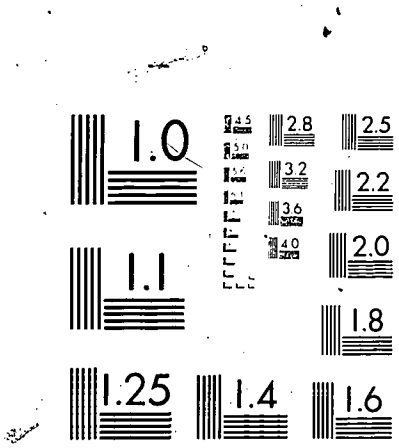


DOCUMENT RESUME

ED 168 883 SE 027 512

TITLE	An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1979. Survey of Science Resources Series.
INSTITUTION	National Science Foundation, Washington, D.C. Div. of Science Resources Studies.
REPORT NO	NSF-78-320
PUB DATE	Dec 78
NOTE	146p.; Not available in hard copy due to marginal legibility of original document
AVAILABLE FROM	Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock Number 038-000-00402-6; $2.50)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Budgets; Cost Indexes; Energy; Environment; *Expenditures; *Federal Aid; Federal Programs; Government Role; National Defense; *Research; *Scientific Enterprise; Social Problems; Space Sciences

ABSTRACT

Federal funds continue to underwrite about 50 of the national research and development (R&D) enterprise, and the nature of this support continues to be of special interest to policymakers. This report provides data on trends within functional areas and noteworthy shifts among areas. It is based on an annual National Science Foundation survey. Federal R&D priorities, identified in order of financial expenditures, are: (1) national defense; (2) space; (3) health; (4) energy; (5) environment; (6) science and technology base; (7) transportation and communication; (8) natural resources; (9) agriculture; (10) social services; (11) education; (12) housing; (13) economics; (14) international cooperation; and (15) crime prevention. The 1979 federal budget presented in January 1978 reflected greater austerity in regard to R&D programs than did the three previous ones in which overall R&D growth exceeded inflation each year. R&D programs emphasized were those that met direct federal needs, general social and economic needs, or the need to accelerate private R&D efforts because of overriding national interest. (BB)

Analysis of Federal R&D Funding by Function

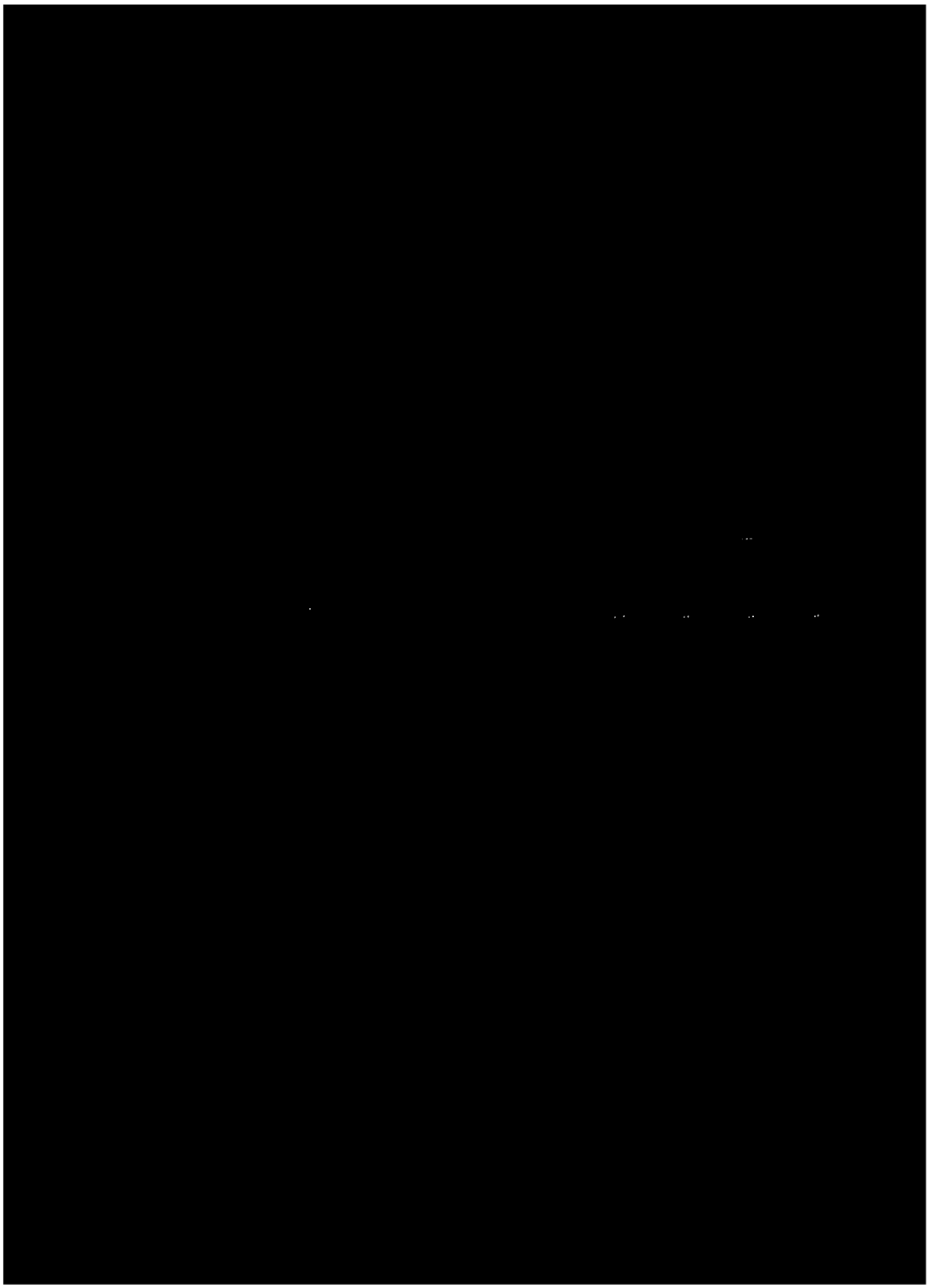
Surveys of Science Resources Series • National Science Foundation • NSF 78-320

Related Publications

REPORTS	NSF No.	Price
Federal Funds for Research and Development, Fiscal Years 1977, 1978, and 1979 Volume XXVII	79-310	In press
Detailed Statistical Tables	78-312	—
National Patterns of R&D Resources: Funds & Personnel in the United States, 1953 — 1978-79	78-313	$2.40
An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1978	77-326	$2.75
HIGHLIGHTS		
"Defense and Space Lead in Federal R&D Growth in the 1979 Budget"	78-317	—
"Congressional Actions Raise R&D Total in 1979 Federal Budget"	79-300	—

Availability of Publications

Those publications marked with a price should be obtained directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Where no price is listed, single copies may be obtained gratis from the National Science Foundation, Washington, D.C. 20550.



FOREWORD

Federal funds continue to underwrite one-half the national R&D enterprise, and the nature of this support continues to be of special interest to policymakers. Aside from the need to know which agencies are involved and the allocation of R&D dollars to the various performing sectors, to fields of science, and geographic areas, decisionmakers have felt a growing need for data on R&D distribution by functional areas: defense, health, energy, education, and other broad concentrations of effort. Changes in funding between one area and another reflect shifts in national concerns and the extent to which science and technology are brought to bear on those concerns.

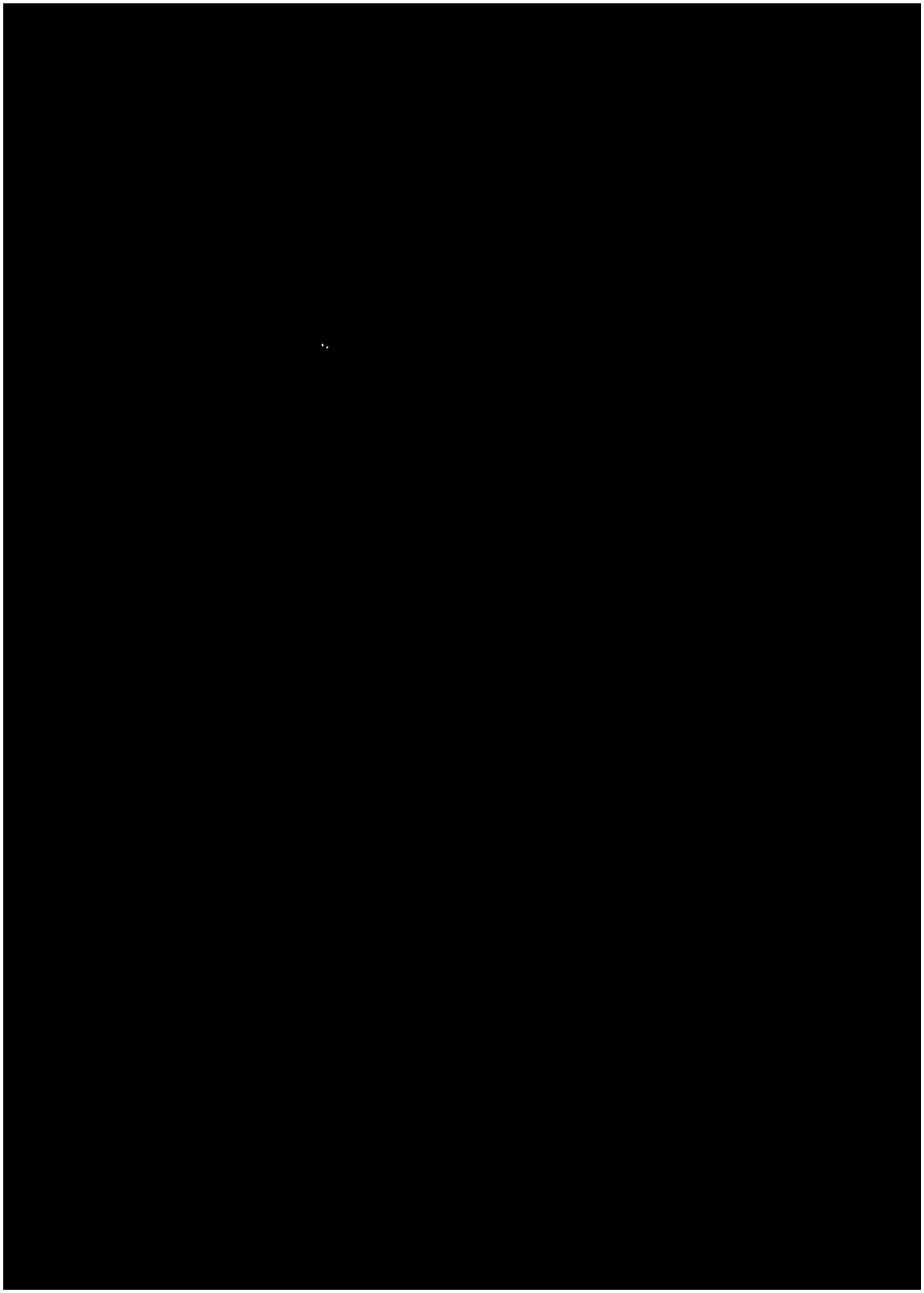
This report is the eighth in a series, the purpose of which has been to provide data on trends within functional areas and noteworthy shifts among areas. It is based on the annual National Science Foundation survey of Federal agency R&D programs. Each year the degree of program detail has been increased so that in the current analysis it is possible to identify 439 programs and program areas. These have been distributed by 15 functions over an 11-year timespan. Aggregations of R&D support on this functional basis reveal trends and changes that cannot be brought to light in any other way.

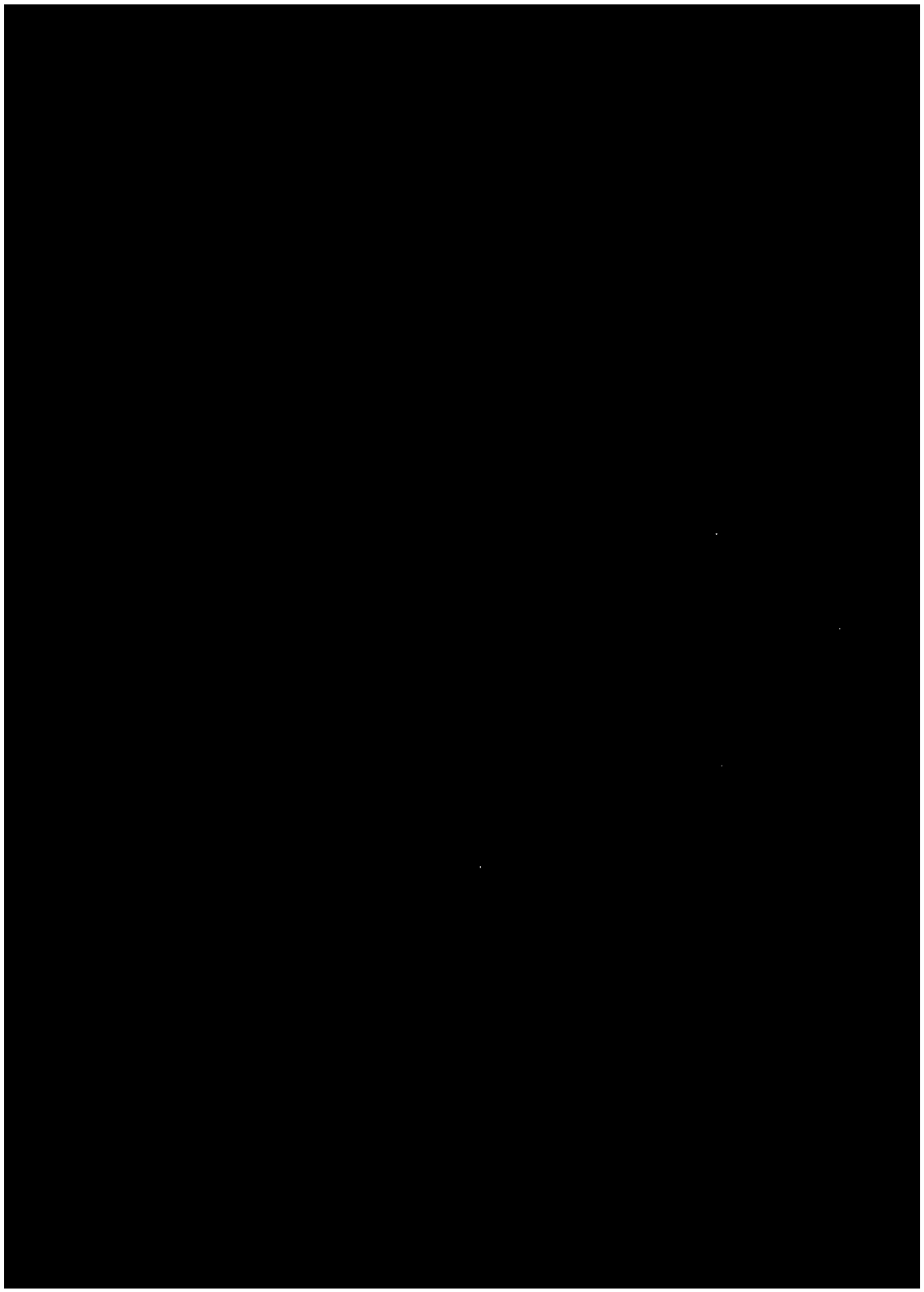
Although the general tendency in the past decade has been toward increased R&D funding, not all areas have grown at the same rate, and some have even declined in an absolute sense, with the result that shares of individual functions within the Federal R&D total keep changing. These changes in relative shares are an indication of shifts in program mix although relative funding magnitude does not necessarily indicate relative importance. R&D programs in certain mission areas, and at certain stages of growth, are inevitably more expensive than those in other areas and stages; for example, a full-scale development program in defense is more costly than a program of basic research in economics.

The data shown in the text and tables are, of necessity, based on the President's 1979 budget. A notation of congressional response to the budget proposals, however, is included wherever legislative actions are sufficiently clear as to research and development programs to indicate final funding levels.

Harvey Averch
Assistant Director
Scientific, Technological, and
International Affairs

December 1978





HIGHLIGHTS

Assessments

- The 1979 Federal budget presented in January 1978 reflected greater austerity in regard to R&D programs than the three previous ones in which overall R&D growth exceeded inflation each year[1]. R&D programs emphasized were those that met direct Federal needs, general social and economic needs, or the need to accelerate private R&D efforts because of overriding national interest.[2]

- A considerable rise was proposed for defense and space R&D programs, about 8 percent for each area, with only a 3-percent rise in funding for all other R&D programs taken as a whole. This would reverse a 13-year trend in which Federal R&D support has shifted steadily toward "civilian" programs. The 1979 change resulted not only from defense/space increases at rates at least equal to anticipated inflation, but also from expected real-dollar declines in the leading civilian R&D areas of health, energy, and environment.

- By November, however, congressional actions had resulted in increases in health, energy, and food that would probably meet inflation in 1979 and exceed it in the case of health. The increase for defense, however, was less than that requested in the budget, and a small reduction from the proposed level occurred for space programs. Since that time, it should be noted, supplemental requests have been added for both defense and space that would, if approved by Congress, result in a large relative increase for each of these areas in 1979.

- Since 1975 a continuous real increase in national defense R&D funding has taken place compared with a constant-dollar decline in the 1969-74 years. The earlier period followed a rapid buildup in defense funding after 1965 that was largely related to the Vietnam conflict. In the early seventies concern with inflation led to fiscal restraint for defense budgets. Not until 1975 did the overall defense budget regain the level of 1968 and set the stage for higher levels thereafter. The R&D portion of defense tends to follow overall defense funding; it has remained almost consistently at 10 percent of the Department of Defense (DOD) total. Major growth in funding in 1979 is planned for tactical systems development, incorporating efforts to improve the early combat capability of the forces in Western Europe. R&D growth may continue as part of overall defense growth for another year or two, with some tendency for large weapons systems to be replaced with lighter, faster weapons within a larger budget.

- Space R&D funding since 1975, although growing steadily in current dollars, has shown only a slight increase in real terms. While the 1979 current-dollar increase is relatively large, no major program initiative is covered. Chief current emphases are on space transportation system programs in support of the space shuttle, which will be operational in 1980, and on space science programs.

- In the health area, third in size of funding after defense and space, the budget increase was less than anticipated inflation, but the final increase will be at least as high as 12 percent over 1978 as a result of congressional action. This function included a substantial increase for basic research as part of an Administration policy, stated in the 1979 budget message, to fund basic research at levels that exceeded inflation. Most biomedical research programs, including basic research, received significant increases from Congress in 1979, although the trend in later years is uncertain at present.

- In energy development and conversion the budget reflected decisions to cancel the breeder reactor demonstration project and reduce funding for the fast flux test facility and breeder technology. The budget also cut back on solar heating and coal gasification, while increasing geothermal and other solar programs and conservation. Congressional actions to date, however, have restored funds for the breeder programs, as well as solar heating, and given a greater increase than was requested for geothermal development.

[1] In the absence of a reliable R&D cost index, the GNP implicit price deflator was used for the years 1969-78, and inflation for 1979 was estimated.

[2] See Office of Management and Budget, *Special Analyses, The Budget of the United States Government, Fiscal Year 1979*, "Special Analysis P: Research and Development" (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1978), p. 305.

Data

- While Federal R&D obligations rose 6 percent to an estimated $28.0 billion in the 1979 budget, an all-time high in current dollars, a drop from the 1978 total in constant dollars would be indicated in view of anticipated inflation. Later congressional actions have raised the overall level to approximately 9 percent above 1978, and further actions on supplemental requests may produce an additional increase of 2 or 3 percentage points.

- Defense and space programs accounted for more than four-fifths of the current dollar rise in R&D support in 1979. Funding for these functions was expected to increase by about 8 percent in each case in 1979 while no other major function[3] reflected as high a relative increase and all the "civilian" functions taken together were expected to grow by only 3 percent. Thus, the defense/space share of the Federal total was an estimated 62 percent in 1979, slightly more than the 1978 share but still considerably lower than the 77-percent share in 1969.

- Health R&D programs grew at an average annual rate of 11.1 percent in the 1969-78 timespan, but only a 4-percent gain was proposed for 1979. Health is one of the few functions with a higher growth rate in the 1969-74 period than in later years; this rapid growth was chiefly spurred by increases in cancer and heart and lung research. The health share within the Federal R&D funding total grew from 7 percent in 1969 to an estimated 11 percent in 1979.

- Energy development and conversion R&D obligations increased by 23.3 percent on an annual average from 1969 to 1978 and 44.1 percent between 1974 and 1978. In the 1979 budget a 1-percent decrease was shown because of decisions to cut back on the breeder reactor and solar heating programs. Congress added considerably to the funds requested by the Administration through restoration of these programs and increases in others, although these increases were provided in a continuing resolution, which awaited final action. Even with sustainment of the increases, the rate of growth for energy will be decidely lower than in recent years. The share of energy in overall Federal R&D obligations rose from 3 percent in 1969 to an estimated 10 percent in 1979.

- Environmental R&D programs reflected a funding increase of less than 2 percent in the 1979 budget — a decline in real support — after having registered an average annual growth rate between 1969 and 1978 of 15.8 percent in current dollars. This significant rise, in both current and constant dollars, was second only to that of energy among the major functions. The environment share rose from 2 percent in 1969 to an estimated 4 percent in 1979.

- Science and technology base, with proposed growth of 7 percent in 1979, is the only major civilian function to show a rise in line with anticipated inflation. This gain compares with an average annual rate of 9.5 percent between 1969 and 1978, a moderate real increase. Most programs within this function support basic research as their primary objective. More than two-thirds of Federal basic research programs, however, are subsumed under functions that contain programs whose primary objectives are to support mission areas, such as health, energy, and space. The increase in the science and technology base share has been from almost 3 percent in 1969 to almost 4 percent in 1979.

[3]Major functions are defined as those with current annual funding levels of $500 million or more.

INTRODUCTION

Policy analysis depends on a factual base, part of which may consist of quantitative information. Among the kinds of quantitative data needed in the formulation of science policy are the magnitude of Federal R&D investment and the relationship of that investment to broader indicators as well as significant internal measures of the distribution of Federal R&D support.

For almost three decades an annual survey of Federal agency support of R&D programs has been conducted by the National Science Foundation (NSF) to meet the need for such a data base. The survey has been expanded over the years to include the distribution of these programs by character of work (basic research, applied research and development), performer, and field of science. In the early seventies a break by individual programs within agencies was added, making possible for the first time a grouping of programs by functional areas that cut across agency lines[1]. This report is the eighth in a series that has been designed to provide a basis for the analysis of Federal R&D activities by function, or objective, as distinct from an agency analysis.

[1]The *Federal Funds for Research and Development* series dates from fiscal year 1952 and covers all Federal agencies that support R&D activities. Detail at the individual program level, however, is obtainable back to 1969 only.

In the system shown in this report R&D programs have been grouped by 15 functions and 32 subfunctions according to the primary purpose of each program with no overlapping between programs or functional areas. The primary purpose of each R&D program was determined by NSF staff rather than the agency respondents. In most cases the primary purpose of a program was evident from descriptions provided by the sponsoring agency, but in some cases two almost equally important purposes or functions might be discernible. With all Federal R&D programs available for simultaneous study and comparison, however, a total perspective was given from which fine points of difference could be determined. In this system functional data are additive to 100 percent. Thus, the total of all R&D programs for a given year in this report will match the total of all R&D programs for that year in the *Federal Funds* report.

Whereas the original report in this series grouped agency R&D programs by the overall functional areas used in the Federal budget, an alternative system was later devised that reflected R&D objectives only. The original system had tended to obscure or distort the purposes of many R&D programs. The new system has been used on a consistent basis since 1973, and the only changes that have been made have been the addition of one function by elevating a subfunction to full-function status plus a few changes in subfunction categories as program emphases have changed.

The data for 1977-79 were collected by NSF from the agencies in the *Federal Funds* survey in March and April 1978. They are based on the agency budgets as incorporated in the President's budget to Congress. The 1979 data show amounts requested in the President's budget for fiscal year 1979 and, therefore, do not reflect subsequent congressional appropriations or changes made by Executive apportionment. Fiscal year 1978 data reflect obligations estimated in the second quarter of fiscal year 1978; agencies based these estimates on funds appropriated, plus obligations carried over from prior years, and on agency program plans at the time. Program amounts shown in the detailed statistical table (appendix C) may differ somewhat from totals shown in agency budgets because of the addition of administrative costs to program costs by NSF staff. Significant known changes in the 1979 data resulting from congressional actions taken at the time this report was prepared are discussed in the text.

Whereas data for 1978 and 1979 are estimated, data for 1969-77 are actual since they represent final actions. In later reports actual data for 1978 and 1979 will become available.

Each year organizational changes take place within the Executive branch through the formation of new agencies, termination of others, and interagency program transfers. The latest agency structure was shown in the appendix table and in the text tables, and prior-year data were spread to conform to this structure as though Federal agencies had been organized that way since 1969. When program emphases change, prior-year programs are sometimes split and recombined to conform to the new program directions.

Function categories were chosen on the basis of size of effort, current public interest in a given area, and the need for a complete framework covering all Federal R&D programs. Other categories could be used by other analysts, depending upon their particular interests. The programs are shown in sufficient detail in the table in appendix C that they can be grouped under different function headings for other analytical purposes.

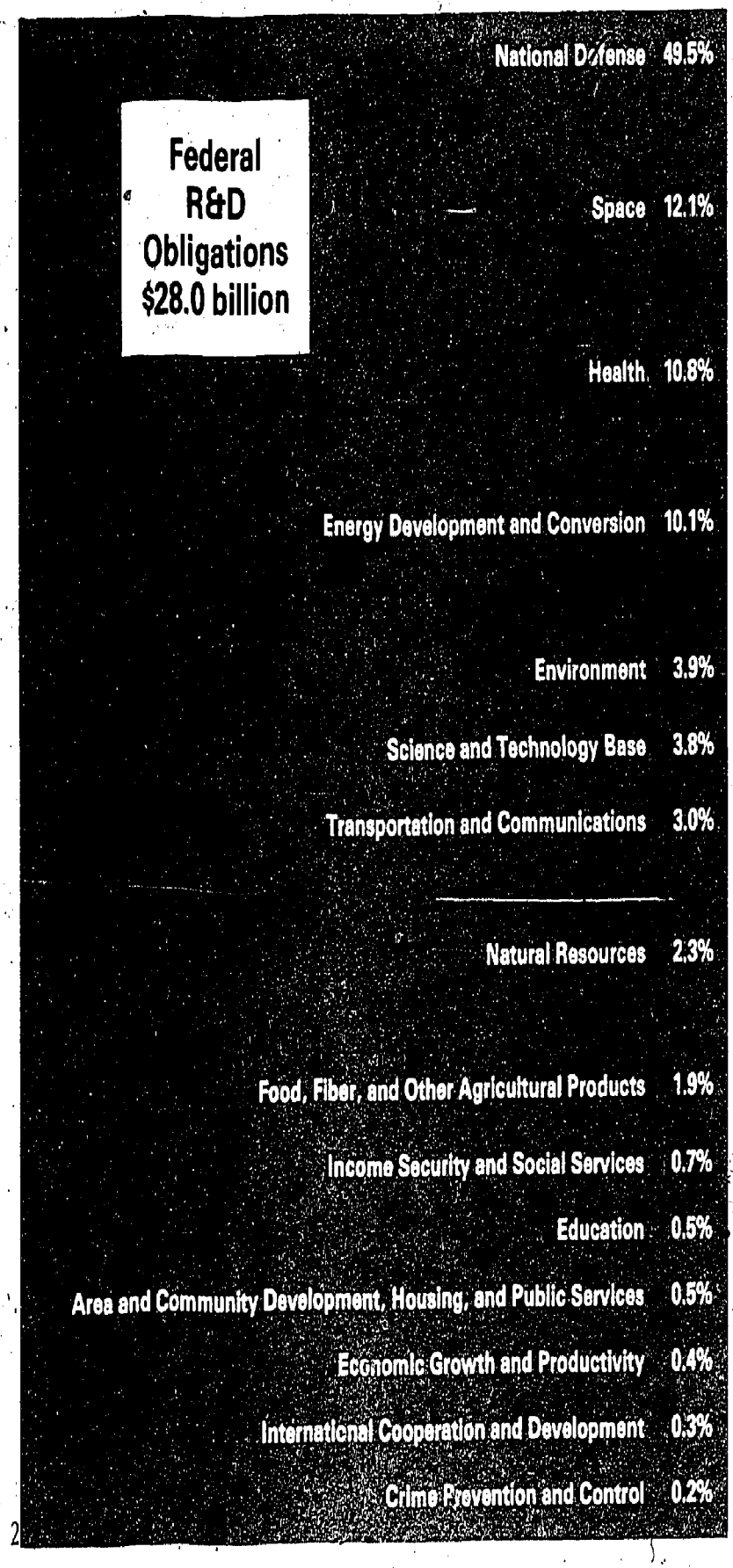
Aside from groupings under new function headings, larger groupings of programs under the present headings can also be made as long as the "100 percent additive" requirement is ignored. With secondary purposes permitted as a basis for inclusion, energy and energy-*related* programs, for example, can be shown under energy, and health and health-*related* programs can be shown under health. Such a system nullifies any analysis of relative priorities, but it can be useful in assessing the extent of R&D activity bearing upon a given area.

FEDERAL AGENCY/PROGRAM ABBREVIATIONS

AAEO — Astronomical, Atmospheric, Earth and Ocean Sciences
ADAMHA — Alcohol, Drug Abuse, and Mental Health Administration
ARS — Agricultural Research Service
ASRA — Applied Science and Research Applications
BBS — Biological, Behavioral and Social Sciences
BLM — Bureau of Land Management
BLS — Bureau of Labor Statistics
CDC — Center for Disease Control
CG — Coast Guard
CSA — Community Services Administration
CSRS — Cooperative State Research Service
DEA — Drug Enforcement Administration
DOD — Defense, Department of
DOE — Energy, Department of
DOT — Transportation, Department of
EPA — Environmental Protection Agency
ESCS — Economics, Statistics, and Cooperatives Service
FAA — Federal Aviation Administration
FBI — Federal Bureau of Investigation
FDA — Food and Drug Administration
FHWA — Federal Highway Administration
FRA — Federal Railroad Administration
FS — Forest Service
FWS — Fish and Wildlife Service
GARP — Global Atmospheric Research Program
GS — Geological Survey
HCFA — Health Care Financing Administration
HDS — Human Development Services
HEW — Health, Education, and Welfare, Department of
HRA — Health Resources Administration
HSA — Health Services Administration
HUD — Housing and Urban Development, Department of
IDOE — International Decade of Ocean Exploration
LEAA — Law Enforcement Assistance Administration
MPE — Mathematical and Physical Sciences and Engineering
NASA — National Aeronautics and Space Administration
NBS — National Bureau of Standards
NHTSA — National Highway Traffic Safety Administration
NIE — National Institute of Education
NIH — National Institutes of Health
NOAA — National Oceanic and Atmospheric Administration
NRC — Nuclear Regulatory Commission
NSF — National Science Foundation
OE — Office of Education
OEO — Office of Economic Opportunity
OMBE — Office of Minority Business Enterprise
OS — Office of the Secretary (DOT) (HEW) (Interior) (Labor)
OWRT — Office of Water Research and Technology
RANN — Research Applied to National Needs
SSA — Social Security Administration
STIA — Scientific, Technological, and International Affairs
TVA — Tennesse Valley Authority
UMTA — Urban Mass Transportation Administration
USDA — Agriculture, Department of
VA — Veterans Administration

FEDERAL R&D PRIORITIES BY FUNCTION

SHARE OF FUNCTIONS IN FEDERAL R&D TOTAL WITH SUBFUNCTIONS: FY 1979 (est.)



SOURCE: National Science Foundation

- Federal R&D obligations rose nearly $11 billion from fiscal year 1969[1] to an estimated $26.4 billion in fiscal year 1978. There were two clearly distinguishable trends during this period. Between 1969 and 1974, Federal R&D funds grew at an average annual rate of 2.2 percent — a decline in constant dollars.[2] The growth rate from 1974 to 1978, however, was 11.0 percent — a moderate increase in real terms. In the 1979 budget, the proposed R&D total of $28.0 billion, 5.9 percent over 1978, represented a departure from the recent growth trend in that it would not meet an inflation rate of more than 6 percent.

- In the earlier period, 1969-74, defense R&D obligations, which accounted for more than one-half of the Federal R&D total, grew only slightly, and space funding actually declined. The civilian-oriented functions, especially health, environment, energy development and conversion, and transportation and communications, were responsible for most of the increase that took place.

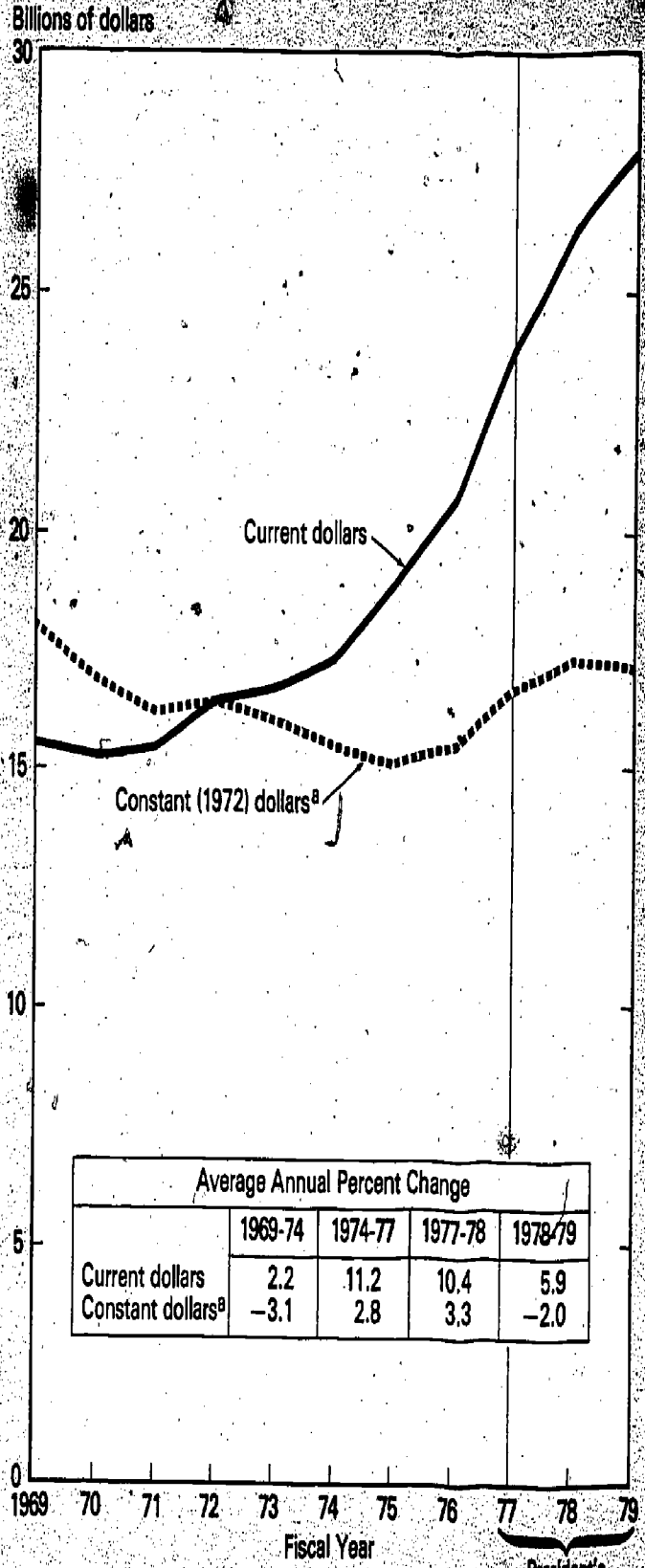
- In the four years that followed, renewed emphasis on defense-related research and development and the Government's response to the energy crisis set off by the oil embargo in the fall of 1973 produced an upward surge in Federal R&D funding. Space funding also began to climb again as the space shuttle entered the development stage. In 1978 all 15 functions showed gains; this was the only year of across-the-board growth in the 1969-79 period. Funding increases in 1978 for most functions exceeded 10 percent. Among major functions,[3] energy, natural resources, transportation and communications, and food led the way.

[1]Data on Federal R&D funding by function are available for prior years back to 1969 only. Accurate detail for earlier years is not obtainable.

[2]In the absence of a reliable R&D cost index the GNP implicit price deflator was used for the years 1969-78, and an estimate for inflation used for 1979.

[3]Major functions are defined as those with current annual funding levels of $500 million or more.

Federal R&D obligations: FY 1969-79



Average Annual Percent Change				
	1969-74	1974-77	1977-78	1978-79
Current dollars	2.2	11.2	10.4	5.9
Constant dollars[B]	−3.1	2.8	3.3	−2.0

[B]Based on GNP implicit price deflator with an estimate for FY 1979.
SOURCE: National Science Foundation

- In the President's 1979 budget a different pattern emerged. R&D programs were ranked by agencies and examined in detail by agency and Administration decisionmakers. Aggregates were adjusted to conform to established policies.[4] In the final budget only three of the nine major R&D functions — national defense, space, and science and technology base — kept pace with anticipated inflation. The energy function, which had been growing faster than any other major function, reflected a slight current-dollar decline. Other leading functions — environment, transportation and communications, and food — remained at about the 1978 level. The relative increases planned for health and natural resources were less than 6 percent in each case.

- Subsequent congressional actions indicate obligational increases for health, energy, and, food with many increases for specific programs exceeding levels proposed in the President's budget. The increase in defense, however, will be somewhat less than requested in the budget.

- Between 1969 and 1978 Federal R&D support was marked by an increasing emphasis on "civilian" programs, as compared with those for defense and space. The defense/space share of the Federal R&D total decreased every year, falling from 77 percent in 1969 to 60 percent in 1978. In the 1979 budget, however, the defense/space share increased somewhat. The long-term trend was reversed as a result of the 8-percent increase proposed in each case for defense and space R&D programs and the 3-percent increase proposed for civilian R&D programs taken as a whole.

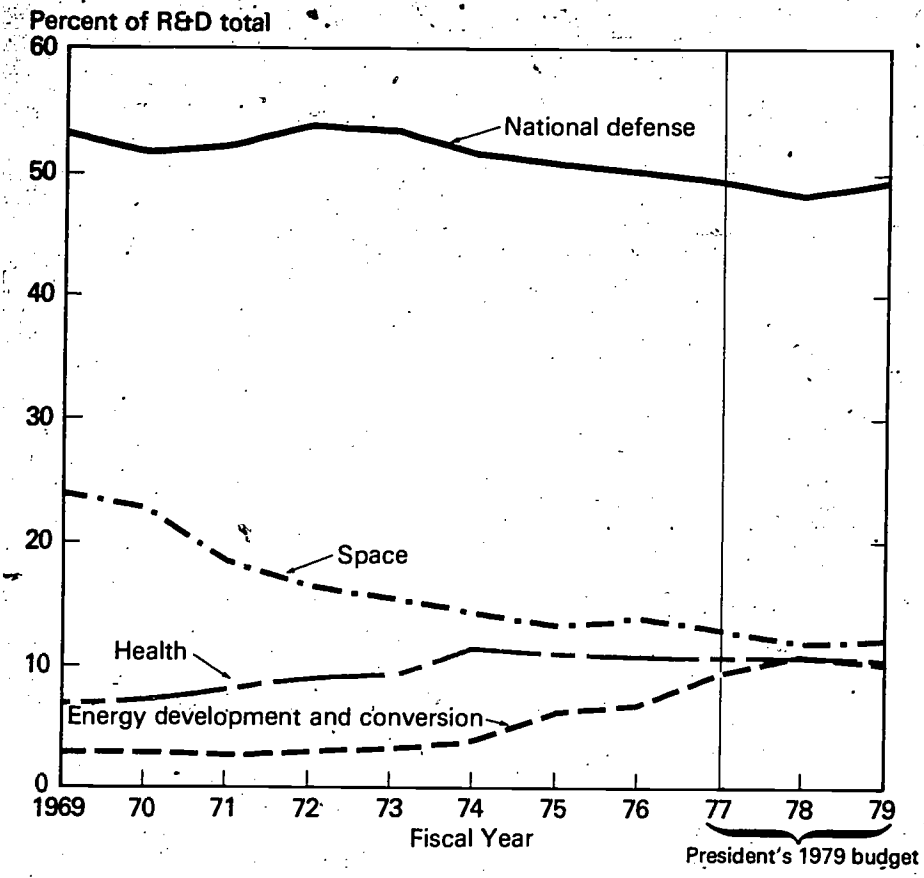
Federal R&D obligations by function:[1]
Average annual percent change in selected periods

Function	1969-74	1974-77	1977-78[2]	1978-79[2]
Total	2.2	11.2	10.4	5.9
National defense	1.5	9.6	7.8	8.2
Space	-7.8	7.4	2.4	7.7
Health	13.2	7.5	11.8	4.2
Energy development and conversion	8.8	51.2	24.4	-1.3
Environment	18.3	13.1	11.7	1.5
Science and technology base	8.0	12.0	9.7	7.4
Transportation and communications	8.9	0.1	17.7	1.0
Natural resources	10.8	14.6	21.7	5.8
Food, fiber, and other agricultural products	5.3	16.3	15.8	2.1
Income security and social services	6.8	5.8	14.7	13.6
Education	2.3	-11.5	13.8	6.8
Area and community development, housing, and public services	14.3	3.4	30.0	-6.7
Economic growth and productivity	3.6	8.9	4.7	12.2
International cooperation and development	-0.2	39.7	2.7	30.3
Crime prevention and control	50.0	-4.6	132.0	-34.2

[1]Listed in descending order of 1979 obligations.
[2]Estimates based on the President's 1979 budget.

[4]American Association for the Advancement of Science, *R&D in the Federal Budget, R&D, Industry, & the Economy, Colloquim Proceedings June 20-21, 1978*. Washington, D.C., 1978, "Federal R&D, Prepared Presentation," W. Bowman Cutter, pp. 23-24.

Trends in distribution of Federal R&D obligations by function: FY 1969-79



Environment	1.8	2.1	2.8	3.0	3.7	3.8	4.2	4.1	4.0	4.0	3.9
Science and technology base	2.8	2.9	3.0	3.3	3.3	3.7	3.8	3.8	3.8	3.7	3.8
Transportation and communications	2.9	3.8	5.0	3.7	3.8	4.0	3.4	3.1	2.9	3.1	3.0
Natural resources	1.3	1.5	2.1	2.1	2.0	1.9	2.1	2.1	2.1	2.3	2.3
Food, fiber, and other agricultural products	1.4	1.6	1.6	1.8	1.8	1.7	1.8	1.9	1.9	2.0	1.9
Income security and social services	.6	.7	.8	.8	.9	.8	.8	.6	.7	.7	.7
Education	1.0	1.0	1.2	1.2	1.3	1.0	.8	.7	.5	.5	.5
Area and community development, housing and public services	.3	.6	.6	.5	.6	.6	.5	.5	.4	.5	.5
Economic growth and productivity	.4	.5	.6	.3	.4	.4	.3	.4	.4	.3	.4
International cooperation and development	.2	.2	.2	.2	.2	.2	.2	.2	.3	.3	.3
Crime prevention and control	(a)	.1	.1	.2	.2	.2	.2	.2	.1	.3	.2

[a]Less than .05 percent.
SOURCE: National Science Foundation

Federal R&D obligations by function:[1] fiscal years 1969-79

[Dollars in millions]

Function	1969	1970	1971	1972	1973	1974	1975	1976s	1977	1978 [2]	1979 [2]
Total	$15,641.1	$15,340.3	$15,545.0	$16,497.8	$16,800.1	$17,414.7	$18,988.4	$20,723.5	$23,929.1	$26,419.5	$27,972.2
lational defense	8,356.2	7,980.7	8,109.9	8,901.6	9,001.9	9,015.8	9,679.3	10,429.7	11,863.8	12,785.8	13,832.8
pace	3,731.7	3,509.9	2,893.0	2,714.3	2,601.3	2,477.6	2,511.3	2,863.2	3,065.9	3,140.8	3,382.9
lealth	1,126.8	1,125.8	1,338.0	1,588.8	1,624.3	2,096.4	2,176.9	2,365.5	2,603.7	2,911.5	3,034.1
nergy development and conversion[3]	435.1	424.8	422.1	475.1	534.7	664.8	1,186.1	1,438.8	2,301.5	2,862.5	2,827.1
nvironment	284.6	321.8	433.9	503.1	620.2	659.2	795.3	847.1	954.3	1,066.3	1,081.9
cience and technology base	436.0	448.5	463.0	543.3	550.2	640.7	713.4	784.6	900.9	988.4	1,061.1
ransportation and communications	458.1	590.2	778.7	614.6	630.1	702.9	640.5	635.7	704.6	829.3	837.4
latural resources	199.3	234.0	321.3	351.2	337.7	332.3	398.4	432.6	499.8	608.4	643.7
ood, fiber, and other agricultural products	225.0	240.6	246.9	290.7	296.9	291.9	349.7	388.2	459.4	531.8	543.1
ncome security and social services	96.7	105.6	127.8	125.2	157.2	134.0	148.6	133.4	158.8	182.1	206.8
ducation	154.8	146.6	186.1	190.7	214.2	173.5	149.1	142.4	120.2	136.8	146.1
rea and community development, housing, and public services	49.4	91.1	88.7	87.4	96.7	96.4	101.8	104.2	106.6	138.6	129.3
conomic growth and productivity	55.8	80.0	92.9	57.5	67.0	66.4	62.3	77.2	85.8	89.8	100.8
nternational cooperation and development	26.8	32.2	32.2	29.5	32.9	26.6	29.6	44.5	72.4	74.3	96.8
rime prevention and control	4.8	8.6	10.3	25.0	34.8	36.3	45.9	36.3	31.5	73.2	48.1

R&D plant excluded.
Estimates based on the President's 1979 Budget to Congress.
The inclusion of R&D plant obligations for energy would add $568.2 million in 1977, $947.3 million in 1978, and $799.1 million in 1979.
ource: National Science Foundation

- **National defense** has in recent years made up approximately one-half of all Federal R&D obligations. In the 1969-78 period the share ranged between a high of 54 percent in 1972 and an estimated low of 48 percent in 1978. The ratio was expected to be 49 percent in 1979.

The growth that was shown in R&D funding for national defense from 1969 to 1974 was slight, considerably less than the growth of inflation. The growth since then, however, has been significant enough to register a small increase in real terms between 1974 and 1978. The requested total of $13.8 billion in the President's budget for 1979 was an 8-percent increase over 1978[5].

Defense military programs include all those within the RDT&E appropriation of the Department of Defense (DOD) plus small amounts from other appropriations, primarily covering pay and allowances of military personnel engaged in R&D activities.

The largest area of R&D concentration is that of *tactical programs* within DOD, which in 1978 represented more than one-third of all defense R&D efforts. The requested total for these programs in 1979 was $5.1 billion, or 15 percent more than 1978.

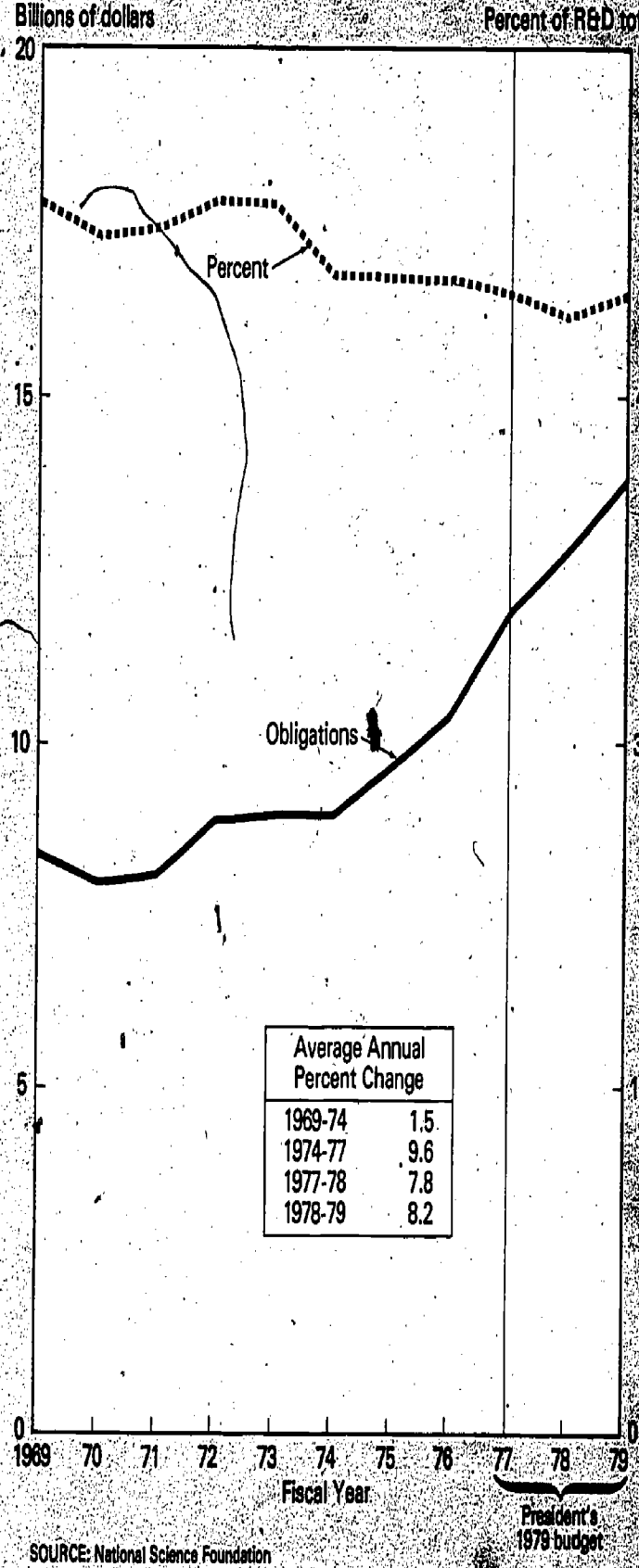
Increases in tactical programs have been substantial in recent years, covering a range of R&D activities related to weapons modernization, partly aimed at offsetting numerical force advantages of the Warsaw Pact nations and also aimed at maintaining a worldwide military balance. Following a decline between 1972[6] and 1976, obligations for tactical programs rose an annual average of 23.3 percent in the next two years as a number of weapons programs, initiated earlier, reached full-scale development. The proposed 1979 increase is to cover development of systems to improve the early combat capability of U.S. forces in defense of Western Europe. Congress made scarcely any change in the overall 1979 funding level for tactical programs.

Strategic programs accounted for almost one-fifth of defense R&D funds in 1978. The proposed obligation level of $2.2 billion in 1979 represented a

[5]Final legislation cut the research, development, test and evaluation (RDT&E) requested funding total by 2.5 percent. The exact effect on individual subfunctional areas cannot be determined because congressional decisions are made on the basis of budget authority whereas the data in this report are based on obligations. Nonetheless, congressional intent can be clearly seen and estimates can be made as to the extent of funding changes.

[6]Data distributed on the basis of the present mission categories (tactical programs, strategic programs, technology base, etc.) are not available prior to 1972.

National Defense
Federal R&D obligations



SOURCE: National Science Foundation

12-percent decline, resulting from near completion of B-1 bomber development. The share of strategic programs within defense was thus reduced. A further small decline in the 1979 level is indicated by congressional actions. Between 1972 and 1978 R&D obligations in the strategic area rose almost steadily, although growth was slow and represented almost no increase in real terms. The programs in this area are relatively few in number but large in concept and deployment. Their purpose is to develop the capability of deterring a nuclear attack on the United States and other nations whose survival is vital to our security. Many of these programs revolve around complex missile systems.

Technology base programs were almost at the $2 billion level in the 1979 budget request. This represented a 10-percent rise for this area, continuing a DOD policy initiated in 1976 to reverse a long-term erosion of effort (support in 1975, for example, was 6 percent below 1972). Congress has supported recent DOD requests for overall increases in technology base funding and has agreed to the general request level for 1979, while reducing some smaller programs. Technology base includes all the basic research programs of DOD, although basic research makes up less than one-fifth of the technology base program total.

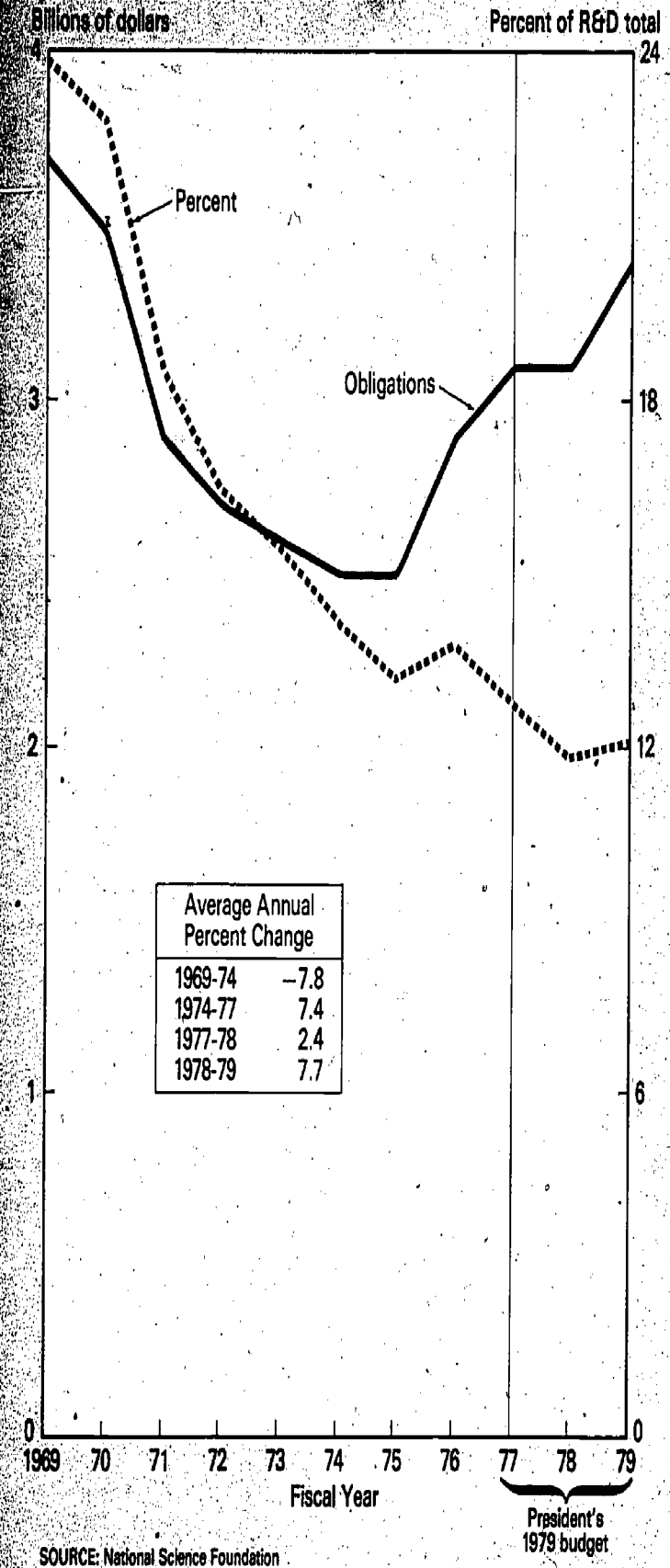
Programwide management and support, after a small funding decrease in 1978, was expected to grow 9 percent in 1979 to the $1.4 billion level, although subsequent congressional actions reduced the increase considerably. Activities include Federal contract research centers, missile ranges, target systems, test facilities, and test and evaluation support.

Intelligence and communications increased 32 percent over the 1978 level in the 1979 budget request, to $1.1 billion. The Air Force supports the chief activity in this area, and one of the largest Air Force programs is the new, reusable, manned space booster to be used with the space shuttle. This booster will replace the expendable space launch vehicles now used to perform military space missions. Congressional action had the effect of reducing the proposed increase for 1979 for intelligence and communications, but no decrease was made in the request for the space booster.

Advanced technology development obligations, which more than doubled between 1972 and 1976, were expected to grow 20 percent in 1979 to almost $600 million after having reflected decreases in 1977 and 1978. The Congress, however, cut back considerably on the request level although a fairly substantial increase was still indicated.

Defense-related atomic energy programs, under the direction of the Department of Energy (DOE), reflected an overall increase of 4 percent in the 1979 budget. Proposed growth in naval reactor development and nuclear materials security more than offset decreases in weapons R&D and testing activities and inertial confinement fusion. The only noteworthy modification made by the Congress in any of these programs was to move funding for inertial confinement fusion activities up to the 1978 level.

Space
Federal R&D obligations



SOURCE: National Science Foundation

- **Space** R&D funding has shown a steady upward trend since 1974 after dropping each year in the 1969-74 period, chiefly as a result of the successful accomplishment of the Apollo lunar landing program, which had represented more than one-half the space total in 1969 but ceased to exist after 1973. As this program was phasing down, the National Aeronautics and Space Administration (NASA) stressed a new balance that was to include space exploration, scientific investigations, and practical applications. Plans for the space shuttle had begun in 1970, but it was not until 1975 that large increases in space shuttle funding produced an increase in funding for space as a whole. The *space sciences*, which had been gaining, fell back between 1973 and 1978 although physics and astronomy continued to increase. In the last two budgets the space sciences have shown expansion.

The 1979 budget proposed for space an increase of 8 percent over 1978 to $3.4 billion. Much of the activity is connected with the shuttle, scheduled to start operations in 1980. A number of programs now under development will be shuttle-launched. Under *space transportation systems* development of the shuttle was to continue, along with growth in supporting programs. Significant growth was planned for the space sciences, both for physics and astronomy and for lunar and planetary exploration. *Space technology* programs were likewise scheduled for significant growth. Even so, space is the only function with lower obligations in 1979 than in 1969. The space share of the Federal R&D total has fallen during the decade from 24 percent to an estimated 12 percent. Congress cut the 1979 budget request for space programs by less than 1 percent, which does not significantly alter the plans described in this report.

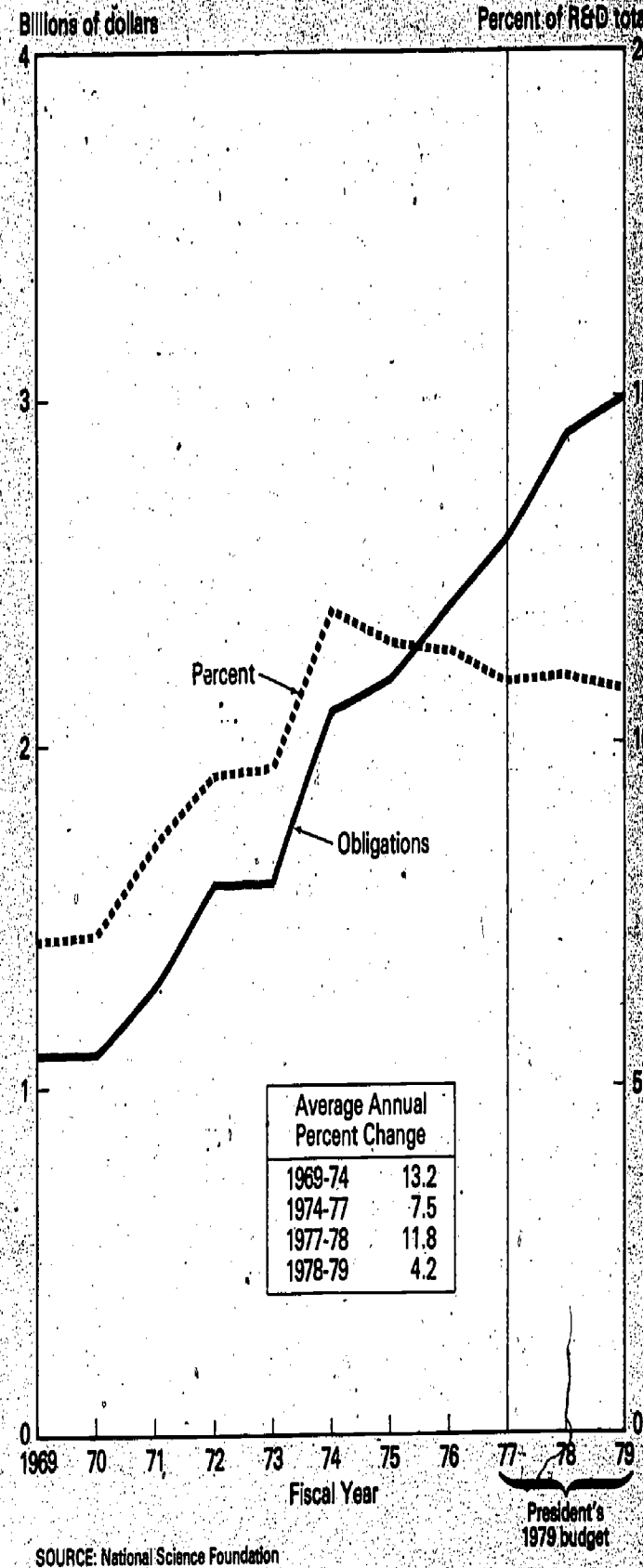
- **Health** R&D programs in the aggregate reflected a 4-percent increase in the 1979 budget. This compares with an average annual growth rate of 11.1 percent in the 1969-78 timespan, or a moderate increase in constant dollars. The share of health in the Federal R&D total has risen from 7 percent in 1969 to an estimated 11 percent in both 1978 and 1979.

Nine out of 10 health R&D dollars are in the *biomedical research* area, and most biomedical research programs are conducted by the National Institutes of Health (NIH) of the Department of Health, Education, and Welfare (HEW). Health is one of the few functions with a higher growth rate between 1969 and 1974 than in later years. In 1971 special emphasis was placed on cancer research and heart and lung research with the result that the two institutes in these areas received sharp increases in funding. The following year a $100 million cancer initiative was announced, and further steep increases followed in cancer and heart and lung research through 1974. In subsequent years the rates of growth in these areas diminished, but, nonetheless, by 1978 cancer and heart and lung research together accounted for approximately one-half of all NIH biomedical research obligations compared with one-third in 1969.

The last two years have seen a reversal in the trend. In 1978 the increase in funds for cancer research was 8 percent and for heart and lung research, 12 percent, while the relative increase for each of the other nine institutes was greater than these with the one exception of dental research. Especially high rates of growth were shown for eye research, aging, and environmental health sciences. In the 1979 budget only two areas showed important increases: child health and human development, and, again, environmental health sciences. All other biomedical research areas reflected a no-growth policy. Since then, however, congressional actions have increased 1979 funding levels for all the institutes so that the overall NIH increase over 1978 may be as much as 15 percent.

Mental health research is the next largest area of health R&D activity in terms of funding, yet between 1969 and 1978 virtually no growth occurred even in current-dollar terms. *Drug abuse prevention and rehabilitation*, the third-largest health R&D area, grew rapidly from 1969 to 1974 and thereafter declined. In 1979, however, these areas reflected increases of 21 percent and 33 percent, respectively, in the budget proposal. The increases reflected recommendations of the President's Commission on Mental Health and were later largely approved by the Congress.

Health
Federal R&D obligations



SOURCE: National Science Foundation

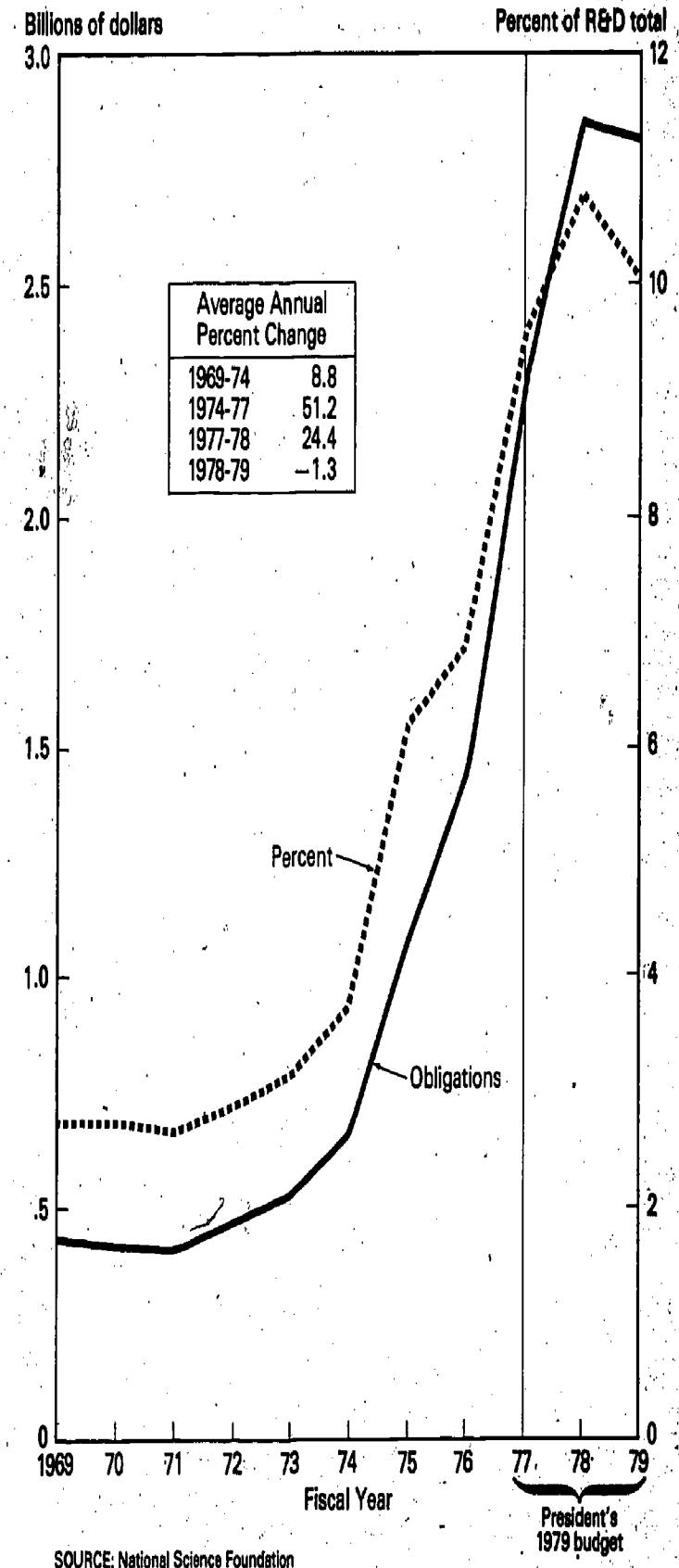
- **Energy development and conversion** R&D programs underwent steep expansion from 1973 to 1978, but the 1979 budget reflected a slight decline. From 1973 to 1978 the average annual growth rate of the energy function was 39.9 percent in current dollars — a sharp increase even on a constant-dollar basis. In the 1979 budget proposal, however, a decrease of 1.2 percent was shown. The share of the energy function within all Federal R&D obligations rose from almost 3 percent in 1969 to an estimated 11 percent in 1978 and 10 percent in 1979.

Congress' subsequent restoration of funds that had been cut back for a number of energy programs would result in a significant increase for energy research and development in 1979. The final resolution of appropriation levels for these programs has been delayed until 1979 when the 96th Congress convenes. A Presidential veto of a bill covering both public works and nuclear energy programs put their status under a continuing resolution for the first few months of fiscal year 1979. This resolution provided for the restoration of funds for several energy programs and increases in others.

Nuclear programs have registered steady growth in funding since 1971 while dropping from seven-tenths of the energy total in 1969 to slightly more than two-fifths in 1978. Nonetheless, obligations for nuclear R&D programs increased fourfold in this period, and by 1978 the breeder reactor program was the largest (more than one-third of the nuclear total), followed by fuel cycle R&D efforts, magnetic fusion, and reactor safety. In the 1979 budget the 13-percent decline primarily reflected a substantial cutback in the overall breeder reactor program of the Department of Energy (DOE), which included cancellation of the demonstration project at Clinch River, Tenn. A decrease was also proposed for the DOE fuel cycle program as part of a reduction in reprocessing technology efforts consistent with the Administration's nonproliferation policy. Congress has restored funding for the breeder reactor demonstration project and the base development program and added funds for fuel cycle efforts. These actions, if signed into final law, would raise the nuclear programs to approximately the level of 1978.

Fossil energy support increased sevenfold between 1974 and 1978, but a small decrease (2 percent) was proposed for 1979. Work in fossil energy now accounts for approximately one-fifth of the energy total. The chief effort has been concentrated in coal: in extraction technology, coal conversion to liquid and gaseous fuels, direct combustion, and advanced power conversion technology. Congressional actions, while increasing some programs, have had the effect of a further reduction in overall funding for the fossil area.

Energy development and conversion
Federal R&D obligations



SOURCE: National Science Foundation

Solar and geothermal energy reflected strong growth from 1972, the year of inception of work in this area, to 1978 when total funding was at almost one-half the billion-dollar level. Solar energy development accounts for most of the work in this area. The increase of 3 percent in the 1979 budget proposal would have been greater except for cutbacks in the DOE solar heating demonstration program. Congressional actions restored funding to solar heating demonstration and increased other solar as well as geothermal energy programs.

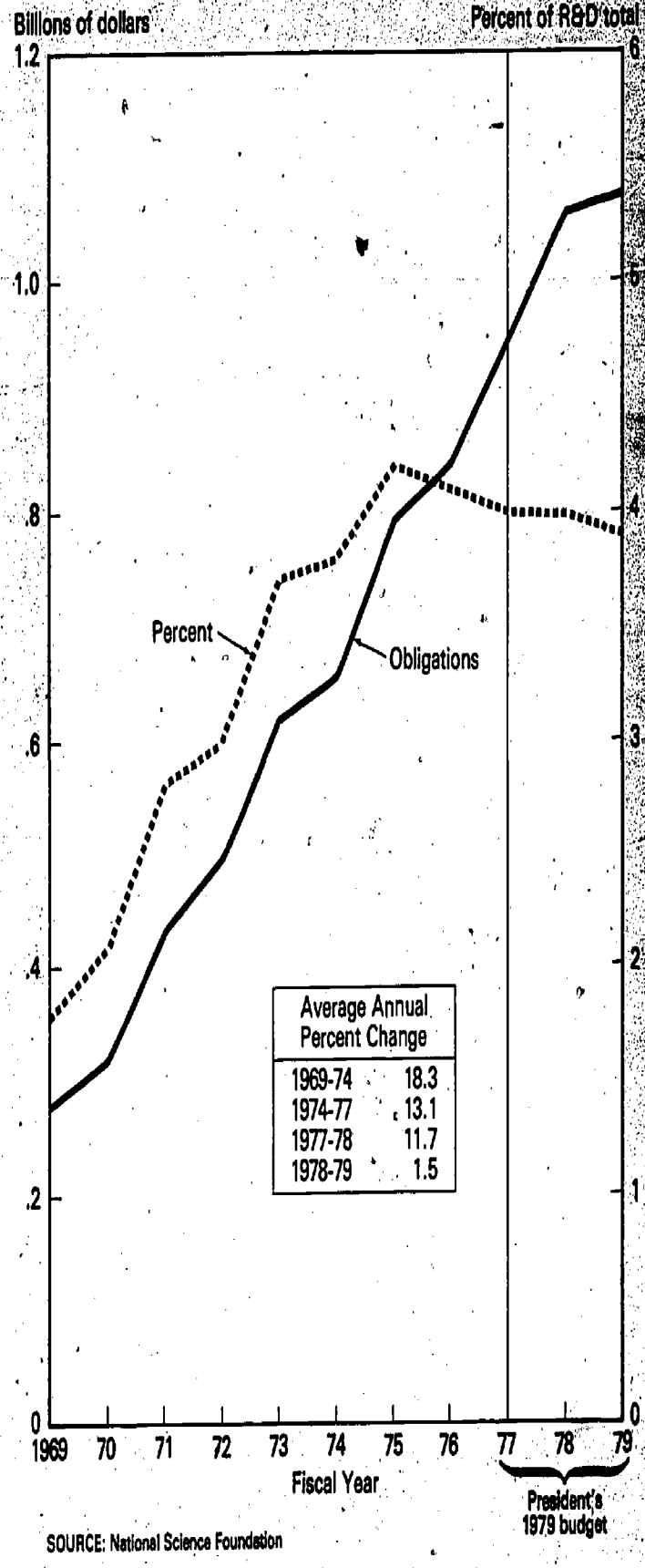
Energy *conservation*, which received little attention until 1976, was the chief growth area in the 1979 budget. Sharp expansion was planned in DOE transportation, energy conservation, improved conversion efficiency, and energy storage systems. Although Congress modified these increases to some extent, overall growth is expected to be substantial.

- The **environment** function has shown steady increases throughout the 1969-79 period, but the increase in the 1979 budget was less than 2 percent — a decline in real support. Over the longer term, 1969-78, this function reflected an average annual growth rate of 15.8 percent, second only to that of energy among the major functions. The share of environment within the Federal R&D funding total is an estimated 4 percent in 1979, compared with 2 percent in 1969.

Environmental health and safety has been the leading subfunction since 1976, currently accounting for approximately two-fifths of total environment R&D funds. The largest program is sponsored by DOE in environmental research and development related to new energy technologies. This program reflected a decline in support in 1979 because of the transfer of certain portions to the Environmental Protection Agency (EPA), but the support level was later restored to that of 1978 through congressional action. Other programs that have contributed importantly to recent funding growth include EPA pollution effects research, health and safety programs for miners and workers generally, food safety, and nuclear fuel cycle research.

Pollution control and environmental protection, accounting for almost one-third of the environmental total in 1978, reflected a moderate decrease in the President's 1979 budget. This decrease primarily reflected the inclusion in the 1978 estimates of a supplemental request for funds for the EPA energy-related R&D program. The growth of this program between 1975 and 1978 was influential in growth of the pollution subfunction.

Environment
Federal R&D obligations



SOURCE: National Science Foundation

Understanding, describing, and predicting the environment; the least rapidly growing area over the longer term, showed a significant increase in the 1979 budget. Major expansion was represented by the NASA climate research program and the National Science Foundation (NSF) earthquake hazards mitigation program, both part of the Administration's climate initiative. Subsequent congressional action reduced funding for the NSF program to the 1978 level.

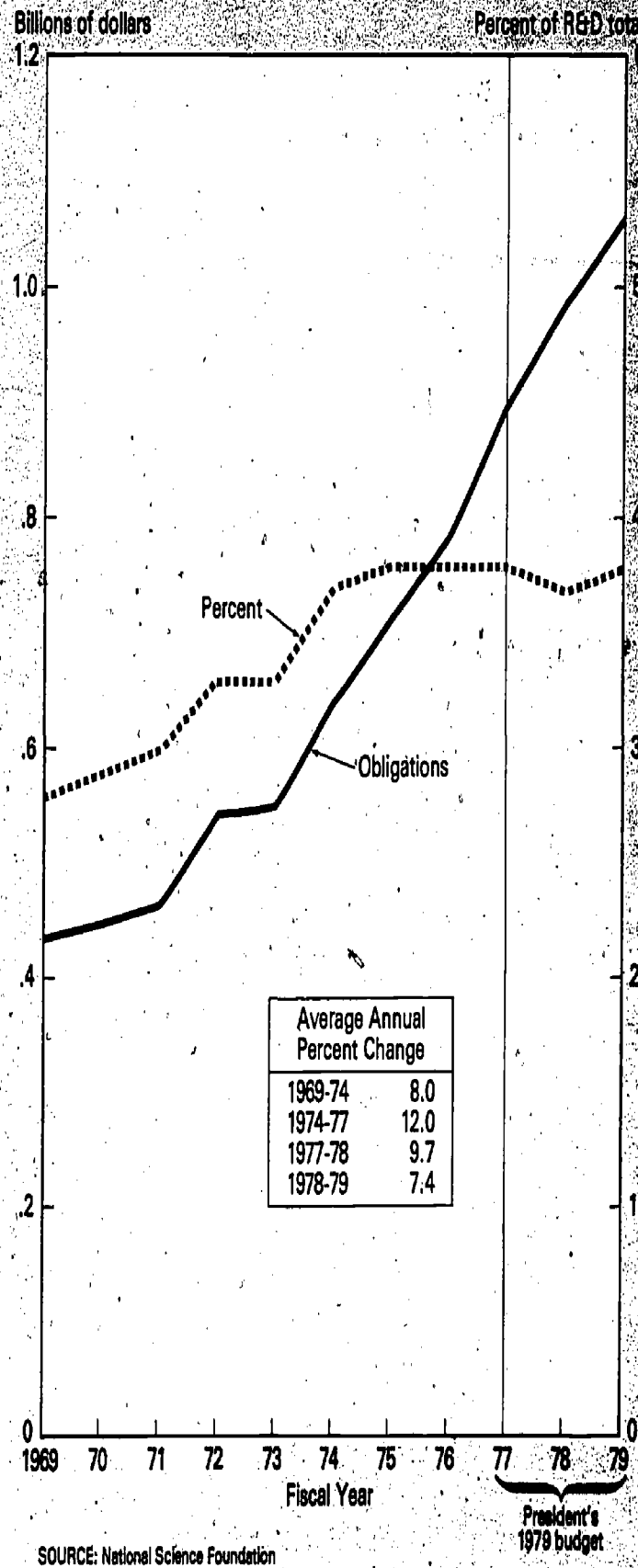
- **Science and technology base,** with a proposed increase in funding of more than 7 percent in 1979, is one of three major functions scheduled for growth sufficient to offset the then estimated effects of inflation. Between 1969 and 1978 this function grew at an average annual rate of 9.5 percent in current dollars, a moderate amount in real terms, although growth was shown every year, especially from 1973 onward.

  The 14 research project support programs of the National Science Foundation (NSF) together have accounted for approximately one-half the total funding for science and technology base over the years. The largest single program area, however, is the DOE energy physics program, which has shown considerable growth since 1974. DOE nuclear physics, the second largest program, has also shown vigorous growth. Between 1969 and 1979 the share of science and technology base in the Federal R&D funding total has risen from almost 3 percent to almost 4 percent. Despite some cuts by Congress, the relative increase in funding for this function in 1979 will be close to that requested in the budget.

- **Transportation and communications** showed only a 1-percent gain in the 1979 budget proposal, a decline in real terms. During the 1969-78 period, this function grew 6.8 percent on an average annual basis, which amounted to virtually no real increase in constant dollars. The share of this function is an estimated 3 percent of total Federal R&D funds in 1979, the same as in 1969.

The NASA aeronautical research and technology program, the largest within this function, was scheduled for an 11-percent increase in funds in 1979, which Congress approved. Aside from this increase in *air* transportation, decreases occurred in the other transportation areas — *ground, water,* and *multimodal. Communications* showed a slight increase; the chief program in this area is NASA space communications.

Science and technology base
Federal R&D obligations



SOURCE: National Science Foundation

- **Natural resources** registered relatively high growth during the entire 1969-78 period with an average annual increase of 13.2 percent in current dollars, a significant increase in real terms. A slight increase in constant dollars was proposed in 1979. The share of natural resources in the Federal R&D funding total has grown from 1 percent in 1969 to an estimated 2 percent in 1978 and 1979.

The only area reflecting a real increase in 1979 was *multiresource*, with a growth of 21 percent proposed. This was mostly derived from a planned increase for the NASA earth resources detection and monitoring program, emphasizing development of Lansat-D, scheduled for launch in 1981. Congress subsequently approved the request. A decline in 1979 in funds for the overall *minerals* programs resulted from termination of the Mined Land Demonstration Program conducted by the Bureau of Mines in the Department of the Interior. *Water*, *land*, and *recreation* R&D programs reflected no significant changes in funding levels in 1979.

- **Food, fiber, and other agricultural products** R&D support began to show important growth in 1975, and this trend continued through 1978. An increase of only 2 percent, however, was proposed in the 1979 budget, amounting to a real decrease. This function grew from 1 percent of the Federal R&D funding total in 1969 to an estimated 2 percent in both 1978 and 1979.

Chief changes shown in the 1979 budget request were increases in competitive research grants in food production and human nutrition and decreases in payments to agriculture experiment stations under the Hatch Act. These changes reflect a reorientation of Department of Agriculture (USDA) R&D programs from formula grants and intramural work to competitive grants and contracts with non-Federal organizations. Although Congress granted only part of the request for the competitive grants program, it increased overall agricultural R&D support well beyond the budget request.

- **Income security and social services** has varied in R&D support from one year to the next. An increase of 14 percent in funding was proposed for 1979. The largest increase was represented by the research and demonstration programs of the Community Services Administration (CSA), designed to test the effectiveness of various mechanisms for delivering social services to the Nation's poor. Other programs within this function are concerned with rehabilitation, child development, employment and training, special analytic studies of social questions, and Federal hospital and medical insurance experiments research. This function has accounted for less than 1 percent of all Federal R&D obligations during the entire 1969-79 period.

- The **education** function has shown a fluctuating support history in the past decade. The chief funding area has been the HEW National Institute of Education (NIE); the proposed increase in the NIE program in 1979 was largely responsible for the overall increase of 7 percent for the education function. Other important programs include vocational education of the HEW Office of Education (OE) and NSF science education development

and research. The education share of the Federal R&D funding total — 1 percent in 1969 — was expected to be only one-half of 1 percent in 1978 and 1979. Subsequent congressional actions indicate a smaller relative increase for this function than requested because of cutbacks in the NIE program.

- **Area and community development, housing and public services** consists mainly of R&D programs of the Department of Housing and Urban Development (HUD) in housing assistance, housing economic data and analyses, community conservation, and related areas. Next in size of effort is the research, demonstration, and evaluation program of the Economic Development Administration (EDA) within the Department of Commerce. Growth in funding for the function was double that for all Federal R&D programs in the 1969-78 period, but a decline was indicated in the 1979 budget, resulting from a decrease in the CSA community development program. The share of this function within the Federal R&D funding total has never been as much as 1 percent.

- **Economic growth and productivity** showed gradual growth in funding during the 1969-78 period, but was expected to increase by 12 percent in 1979. This increase primarily stemmed from the budget proposal to more than double funding for work on the improvement of computer technology applications by the National Bureau of Standards (NBS) within Commerce. This proposal was largely approved by the Congress. Included in the function are programs of a number of agencies with varying missions. The larger ones are NBS services to improve use of materials, Forest Service (USDA) forest products utilization research, and the NASA technology utilization program.

- **International cooperation and development** funding grew at twice the rate of all Federal R&D programs in the 1969-78 timespan. The chief R&D effort within this function is made up of a cluster of programs of the Agency for International Development (State), and the recent expansion of these programs, focused to a large extent on agricultural problems, is the chief cause of growth for the function. In 1979 the requested increase for these programs was 35 percent, which the Congress reduced somewhat.

- **Crime prevention and control** R&D programs grew very rapidly between 1969 and 1975, but the next two years registered fairly sharp declines. The precipitous rise in obligations in 1978 — followed by a sharp decline in 1979 — reflected a carryover of 1977 funds for the Department of Justice, mainly the Law Enforcement Assistance Administration (LEAA). In terms of budget authority, an increase in Justice R&D programs was shown for 1979, and Congress approved the requested amounts. LEAA has been the dominant influence in funding for this function, with a group of programs covering juvenile delinquency, crime correlates, technology transfer, program evaluation, and other areas.

APPENDIXES

A. Functions in Detail: Current Programs

B. Technical Notes

C. Detailed Statistical Table

APPENDIX A

ınctions in Detail: Current Programs

- The **defense military** subfunction accounts for almost 93 percent of all R&D funding for national defense and is primarily made up of DOD RDT&E programs.[1] Congress cut the 1979 budget for these programs by approximately 2.5 percent. The cut covered advanced technology development, intelligence and communications, and some individual programs in strategic and tactical areas.

Tactical programs represented more than one-third of the national defense total in 1978 — $4.4 billion. The President's budget provided for an increase of 15 percent, to $5.1 billion in 1979. This was the largest dollar increase for any defense area. In both 1977 and 1978 tactical programs also received the largest dollar increases of any defense area.

The Navy F-18 air combat fighter is the largest single program, even though a decrease in funding is expected in 1979 as the development phase of this aircraft nears completion. The Army Patriot air defense missile, the second largest tactical program, is scheduled for an increase.

Other major programs scheduled for increases in 1979 include the Army advanced attack helicopter (AAH), the Air Force NAVSTAR global positioning system, and the Navy LAMPS antisubmarine warfare helicopter. Development of the Air Force F-16 air combat fighter will continue but at a reduced level as development enters later stages.

Significant funding increases were proposed for other tactical programs: the Army divisional air defense (DIVAD) gun and surface-to-surface missile rocket system; the Navy Standard ER air defense missile, vertical/short takeoff and landing V/STOL aircraft, and AV-8B vertical takeoff and landing (V/TOL) aircraft; and the Air Force precision location strike system (PLSS) and close air support weapon system (CASWS).

[1]Defense military covers all obligations for the research, development, test and evaluation (RDT&E) appropriation except for relatively small amounts used for R&D plant plus minor amounts of R&D support from other appropriations, primarily pay and allowances of military personnel working in research and development. The RDT&E funds are broken into mission categories, which in this report are treated as subcategories within the defense military subfunction. Obligations for programs within some mission categories show an erratic pattern with sharp increases and decreases. The reason is that development of a new weapons system from initial definition to completion of testing and introduction into the operating forces may take five years or more. As the definition phase is completed and the new system moves into full-scale development, steep increases in funding are required, but as this phase nears completion, R&D funding falls off sharply.

Strategic programs made up one-fifth of the national defense total in 1978 but a projected decline of 12 percent to $2.2 billion in 1979 reduced this share. The decline results primarily from a decrease in funding for the B-1 bomber as development nears completion[2]. The President's 1979 budget provided, however, for the continued development of such major programs as the Air Force air launched cruise missile (ALCM), the Air Force M-X intercontinental ballistic missile, and the Navy Trident I missile and submarine. Two strategic Army programs, important in size and showing a steady level of effort, are the ballistic missile defense systems technology program and the ballistic missile defense advanced technology program.

[2]Procurement of the B-1 bomber was terminated after fiscal year 1977 by Presidential directive although development continued.

National defense R&D obligations for selected years

[Dollars in millions]

	1969	1977	1978[1]	1979[1]
National defense, total	$8,356.2	$11,863.8	$12,785.8	$13,832.8
Defense military	7,687.0	10,939.5	11,798.7	12,809.8
DOD-RDT&E	7,386.9	10,522.2	11,329.6	12,342.9
Tactical programs	NA	3,847.8	4,398.0	5,056.4
Strategic programs	NA	2,332.5	2,517.6	2,207.7
Technology base	NA	1,682.1	1,805.1	1,989.8
Programwide management and support	NA	1,293.0	1,284.0	1,397.7
Intelligence and communications	NA	830.0	833.4	1,100.5
Advanced technology development	NA	536.7	491.5	590.8
Other DOD military	300.1	417.3	469.1	466
Defense-related atomic energy	668.7	924.3	987.1	1,023.0
Weapons R&D and testing activities (DOE)	551.2	591.8	590.3	584.7
Inertial confinement fusion (DOE)		80.2	104.0	91.8
Intelligence and arms control (DOE)		19.1	24.7	28.4
Naval reactors (DOE)	115.1	191.8	216.6	265.6
Nuclear materials security and safeguards (DOE)	2.5	27.4	38.0	40.1
Special materials production (DOE)	NA	14.0	13.6	12.4
Other defense-related activities	.5	—	—	—
Office Emergency Preparedness	.5	—	—	—

[1]Estimates based on the President's 1979 budget to Congress
Source: National Science Foundation

Technology base programs accounted for more than 14 percent of the national defense total in 1978, and in the budget request funds for these programs were increased by 10 percent to $2.0 billion. This increase was approved. This activity is composed of basic research and applied research plus exploratory development of technologies that have potential military applications. Efforts cover research in the physical, mathematical, environmental, engineering, biomedical, and behavioral sciences as well as efforts toward the solution of broadly defined problems short of major development. In 1976 DOD started a policy of building up its technology base to maintain the technological lead of the Nation relative to those countries that could pose a threat to U.S. interests. From 1972 to 1975 support to this area had shown no growth.

Programwide management and support accounted for one-tenth of the national defense total in 1978 and was scheduled for a 9-percent increase to $1.4 billion in 1979. This activity includes Federal contract research centers, missile ranges, target systems, test facilities, and test and evaluation support.

Intelligence and communications covers improvements to defense capabilities in intelligence and worldwide communications. A 32-percent increase was proposed for 1979 compared with an average annual growth rate of more than 9 percent between 1972 and 1978. The effect of congressional actions has been to reduce this increase considerably.

Advanced technology development programs are an extension of technology base activities. They cover the exploration of alternatives and proof of design concepts prior to development of weapons systems for service use. Between 1972 and 1977 funding for programs in this area more than doubled. Following a decrease of 8 percent in 1978, an increase of 20 percent was requested for 1979, but the Congress cut back on this increase.

Other DOD military activities consist of DOD support that is outisde the RDT&E appropriation. These mostly cover pay and allowances of military personnel working in research and development.

- **Defense-related atomic energy** now consists of six programs of DOE, of which the largest (almost three-fifths of the total) is weapons R&D and testing. This program showed a slight decline in the budget request. The next program (one-fourth of the total) is naval reactor development, which reflected a 23-percent increase, enough to increase the defense-related atomic energy subfunction somewhat in 1979 even though inertial confinement fusion research was scheduled for a considerable decline to allow for funding of construction projects. The only significant modification made by Congress was to move the inertial confinement fusion program to the 1978 level.

- **Space transportation systems** is the major component of space R&D funding, accounting for two-thirds of the space total in the current budget period. An increase of 4 percent was shown for 1979.

The space shuttle, the key element of the whole space transportation system, is reaching its peak period of development, with an increase of 7 percent proposed for 1979 bringing total obligations to $1.4 billion. The space shuttle is the first reusable space vehicle. It has already successfully completed a series of approach and landing tests. The first test flight in orbit is scheduled to begin in 1980. When fully operational, the shuttle transportation system will replace virtually all expendable launch vehicles currently used by DOD or NASA. This system will be used by Government agencies and by commercial and international customers as well. The President's 1979 budget recommended the procurement of four operational shuttle orbiters to provide services from two bases — the Kennedy Space Center in Florida and the Vandenburg Air Force Base in California.

Space flight operations reflected a 16-percent increase in funds for 1979, covering space transportation system (STS) operations capability development and STS operations. Funding for both these programs was expected almost to double in 1979. STS operations capability development includes the spacelab, upper stages, multiuse mission and payload support equipment, mission control center upgrading, and payload and operations support. STS operations integrate the space shuttle system, the spacelab, and the upper stages into a versatile and economical system. Development, test, and mission operations (DT&MO) provide the common engineering, scientific, and technical support for all NASA space transportation systems R&D activities. The DT&MO program, although large in support, shows a planned decrease of 8 percent in 1979.

The NASA expendable launch vehicle development and support program is expected to decrease in funding by 43 percent in 1979. This program covers expendable launch vehicle activities and engineering and maintainance to sustain launch activities and component reliability improvement.

Congress made few changes in these space transportation systems programs except for an increase in funds to support an optional fifth orbiter and a further decrease for expendable launch vehicles.

Space R&D obligations for selected years

[Dollars in millions]

	1969	1977	1978[1]	1979[1]
Space, total	$3,731.7	$3,065.9	$3,140.8	$3,382.9
Space transportation systems	2,627.7	2,121.5	2,120.4	2,203.0
Space shuttle (NASA)	—	1,409.2	1,345.5	1,435.7
Space flight operations (NASA)	158.5	198.7	267.1	311.1
Development, test, and mission operations	—	166.4	175.9	162.6
Space transportation system operations capability development	—	16.8	59.5	110.2
Space transportation system operations	—	—	17.7	33.3
Advanced programs	17.3	12.0	10.0	5.0
Planning and program integration	—	3.5	4.0	—
Skylab	141.2	—	—	—
Expendable launch vehicle development and support (NASA)	59.4	151.0	134.2	76.3
Apollo (NASA)	2,080.7	—	—	—
Research and program management (NASA)	329.0	362.6	373.6	379.9
Space sciences	372.6	484.5	514.6	625.1
Physics and astronomy (NASA)	150.6	165.8	223.6	284.8
Lunar and planetary exploration (NASA)	103.0	191.4	146.8	186.6
Life sciences (NASA)	39.6	22.1	33.2	40.5
Research and program management (NASA)	79.3	105.2	111.0	113.2
Space technology	407.9	163.9	186.0	206.8
Space research and technology (NASA)	313.1	143.8	155.0	167.4
Nuclear power and propulsion (NASA)				
Space nuclear system (DOE)	94.8	20.1	31.0	39.4
Supporting space activities	323.6	296.0	319.8	348.0
Tracking and data acquisition (NASA)	323.6	296.0	319.8	348.0

[1]Estimates based on the President's 1979 budget to Congress.

Source: National Science Foundation

- **Space sciences** reflects a planned increase of 21 percent in 1979, which makes this subfunction almost one-fifth of the space funding total. Under physics and astronomy, continuing development is planned for the Earth-orbiting space telescope to be launched by the space shuttle in 1983. Two new science missions are proposed: the solar polar mission, which will investigate the polar regions of the Sun for the first time, and the solar mesospheric explorer, which will study the effect of solar radiation on the Earth's ozone layer. These missions will also be launched by the shuttle. Work will continue on development of the solar maximum mission, planned for launch in 1979, and on the two remaining missions of the high-energy astronomy observatories (HEAO's). An overall funding growth of 27 percent for physics and astronomy was proposed. Congressional actions have indicated approval for the significant programs in this area.

A 27-percent increase was also proposed in 1979 for lunar and planetary exploration. This covers the Jupiter orbiter/probe, (JOP), initiated in 1978 and scheduled for launching by the space shuttle in 1982. JOP represents the first direct probe of a giant planet and includes an orbiter to study Jupiter, its satellites, and magnetosphere. Congress indicated approval of these plans but reduced funds for lunar sample analysis.

- **Space technology** is expected to rise 11 percent in 1979 but to account for less than one-tenth of space R&D support. The major element of this subfunction is the NASA space research and technology program, designed to provide a technology base that will adequately support current and future space activities. The proposed 1979 funding increase is 8 percent. Support for the DOE space nuclear systems program, the other element, is expected to increase 27 percent in 1979.

- **Supporting space activities** consists of only one program, the tracking and data acquisition support effort for the entire NASA flight program. This includes automated missions in Earth orbit and to the planets, manned missions, sounding rockets, and aerodynamic test flights. The 1979 budget provides for an increase of 9 percent for this program.

- **Biomedical research** makes up the predominant share of funding for the health R&D total — an estimated 91 percent in 1979. The average annual growth of this subfunction was 12.1 percent from 1969 to 1968, compared with a proposed 3-percent increase for 1979.

The National Institutes of Health (NIH) within HEW provide more than nine-tenths of the R&D activity under biomedical research. NIH support for cancer research and heart and lung research combined now account for almost one-half of all NIH biomedical research activities. Between 1969 and 1977 support for these two program areas grew faster than for any of the other Institute programs, at an average annual rate of 20.2 percent for cancer research and 13.6 percent for heart and lung research, while growth for the rest of the NIH programs combined was only 8.7 percent. In 1978, however, the increase for cancer was 8 percent and for heart and lung research, 12 percent, while the relative increase of each of the other NIH programs was greater with the exception of dental research. Funding for research on eye diseases increased 36 percent; aging, 26 percent; environmental health sciences, 25 percent; and arthritis, metabolism, and digestive disease, 16 percent. Child health and human development, neurological and communicative disorders and stroke, and allergy and infectious diseases each increased 15 percent.

The NIH 1979 budget reflected a substantial shift from applied research to basic research. Total R&D obligations increased only 3 percent in the budget proposal, but those for basic research increased 12 percent. Small relative increases were shown for most broad NIH programs. The chief exception was a proposed 22-percent increase in child health and human development programs, reflecting expanded support for research in developmental biology and for behavioral and biological reproductive studies, including nutrition. This research complements Administration initiatives in child health assessment and in the prevention of unwanted teenage pregnancies. An increase of 9 percent was also proposed for environmental health sciences.

Health R&D obligations for selected years

[Dollars in millions]

	1969	1977	1978[1]	1979[1]
Health, total	$1,126.8	$2,603.7	$2,911.5	$3,034.1
Biomedical research	957.5	2,388.3	2,681.0	2,766.2
National Cancer Institute (NIH)(HEW)	165.7	722.3	778.8	797.2
National Heart, Lung, and Blood Institute (NIH)(HEW)	135.6	376.8	420.5	428.2
National Institute of Arthritis, Metabolism, and Digestive Diseases (NIH)(HEW)	116.8	210.0	243.7	249.4
National Institute of Child Health and Human Development (NIH)(HEW)	57.0	135.5	156.0	190.5
National Institute of General Medical Sciences (NIH)(HEW)	90.6	159.3	182.1	182.8
National Institute of Neurological and Communicative Disorders and Stroke (NIH)(HEW)	102.9	148.7	170.7	173.0
National Institute of Allergy and Infectious Diseases (NIH) (HEW)	78.5	133.7	153.6	159.3
Division of Research Resources (NIH)(HEW)	79.5	137.1	144.6	148.5
Medical and rehabilitation research (VA)	50.2	102.3	110.9	110.7
National Eye Institute (NIH) (HEW)	([2])	58.9	80.3	81.9
National Institute of Environmental Health Sciences (NIH) (HEW)	13.8	46.9	58.8	63.9
National Institute of Dental Research (NIH)(HEW)	21.9	52.2	57.6	57.8
National Institute of Aging (NIH)(HEW)	([3])	27.6	34.8	35.8
Disease control (CDC)(HEW)	16.3	14.4	18.3	18.1
Office of the Director (NIH) (HEW)	—	15.6	17.5	17.8
Drugs and devices (FDA)(HEW)	8.0	15.2	17.5	17.6
National Center for Toxicological Research (FDA)(HEW)	—	8.9	10.0	10.2
Other	20.7	22.8	25.4	23.6
Mental health	100.6	104.2	112.7	136.1
Mental health (ADAMHA)(HEW)	100.6	104.2	112.7	136.1
Drug abuse prevention and rehabilitation	15.3	49.8	51.4	68.2
Drug abuse research (ADAMHA) (HEW)	10.2	34.0	34.1	45.9
Alcoholism research (ADAMHA) (HEW)	5.0	14.8	16.2	21.2
Drug abuse program (VA)	—	1.0	1.0	1.0
Delivery of health care	53.5	61.4	66.4	63.7
Health services research (OASH) (HEW)	41.6	30.4	37.2	34.2
Health care demonstration (HCFA) (HEW)	—	7.8	5.8	5.8
Maternal and child health services (HSA)(HEW)	6.2	5.3	5.3	5.3
Patient care and special health services (HSA)(HEW)	2.0	3.5	4.0	4.0
Health services research (VA)	—	3.7	4.1	3.5
National health statistics (OASH)(HEW)	1.2	1.8	2.2	3.0
Emergency medical services (HSA) (HEW)	—	3.9	3.0	3.0
Family planning services (HSA) (HEW)	—	2.5	2.5	2.5
Other	2.5	2.5	2.2	2.5

[1]Estimates based on the President's 1979 budget to Congress.
[2]National Eye Institute included in National Institute of Neurological Disease and Stoke.
[3]National Institute of Aging included in National Institute of Child Health and Human Development.
Source: National Science Foundation

Congressional appropriations signed into law as of October 1978 indicated growth for overall NIH biomedical research of approximately 11 percent to 12 percent in 1979. These appropriations included greater growth for cancer research and heart and lung research than was requested in the budget but considerably more relative growth for the other Institutes.

Other biomedical research activities are represented chiefly by medical and rehabilitation research programs of the Veterans Administration, which are expected to stay at about the 1978 funding level; R&D activities of the Center for Disease Control (HEW), funding for which is scheduled to decline somewhat, and the drugs and devices and toxicological programs of the Food and Drug Administration (HEW), expected to increase slightly in level of funding.

- **Mental health** research declined as a share of the Health R&D funding total from 9 percent in 1969 to 4 percent in 1977. The support level in 1977 was only slightly higher than in 1969. In 1978, however, R&D support for mental health increased by an estimated 8 percent and the President't 1979 budget proposed a further increase of 21 percent.

The National Institute of Mental Health within the HEW Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) undertakes all of the R&D activity in this area. The 1979 proposed increases, which reflect the recommendations of the President't Commission on Mental Health, fall into four broad categories: mental disorders and maladaptive behavior; basic biological and developmental studies; social and cultural issues and problems; and mental health services research. Congress subsequently approved most of these requested increases.

- **Delivery of health care** shows a 4-percent decrease in 1979. The share of this subfunction in the health R&D funding total has dropped from 5 percent in 1969 to an estimated 2 percent in 1978 and 1979.

Health services research in the Office of the Assistant Secretary for Health (HEW) is the main program under deliver of health care. It is devoted to improving the organization, delivery, quality, and financing of health services.

Other programs within this subfunction include health care demonstrations under the sponsorship of the recently established Health Care Financing Administration (HEW) as well as maternal and child services, patient care and special health services, emergency medical services, and family planning services, all within the Health Services Administration (HEW).

- **Drug abuse prevention and rehabilitation** R&D funds increased almost fourfold between 1969 and 1974 but declined in 1975 and then changed little until 1979, when the President's budget recommended a 33-percent increase. The major programs affected are the drug abuse research program and the alcoholism research program within ADAMHA. The increase of more than 30 percent proposed for these programs in 1979 reflects the recommendations of the President's Commission on Mental Health. Congress later approved most of these proposals.

ENERGY DEVELOPMENT AND CONVERSION

- The **nuclear** subfunction accounted for almost two-fifths of the energy function in 1979, compared with more than two-thirds in 1969. Despite this declining share, obligations for nuclear energy R&D activities increased almost fourfold during this period. The 1979 budget, however, reflected a decrease of 13 percent in funding.

The 1979 budget recommended an overall 39-percent decrease for the DOE breeder reactor program, which covered a strong but reduced base program and a reduced technology effort for the liquid metal fast breeder reactor (LMFBR) as well as cancellation of the Clinch River, Tenn. breeder reactor project, and funds to accelerate investigations of alternative breeder concepts, especially those not involving fuels that could be readily used to produce nuclear weapons.

Subsequent legislative action on the breeder reactor program, as well as on other nuclear energy programs, may bring the 1979 total for the nuclear subfunction close to that of 1978.

The DOE nuclear research and applications program, which includes a spectrum of nuclear energy and nuclear-related technologies, was recommended for a 19-percent increase in funds in 1979. This would cover expanded efforts on gas-cooled and water-cooled breeder reactors, light-water reactor technology, and advanced isotope separation technology. The budget also provided funds to accelerate investigations of alternative advanced reactor system. Although the last program was not approved by Congress, the overall DOE nuclear research and applications program will still reflect a substantial increase.

A 10-percent increase was proposed for the DOE magnetic fusion program to allow continued research on two mainline approaches for magnetic confinement as well as various alternative concepts. Funds for this program were further increased by Congress, and await final legislative action.

Fuel cycle R&D activities are directed toward the development and evaluation of fuel processing technology, development of technology for the terminal storage of radioactive waste, and provision of interim storage for spent fuels while geologic facilities are being developed. A 19-percent reduction in funds was shown in 1979 as a result of cutbacks in the reprocessing technology program consistent with the nonproliferation policy. Later congressional action will probably still make for a decline in 1979, although a lesser one.

Energy development and conversion R&D obligations for selected years

[Dollars in millions]

	1969	1977	1978[1]	1979[1]
Energy development and conversion, total	$435.1	$2,301.5	$2,862.5	$2,827.1
Nuclear	305.9	1,086.6	1,244.7	1,080.4
Breeder reactor (DOE)	209.0	479.5	455.2	279.7
Nuclear research and applications (DOE)		139.2	177.1	210.3
Magnetic fusion (DOE)	26.5	195.2	203.9	225.0
Fuel cycle research and development (DOE)		136.1	250.9	204.0
Uranium enrichment activities (DOE)	26.1	3.0	3.5	3.0
Uranium resource assessment (DOE)		4.3	6.5	7.9
Reactor safety research (NRC)	24.5	94.0	111.1	134.2
Other	19.7	35.2	36.5	16.3
Fossil	22.8	557.4	636.5	623.7
Coal research and development (DOE)	18.1	490.7	526.3	519.9
Petroleum development (DOE)	4.7	48.4	77.6	78.2
Gas development (DOE)		18.3	32.6	25.2
Solar and geothermal		306.7	449.7	463.9
Solar energy development (DOE)	—	184.3	260.3	274.8
Solar demonstration: heating and cooling (DOE)		62.0	64.4	36.0
Fuels from biomass (DOE)		9.5	20.4	26.4
Geothermal energy development (DOE)		50.8	104.6	126.7
Conservation	—	171.2	306.1	376.5
Transportation energy conservation (DOE)	—	43.1	65.6	94.8
Multisector conservation: improved conservation efficiency (DOE)		30.0	58.5	77.0
Residential and commercial conservation: building and community systems (DOE)		27.5	59.5	57.8
Multisector conservation: energy storage systems (DOE)		31.2	48.5	55.9
Industrial energy conservation (DOE)		12.6	31.0	48.0
Utilities energy conservation: electric systems (DOE)		22.1	38.0	38.0
Other multisector conservation (DOE)		—	3.0	5.0
Energy conservation (OS) (DOT)		4.6	1.9	—
Other	106.4	179.6	225.5	282.6
Basic energy sciences (DOE)	104.3	129.1	149.7	175.6
Power supply and use (TVA)	(2)	15.8	22.9	37.2
Energy programs	—	26.3	39.8	26.5
Advanced technology and assessment projects (DOE)	-	1.1	7.5	21.0
Bonneville Power Administration (DOE)	2.1	5.4	4.0	13.9
Hydroelectric development (DOE)	—	1.6	10.0	8.0
Energy R&D program (Bu. Reclamation) (Interior)	—	.3	.5	.4
Federal Energy Administration	—	(3)	(3)	(3)

[1] Estimates based on the President's 1979 budget to Congress.
[2] Less than $50,000.
[3] The functions of the Federal Energy Administration were transferred to the Department of Energy.
Source: National Science Foundation

A 21-percent increase was proposed for the Nuclear Regulatory Commission (NRC) reactor safety research program in 1979. This program is concerned with analytical methods to assess the safety of nuclear power reactors. This increase was slightly modified by the Congress.

- **Fossil** energy programs constitute the second largest energy subfunction, accounting for one-fifth of all energy R&D obligations in 1979. The DOE coal resources program is predominant; a small decline in funding was proposed for 1979. The purpose of this program is to improve coal extraction technology, to develop technology for converting coal to liquid and gaseous fuels, to improve methods for the direct combustion of coal and to develop advanced power conversion systems, including magnetohydrodynamics, for generating electricity from coal.

The DOE petroleum program, which grew an estimated 60 percent in 1978, was expected to remain at about the same level in 1979. Enhanced oil recovery technologies and development of techniques for recovering oil from shale are the major elements of this program.

The DOE gas program reflects a 21-percent decrease for 1979 as a result of proposed cutbacks in enhanced gas recovery technologies. Congress reduced funds for overall fossil energy activities for 1979; the effect on individual programs will be seen later.

- **Solar and geothermal** energy is a relatively new but fast-growing subfunction, accounting for 16 percent of all energy R&D obligations in 1978 and 1979. The President's budget provided for an increase of 3 percent for this subfunction in 1979. This smaller growth results from reductions in the DOE solar heating and cooling demonstration program. Later congressional actions, increasing funds for this program as well as other solar and geothermal energy programs, could result in significant growth for this subfunction in 1979.

The DOE solar energy development program is comprised of three subprograms: thermal applications, solar electric applications, and technology support and utilization. A 6-percent increase was recommended in 1979, but the Congress substantially raised the requested level in a bill that was vetoed. Final legislative action was still pending at the end of 1978.

The DOE fuels from biomass program is directed toward developing the capability for converting renewable biomass resources—such as forest and agricultural residue, and animal manures and plants—into clean fuel. A 29-percent funding increase proposed in 1979, was again substantially raised by the Congress, with the final outcome still pending.

The DOE geothermal development program was recommended for a large increase in 1979. This increase would cover additional work in resource exploration and assessment activities, engineering research, hot dry rock studies, and market-oriented research studies. The Congress further increased the funding level, but final action is yet to be taken.

- The **conservation** subfunction has shown the most rapid growth of any energy area with an increase in support of 79 percent in 1978 and a proposed further increase of 23 percent in 1979, which was virtually all approved by the Congress with final action to take place later. During the 1977-79 period conservation as a share of the total energy R&D effort has increased from 7 percent to an estimated 13 percent.

In 1979 the DOE transportation energy conservation program showed a funding increase of 45 percent, which would cover efforts toward improved efficiency of energy use in transportation with emphasis on passenger automobiles. A substantial increase in the improved conversion efficiency program provides for expanded efforts in utilization of alternate fuels, advanced cogeneration technology, and the utilization of waste heat from federally owned facilities.

The DOE residential and commercial conservation program aims to reduce energy consumed by buildings, mostly through cost-sharing with industry. A slight decrease was proposed for this program in 1979.

Funds for the development of reliable and inexpensive energy storage systems will be substantially increased in 1979. The fastest growing R&D conservation area in the current period, however, is in the industrial sector. Among cost-sharing programs conducted by industry the largest increase in 1979 was proposed for industrial cogeneration.

- **Other** energy efforts account for an estimated 10 percent of the funding for the total energy function in 1979. The basic energy sciences program of DOE, the major one within this subfunction, was proposed for a 17-percent increase in 1979, which was somewhat reduced by the Congress. The objective of this program is to expand the knowledge base in science and engineering for all energy production and conservation technologies. Significant increases were also proposed for the TVA power supply and use program and the Bonneville Power Administration fund, now managed by DOE.

- The **environmental health and safety** subfunction has been the most heavily funded area within the environment function since 1976, and is expected to account for two-fifths of the total in 1979. A relatively small increase (2 percent) was proposed for these R&D efforts in 1979, however.

The DOE environmental R&D program, by far the largest program, is aimed at assuring the environmental health and safety acceptability of energy technologies under development. The decline in support for this program in 1979 reflected the transfer to the Environmental Protection Agency (EPA) of programs in support of long-range environmental goals and regulatory standards.

EPA pollution effects research covers eight programs, each concentrating on a specific medium or pollutant. The overall 23-percent increase proposed for these programs in 1979 primarily reflects an increase in energy-related environmental effects research, the largest program area, because of the transfer from DOE of the fossil fuel health and environmental research projects just mentioned. A decline in funding for EPA air pollution effects research is more than offset by increases in EPA water pollution, toxic substance, and interdisciplinary effects research.

Although the health and safety research program of the Bureau of Mines (Interior) showed a small decline in 1979, the level would still be 42 percent higher than in 1977.

The National Institute for Occupational Safety and Health (NIOSH) within the HEW Center for Disease Control provides the research base for Federal efforts to assure healthful and safe working conditions generally. Little change is expected in the support level in 1979.

The Bureau of Mines mining and environmental research program was first funded in 1977. Little change in support has been shown in the three years of this program.

The HEW Food and Drug Administration (FDA) sponsors a food safety research program covering the toxicology of environmental chemicals, and the USDA Agricultural Research Service (ARS) supports a human health and safety research program to assure that foods are free from toxic substances. Both programs showed small increases in the 1979 budget.

Funding for the NRC environmental and fuel cycle research program reveals an almost sixfold increase from the year of its inception, 1975, to 1978. No significant change however, was proposed for 1979.

Environment R&D obligations for selected years

[Dollars in millions]

	1969	1977	1978[1]	1979[1]
Environment, total	$284.6	$954.3	$1,066.3	$1,081.9
Environment health and safety	93.2	370.3	429.4	440.0
Environmental R&D (DOE)	62.6	163.2	191.0	184.0
Pollution effects research (EPA)	(2)	60.1	63.3	77.8
Health and safety research (Bu. Mines) (Interior)	2.2	35.4	52.3	50.4
National Institute for Occupational Safety and Health (CDC) (HEW)	15.1	40.8	44.4	45.0
Mining environmental research (Bu. Mines) (Interior)	—	14.8	15.2	14.6
Food safety research	NA	12.5	14.0	14.3
Environmental effects and fuel cycle research (NRC)	—	9.5	13.8	14.0
Other	13.3	33.9	35.1	39.7
Pollution control and environmental protection	76.8	315.9	347.5	325.1
Energy-related R&D programs (EPA)	—	100.8	119.8	96.2
Water quality control (EPA)	33.6	57.2	61.0	56.1
Air quality control (EPA)	32.2	31.8	26.9	35.1
Environmental quality monitoring (NASA)	—	34.2	36.2	27.1
Interdisciplinary studies (EPA)	—	22.9	24.5	24.6
Other	11.0	69.0	79.2	85.9
Understanding, describing, and predicting the environment	114.6	268.1	289.4	316.8
Environmental satellite programs (NASA)	73.4	94.0	71.7	75.3
Environmental programs (NOAA) (Commerce)	23.0	56.4	63.4	66.9
U.S. Antarctic Research Program (AAEO) (NSF)	6.9	39.9	43.6	47.5
Other environment-related programs (NOAA) (Commerce)	2.9	24.2	23.6	28.8
Mapping of earthquake geologic hazards and earthquake prediction (GS) (Interior)	1.2	11.9	30.8	31.5
Earthquake hazards mitigation (ASRA) (NSF)	—	9.9	19.4	28.6
Other environment-related programs (NSF)	3.7	19.1	22.5	23.8
Other	3.6	12.7	14.6	14.6

[1]Estimates based on the President's 1979 budget to Congress.
[2]Included under pollution control and environmental protection within water quality control and air quality control programs of EPA.
Source: National Science Foundation.

- **Pollution control and environmental protection** showed a 6-percent drop in funding in 1979. This decrease was primarily influenced by the largest program, the EPA energy-related R&D effort, for which supplemental requests were made in 1978, raising the level considerably. With the inclusion of these requests, funding levels reflected an estimated 19-percent increase in 1978 and a 20-percent decrease in 1979.

The EPA water quality control program includes R&D efforts to improve monitoring methods, establish cost-effective waste treatment technology, and develop strategies for controlling pollution from different sources. A moderate decrease in funding was shown in 1979.

The EPA air quality control program concentrates on data accumulation and technology development for establishing regulations and controls for limiting air pollution. The 30-percent increase in the 1979 budget provided for accelerated research efforts toward fulfilling the requirements of the Clean Air Act Amendments of 1977, as well as continuing to support EPA regulation under the Toxic Substances Control Act.

The NASA environmental quality monitoring program was expected to decline by 25 percent in 1979, reflecting the completion of the Nimbus-G spacecraft, an experimental air and water pollution monitoring satellite. But the budget provided funds for the new Halogen occultation experiment to improve the ability to monitor pollution of the upper atmosphere.

Other pollution control and environmental protection programs include EPA interdisciplinary studies and solid waste management, efforts in pesticides control, radiation protection, drinking water control, toxic substances research and noise control, and several programs of other agencies.

- **Understanding, describing, and predicting the environment** shows an increase of more than 9 percent in funding in 1979.

The NASA environmental satellite programs, important in this area, consist of four efforts that together were scheduled for a 5-percent increase in funding in 1979. The largest, weather observation and forecasting, showed a decrease because of completion in 1978 of development of the Tiros-N meteorological satellite. NASA severe storm research and global atmospheric research, however, continued at higher levels. The ocean condition monitoring and forecasting program, second in size of funding, also was to receive a cutback in funds in 1979 as development of the Seasat-A satellite is completed, with launching scheduled for 1978. As part of a Government-wide initiative in climate research, the 1979 budget proposed an almost fivefold increase in the NASA climate research program, third among the environmental satellite programs in size of funding in 1979. The chief feature of this program is the Earth radiation budget satellite system (ERBS), scheduled for launch in 1982, to measure variations in the energy exchange between the Earth's atmosphere and space.

The fourth largest NASA environmental satellite program, earth dynamics monitoring and forecasting, showed increased funding in 1979. Work under this program contributes to earthquake prediction capability.

The National Oceanic and Atmospheric Administration (NOAA) within Commerce supports a group of eight programs that are environment-related. These combined programs showed an increase of 6 percent for 1979.

The U.S. Antarctic research program, sponsored by NSF, has increased in funding every year since 1969 and was scheduled to expand by 9 percent in 1979. Scientific efforts are centered on environmental and resource-related studies.

Geological Survey (Interior) mapping of earthquake geologic hazards and earthquake prediction more than doubled in funding in 1978, but only a small increase of 2 percent was proposed for 1979. Efforts are concentrated on developing basic data on geologic principles and processes, especially on terrain and foundation conditions susceptible to earthquakes.

NSF is sponsoring a complementary program on earthquake hazards mitigation. Support for this program almost doubled in 1978, and a further increase of 46 percent was proposed in the 1979 budget. These funds would have provided for new research on the understanding of earthquake mechanisms and processes, improved engineering design of structures for seismic safety, and the development of effective strategies for community emergency preparedness programs. However, as a result of later legislative action, 1979 funding for this program is likely to remain near the 1978 level.

Other NOAA programs cover marine ecosystems investigations, environmental satellite services, and international projects. Each of these programs showed an increase in the 1979 budget.

Other NSF efforts include the international biological program, the global atmospheric research program, climate dynamics, environmental forecasting, and the Arctic research program. A 6-percent increase in these combined efforts was proposed for 1979.

- The high-energy physics program of DOE accounts for almost one-fifth of the funding within the **science and technology base function.** This program supports studies of the fundamental properties and structure of energy and matter to obtain new scientific knowledge about the underlying forces of nature. High-energy physics research depends primarily upon the utilization of large national accelerator facilities. A small increase in funding proposed for this program in 1979 was approved by the Congress.

The DOE nuclear physics program, next in size of support, accounted for 7 percent of R&D funding for this function in the 1979 budget. This program is concerned with experimental and theoretical studies of the properties and dynamics of atomic nuclei and the characterization of the forces that govern their interaction. These investigations are also largely carried out in national accelerator facilities. A 5-percent increase in support for this program was proposed in the 1979 budget and was slightly raised by the Congress.

NSF research project support programs are aimed at providing the Nation with a strong scientific capability and an expanding base of scientific knowledge. The combined funding for the 14 NSF research project support areas makes up approximately one-half of all obligations for the science and technology base function. A 9-percent increase in funding for overall NSF research project support was proposed for 1979. The largest support areas are materials; physiology, cellular and molecular biology; physics; engineering; and chemistry. Each of these five areas was scheduled for an increase in 1979 ranging between 7 percent and 9 percent. All nine remaining areas were scheduled for growth in 1979, but the largest relative increases were planned for social sciences research, behavioral and neural sciences research, and earth sciences research.

NSF supports six national research centers—five for astronomy and one for atmospheric sciences. These centers provide specialized facilities, equipment, staffing, and operational support that are beyond the capability of most individual educational or research institutions. The funding level of the six centers combined is expected to rise 13 percent in 1979. Each of the centers is scheduled for a substantial increase except for the National Astronomy and Ionosphere Center, which is scheduled for a decrease.

The DOE life science and biomedical applications program seeks better understanding of the way physical and chemical agents interact with life processes in ecological systems and in human and animal populations. The program also seeks to develop medical uses of nuclear technology, such as the use of stable and radioactive isotopes for disease detection. A slight decline in support for this program was planned for 1979, and no change was made through congressional action.

The increase in funding of 31 percent planned for the NASA program on materials processing in space is primarily for the full-scale development of shuttle/spacelab payloads. These payloads will provide for systematic materials research and development in the early years of shuttle operations, making practical applications possible in the late eighties.

The National Bureau of Standards (Commerce) has for many years conducted research and development to ensure that users of science and technology in the United States will be able to make physical measurements with the required accuracy, yielding the same results over time, and reconcilable with other like measurements made elsewhere. An increase of 3 percent in funds for this program was proposed for 1979.

The remaining programs within science and technology base include some specially targeted NSF programs, such as oceanographic facilities operations support, the ocean sediment coring program, and science information; a portion of NSF applied science and research applications (ASRA) programs; patent activities within Commerce; and work of the Library of Congress. A reduction in some of the ASRA programs of NSF was made by the Congress.

Science and technology base R&D obligations for selected years

[Dollars in millions]

	1969	1977	1978[1]	1979[1]
Science and technology base, total	$ 436.0	$ 900.9	$ 988.4	$1,061.1
High-energy physics (DOE)	118.6	170.0	188.0	194.0
Nuclear physics (DOE)	24.2	64.2	69.1	72.9
Materials research project support (MPE) (NSF)	7.8	56.2	64.1	69.0
Physiology, cellular and molecular biology research project support (BBS)(NSF)	27.6	54.9	61.4	65.6
Physics research project support (MPE)(NSF)	25.7	55.7	52.5	57.3
National Research Centers (NSF)	24.5	47.1	50.8	57.3
Engineering research project support (MPE)(NSF)	16.0	44.7	48.8	53.1
Chemistry research project support (MPE)(NSF)	17.8	43.0	46.7	51.0
Life sciences and biomedical applications (DOE)	26.9	42.7	41.5	39.7
Environmental biology research project support (BBS)(NSF)	7.0	32.3	34.9	36.6
Behavioral and neural sciences research project support (BBS)(NSF)	8.2	25.5	30.3	35.4
Smithsonian Institution	14.8	29.7	32.6	34.0
Social sciences research project support (BBS)(NSF)	10.8	22.8	25.7	31.5
Materials processing in space (NASA)	—	11.4	21.0	27.5
Earth sciences research project support (MPE)(NSF)	7.9	17.4	22.4	25.8
Mathematical sciences research project support (MPE)(NSF)	12.7	21.5	23.0	24.7
Basis for national physical measurement system (NBS) (Commerce)	16.4	22.9	23.4	24.2
Atmospheric sciences research project support (AAEO)(NSF)	8.2	18.9	21.2	22.2
Oceanographic facilities and support (AAEO)(NSF)	8.6	19.7	21.4	22.1
Oceanography research project support (AAEO)(NSF)	11.0	18.9	20.5	21.3
Computer research project support (MPE)(NSF)	11.4	16.9	17.8	19.4
Astronomy research project support (AAEO)(NSF)	6.8	14.4	16.8	17.8
Ocean sediment coring program (AAEO)(NSF)	2.4	13.7	14.3	15.4
Other	20.3	36.8	40.4	43.4

[1]Estimates based on the President's 1979 budget to Congress

Source: National Science Foundation

Appendix B

Technical Notes

These notes deal with the scope and method of compiling this report and with its relationship to other reports and studies.

Scope

This report is based on data reported to the National Science Foundation (NSF) by Federal agencies and agency subdivisions in a survey conducted in the March-May period of each year (*Federal Funds for Research and Development*, Volumes XIX through XXVII). All agencies with R&D programs are covered. The data are based on the President's budget to Congress and cover the three fiscal years of each budget period. Thus, in the latest survey fiscal years 1977, 1978, and 1979 were covered. Data for 1978 and 1979 are estimates subject to subsequent congressional appropriations and Executive apportionment. But data for fiscal year 1977 and the earlier years, 1969-76, are actual since they reflect final fiscal actions.

In Volume XX obligational data were reported by agency program for the first time, making possible the compilation of a report of this nature. Programs have been identified in each annual survey since then by the appropriation titles and program activities under which they appear in the Federal budget. With this information and some additional program breaks obtained by interview, the function series could be constructed from 1970 through the latest year. Comparable program data for 1969 were informally obtained from the agencies, but data for earlier years were not obtainable.

At this point, an 11-year perspective on Federal R&D programs is available for analysis. The purpose of the analysis is to make visible the main directions of Federal R&D efforts and to provide a view of changes in priorities over a period of time.

The data are additive to 100 percent so that no overlap occurs between functions or programs since programs are assigned to functions and subfunctions on the basis of their *primary* R&D purposes. Such a system permits a comparison of priorities on an internally consistent and mutually exclusive basis. The report is constructed on the basis of the agency/program structure existing at the present time with the data for prior years arranged to conform to the present structure. The only exceptions are in the case of programs that have been terminated but must still be shown as part of prior-year totals; these are listed in program stubs under the agencies that sponosred them at the time. In a number of instances the allocation of dollar amounts to earlier programs had to be estimated either because some agencies did not exist in earlier years, or did not exist as identifiable units, or because agency reorganizations have resulted in program splitting.

NSF staff decided on the assignment of programs to given functions and subfunctions; with all the Federal R&D programs available for comparison simultaneously the staff could resolve fine points of difference and group like programs together. The judgment of other analysts might result in somewhat different groupings. The programs are shown in appendix table C in sufficient detail, however, to provide the basis for the construction of various systems and analytic approaches.

Timing

Data obtained from the current *Federal Funds* survey for fiscal years 1977-79 are based on program requests contained in the President's budget message to Congress in January 1978. By the time the *Federal Funds* questionnaire was completed in March-April 1978, however, some revisions had been made in budget program levels to reflect reprogramming or other changes.

Data for 1978 and 1979 are estimated and do not reflect final apportionment actions and programming for 1978 or appropriation and apportionment actions for 1979 occurring after the President's budget request.

Organization

This report is organized into a summary analysis and three appendixes. The summary is concerned with broad comparisons of growth rates and program changes for the various functions throughout the 1969-79 period, and for shorter periods within that timespan, and with shifts in priorities between functional areas. Brief discussions of the most important programs within each function are included. Appendix A is concerned with a detailed discussion of the current programs of the six leading functions and their subfunctions with summary tables. Special attention is given to significant changes between 1978 and 1979, and congressional action for 1979 is noted. Appendix B covers technical notes, and appendix C is the detailed table.

In this report, 439 programs or program areas are covered. The sources for program descriptions were (1) the narrative sections of the *Federal Funds* survey responses; (2) the *Budget Appendix, 1979*; (3) *Special Analysis P: Research and Development* of the 1979 budget; and (4) congressional committee reports.

Method

Structure: The classification system in this report is based on 15 functions and 32 subfunctions that form the structure for the analysis. The categories were chosen to make visible the most important R&D objectives as reflected in agency programs in the 1979 Federal budget. Functions and subfunctions were chosen on the basis of size of effort, current and ongoing public interest in an area, and the need for a clear-cut definitional framework encompassing all Federal R&D programs. No ambiguous function headings, such as "other" or "miscellaneous" were used.

The data are additive to 100 percent so that no overlap occurs between functions or programs, and programs are assigned to functions and subfunctions in terms of their primary R&D purposes. Such a system permits a comparison of priorities on an internally consistent and mutually exclusive basis.

Definitions: The definitions of R&D activities are those provided the agencies by NSF in its *Federal Funds* survey instructions.

The definitions of functions and subfunctions are implicit in their titles and content. Some programs, however, might appear to span more than one functional area with equal emphasis in each area. This situation has arisen in the case of some programs related to *natural resources and environment*. Then, a rule was evolved that R&D programs primarily devoted to studying, inventorying, or managing resources would be placed under *natural resources* and that R&D programs primarily devoted to studying interactions within systems or studying pollution and/or its effects on living systems would be placed under *environment*. Safety programs were additionally placed under *environment* (under the *environmental health and safety* subfunction).

Also, in the case of programs that might fall between *area and community development, housing, and public services* and *income security and social services*, the criterion was established that programs primarily directed to improving the economies or general conditions of regions, including urban areas, were to be placed under the *area and community development* function and programs directed primarily to bettering the economic or social conditions of individuals were to be placed under *income security and social services*.

NSF staff decided on the assignment of the programs to given functions or subfunctions, and with all the Federal R&D programs studied and compared at one time, the staff could resolve fine points of difference and group like programs together.

Average annual growth rate comparisons: Tables showing average annual percent changes are based on growth rate conversion tables, which provide average annual growth rates for given timespans and given ratios of terminal-year data to initial-year data. Conversion tables are based on a standard compound interest rate formula.

Relation to Other Reports

(1) Since 1952 NSF has published an annual series covering Federal R&D funding by agencies. The reports are issued under the title *Federal Funds for Research and Development*. They include R&D expenditures and R&D obligations by agencies. The obligational data are further broken down by basic research, applied research, and development, as well as by performing sector, field of science, and State distribution. As noted above, the agency R&D program data furnished for *Federal Funds*, Volumes XX through XXVII were used for this report to construct the series back to 1969. Overall totals in the historical tables for *Federal Funds*, Volume XXVII and in this report are identical.

(2) *An Analysis of Federal R&D Funding by Budget Function, Fiscal Years 1960-1972*, published in 1971, was the first NSF report to compile and analyze Federal R&D data on a functional basis. It was based for the most part on aggregate program totals of Federal agencies and agency subdivisions, and did not probe deeper to the individual program level. It followed the function system in the Federal

budget, which is shown in terms of outlays only. For comparability, R&D data were shown in terms of expenditures. The R&D program distribution, which followed the budget function scheme established by the Office of Management and Budget (OMB), placed programs under function headings that embraced overall missions of the sponsoring agencies. While ratios could thus be obtained of the R&D effort to the total Federal effort in each function area, many R&D programs had to be placed under inappropriate categories.

(3) *An Analysis of Federal R&D Funding by Function, Fiscal Years 1963-1973,* published in 1972, also followed the budget function system and provided R&D data in terms of expenditures. It again placed R&D programs under functions that embraced the overall missions of sponsoring agencies. In addition, however, this report offered an alternative system whereby R&D programs were arranged by a separate set of functions that reflected the primary purposes of the programs so that a truer perspective on R&D priorities could be obtained.

(4) *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1974,* published in 1973, was based on a classification system that evolved from the alternative approach. This report did not follow the budget function structure, which is shown in outlays, and therefore data could be shown in obligations, which more closely reflect budget planning than do expenditures. A total of 14 function headings was used, with 40 subfunctions.

Even though function headings were similar in some cases to those used in the Federal budget (e.g., national security, space, and health), the criteria for assigning R&D programs to functions differed between the two systems. Hence, ratios of R&D programs to overall Federal programs could not be calculated, function by function. For example, in the budget system, under the *health* function the health-related R&D programs of the Veterans Administration (VA) are omitted because they are posted under a *veterans benefits* function, whereas in the system used in this report the R&D portion of VA programs related to health were included under *health.* In all other cases where a function heading was the same in concept in this report and previous reports, the differences in overall function structures meant that the R&D program content for a function would differ somewhat between reports.

(5) *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1975,* published in 1974, and *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1976,* published in 1975, followed exactly the same function/subfunction structure as the 1969-1974 report. From one report to another, however, programs were sometimes shifted between functions as program purposes were reevaluated. Each report was, thus, a revised edition with changed historical series.

(6) *An Analysis of Federal R&D Funding by Fucntion, Fiscal Years 1969-1977,* differed from the previous reports in that the structure was based on 15 functions and 34 subfunctions. A new major function was added—*food, fiber, and other agricultural products.* The programs under this function consisted of those formerly assigned to a *food* subfunction within *natural resources,* plus five programs formerly placed under *economic growth and productivity.*

(7) *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1978,* and *1969-1979,* follow the same function/subfucntion structure as in the 1969-1977 report except for the elimination of the two subfunctions under *crime prevention and control.* In the latest report, however, appendix A covers only the six largest function areas.

(8) In *Special Analyses, Budget of the United States Government, Fiscal Year 1979, Special Analysis P: Research and Development,* OMB published estimates of obligations and expenditures for Federal research, development, and R&D plant. A broad comparison of defense, space, and "civilian" programs was shown over a timespan, but more detailed functional analyses were not provided.

(9) Other reports based on functional studies of the Federal budget have been published, some of them covering R&D data specifically. These have not followed the budget classificaiton completely but have made certain rearrangements of data under functional headings, and retitled some of the headings. It should be stressed that every function system is judgmental and each system reflects the concerns of the times and the needs of the audience for whom it is devised.

APPENDIX C
Detailed Statistical Table

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

/Dollars in millions/

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total, all functions	$15,641.1	$15,340.3	$15,545.0	$16,497.8	$16,800.1	$17,414.7	$18,988.4	$20,723.5	$23,929.1	$26,419.5	$27,972.2
National defense, total	8 356.2	7,980.7	8,109.9	8,901.6	9,001.9	9,015.8	9,679.3	10,429.7	11,863.8	12,785.8	13,832.8
Defense military	7,687.0	7,350.9	7,500.5	8,307.1	8,394.1	8,409.0	9,001.0	9,629.1	10,939.5	11,798.7	12,809.8
DOD-RDT&E	7,386.9	6,984.4	7,161.4	7,945.3	8,000.4	8,008.5	8,571.9	9,212.4	10,522.2	11,329.6	12,342.9
Technology base	(1)	(1)	(1)	1,461.9	1,376.1	1,353.4	1,371.5	1,486.6	1,682.1	1,805.1	1,989.8
Advanced technology development	(1)	(1)	(1)	238.4	160.0	200.2	300.0	556.9	536.7	491.5	590.8
Strategic programs	(1)	(1)	(1)	1,581.1	1,896.1	1,882.0	2,143.0	2,222.3	2,332.5	2,517.6	2,207.7
Tactical programs	(1)	(1)	(1)	3,019.2	2,936.2	2,811.0	2,923.0	2,895.3	3,847.8	4,398.0	5,056.4
Intelligence and communications	(1)	(1)	(1)	492.6	528.0	664.7	642.9	886.9	830.0	833.4	1,100.5
Programwide management and support	(1)	(1)	(1)	1,152.1	1,104.1	1,097.2	1,191.5	1,164.3	1,293.0	1,284.0	1,397.7
Other DOD military	300.1	366.5	339.1	361.8	393.7	400.5	429.1	416.7	417.3	469.1	466.9
Defense-related atomic energy	668.7	628.8	608.9	593.9	607.8	606.8	678.3	800.6	924.3	987.1	1,023.0
Intelligence and arms control (DOE)	551.2	502.6	468.8	451.2	454.3	411.5	447.4	10.1	19.1	24.7	28.4
Weapons R&D and testing activities (DOE)								518.4	591.8	590.3	584.7
Inertial confinement fusion (DOE)						36.9	45.6	60.7	80.2	104.0	91.8
Naval reactors (DOE)	115.1	121.8	136.3	138.9	149.5	154.1	172.6	188.7	191.8	216.6	265.6
Special materials production (DOE)	NA	NA	NA	NA	NA	NA	6.5	11.0	14.0	13.6	12.4
Nuclear materials security and safeguards (DOE)	2.5	4.4	3.8	3.8	4.0	4.4	6.2	11.8	27.4	38.0	40.1
Other defense-related activities	.5	1.0	.6	.5	-	-	-	-	-	-	-
Office of Emergency Preparedness	.5	1.0	.6	.5	-	-	-	-	-	-	-

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

[Dollars in millions]

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Space, total	3,731.7	3,509.9	2,893.0	2,714.3	2,601.3	2,477.6	2,511.3	2,863.2	3,065.9	3,140.8	3,382.9
Space transportation systems	2,627.7	2,427.4	1,816.1	1,634.0	1,526.6	1,420.2	1,502.7	1,897.8	2,121.5	2,120.4	2,203.0
Space shuttle (NASA)	-	12.5	63.1	63.8	202.0	514.7	794.4	1,202.6	1,409.2	1,345.5	1,435.7
Space flight operations (NASA)	158.5	332.0	420.6	555.9	815.6	511.3	297.7	188.1	198.7	267.1	311.1
Space transportation system operations capability development	-	-	-	-	-	-	3.0	15.5	16.8	59.5	110.2
Space transportation system operations	-	-	-	-	-	-	-	-	-	17.7	33.3
Development, test, and mission operations	-	-	-	-	266.0	224.0	169.1	160.6	166.4	175.9	162.6
Advanced programs	17.3	7.4	18.4	21.1	20.0	16.4	16.0	12.0	12.0	10.0	5.0
Planning and program integration	-	-	-	-	-	-	-	-	3.5	4.0	-
Skylab	141.2	324.6	402.2	534.8	484.6	179.3	-	-	-	-	-
Apollo-Soyuz Test Project	-	-	-	-	45.0	91.5	109.6	-	-	-	-
Expendable launch vehicle development and support (NASA)	59.4	69.5	79.6	98.8	119.2	80.4	91.6	165.5	151.0	134.2	76.3
Apollo (NASA)	2,080.7	1,679.0	910.0	582.2	71.3	-	-	-	-	-	-
Research and program management (NASA)	329.0	334.4	342.8	333.3	318.5	313.8	319.0	341.6	362.6	373.6	379.9

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

(Dollars in millions)

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Space sciences	372.6	400.5	408.4	554.3	657.4	620.0	567.2	535.4	484.5	514.6	625.1
Physics and astronomy (NASA)	150.6	129.2	122.9	117.8	139.1	133.7	150.2	158.9	165.8	223.6	284.8
Lunar and planetary exploration (NASA)	103.0	161.9	181.0	313.8	383.7	348.5	281.8	253.5	191.4	146.8	186.6
Life sciences (NASA)	39.6	19.4	14.9	17.1	23.2	21.3	19.8	20.5	22.1	33.2	40.5
Research and program management (NASA)	79.3	90.1	89.6	105.6	113.4	116.5	115.4	102.5	105.2	111.0	113.2
Space technology	407.9	368.2	340.6	236.3	161.4	152.0	154.5	145.6	163.9	186.0	206.8
Space research and technology (NASA)	313.1	196.2	180.9	134.2	122.8	125.8	127.8	125.9	143.8	155.0	167.4
Nuclear power and propulsion (NASA)		91.1	84.9	60.3							
Space nuclear systems (DOE)	94.8	80.9	74.8	41.8	38.6	26.2	27.2	19.7	20.1	31.0	39.4
Supporting space activities	323.6	313.8	327.9	289.7	255.9	285.5	286.9	284.4	296.0	319.8	348.0
Tracking and data acquisition (NASA)	323.6	313.8	327.9	289.7	255.9	285.5	286.9	284.4	296.0	319.8	348.0

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

[Dollars in millions]

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Health, total	1,126.8	1,125.8	1,338.0	1,588.8	1,624.3	2,096.4	2,176.9	2,365.5	2,603.7	2,911.5	3,034.1
Biomedical research	957.5	943.9	1,115.4	1,350.5	1,421.5	1,861.3	1,971.9	2,159.8	2,388.3	2,681.0	2,766.2
Disease control (CDC)(HEW)	16.3	14.6	20.4	16.0	15.5	16.3	13.4	17.8	14.4	18.3	18.1
Drugs and devices (FDA)(HEW)	8.0	5.7	7.6	10.3	10.9	14.9	12.5	12.5	15.2	17.5	17.6
National Center for Toxicological Research (FDA)(HEW)	-	-	-	-	5.4	6.4	7.6	9.0	8.9	10.0	10.2
National Cancer Institute (NIH)(HEW)	165.7	166.5	217.8	313.5	370.6	522.3	605.0	676.7	722.3	778.8	797.2
National Heart, Lung, and Blood Institute (NIH)(HEW)	135.6	135.7	170.6	206.8	226.8	306.9	306.8	346.9	376.8	420.5	428.2
National Institute of Arthritis, Metabolism, and Digestive Diseases (NIH)(HEW)	116.8	110.2	116.5	132.0	123.2	157.9	159.5	173.0	210.0	243.7	249.4
National Institute of General Medical Sciences (NIH)(HEW)	90.6	83.6	95.8	112.0	104.5	126.9	135.0	144.5	159.3	182.1	182.8
National Institute of Neurological and Communicative Disorders and Stroke (NIH)(HEW)	102.9	79.5	85.6	98.7	91.2	124.3	130.0	132.1	148.7	170.7	173.0
National Institute of Allergy and Infectious Diseases (NIH)(HEW)	78.5	84.2	89.6	96.2	90.1	111.3	110.7	117.8	133.7	153.6	159.3
National Institute of Child Health and Human Development (NIH)(HEW)	57.0	61.3	80.0	101.9	99.3	128.5	130.0	125.8	135.5	156.0	190.5
National Institute of Dental Research (NIH)(HEW)	21.9	21.7	28.5	36.4	36.5	40.6	44.2	45.3	52.2	57.6	57.8
National Eye Institute (NIH)(HEW)	(2)	18.8	25.2	32.1	29.8	39.2	39.3	45.2	58.9	80.3	81.9
National Institute of Aging (NIH)(HEW)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	17.4	27.6	34.8	35.8
Division of Research Resources (NIH) (HEW)	79.5	66.1	65.8	74.5	98.6	129.5	126.7	129.9	137.1	144.6	148.5

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

(Dollars in millions)

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
John E. Fogarty International Center (NIH)(HEW)	.2	1.5	2.2	2.5	3.9	5.0	5.7	5.7	7.7	8.5	8.5
National Library of Medicine (NIH) (HEW)	4.9	4.2	4.2	5.4	4.5	5.2	5.0	8.5	7.6	7.9	8.0
Scientific activities overseas (NIH)(HEW)	7.3	4.5	10.4	3.8	2.5	.9	.5	3.3	3.9	5.2	3.7
Office of the Director (NIH)(HEW)	-	6.6	7.1	9.3	9.2	10.8	14.7	16.7	15.6	17.5	17.8
Division of Biologics Standards (NIH)(HEW)	6.3	5.6	6.7	5.6	-	-	-	-	-	-	-
National Institute of Environmental Health Sciences (NIH)(HEW)	13.8	13.3	16.7	22.8	23.6	27.3	32.4	34.9	46.9	58.8	63.9
Office of International Health (HEW)	-	-	-	-	.7	2.7	-	-	-	-	-
Aviation medicine (FAA)(DOT)	2.0	1.9	2.1	2.4	2.8	3.1	2.9	2.8	3.6	3.8	3.4
Medical research (VA)	48.8	57.0	60.6	66.4	67.8	77.9	86.2	91.9	97.8	104.4	104.1
Rehabilitation research (VA)	1.4	1.6	2.0	2.0	4.2	3.2	3.8	3.4	4.5	6.5	6.6
Mental health	100.6	94.2	99.5	104.7	85.7	108.3	94.3	94.0	104.2	112.7	136.1
Mental health (ADAMHA)(HEW)	100.6	94.2	99.5	104.7	85.7	108.3	94.3	94.0	104.2	112.7	136.1
Drug abuse prevention and rehabilitation	15.3	17.3	21.3	36.1	49.5	59.2	49.9	46.5	49.8	51.4	68.2
Drug abuse program (VA)	-	-	.3	.7	1.0	.8	1.0	1.0	1.0	1.0	1.0
Special Action Office for Drug Abuse Prevention	-	-	-	-	12.0	11.1	3.8	-	-	-	-
Drug abuse (ADAMHA)(HEW)	10.2	12.1	14.5	27.3	29.6	34.0	34.0	33.8	34.0	34.1	45.9
Alcoholism (ADAMHA)(HEW)	5.0	5.2	6.6	8.1	6.9	13.3	11.1	11.7	14.8	16.2	21.2

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

[Dollars in millions]

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Delivery of health care	53.5	70.4	101.8	97.4	67.6	67.6	60.8	65.3	61.4	66.4	63.7
Health services research (OASH)(HEW)	41.6	38.3	56.3	56.2	46.9	51.6	37.9	33.1	30.4	37.2	34.2
National health statistics (OASH)(HEW)	1.2	1.1	.6	.6	1.8	.6	1.7	2.2	1.8	2.2	3.0
Maternal and child health services (HSA)(HEW)	6.2	5.9	5.7	5.9	5.9	5.7	6.6	5.3	5.3	5.3	5.3
Family planning services (HSA)(HEW)	-	-	1.1	2.6	2.5	2.5	1.6	2.4	2.5	2.5	2.5
Patient care and special health services (HSA)(HEW)	2.0	1.9	2.0	2.1	3.2	2.9	3.5	3.5	4.0	4.0	
Indian health services (HSA)(HEW)	.6	.6	.7	.8	.9	1.0	1.0	1.0	1.0	1.0	
Special foreign currency program (HSA)(HEW)	1.9	.5	3.4	1.5	1.2	.1	.8	1.2	.9	.6	.9
Emergency medical services (HSA)(HEW)	-	-	-	-	-	-	4.4	4.1	3.9	3.0	3.0
Health underserved rural areas (HSA)(HEW)	-	-	-	-	-	-	-	9.1	.6	.6	.6
Health care demonstration (HCFA)(HEW)	-	-	-	-	-	-	-	2.1	7.8	5.8	5.8
Health and nutrition (OEO)		22.2	32.0	27.7	4.4	-	-	-	-	-	
Health services research (VA)	-	-	-	-	1.3	2.9	3.9	1.3	3.7	4.1	3.5

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

[Dollars in millions]

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Energy development and conversion, total	435.1	424.8	422.1	475.1	534.7	664.8	1,186.1	1,438.8	2,301.5	2,862.5	2,827.1
Nuclear	305.9	295.9	285.5	334.7	373.1	430.3	594.5	715.9	1,086.6	1,244.7	1,080.4
Magnetic fusion (DOE)	26.5	27.7	28.3	31.0	37.0	53.0	97.9	130.2	195.2	203.9	225.0
Breeder reactor (DOE)								347.9	479.5	455.2	279.7
Nuclear research and applications (DOE)	209.0	194.3	195.6	234.0	256.7	289.6	399.0	[5]103.9	[5]139.2	[5]177.1	210.3
Fuel cycle R&D (DOE)							33.6	48.8	136.1	250.9	204.0
Uranium enrichment activities (DOE)	26	27.9	26.0	30.7	35.0	45.4	1.9	2.1	3.0	3.5	3.0
Uranium resource assessment (DOE)							.4	1.8	4.3	6.8	7.9
Light water reactor facilities (DOE)	-	-	-	-	-	-	-	-	26.5	24.3	6.5
International spent fuel storage (DOE)	-	-	-	-	-	-	-	-	-	5.0	3.0
Applied energy technology (DOE)	19.7	20.1	13.8	12.6	10.6	(6)	(6)	(6)	(6)	(6)	(6)
Reactor safety research (NRC)	24.5	26.0	21.7	26.4	33.9	41.7	60.4	78.2	94.0	111.1	134.2
Safeguards research (NRC)	-	-	-	-	-	.6	1.3	3.0	8.7	7.2	6.8
Fossil	22.8	21.8	36.5	39.1	50.3	89.2	314.0	368.6	557.4	636.5	623.7
Coal R&D (DOE)	18.1	16.7	30.7	32.9	43.8	78.0	276.2	330.3	490.7	526.3	519.9
Petroleum development (DOE)									48.4	77.6	78.2
Gas development (DOE)	4.7	5.1	5.8	6.2	6.5	11.2	37.9	38.4	18.3	32.6	25.7
Solar and geothermal	-	-	-	2.4	5.2	19.1	82.8	126.6	306.7	449.7	463.9
Fuels from biomass (DOE)								4.6	9.5	20.4	26.4
Solar demonstration: heating and cooling (DOE)	-	-	-	1.7	4.0	12.1	54.7	14.8	62.0	64.4	36.0
Solar energy development (BOS)								76.5	184.3	260.3	274.8
Geothermal energy development (DOE)	-	-	-	.7	1.1	7.1	28.0	30.7	50.8	104.6	126.7

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

[Dollars in millions]

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Conservation	-	.5	2.2	5.5	6.3	17.9	52.0	70.5	171.2	306.1	376.2
Utilities energy conservation: electric energy systems (DOE)								11.9	22.1	38.0	38.0
Residential and commercial conservation: building and community systems (DOE)								10.7	27.5	59.5	57.8
Industrial energy conservation (DOE)	-	.5	2.2	5.1	5.9	14.6	45.9	3.8	12.6	31.0	48.0
Transportation energy conservation (DOE)								12.2	43.1	65.6	94.8
Multisector conservation: energy storage systems (DOE)								19.9	31.2	48.5	55.9
Multisector conservation: improved conversion efficiency (DOE)								7.0	30.0	58.5	77.0
Other multisector conservation (DOE)								-	-	3.0	5.0
Energy conservation (OS)(DOT)	-	-	-	.4	.4	3.3	6.0	5.0	4.6	1.9	-
Other	106.4	106.6	97.9	93.4	99.9	108.4	142.9	157.2	179.6	225.5	282.6
Federal Energy Administration	-	-	-	-	-	-	1.3	3.0	(8)	(8)	(8)
Energy R&D program (Bu. Reclamation) (Interior)	-	-	-	-	-	-	-	.4	.3	.5	.4
Energy systems (RANN)(NSF)	-	1.3	2.0	1.4	3.0	3.7	4.5	-	-	-	-
Energy programs (NASA)	-	-	-	-	-	[9]7.2	[9]13.3	[9]23.0	[9]26.3	[9]30.8	[9]26.5
Power supply and use (TVA)	(7)	.1	.6	.3	4.6	[9]6.5	[9]9.1	[9]10.8	[9]15.8	[9]22.9	[9]37.2
Advanced technology and assessment projects (DOE)	-	-	-	-	-	-	-	-	1.1	7.5	21.0
Basic energy sciences (DOE)	104.3	103.4	93.4	89.2	89.4	88.7	108.5	112.9	129.1	149.7	175.6
Hydroelectric development (DOE)	-	-	-	-	-	-	-	-	1.6	10.0	8.0
Bonneville Power Administration fund (DOE)	2.1	1.8	1.9	2.5	2.8	2.4	[illegible]	7.0	5.4	4.0	13.9

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-79

[Dollars in millions]

Function, subfunction, and agency program	Actual									Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Environment, total	284.6	321.8	433.9	503.1	620.2	659.2	795.3	847.1	954.3	1,066.3	1,081.9
Environmental health and safety	93.2	113.7	125.9	166.2	180.7	200.4	259.2	326.7	370.3	429.4	440.0
Human health and safety research (ARS)(USDA)	8.5	9.5	9.8	12.9	15.4	15.6	8.5	9.3	10.9	11.5	12.2
National Fire Prevention and Control Administration (Commerce)	-	-	-	-	-	-	3.6	6.4	6.[illegible]	[illegible].1	8.0
National Institute for Occupational Safety and Health (CDC)(HEW)	15.1	10.7	12.2	19.0	23.0	28.7	29.2	31.8	40.8	44.4	45.0
Food safety research (FDA)(HEW)	NA	14.8	12.9	13.6	10.0	13.2	10.3	9.7	[illegible].5	14.0	14.3
Radiological products research (FDA) (HEW)	[10]4.7	[10]4.2	[10]4.6	[10]5.7	3.9	9.0	5.4	5.9	6.[illegible]	7.1	7.1
Special foreign currency program (FDA)(HEW)	-	.5	.6	.8	-	-	-	-	-	-	-
Health and safety research (Bu. of Mines)(Interior)	2.2	10.9	20.8	32.3	30.9	30.7	31.9	34.6	[illegible]	52.3	50.4
Mining environmental research (Bu. of Mines)(Interior)	-	-	-	-	-	-	-	-	14.8	15.2	14.6
Occupational Safety and Health Administration (Labor)	.1	.1	.3	.2	.9	1.4	2.0	2.9	3.4	4.5	6.5
Consumer Product Safety Commission	-	-	-	-	.3	4.3	6.0	5.6	6.7	4.0	5.0
Air quality effects research (EPA)	(11)	(11)	(11)	5.4	10.7	2.1	15.2	14.1	22.3	20.8	17.8
Water pollution effects research (EPA)	(11)	(11)	(11)	1.3	4.1	(7)	1.1	1.0	2.5	4.1	7.7
Pesticides effects research (EPA)	(11)	(11)	(11)	1.8	2.0	2.0	2.5	8.3	6.8	6.3	6.2
Radiation effects research (EPA)	(11)	(11)	(11)	1.6	2.0	2	1.5	1.6	.9	.9	1.0
Interdisciplinary effects research (EPA)	-	-	-	3.9	3.3	3.0	3.0	5.9	6.1	7.9	10.0
Drinking water effects research (EPA)	-	-	-	-	1.4	2.1	2.9	9.1	6.7	7.7	7.7
Toxic substances effects research (EPA)	-	-	-	-	-	-	.6	.8	1.2	1.8	4.4
Energy-related effects research (EPA)	-	-	-	-	-	-	13.9	36.7	13.6	13.8	23.0
Noise effects research (EPA)	-	-	-	-	.2	.4	.2	.3	-	-	-