OF JUSTICE ASSISTANCE, RESEARCH, AND STATISTICS	32.2	34.4	32.5	35.5	35.9	49.2
DEPARTMENT OF LABOR, TOTAL	137.0	164.0	192.8	109.2	167.7	216.9
BUREAU OF LABOR STATISTICS	.9	.9	1.1	.9	.9	1.1
EMPLOYMENT STANDARDS ADMINISTRATION	5.3	6.3	6.5	5.1	6.2	6.3
EMPLOYMENT AND TRAINING ADMINISTRATION	120.8	145.4	169.9	93.0	149.4	194.2
LABOR-MANAGEMENT SERVICES ADMINISTRATION	3.2	3.2	3.3	3.5	3.6	3.2
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	5.1	6.5	10.3	5.1	6.5	10.3
OFFICE OF THE SECRETARY	1.6	1.6	1.8	1.6	1.6	1.8
DEPARTMENT OF STATE, TOTAL	3.2	2.8	2.7	3.2	2.8	2.7
DEPARTMENTAL FUNDS	3.2	2.8	2.7	3.2	2.8	2.7
DEPARTMENT OF TRANSPORTATION, TOTAL	370.1	362.2	378.3	356.2	339.1	344.8
COAST GUARD	21.1	22.0	24.0	20.5	20.0	22.0
FEDERAL AVIATION ADMINISTRATION	110.5	103.1	115.1	101.9	98.3	105.9
FEDERAL HIGHWAY ADMINISTRATION	52.9	55.2	55.5	48.7	54.6	54.8
FEDERAL RAILROAD ADMINISTRATION	44.2	48.1	45.8	51.7	39.7	38.3
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION	56.6	59.0	62.5	53.4	54.0	59.0
OFFICE OF THE SECRETARY	11.7	12.5	12.0	16.7	17.0	14.5
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION	15.0	14.4	14.6	12.8	12.5	12.8
URBAN MASS TRANSPORTATION ADMINISTRATION	58.0	47.9	48.9	50.5	43.0	37.6
DEPARTMENT OF THE TREASURY, TOTAL	9.5	12.5	11.9	9.5	12.5	11.9
BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS	2.5	1.6	.8	2.5	1.6	.8
BUREAU OF ENGRAVING AND PRINTING	2.1	3.7	4.0	2.1	3.7	4.0
CUSTOMS SERVICE	1.3	3.6	3.2	1.3	3.6	3.2
INTERNAL REVENUE SERVICE	3.6	3.6	3.9	3.6	3.6	3.9
OTHER AGENCIES						
ACTION	1.6	1.6	2.6	1.6	1.6	2.6
ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS	1.7	1.7	1.8	1.7	2.1	1.8
APPALACHIAN REGIONAL COMMISSION	.9	.8	.8	.9	.8	.8
CIVIL AERONAUTICS BOARD	.6	.7	.6	.6	.7	.6
COMMUNITY SERVICES ADMINISTRATION	20.7	25.0	24.0	19.5	21.5	22.3
CONSUMER PRODUCT SAFETY COMMISSION	3.9	3.5	4.9	3.1	3.6	4.6
ENVIRONMENTAL PROTECTION AGENCY	410.1	414.8	444.9	386.5	433.1	462.7
EXECUTIVE OFFICE (ENERGY SECURITY TRUST FUND)	-	15.0	39.0	-	15.0	33.0
FEDERAL COMMUNICATIONS COMMISSION	2.9	3.9	3.3	1.9	3.6	3.5
FEDERAL EMERGENCY MANAGEMENT AGENCY	12.6	11.8	14.2	12.0	11.2	13.5
FEDERAL HOME LOAN BANK BOARD	.9	1.2	1.3	.9	1.2	1.3
FEDERAL TRADE COMMISSION	1.5	1.3	1.5	1.5	1.3	1.5
GENERAL SERVICES ADMINISTRATION	.5	.3	.4	.5	.3	.4
INTERNATIONAL COMMUNICATION AGENCY	.1	.2	.1	.1	.2	.1
INTERNATIONAL DEVELOPMENT COOPERATION AGENCY	106.5	118.9	131.4	75.8	105.5	115.8
AGENCY FOR INTERNATIONAL DEVELOPMENT	106.5	59.8	73.5	75.8	59.0	66.0
INST FOR SCIENTIFIC & TECHNOLOGICAL COOPERATION	-	59.1	57.9	-	46.5	49.8
INTERSTATE COMMERCE COMMISSION	.2	.2	.2	.2	.2	.2
LIBRARY OF CONGRESS	5.9	5.3	5.2	5.4	5.9	5.2
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	4,411.0	5,113.7	5,397.7	4,063.8	4,868.7	5,059.7
NATIONAL SCIENCE FOUNDATION	807.9	904.3	994.8	775.2	851.9	926.3
NUCLEAR REGULATORY COMMISSION	148.8	196.3	217.9	137.5	181.4	201.4
OFFICE OF PERSONNEL MANAGEMENT	6.0	6.7	8.1	6.0	6.8	8.1
SMITHSONIAN INSTITUTION	36.9	41.0	45.2	37.2	40.0	44.0
TENNESSEE VALLEY AUTHORITY	38.4	59.0	72.1	37.2	57.9	72.3
UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY	3.5	3.8	3.9	3.5	4.2	3.9
UNITED STATES INTERNATIONAL TRADE COMMISSION	3.4	2.7	4.1	3.4	2.7	4.1
VETERANS ADMINISTRATION	127.0	130.7	133.7	120.3	129.7	133.3

SOURCE: NATIONAL SCIENCE FOUNDATION

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