SCIENTIFIC AND ENGINEERING RESEARCH FACILITIES AT COLLEGES AND UNIVERSITIES

Division of Science Resources Studies
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Leslie Christovich, Project Director

Division of Science Resources Studies
Directorate for Social, Behavioral, and Economic Sciences

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National Science Foundation
Rita R. Colwell
Director

Directorate for Social, Behavioral, and Economic Sciences
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- Lynda Brewer, Educational Facility Planner, University of California-Irvine
- Jaleh Daie, Professor of Botany, University of Wisconsin-Madison
- William A. Daigneau, Associate Vice President and Chief Facilities Officer, University of Texas—MD Anderson Cancer Center
- John Daniel, Professor of Sociology, Howard University
- Bruce Gillars, Manager, Space Planning/ Management, University of Utah
- David A. Goodwin, Director of Capital Budgeting, Virginia Commonwealth University
- Robert McGhee, Institute Architect and Senior Facilities Officer, Howard Hughes Institute
- Alexander McQuilkin, Associate Vice President, Facilities, Chapman University
- Julie T. Norris, Director, Office of Sponsored Programs, Massachusetts Institute of Technology
- Earl S. Richardson, President, Morgan State University
- Patricia Seller-Wolff, Associate, Kirksey and Partners Architects
- James E. Swartz, Vice President for Academic Affairs, Dean of the College, and Professor of Chemistry, Grinnell College
- William R. Tibbs, Jr., Principal, Tibbs Associates
- Jacqueline Wender, Assistant to the President, Stanford University
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Chapter 1—Amount and Distribution of Research Space

Highlights

- In 1998, the science and engineering fields occupied 286 million net assignable square feet in the Nation's research-performing colleges and universities. Half of this space, 143 million NASF, was devoted to research (table 1-1).
- Fifty-nine percent of the total academic space in the Nation's research-performing institutions was allocated to S&E fields in 1998 (table 1-2).
- The top 100 universities in research and development expenditures accounted for 71 percent of all S&E research space in 1998 (table 1-1), and 80 percent of all R&D dollars in 1996 (the most recent year for which data were available).
- Between 1988 and 1998, the amount of S&E research space increased by 28 percent, from 112 million to 143 million NASF (table 1-3).
- In 1998, 84 percent of all research-performing institutions had S&E research space in the biological sciences outside of medical schools, and 83 percent had S&E research space in the physical sciences. Only 16 percent of the research-performing institutions had S&E research space in the agricultural sciences (table 1-5).
- The amount of research space in engineering and the agricultural sciences increased the most (7 million NASF each) over the last decade (table 1-6).

Introduction

How much space is available for scientific and engineering research in the Nation's colleges and universities? Has the space increased since 1988, the first year in which NSF conducted the facilities survey? How is the space distributed among different science and engineering fields? This chapter compares the amount of S&E research space in different types of colleges and universities and in different S&E fields and examines changes in the amount of space available for S&E research since 1988.

This chapter is based on responses to Items 1a and 1b of the survey (see Appendix C). Item 1a collects data on space for each of the S&E fields in units of net assignable square feet. NASF is defined as the sum of all areas (in square feet) on all floors assignable to, or available to be assigned to, an occupant for specific use, such as instruction or research. Two categories of S&E space are included:

- ***Instructional and research NASF.*** This includes all space used for academic purposes; it includes space that is used for instruction and space that is used for research.
- ***Research NASF.*** This is space that is used only for research; it does not include space that is used for instruction.

Respondents were asked to consider several issues in determining the amount of space their college or university devotes to S&E research:

- ***Space may be used for more than one purpose or be shared by more than one field.*** Examples include a laboratory that is used for research only part of the time or a building that is shared by two or more fields. For multipurpose or shared space, the survey asks respondents to prorate the space. For instance, if a laboratory is used for research 30 percent of the time, respondents should consider 30 percent of the laboratory's NASF to be research space. If mathematics and computer sciences use the same laboratory, the space reported for each field should reflect the amount prorated by the amount of time that field uses the space.
- ***Some fields require more research space than others.*** More research space in a field does not necessarily indicate that that field has sufficient space for conducting research. For instance, research in the agricultural sciences requires considerably more space than research in mathematics.

- ***Some space reported as under construction may be included in current space estimates.*** Research space under construction during the 1996 or 1997 fiscal years (see Item 4a) may or may not be included in estimates of existing research space if that space was completed and occupied before the fall of 1997.

FINDINGS

AMOUNT OF S&E SPACE

In 1998, the Nation's 660 research-performing academic institutions had a total of 488 million net assignable square feet of academic space in all fields (table 1-1). The doctorate-granting universities accounted for 85 percent of this space (416 million NASF) and the nondoctorate-granting institutions accounted for the remaining 15 percent (72 million NASF). The top 100 institutions in research expenditures had 16 million or 7 percent more NASF than the other 560 research-performing colleges and universities (other doctorate-granting and nondoctorate-granting) combined. In other words, although the top 100 institutions constitute only 15 percent of all research-performing colleges and universities, they account for 52 percent of the space in all academic fields (252 million NASF).

The top 100 universities also devoted more of their academic space to S&E than either the other doctorate-granting institutions or the nondoctorate-granting institutions. Whereas the top 100 universities devoted 70 percent of all academic space (instructional and research) to S&E, the other doctorate-granting and nondoctorate-granting institutions dedicated 51 and 35 percent, respectively (table 1-2; figure 1-1).

AMOUNT OF S&E SPACE USED FOR RESEARCH

In 1998, 59 percent of the total academic space at the Nation's research-performing institutions was allocated to S&E fields (table 1-2). Half of all space in the S&E fields (143 million NASF) was devoted to S&E research:

- The top 100 universities devoted the largest share of their S&E space to research, 57 percent;
- Other doctorate-granting universities dedicated 41 percent of their S&E space to research; and
- Nondoctorate-granting institutions dedicated 29 percent of their S&E space to research.

The distribution of S&E research space in research-performing colleges and universities is roughly proportional to the distribution of research and development expenditures. In 1996, the most recent year for which data were available, the top 100 universities accounted for 80 percent of all R&D expenditures[12] and 71 percent of the total S&E research space in 1998 (table 1-1).

[12] National Science Foundation/Division of Science Resources Studies, *Academic Research and Development Expenditures: Fiscal Year 1996*, NSF 98-304.

Table 1-1. Amount of instructional and research space by institution type: 1998

Institution type	Number of institutions	Instructional and research space in all academic fields	Instructional and research space in S&E fields	Research space in S&E fields
		NASF in millions		
Total	660	488	286	143
Doctorate-granting	378	416	261	136
Top 100 in research expenditures	100	252	177	101
Other	278	164	84	35
Nondoctorate-granting	282	72	25	7

KEY: S&E = science and engineering.
NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

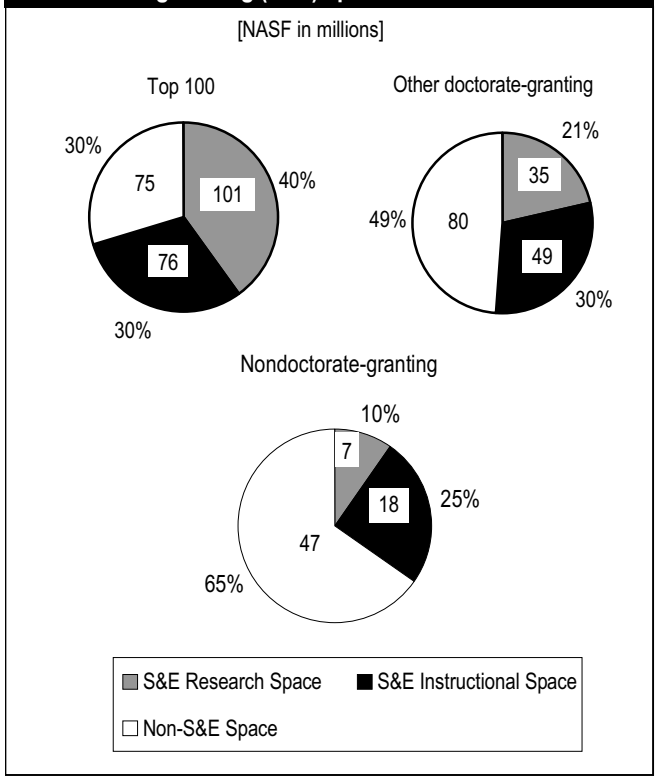
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 1-2. Science and engineering research space utilization by institution type: 1998

Institution type	S&E space: As a percentage of total academic space	Research space: As a percentage of total S&E space	Research space: As a percentage of total academic space
Total	59	50	29
Doctorate-granting:			
Top 100 in research expenditures	70	57	40
Other	51	41	21
Nondoctorate-granting	35	29	10

KEY: S&E = science and engineering.
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Figure 1-1. Amount and percent of science and engineering (S&E) space and non-S&E



KEY: NASF = net assignable square feet.
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Changes in the Amount of S&E Research Space

Over the last decade, the amount of S&E research space has increased steadily, from 112 million NASF in 1988 to 143 million NASF in 1998 (table 1-3). This change represents a 28-percent increase.

Most of the increase in the amount of research space resulted from steady growth at the top 100 institutions. S&E research space at these institutions increased by 25 percent or 20 million NASF—from 81 million NASF in 1988 to 101 million in 1998. The increase in the amount of research space at other doctorate-granting and nondoctorate-granting institutions was smaller—8 million NASF and 2 million NASF, respectively. It is important to note, however, that although the increases these institutions experienced are smaller in absolute terms than that of the top 100 institutions, the relative proportional increase is larger, a 30-percent increase for the other doctorate-granting institutions and a 40-percent increase for the nondoctorate-granting institutions.

Table 1-3. Trends in the amount of science and engineering research space by institution type: 1988–98

Institution type	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	112	116	122	127	136	143
Doctorate-granting	107	111	117	122	131	136
Top 100 in research expenditures	81	82	88	91	98	101
Other	27	30	30	31	32	35
Nondoctorate-granting	5	5	5	5	6	7

KEY: NASF = net assignable square feet.
NOTE: Components may not add to totals due to rounding.
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Amount of Leased S&E Space

In 1998, research-performing colleges and universities leased 6.1 million NASF, or 4 percent of their total S&E research space (table 1-4). This represents a 61-percent increase in leased S&E research space since 1988 when 3.8 million NASF of research space was leased. The top 100 institutions leased the most space: 4.8 million NASF (5 percent of their total S&E research space). Although not addressed in the survey, there are a number of possible explanations for why institutions lease rather than build or purchase S&E research space: an unanticipated need for space that cannot be met with existing facilities; a short-term need that does not warrant the construction of new space or the conversion of existing space; research projects that the institution considers low priority; and insufficient funds to construct new S&E research space.

Table 1-4. Trends in the amount of leased science and engineering research space by institution type: 1988–98

Institution type	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	3.8	3.6	4.8	4.4	5.5	6.1
Doctorate-granting	3.8	3.5	4.7	4.3	5.4	6.0
Top 100 in research expenditures	2.8	2.6	3.5	3.7	4.5	4.8
Other	0.9	0.9	1.2	0.6	0.9	1.2
Nondoctorate-granting*	0.0	0.0	0.0	0.0	0.0	0.1

*Nondoctorate-granting values for 1988–96 have been revised from the 1996 report.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Distribution of Research Space Across S&E Fields

In 1998, a majority of institutions had S&E research space in seven of the S&E fields. These fields include:

- The biological sciences outside of medical schools (84 percent);
- The physical sciences (83 percent);
- Psychology (70 percent);
- The social sciences (63 percent);
- Mathematics (60 percent);
- The computer sciences (56 percent); and
- The earth, atmospheric, and ocean sciences (53 percent) (table 1-5).

While only 44 percent of all research-performing institutions reported S&E research space in engineering and only 16 percent reported research space in the agricultural sciences, the total amount of research space in these two fields—23 million NASF and 25 million NASF, respectively (see table 1-6)—is greater than that in any other field.

About one fifth of all research-performing institutions reported S&E research space in medical schools, both in the biological sciences (19 percent) and the medical sciences (19 percent). Among the top 100 institutions, 62 percent reported research space in the medical sciences in medical schools, and 53 percent reported research space in the biological sciences in medical schools, whereas among the other doctorate-granting institutions, 23 percent reported research space in the medical sciences in medical schools and 26 percent reported research space in the biological sciences in medical schools. By contrast, nondoctorate-granting institutions had virtually no research space in medical schools.[13]

[13] One nondoctorate-granting institution reported space in the biological sciences in a medical school. This institution conducts research and grants masters' degrees through an arrangement with another university that has a medical school.

Table 1-5. Percentage of institutions with science and engineering research space by institution type and field: 1998

Field	Total	Institution type: Doctorate-granting: Top 100 in research expenditures	Institution type: Doctorate-granting: Other	Institution type: Nondoctorate-granting
Number of institutions	660	100	278	282
	Percentage			
Biological sciences—				
inside medical schools	19	53	26	--
outside medical schools	84	94	78	87
Physical sciences	83	89	78	85
Psychology	70	86	59	76
Social sciences	63	89	57	59
Mathematics	60	82	54	58
Computer sciences	56	76	51	53
Earth, atmospheric, and ocean sciences	53	85	51	43
Engineering	44	86	47	26
Agricultural sciences	16	40	10	14
Medical sciences—				
inside medical schools	19	62	23	--
outside medical schools	40	75	41	26
Other sciences	23	36	21	19

KEY: -- = no institutions had space in this field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

S&E Research Space by Field

Increases in research space in any single field tended to be gradual over the decade from 1988–98. Research space in engineering and the agricultural sciences grew the most (7 million NASF each), followed by the medical sciences in medical schools and the biological sciences in medical schools (4 million NASF each) (table 1-6).

The distribution of research space across the S&E fields approximated the distribution of R&D expenditures across the same fields. The life sciences occupied 56 percent of the S&E research space in 1998 and accounted for 55 percent of 1996 R&D expenditures in 1996.[14] Similarly, psychology and other sciences each occupied 2 percent of the S&E research space, and each accounted for 2 percent of R&D expenditures (table 1-7).

[14] The 1998 expenditure data were not available at the time this report was written. The most recent expenditure data, 1996, were therefore used. National Science Foundation/Division of Science Resources Studies, *Academic Research and Development Expenditures: Fiscal Year, 1996*, NSF 98-304.

Table 1-6. Trends in the amount of science and engineering research space by field: 1988–98

Field	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	112	116	122	127	136	143
Biological sciences—						
inside medical schools	8	9	11	11	11	12
outside medical schools	16	18	17	17	19	19
Physical sciences	16	16	16	17	18	18
Psychology	3	3	3	3	3	3
Social sciences	3	3	3	3	4	5
Mathematics	1	1	1	1	1	1
Computer sciences	1	1	2	2	2	2
Earth, atmospheric, and ocean sciences	6	6	7	7	7	8
Engineering	16	17	18	21	22	23
Agricultural sciences	18	21	20	20	22	25
Medical sciences—						
inside medical schools	14	15	16	17	18	18
outside medical schools	5	5	6	6	7	7
Other sciences	4	2	2	2	2	3

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 1-7. Comparison of the distribution of 1996 research and development (R&D) expenditures and 1998 science and engineering (S&E) research space by field

	1996 R&D expenditures		1998 S&E research space	
Field	Distribution [Percent]	Dollars [In millions]	Distribution [Percent]	NASF [In millions]
Total	100	22,995	100	143
Engineering	16	3,675	16	23
Physical sciences	10	2,260	13	18
Earth, atmospheric, and ocean sciences	6	1,478	5	8
Mathematics	1	289	1	1
Computer science	3	702	1	2
Life sciences	55	12,697	56	81
Psychology	2	372	2	3
Social sciences	5	1,104	3	5
Other sciences	2	419	2	3

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Life sciences includes the biological sciences and the medical sciences, inside and outside of medical schools, and the agricultural sciences.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; and *Academic Research and Development Expenditures: Fiscal Year 1996.*

Chapter 2—Adequacy of the Amount of Research Space and Its Condition

Highlights

- In light of their current research commitments, more than half of all institutions reported inadequate amounts of research space in every science and engineering field except mathematics, where 44 percent of the institutions indicated that their research space was inadequate (table 2-1).
- In order to meet their current research commitments, the research-performing institutions reported that they needed an additional 28.5 million net assignable square feet of science and engineering research space, or 20 percent more than they currently have (tables 2-2 and 2-3).
- Eighteen percent of all S&E research space (26 million NASF) was considered to require major renovation. An additional 5 percent of all S&E research space (7 million NASF) was considered to require replacement (table 2-4).
- Since 1988, the amount of research space requiring major renovation or replacement has increased in 11 of the 12 S&E fields included in the survey. Five of these fields (the social sciences; the medical sciences outside medical schools; the earth, atmospheric, and ocean sciences; the agricultural sciences; and the biological sciences outside medical schools) have experienced a 100-percent or more increase in the amount of research space in this condition (table 2-5).

Introduction

Information focused solely on the amount of science and engineering research space and its growth or decline over time is insufficient for understanding whether there is enough space to conduct research in general, and whether the condition of that space is suitable for conducting particularly sophisticated research. Respondents' assessments of both the quantity and quality of existing research space at their institutions from 1988–98 are examined in this chapter.

Respondents were asked to rate the adequacy of the amount of research space in each field at their institution by choosing one of the following categories (see Item 2 of the survey in Appendix C):

A Adequate amount of space: sufficient to support all the needs of your current S&E research program commitments in the field;

B Inadequate amount of space: not sufficient to support the needs of your current S&E research program commitments in the field; or nonexistent, but needed; or

NA Not applicable or no space needed in this field.

They were also asked to report in either net assignable square feet or in percents the amount of additional space needed to support current program commitments.

For each field, respondents indicated the condition of research space by reporting the percentage of space falling into one of the following categories (see Item 3 of the survey in Appendix C):

A Suitable for the most scientifically competitive research in the field;

B Effective for most levels of research in the field, but may need limited repair/renovation;

C Requires major renovation to be used effectively;

D Requires replacement; or

NA Not applicable or no research space in that field.

Measures of the adequacy of the amount of S&E research space and the condition of this space in each S&E field are based upon the assessments of several different individuals, including the survey coordinator at the institution, as well as deans and other administrators. These questions elicit more subjective responses than do other survey items.

Tables that analyze differences among S&E fields have been limited to only those institutions that had research space or reported a need for additional research space in those fields.

Findings

Adequacy of the Amount of S&E Research Space for Current Research Commitments

Institutions assessed the adequacy of the amount of science and engineering research space for each field for which they had research space. They assessed this space relative to their current research commitments. At least half of all institutions reported inadequate amounts of space in every field except mathematics, where 44 percent of the institutions indicated that their research space was inadequate (table 2-1). Regardless of institution type, the amount of existing S&E research space in every field was rated as inadequate by 40 percent or more of the institutions that had space in that field.

In four fields, more than 70 percent of the top 100 institutions indicated that the amount of existing research space was inadequate to meet their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In engineering, 78 percent of the top 100 institutions reported that their existing research space was inadequate;
- In the biological sciences outside medical schools, 74 reported that their research space was inadequate;
- In the medical sciences in medical schools, 73 percent reported that their research space was inadequate; and
- In the physical sciences, 71 percent reported that their research space was inadequate.

Table 2-1. Percentage of institutions reporting inadequate amounts of science and engineering research space by institution type and field: 1998

Field	Total	Institution type: Doctorate-granting: Top 100 in research expenditures	Institution type: Doctorate-granting: Other	Institution type: Nondoctorate-granting
Any field	83	92	80	83
Biological sciences—				
inside medical schools	70	62	78	--
outside medical schools	64	74	56	67
Physical sciences	64	71	55	69
Psychology	51	59	56	45
Social sciences	61	65	60	59
Mathematics	44	47	41	45
Computer sciences	56	63	47	60
Earth, atmospheric, and ocean sciences	62	61	61	63
Engineering	60	78	52	54
Agricultural sciences	55	65	53	47
Medical sciences—				
inside medical schools	67	73	62	--
outside medical schools	54	68	48	51

KEY: -- = number of institutions with nonmissing data less than 5. These institutions are included in the total.

NOTE: Includes only institutions that reported existing and/or needed research space in that field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

In four fields, 60 percent or more of other doctorate-granting institutions indicated the amount of existing research space they had was inadequate for meeting their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In the biological sciences in medical schools, 78 percent of other doctorate-granting institutions reported that their existing research space was inadequate;
- In the medical sciences in medical schools, 62 percent reported that their research space was inadequate;
- In the earth, atmospheric, and ocean sciences, 61 percent reported that their research space was inadequate; and
- In the social sciences, 60 percent reported that their research space was inadequate.

Finally, in four fields, 60 percent or more of nondoctorate-granting institutions reported that the amount of research space was inadequate for their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In the physical sciences, 69 percent of nondoctorate-granting institutions reported that their research space was inadequate;
- In the biological sciences outside medical schools, 67 percent reported that their research space was inadequate;
- In the earth, atmospheric, and ocean sciences, 63 percent reported that their research space was inadequate; and
- In the computer sciences, 60 percent reported that their research space was inadequate.

Overall, a larger proportion of top 100 institutions (92 percent) reported inadequate amounts of research space in at least one field than did other doctorate-granting institutions (80 percent) and nondoctorate-granting institutions (83 percent). In engineering an appreciably larger proportion of top 100 institutions (78 percent) reported inadequate amounts of research space than either other doctorate-granting institutions (52 percent) or nondoctorate-granting institutions (54 percent).

Need for Additional S&E Research Space

The research-performing institutions reported that they needed an additional 28.5 million net assignable square feet of S&E research space, or 20 percent more than they had in order to meet their research commitments. The amount and proportion of need varied by field (table 2-2). Mathematics needed the least amount of additional research space (0.2 million NASF), while the biological sciences outside medical schools needed the most (4.8 million NASF). Other fields needing more than 2 million additional NASF of research space include:

- Engineering (4.0 million NASF);
- The medical sciences in medical schools (4.0 million NASF);
- The physical sciences (3.7 million NASF);

Table 2-2. Amount and percentage of total science and engineering (S&E) research space needed by field: 1998

Field	Total S&E research NASF	Additional NASF needed	Percentage needed
	NASF in millions		
Total	143	28.5	20
Biological sciences—			
inside medical schools	12	2.5	21
outside medical schools	19	4.8	25
Physical sciences	18	3.7	20
Psychology	3	0.7	25
Social sciences	5	1.3	26
Mathematics	1	0.2	24
Computer sciences	2	0.8	40
Earth, atmospheric, and ocean sciences	8	1.5	20
Engineering	23	4.0	17
Agricultural sciences	25	2.4	10
Medical sciences—			
inside medical schools	18	4.0	22
outside medical schools	7	1.9	27
Other sciences	3	0.6	21

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Includes only institutions that reported existing and/or needed research space in that field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The biological sciences in medical schools (2.5 million NASF); and
- The agricultural sciences (2.4 million NASF).

A slightly different picture emerges when institutions' need for additional space is assessed as a proportion of their current amount of space. The agricultural sciences needed the smallest relative increment in research space (10 percent), while the computer sciences needed the largest relative increment (40 percent).

This need for space was not distributed equally across institution types (table 2-3). The top 100 institutions had the smallest relative need for additional research space (18 percent more), but they needed the greatest amount of space (18.6 million NASF). By contrast, the nondoctorate-granting institutions had the greatest relative need for additional research space (42 percent more), but needed the least amount of space (2.9 million NASF). The other doctorate-granting institutions fell in between. They needed 20 percent more space or 6.9 million NASF.

Condition of S&E Research Space

Over a third (39 percent or 56 million NASF) of the S&E research space at research-performing institutions was rated as "suitable for the most scientifically competitive research." The proportion of research space in this condition did not differ among the different types of research-performing institutions. The top 100 institutions rated 39 percent or 39 million NASF of their research space this way. Similarly, other doctorate-granting institutions reported that 41 percent or 14 million NASF of their research space was in the highest quality condition, and the nondoctorate-granting institutions reported that 32 percent or 2 million NASF of their research space was in this condition (table 2-4).

The research-performing colleges and universities classified a total of 18 percent (26 million NASF) of their S&E research space as requiring major renovation. The proportion of research space requiring renovation was greater at the top 100 institutions than at other doctorate-granting institutions (19 percent or 19 million NASF

Table 2-3. Amount and percentage of total science and engineering (S&E) research space needed by institution type: 1998

Institution type	Total S&E research NASF	Additional NASF needed	Percentage needed
	NASF in millions		
Total	143	28.5	20
Doctorate-granting	136	26	19
Top 100 in research expenditures	101	19	18
Other	35	7	20
Nondoctorate-granting	7	3	42

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 2-4. Institutional assessment of the quality and condition of science and engineering research space by institution type: 1998

Institution type	Suitable for the most scientifically competitive research in the field	Effective for most levels of research	Requires major renovation	Requires replacement
	Percentage of space			
Total	39	38	18	5
Doctorate-granting	40	38	18	5
Top 100 in research expenditures	39	37	19	5
Other	41	41	15	4
Nondoctorate-granting	32	37	26	5

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

compared with 15 percent or 5 million NASF). Nondoctorate institutions reported that 26 percent of their research space required major renovation.

There was general consistency among the different types of institutions regarding the proportion of S&E research space requiring replacement: 5 percent of the S&E research space at the top 100 and nondoctorate-granting institutions (5 million and 0.4 million NASF, respectively) was assessed as needing replacement, and 4 percent of S&E research space at other doctorate-granting institutions (1 million NASF) needed replacement.

Amount of S&E Research Space in Each Field Requiring Either Major Renovation or Replacement

Research-performing institutions reported 33.0 million NASF of S&E research space in need of major renovation or replacement in 1998. This represents almost one quarter (23 percent) of all S&E research space. The amount of research space in this condition has increased continuously since 1988, when 17.7 million NASF (16 percent) of all S&E research space needed major renovation or replacement.

Consistent with all previous surveys, in 1998, the agricultural sciences was again the field with the greatest amount of research space in need of major renovation or replacement. Of the 25 million NASF of S&E research space in the agricultural sciences (table 1-6), almost a third (7.5 million NASF or 30 percent) was assessed as requiring major renovation or replacement (table 2-5). This relatively large need is concentrated in a small number of institutions. Only 16 percent of all research-performing institutions have research space in the agricultural sciences (table 1-5), and more than half of these institutions (55 percent) reported inadequate research space in this field (table 2-1).

At the time of the survey, the research-performing institutions indicated that more than 3 million NASF of research space in four other fields required major renovation or replacement:

- The biological sciences outside of medical schools contained 4.8 million NASF in need of major renovation or replacement;
- The medical sciences in medical schools contained 4.6 million NASF of research space in this condition;
- Engineering contained 4.3 million NASF; and
- The physical sciences contained 3.9 million NASF.

Since 1988, the amount of research space requiring major renovation or replacement has increased in all but one S&E field (mathematics). Five fields have experienced an increase of 100 percent or more in the amount of research space in this condition over the decade:[15]

- The social sciences have experienced a 147-percent increase in research space in need of renovation or replacement (from 0.30 million NASF to 0.74 million NASF);
- The medical sciences outside medical schools have experienced a 125-percent increase in research space in this condition (from 0.8 million NASF to 1.8 million NASF);
- The earth, atmospheric, and ocean sciences have experienced a 111-percent increase (from 0.9 million NASF to 1.9 million NASF);
- The agricultural sciences have experienced a 108-percent increase (from 3.6 million NASF to 7.5 million NASF); and
- The biological sciences outside medical schools have experienced a 100-percent increase (from 2.4 million NASF to 4.8 million NASF).

Two other fields have experienced a near doubling of research space in need of major renovation or replacement since 1988. In engineering, research space in this condition grew from 2.2 million NASF to 4.3 million NASF (a 95-percent increase), while research space in this condition in the medical sciences in medical schools grew from 2.4 million NASF to 4.6 million NASF (a 92-percent increase).

[15] Data in table 2-5 have been rounded to one decimal place. In order to calculate meaningful percent changes over time, data in the text for some fields are presented as rounded to the second decimal place.

Table 2-5. Trends in the amount of science and engineering research space requiring major renovation or replacement by field: 1988–98

Field	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	17.7	18.0	19.4	21.7	25.2	33.0
Biological sciences—						
inside medical schools	1.0	1.2	1.6	1.6	1.6	1.9
outside medical schools	2.4	2.5	2.6	3.2	3.4	4.8
Physical sciences	2.9	2.7	2.4	3.1	3.4	3.9
Psychology	0.4	0.4	0.3	0.4	0.4	0.6
Social sciences	0.3	0.3	0.4	0.3	0.5	0.7
Mathematics	0.1	0.1	0.1	0.1	0.1	0.1
Computer sciences	0.2	0.1	0.1	0.1	0.2	0.3
Earth, atmospheric, and						
ocean sciences	0.9	0.9	0.8	1.3	1.3	1.9
Engineering	2.2	2.6	2.3	3.2	4.0	4.3
Agricultural sciences	3.6	4.6	5.2	4.4	5.3	7.5
Medical sciences—						
inside medical schools	2.4	1.9	2.7	2.9	3.6	4.6
outside medical schools	0.8	0.9	1.0	1.0	1.5	1.8

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. The total includes other sciences.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Between the last survey (1996) and the current one, the amount of research space requiring major renovation or replacement increased by 40 percent or more in six fields:[16]

- In the computer sciences, it increased by 100 percent (from 0.16 million NASF to 0.32 million NASF);
- In psychology, it increased by 55 percent (from 0.40 million NASF to 0.62 million NASF);
- In the social sciences, it increased by 48 percent (from 0.50 million NASF to 0.74 million NASF);
- In the earth, atmospheric, and ocean sciences, it increased by 46 percent (from 1.3 million NASF to 1.9 million NASF);
- In the agricultural sciences, it increased by 42 percent (from 5.3 million NASF to 7.5 million NASF); and
- In the biological sciences outside medical schools, it increased by 41 percent (from 3.4 million NASF to 4.8 million NASF).

[16] Ibid.

CHAPTER 3—THE CONSTRUCTION OF S&E RESEARCH SPACE

HIGHLIGHTS

- In fiscal years 1996 and 1997, research-performing institutions began construction on 11.1 million net assignable square feet of science and engineering research space. This space is 17 percent more than was started in 1994 and 1995 (9.5 million NASF) (table 3-1).
- Research-performing institutions committed $3.1 billion to the construction of new S&E research facilities in fiscal years 1996 and 1997. This is 15 percent more (in constant dollars) than they committed to new construction a decade ago (table 3-2).
- Almost one third (30 percent) of all research-performing colleges and universities initiated new S&E research space construction projects during fiscal years 1996 and 1997 (table 3-5).
- Four fields account for more than half (61 percent) of the $3.1 billion committed to the construction of new research facilities in 1996 and 1997. These fields are the medical sciences in medical schools ($784 million), the biological sciences outside medical schools ($404 million), the physical sciences ($381 million), and engineering ($332 million) (table 3-8).
- For fiscal years 1998 and 1999, research-performing institutions are scheduled to commit $3.9 billion to construct S&E research facilities and one tenth of that amount ($396 million) to construct central campus infrastructure (table 3-4).

INTRODUCTION

This chapter discusses the state of recently initiated construction of new science and engineering research facilities in research-performing colleges and universities. The term "construction" in this chapter and throughout this report refers to the building of facilities that currently do not exist.

Institutions were asked to estimate the research-related costs and space for construction projects costing over $100,000 begun during fiscal years 1996 and 1997, and to make the same estimates for projects scheduled for fiscal years 1998 and 1999. Project start-up was defined as the fiscal year in which construction began or was expected to begin. In the case of multiyear projects, total project costs were allocated to the fiscal year in which the construction began. Note, however, that the costs and parameters of multiyear projects can change between the time a project begins and the time it is completed.

The reported financial commitments, defined as the costs to complete a project, include planning, site preparation, construction, fixed equipment, and building infrastructure. It should be noted that fluctuations in funds committed to construction from one year to another can result from large projects at a small number of institutions. Given the costs of constructing S&E research facilities, a large increase could reflect a new building on one or two campuses. Indeed, this is often the case for the nondoctorate-granting institutions.

Institutions were also asked to report planned expenditures for central campus infrastructure (see Item 6 of the survey in Appendix C). Central campus infrastructure was defined as those systems that exist between the buildings of a campus and the nonarchitectural elements of campus design. Examples included central wiring for telecommunications systems, waste storage and disposal facilities, electrical wiring between buildings, central heating and air exchange systems, drains, sewers, roadways, walkways, and parking systems. Plumbing, lighting, wiring, air exchange systems, and the like that exist within a building or within five feet of the building foundation were considered building infrastructure and were excluded from this definition of central campus infrastructure.

In 1998, for the first time, institutions were asked to list separately any nonfixed equipment costing $1 million or more that was included as part of their new construction costs for fiscal years 1996 and 1997. If a project were to

serve both research and nonresearch purposes, respondents were asked to prorate the construction costs and space estimates so that the research-related portion of the costs was reflected (see Items 4a, 4b, and 4c of the survey in Appendix C).

Findings

Amount of New S&E Research Space Under Construction

New construction projects initiated in 1996 and 1997 are expected to produce 11.1 million net assignable square feet of new science and engineering research space. This is a 17-percent increase in new research space under construction compared with new construction projects begun in 1994 and 1995 (9.5 million NASF) (table 3-1). These 11.1 million NASF are the equivalent of 8 percent of existing research space (143.3 million NASF).

Doctorate-granting institutions initiated the greatest amount of square footage of new facilities construction, 89 percent or 9.9 million NASF. This square footage is a 12-percent increase over 1994–95 levels (8.8 million NASF). The top 100 institutions account for 70 percent (6.9 million NASF) of the new construction projects begun at doctorate-granting institutions.

Funds Committed to the Construction of S&E Research Space

Research-performing institutions committed $3.1 billion to the construction of S&E research space in 1996 and 1997. This is 15 percent or $399 million more (in constant dollars) than they committed to new construction a decade ago (table 3-2; figure 3-1).

The doctorate-granting institutions committed more funds to new construction in 1996 and 1997 than they did a decade ago, with the largest increases occurring at the other doctorate-granting institutions. Between 1986–87 and 1996–97:

- Doctorate-granting institutions committed $348 million or 14 percent more funds to new construction;
  - Top 100 institutions committed $59 million or 3 percent fewer funds; and
  - Other doctorate-granting institutions committed $408 million or 107 percent more funds.

Table 3-1. Trends in the amount of science and engineering research space under construction for projects costing more than $100,000 by institution type: 1986–97

Institution type	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97
	NASF in thousands					
Total	9,922	10,647	11,433	12,405	9,521	11,101
Doctorate-granting	8,908	9,840	11,022	12,014	8,818	9,914
Top 100 in research expenditures	7,261	6,073	6,972	8,197	6,426	6,944
Other	1,647	3,767	4,050	3,818	2,391	2,970
Nondoctorate-granting	1,014	807	411	391	703	1,187

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. The reader is cautioned against summing the NASF constructed over time or adding the amount of newly constructed space to existing space. The data collected do not indicate whether newly constructed space replaces existing NASF or whether new space provides additional S&E resources for the institution.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

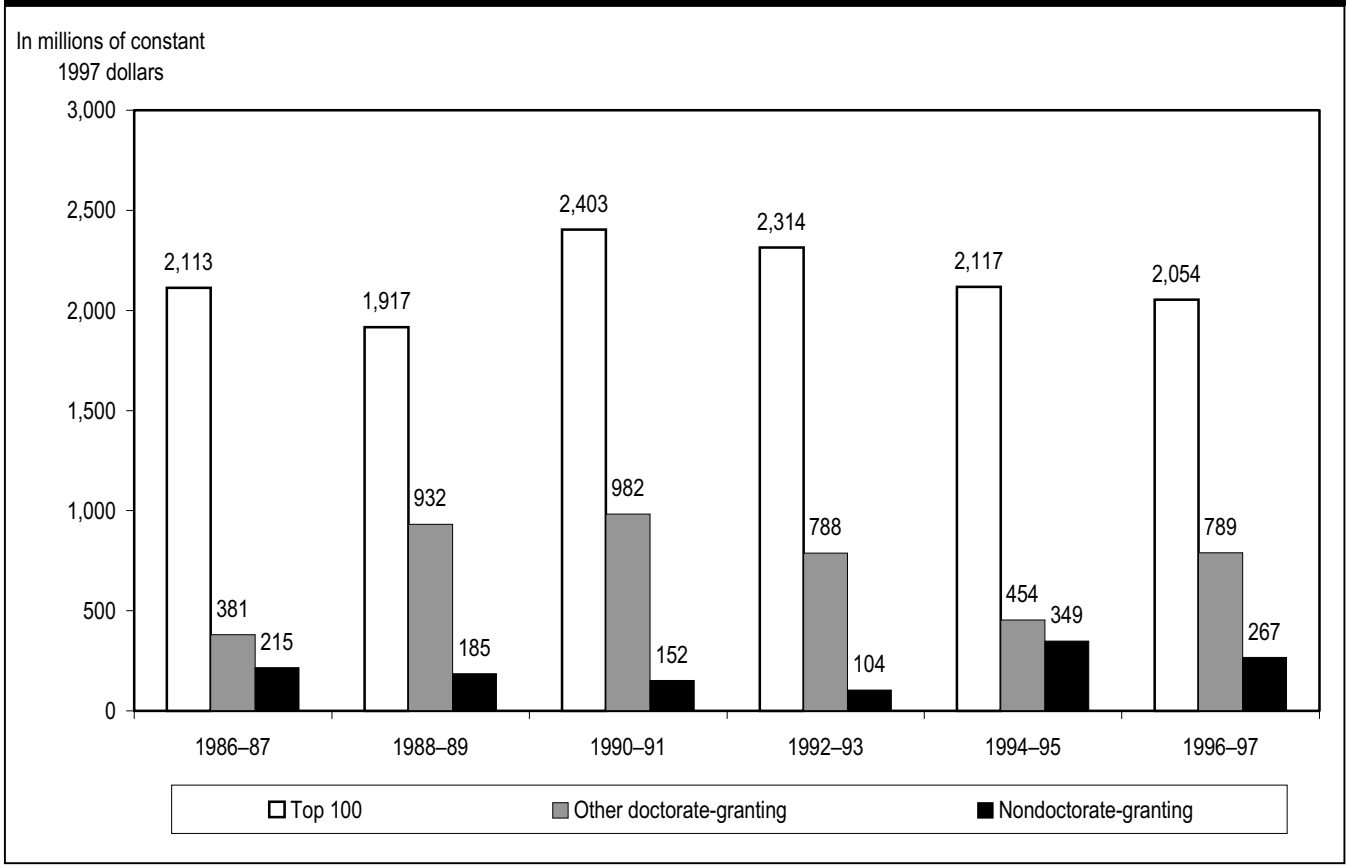
Table 3-2. Trends in funds committed to construct science and engineering research facilities for projects costing more than $100,000 by institution type: 1986–97

Institution type	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97
	In millions of constant 1997 dollars					
Total	2,711	3,032	3,537	3,207	2,920	3,110
Doctorate-granting	2,495	2,849	3,383	3,102	2,571	2,843
Top 100 in research expenditures	2,113	1,917	2,403	2,314	2,117	2,054
Other	381	932	982	788	454	789
Nondoctorate-granting	215	185	152	104	349	267

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universitites.

Figure 3-1. Trends in science and engineering construction expenditures by type of institution: 1986–97



NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Overall, in 1996 and 1997, a subset of 383 research-performing institutions that were in both the 1996 and 1998 samples committed close to what, in the 1996 survey, they anticipated committing to new construction projects in 1996 or 1997 (table 3-3).[17] They were scheduled to commit $2,828 million and actually committed $2,801 million, a difference of $27 million or 1 percent. The doctorate-granting institutions were most consistent with their earlier plans:

- Doctorate-granting institutions committed $44 million or 2 percent fewer funds than they had scheduled;
  - The top 100 institutions committed $23 million or 1 percent fewer funds than they had scheduled; and
  - Other doctorate-granting institutions committed $21 million or 3 percent fewer funds than they had scheduled.

Table 3-3. Scheduled and actual construction expenditures for projects costing more than $100,000 for science and engineering research space by institution type: 1996–97

Institution type	Number of institutions	1996–97 (scheduled)	1996–97 (actual)
		In millions of dollars	
Total	383	2,828	2,801
Doctorate-granting	257	2,726	2,682
Top 100 in research expenditures	99	2,077	2,054
Other	158	649	628
Nondoctorate-granting	126	103	119

NOTE: Components may not add to totals due to rounding. Includes only institutions that were in both the 1996 and 1998 samples.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1996 and 1998 Surveys of Scientific and Engineering Research Facilities at Colleges and Universities.

Funds Scheduled for the Construction of S&E Research Space and Central Campus Infrastructure

For fiscal years 1998 and 1999, research-performing institutions are scheduled to commit $3.9 billion to begin construction on new S&E research space. If all this construction were to occur, it would represent a 27-percent ($839 million) increase over the amount the research-performing institutions committed to new S&E construction begun in 1996 or 1997 ($3.1 billion).

This anticipated increase is greater in relative terms among nondoctorate-granting institutions than among the different types of doctorate-granting institutions. Anticipated increases in financial commitments to new S&E construction projects between the current survey period and the next are as follows:

- Doctorate-granting institutions plan to commit 23 percent or $651 million more to new S&E construction projects in 1998 and 1999 than they did in 1996 and 1997;
  - Top 100 institutions plan to commit 24 percent or $483 million more;
  - Other doctorate-granting institutions plan to commit 21 percent or $168 million more; and
- Nondoctorate-granting institutions plan to commit 70 percent or $188 million more to new S&E construction projects (tables 3-4 and 3-2).

Research-performing institutions are scheduled to commit another $396 million to new central campus infrastructure construction projects in 1998 and 1999. These funds are distributed among the institution types as follows:

- Doctorate-granting institutions plan to commit 91 percent or $359 million of all new central campus infrastructure funds;
  - Top 100 institutions plan to commit 75 percent or $297 million of these funds;
  - Other doctorate-granting institutions plan to commit 16 percent or $62 million of these funds; and

[17] The scheduled 1996–97 data come from National Science Foundation/Division of Science Resources Studies, *1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.* Because this analysis is limited to the subset of research-performing institutions that were in both the 1996 and 1998 samples, the results do not generalize to the population of research-performing institutions.

- Nondoctorate-granting institutions plan to commit 9 percent or $37 million of these funds.

Colleges and Universities Starting S&E Construction Projects

In fiscal years 1996 and 1997, 30 percent of all research-performing institutions initiated new S&E construction projects. This proportion is less than in fiscal years 1986–87 through 1992–93 when a larger proportion of institutions started new S&E construction projects.

A larger proportion of doctorate-granting institutions began S&E construction in these years than began construction projects in 1996 and 1997 (38 percent). The proportion of nondoctorate-granting institutions starting new S&E construction projects in fiscal years 1996 and 1997 (19 percent) is not appreciably different from any year except 1988–89, when 32 percent of nondoctorate-granting institutions started new S&E construction projects (table 3-5).

Table 3-4. Funds scheduled for construction of science and engineering (S&E) research space and central campus infrastructure for projects costing more than $100,000 by institution type: 1998–99

Institution type	Scheduled construction		
	S&E research space	Central campus infrastructure	Total*
	In millions of dollars		
Total	3,949	396	4,344
Doctorate-granting	3,494	359	3,853
Top 100 in research expenditures	2,537	297	2,834
Other	957	62	1,019
Nondoctorate-granting	455	37	492

*This is the total of scheduled S&E research space and central campus infrastructure construction. It does not represent total scheduled construction across all science and nonscience disciplines.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

In 1998 and 1999, 31 percent of research-performing institutions are scheduled to start new S&E construction projects. Only the top 100 institutions anticipated a change in the percentage of institutions scheduled to start new S&E construction projects. If the top 100 institutions act in accordance with their plans, 64 percent of them will start new construction projects in 1998 and 1999. This represents a 4-percentage point drop from 1996 and 1997 when 68 percent of these institutions started new projects.

A separate analysis (table 3-6) of the 383 institutions that were in both the 1996 and 1998 samples reveals that 104 or 71 percent of all research-performing institutions that had scheduled new construction for 1996 or 1997 actually undertook it.[18] The actions of the top 100 institutions were more consistent with their plans than that of the other types of institutions. Overall, 91 or 74 percent of all doctorate-granting institutions that had scheduled construction acted in accordance with their plans, as did:

- 55 or 89 percent of top 100 institutions;
- 36 or 59 percent of other doctorate-granting institutions; and
- 14 or 58 percent of nondoctorate-granting institutions.

[18] Because this analysis is limited to the subset of research-performing institutions that were in both the 1996 and 1998 samples, the results do not generalize to the population of research-performing institutions.

Table 3-5. Trends in the percentage of institutions starting projects to construct science and engineering research facilities costing more than $100,000 by institution type: 1986–99

Institution type	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97	(scheduled) 1998–99
	Percentage						
Total	37	44	37	33	29	30	31
Doctorate-granting	47	53	57	44	42	38	38
Top 100 in research expenditures	72	71	81	79	75	68	64
Other	34	44	45	28	26	27	29
Nondoctorate-granting	25	32	12	15	13	19	21

NOTE: As used here, capital projects are construction projects with prorated costs of $100,000 or more for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 3-6. Number of institutions starting science and engineering research facilities construction projects costing more than $100,000 and whether construction was scheduled by institution type: 1996–97

Institution type	Number of institutions that scheduled construction	Number of institutions that scheduled construction and actually started construction	Number of institutions that did not schedule construction	Number of institutions that did not schedule construction but started construction
Total	147	104	236	29
Doctorate-granting	123	91	134	28
Top 100 in research expenditures	62	55	37	13
Other	61	36	97	15
Nondoctorate-granting	24	14	103	1

NOTE: Components may not sum to totals due to rounding. Includes only 383 institutions that were in both the 1996 and 1998 samples.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1996 and 1998 Surveys of Scientific and Engineering Research Facilities at Colleges and Universities.

It is also worth noting that 29 or 12 percent of institutions that had not scheduled construction for 1996 or 1997, did, in fact, start new construction projects during that period. Overall, 28 or 21 percent of doctorate-granting institutions that had not scheduled any construction projects began construction projects; 13 or 35 percent of the top 100 institutions that had not scheduled construction projects did so.

Fields In Which Construction Projects Started

Overall, the proportion of institutions that began new S&E construction projects declined by 7-percentage points over the decade, from 37 to 30 percent of institutions. Two fields registered an appreciable change during this time period:

- In engineering, the proportion of institutions starting new construction projects decreased from 28 to 11 percent; and
- In the agricultural sciences, the proportion of institutions starting new construction projects decreased from 38 to 28 percent (table 3-7).

Only one field registered an appreciable increase in the proportion of institutions starting new construction since the last survey period. The proportion of institutions starting new construction projects in the biological sciences outside medical schools increased from 9 percent of institutions to 13 percent.

Finally, the proportion of institutions scheduled to start new construction projects in the various S&E fields in 1998 and 1999 is expected to decline appreciably from 1996–97 levels in one field. The proportion of institutions scheduled to start new construction projects in the medical sciences in medical schools is expected to decrease from 33 to 20 percent of institutions.

Funds Committed to S&E Research Space Construction Projects in Different Fields

Four fields account for more than half (61 percent) of the $3.1 billion committed to the construction of new S&E research space by research-performing institutions in fiscal years 1996 and 1997:

- The medical sciences in medical schools account for $784 million;
- The biological sciences outside medical schools account for $404 million;

Table 3-7. Trends in the percentage of institutions starting projects to construct science and engineering research facilities costing more than $100,000 by field: 1986–99

Field	1986–87	1988–89	1990–91	1992–93	1994–95[1]	1996–97	(scheduled) 1998–99
	Percentage						
Total	37	44	37	33	29	30	31
Biological sciences—							
inside medical schools	20	26	33	20	10	14	22
outside medical schools	9	19	10	10	8	13	12
Physical sciences	9	15	11	9	9	11	14
Psychology	5	3	7	2	2	4	5
Social sciences	5	4	--[2]	3	4	5	4
Mathematics	1	2	4	2	1	1	5
Computer sciences	8	6	7	4	1	4	3
Earth, atmospheric, and ocean sciences	9	6	15	9	5	11	9
Engineering	28	18	16	17	14	11	14
Agricultural sciences	38	33	30	27	23	28	20
Medical sciences—							
inside medical schools	32	23	41	33	26	33	20
outside medical schools	7	5	13	11	6	9	11

[1] Some 1994–95 values have been revised from the 1996 report.

[2] Psychology and the social sciences were not differentiated in the questionnaire item for the 1990–91 period.

NOTE: Percentages are based on the number of institutions with existing research space and/or planned construction of research space in a given field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The physical sciences account for $381 million; and
- Engineering accounts for $332 million (table 3-8).

In addition to these four fields, research-performing institutions committed more than $100 million to construct new research space in five other fields:

- The agricultural sciences account for $273 million;
- The medical sciences outside of medical schools account for $259 million;
- The biological sciences in medical schools account for $178 million;
- The earth, atmospheric, and ocean sciences account for $172 million; and
- The other sciences account for $145 million.

The amount of funds committed to the construction of new research space more than doubled in three fields since the last survey:

- In the earth, atmospheric, and ocean sciences, funds increased from $35 million to $172 million (a 391-percent increase);
- In mathematics, funds increased from $2 million to $9 million (a 350-percent increase); and
- In the medical sciences outside medical schools, funds increased from $129 million to $259 million (a 101-percent increase).

The amount of funds committed for the construction of new research space declined by 25 percent or more in three fields since the last survey:

- In the computer sciences, from $49 million to $21 million (a 57-percent decrease);

Table 3-8. Trends in funds committed to construct science and engineering research facilities for projects costing more than $100,000 by field: 1986–99

Field	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97	(scheduled) 1998–99
	In millions of constant 1997 dollars						
Total	2,711	3,032	3,537	3,207	2,920	3,110	3,949
Biological sciences—							
inside medical schools	184	223	453	389	238	178	597
outside medical schools	428	487	536	333	409	404	812
Physical sciences	241	494	511	384	449	381	525
Psychology	31	31	43	18	44	77	91
Social sciences	51	59	-- *	51	118	75	81
Mathematics	2	11	15	12	2	9	19
Computer sciences	81	80	47	54	49	21	27
Earth, atmospheric, and ocean sciences	75	100	202	140	35	172	235
Engineering	568	478	469	326	607	332	528
Agricultural sciences	198	187	208	239	158	273	169
Medical sciences—							
inside medical schools	399	722	779	957	554	784	613
outside medical schools	268	75	179	183	129	259	206
Other sciences	184	87	95	117	129	145	46

* Psychology and the social sciences were not differentiated in the questionnaire item for the 1990–91 period.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- In engineering, from $607 million to $332 million (a 45-percent decrease); and
- In the biological sciences in medical schools from $238 million to $178 million (a 25-percent decrease).

In 1998 and 1999, funds committed to new construction are scheduled to more than double in three fields:

- In the biological sciences in medical schools, funds are expected to increase from $178 million to $597 million (a 235-percent increase);
- In mathematics, funds are expected to increase from $9 million to $19 million (a 111-percent increase); and
- In the biological sciences outside medical schools, funds are expected to increase from $404 million to $812 million (a 101-percent increase).

At the same time, funds committed to new construction are scheduled to decrease by at least 20 percent in four fields:

- In other sciences, from $145 million to $46 million (a 68-percent decrease);
- In the agricultural sciences, from $273 million to $169 million (a 38-percent decrease);
- In the medical sciences in medical schools, from $784 million to $613 million (a 22-percent decrease); and
- In medical sciences outside medical schools, from $259 million to $206 million (a 20-percent decrease).

Funds Committed to Nonfixed Equipment Costing Over $1 Million in New Construction Projects

In 1996 and 1997, 10 doctorate-granting institutions (4 top 100 institutions and 6 other doctorate-granting institutions) committed $18.9 million to nonfixed equipment costing $1 million or more in their new S&E construction projects. These commitments occurred in only four fields and represented 11 percent of total construction commitments in those fields:

- In the biological sciences outside medical schools, the amount of funds committed by two institutions to nonfixed equipment costing over $1 million accounted for 8 percent of all construction commitments in this field;
- In the physical sciences, the amount of funds committed by three institutions to this type of equipment accounted for 9 percent of all construction commitments in this field;
- In engineering, the amount of funds committed by two institutions to this type of equipment accounted for 17 percent of all construction commitments in this field; and
- In the medical sciences outside medical schools, the amount of funds committed by two institutions to this type of equipment accounted for 15 percent of all construction commitments in this field.

Chapter 4—The Repair/Renovation of S&E Research Facilities

Highlights

- In fiscal years 1996 and 1997, research-performing institutions committed $1.5 billion to the repair/renovation of science and engineering research facilities. This is 22 percent more (in constant dollars) than they committed to new repair/renovation projects in 1994 and 1995 ($1.3 billion) (table 4-1).
- More than half (52 percent) of all research-performing colleges and universities undertook some type of repair/renovation project costing over $100,000 during fiscal years 1996 and 1997 (table 4-5).
- In the current survey period, financial commitments to repair/renovation projects accounted for 33 percent of total capital project expenditures, up from 25 percent in fiscal years 1990 and 1991 (table 4-3).
- Five fields account for more than three quarters (76 percent) of the $1.3 billion committed to the repair/renovation of research facilities costing over $100,000 in 1996 and 1997. These fields are the physical sciences ($244 million), engineering ($208 million), the biological sciences outside medical schools ($200 million), the medical sciences in medical schools ($196 million), and the biological sciences in medical schools ($164 million) (table 4-8).
- For fiscal years 1998 and 1999, research-performing institutions are scheduled to commit $1.6 billion to S&E repair/renovation projects costing more than $100,000 and $983 million to central campus infrastructure repair/ renovation projects costing more than $100,000 (table 4-4).

Introduction

After years of deferring building repair projects, many of the Nation's colleges and universities have begun pushing aggressively to fund improvements to college facilities.[19] In this chapter, we examine the extent to which research-performing colleges and universities were engaged in the repair/renovation of science and engineering research facilities in 1996 and 1997 and the fields in which this activity occurred.

As was the case for construction in Chapter 3, institutions were asked to estimate the research-related costs and space for repair/renovation projects begun during fiscal years 1996 and 1997, and to make the same estimates for projects scheduled to begin in fiscal years 1998 and 1999. The project start-up time was defined as the fiscal year in which actual work began (or was expected to begin). In the case of projects conducted over multiple years, total project costs were allocated to the fiscal year in which the repair/renovation began. Note, however, that the costs and parameters of multiyear projects can change between the time a project begins and the time it is completed.

The reported financial commitments, defined as the cost to complete a project, included planning, site preparation, fixed equipment, and building infrastructure. Projects costing over $100,000 and those costing between $5,000 and $100,000 were reported separately.

It should be noted that fluctuations in repair/ renovation spending from one year to another can result from large projects at a small number of institutions. Given the costs of repairing/renovating S&E research facilities, a large increase could reflect a big project on one or two campuses. Indeed, this is often the case for the nondoctorate-granting institutions.

This year, for the first time, institutions were asked to report any nonfixed equipment costing $1 million or more that was included as part of their repair/renovation costs for fiscal years 1996 and 1997. If a project were to serve both research and nonresearch purposes, repair/ renovation costs and space estimates were to be prorated to reflect the research-related portion of the cost and space (see Items 4a, 4b, and 4c in Appendix C).

[19] Peter Schmidt. (1998, June 12). A building boom for public colleges. *The Chronicle of Higher Education*, A29-A30.

Findings

Funds Committed to the Repair/Renovation of S&E Research Facilities

Research-performing institutions committed a total of $1.5 billion to the repair/renovation of science and engineering research facilities in 1996 and 1997. This is 22 percent more (in constant dollars) than they committed to new repair/renovation projects in the last survey period ($1.3 billion).

Between fiscal years 1994 and 1995 and fiscal years 1996 and 1997, doctorate-granting institutions and nondoctorate-granting institutions increased the amount of funds committed to new repair/renovation projects:

- Doctorate-granting institutions committed $166 million or 14 percent more funds;
  - The top 100 institutions committed $78 million or 9 percent more funds; and
- Nondoctorate-granting institutions committed $107 million or 122 percent more funds (table 4-1).

Financial commitments to repair/renovation projects costing over $100,000 constituted 86 percent of all repair/renovation funds in 1996 and 1997. Funds committed to these types of repair/renovation projects increased by 19 percent since the last survey (from $1,116 million to $1,325 million). Funds for projects costing over $100,000 increased at doctorate-granting institutions and nondoctorate-granting institutions during both of these time periods (figure 4-1):

Table 4-1. Trends in funds committed to repair/renovate science and engineering research facilities by institution type and cost of project: 1986–97

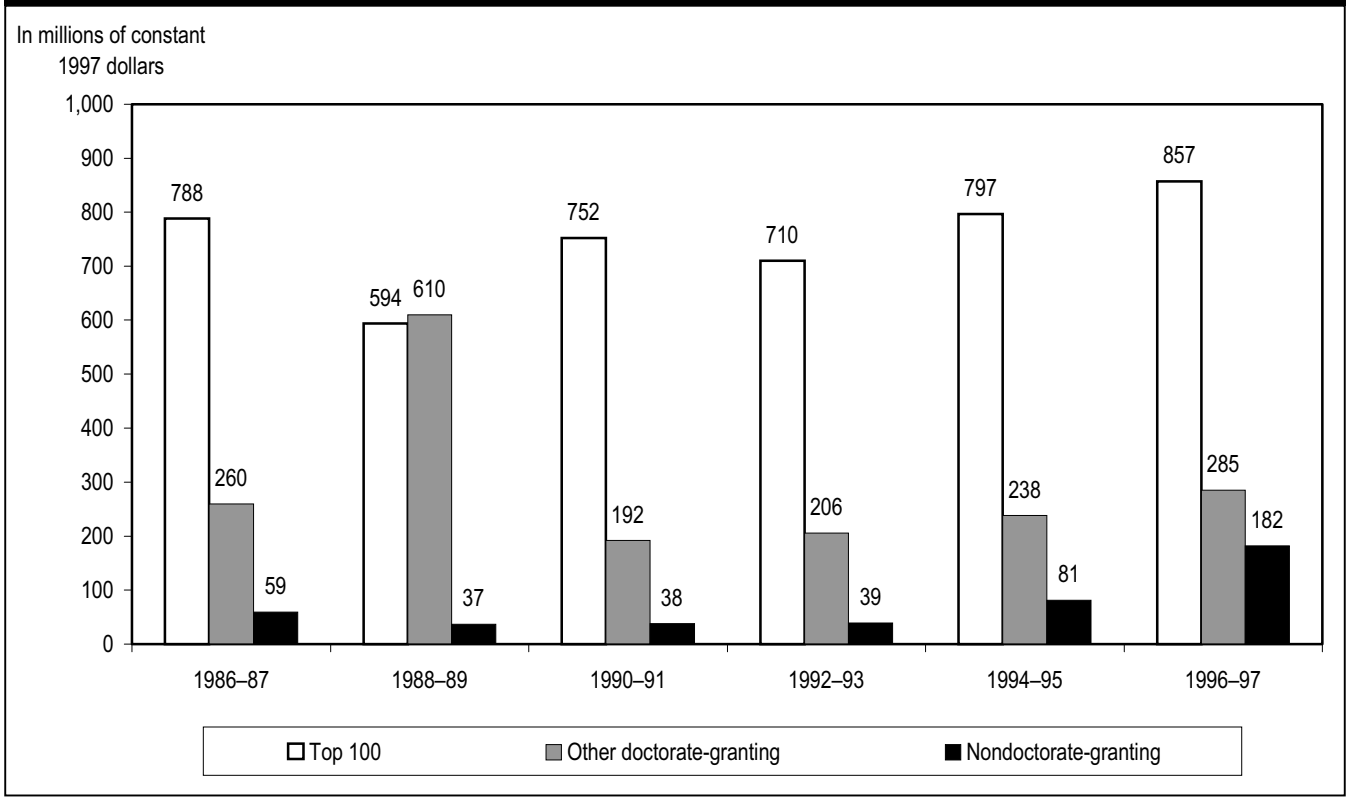
Institution type	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97
	In millions of constant 1997 dollars					
Total						
Total cost	--	--	1,155	1,230	1,259	1,532
Over $100,000	1,108	1,243	982	955	1,116	1,325
Under $100,000	--	--	173	275	142	208
Doctorate-granting						
Total cost	--	--	1,112	1,153	1,171	1,337
Over $100,000	1,048	1,205	944	916	1,035	1,142
Under $100,000	--	--	168	237	136	195
Top 100 in research expenditures						
Total cost	--	--	867	915	904	982
Over $100,000	788	594	752	710	797	857
Under $100,000	--	--	115	205	108	125
Other						
Total cost	--	--	245	238	267	355
Over $100,000	260	610	192	206	238	285
Under $100,000	--	--	53	33	28	70
Nondoctorate-granting						
Total cost	--	--	43	77	88	195
Over $100,000	59	37	38	39	81	182
Under $100,000	--	--	5	38	6	13

KEY: -- = Data were not collected.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Figure 4-1. Trends in funds committed to science and engineering research facilities repair/renovation projects costing more than $100,000 by institution type: 1986–97



NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- At doctorate-granting institutions, the funds for projects costing over $100,000 increased by $107 million or 10 percent since the last survey (from $1,035 million to $1,142 million);
  - At the top 100 institutions, the funds for these projects increased by $60 million or 8 percent since the last survey (from $797 million to $857 million); and
  - At nondoctorate-granting institutions, the funds for these projects increased by $101 million or 125 percent since the last survey (from $81 million to $182 million).

Total funds committed to new repair/renovation projects costing less than $100,000 increased by 46 percent since the last survey, from $142 million to $208 million. In 1996 and 1997, these less expensive projects accounted for 14 percent of all funds committed to new repair/renovation projects. Since the last survey, all institution types increased their allocations to these kinds of projects (table 4-1):

- Doctorate-granting institutions increased their allocations by $59 million or 43 percent (from $136 million to $195 million);
  - The top 100 institutions increased their allocations by $17 million or 16 percent (from $108 million to $125 million);
  - Other doctorate-granting institutions increased their allocations by $42 million or 150 percent (from $28 million to $70 million); and
- Nondoctorate-granting institutions increased their allocations by $7 million or 117 percent (from $6 million to $13 million).

A subset of 383 research-performing institutions were in both the 1996 and 1998 samples. These institutions actually committed in fiscal years 1996 and 1997 close to the amounts that in the 1996 survey they had estimated they would commit to new repair/renovation projects costing over $100,000; they would start in 1996 and 1998.[20] They were scheduled to commit $1,188 million and actually committed $1,145 million, a difference of $43 million or 4 percent. The doctorate granting institutions committed fewer funds than they had planned:

- Doctorate-granting institutions committed $48 million or 4 percent fewer funds than they had scheduled;
  - The top 100 institutions committed $42 million or 5 percent fewer funds than they had scheduled; and
  - Other doctorate-granting institutions committed $6 million or 3 percent fewer funds than they had scheduled (table 4-2).

Table 4-2. Scheduled and actual repair/renovation commitments for projects costing more than $100,000 for science and engineering research space by institution type: 1996–97

Institution type	Number of institutions	1996–97 (scheduled)	1996–97 (actual)
		In millions of dollars	
Total	383	1,188	1,145
Doctorate-granting	257	1,098	1,050
Top 100 in research expenditures	99	898	856
Other	158	200	194
Nondoctorate-granting	126	89	95

NOTE: Components may not add to totals due to rounding. Includes only institutions in both the 1996 and 1998 samples.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1996 and 1998 Surveys of Scientific and Engineering Research Facilities at Colleges and Universities.

[20] The scheduled 1996–97 data come from National Science Foundation/Division of Science Resources Studies, 1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities. Because this analysis is limited to the subset of research-performing institutions that were in both the 1996 and 1998 samples, the results do not generalize to the population of research-performing institutions.

Funds Committed to Repair/Renovation Projects as a Proportion of Total Capital Projects

The share of total capital project funds committed to initiate the repair/renovation of S&E research space has risen in each survey period since data were first collected on this topic in 1990–91.[21] In the 1990–91 period, total financial commitments to repair/renovation projects—both under and over $100,000—represented 25 percent of all capital project commitments. In the most recent survey period (1996–97), these commitments grew to 33 percent of all capital projects (table 4-3).

Between 1990–91 and 1996–97, the proportion of funds committed to new repair/renovation projects as a function of total capital projects increased substantially at the following types of institutions:

- Doctorate-granting institutions' proportion of repair/renovation commitments increased from 25 percent of all capital projects to 32 percent;
  - The top 100 institutions' proportion increased from 27 to 32 percent; and
- Nondoctorate-granting institutions' proportion increased from 22 to 42 percent.

Between the last survey period (1994–95) and the current one, the proportion of funds committed to new repair/renovation projects as a function of total capital projects by the nondoctorate-granting institutions increased from 20 to 42 percent. However, the proportion of funds committed by these institutions has fluctuated by roughly 20 percentage points from survey period to survey period.

Funds Scheduled for the Repair/Renovation of S&E Research Facilities and Central Campus Infrastructure

For fiscal years 1998 and 1999, research-performing institutions are scheduled to commit $1.6 billion to S&E repair/renovation projects costing over $100,000. Most of this repair/renovation is scheduled to occur among the doctorate-granting institutions, the top 100 institutions in particular. Doctorate-granting institutions plan to commit 23 percent or $257 million more to new repair/renovation

[21] Trends are reported from the 1990 and 1991 fiscal years because this was the first time period for which institutions reported repair/renovation expenses for projects costing over $100,000 and for projects costing less than $100,000.

Table 4-3. Funds committed to science and engineering repair/renovation as a percentage of total capital project expenditures by institution type: 1990–97

Institution type	1990–91 Total capital projects	1990–91 Repair/ renovation	1990–91 Repair/ renovation as percent of total	1992–93 Total capital projects	1992–93 Repair/ renovation	1992–93 Repair/ renovation as percent of total
	In millions of dollars			In millions of dollars		
Total	4,693	1,155	25	4,437	1,230	28
Doctorate-granting	4,495	1,112	25	4,255	1,153	27
Top 100 in research expenditures	3,271	867	27	3,228	915	28
Other	1,227	245	20	1,027	238	23
Nondoctorate-granting	195	43	22	181	77	42
	1994–95*			1996–97		
Total	4,179	1,259	28	4,644	1,532	33
Doctorate-granting	3,742	1,171	31	4,181	1,337	32
Top 100 in research expenditures	3,022	904	30	3,036	982	32
Other	721	267	37	1,145	355	31
Nondoctorate-granting	437	88	20	463	195	42

*Some 1994–95 values have been revised since the 1996 report.

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

projects in fiscal years 1998 and 1999 than they did in 1996 and 1997 (from $1.1 billion to $1.4 billion). Top 100 institutions plan to commit 19 percent or $166 million more (from $857 million to $1,023 million) (tables 4-4 and 4-1).

Research-performing institutions are scheduled to commit $983 million to new central campus infrastructure repair/renovation projects in 1998 and 1999. These funds are distributed among the institution types as follows:

- Doctorate-granting institutions plan to commit $936 million to new central campus infrastructure projects; this represents 95 percent of these funds;
  - The top 100 institutions plan to commit $612 million or 62 percent of these funds;
  - Other doctorate-granting institutions plan to commit $325 million or 33 percent of these funds; and

Table 4-4. Funds scheduled for the repair/renovation of science and engineering (S&E) research facilities and central campus infrastructure by institution type: 1998–99

Institution type	Scheduled repair/renovation: S&E research space	Central campus infrastructure	Total
	In millions of dollars		
Total	1,580	983	2,563
Doctorate-granting	1,399	936	2,336
Top 100 in research expenditures	1,023	612	1,635
Other	376	325	700
Nondoctorate-granting	181	46	227

NOTE: Components may not add to totals due to rounding. As used here, repair/renovation projects are limited to those with prorated costs at $100,000 or more for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- Nondoctorate-granting institutions plan to commit $46 million or 5 percent of these funds.

Overall, research-performing institutions are scheduled to commit fewer funds to new S&E facilities repair/renovation projects as they are scheduled to commit to new S&E construction projects ($1.6 billion versus $3.9 billion). By contrast, research-performing institutions are scheduled to commit more than twice as much to new central campus infrastructure repair/renovations projects in 1998 and 1999 as they are scheduled to commit to new central campus infrastructure construction projects ($983 million versus $396 million). (See table 3-4 for funds committed to scheduled construction of research facilities and central campus infrastructure.)

Colleges and Universities Starting S&E Repair/Renovation Projects

In 1996 and 1997, slightly over half (52 percent) of all research-performing institutions reported that they initiated repair/renovation projects costing over $100,000 (table 4-5). More institutions started new repair/renovation projects in 1996 and 1997 than started new construction projects (52 percent compared with 30 percent). (See table 3-5 for the proportion of institutions starting construction projects.)

In 1986–87, a higher proportion of doctorate-granting institutions in general, and top 100 institutions in particular, started repair/renovation projects than began them in the current survey period (1996–97), while a lower proportion of other doctorate-granting institutions started new construction projects:

- The proportion of doctorate-granting institutions beginning repair/renovation projects declined from 78 to 67 percent of institutions;
  - The proportion of top 100 institutions declined from 96 to 92 percent of institutions; and
  - The proportion of other doctorate-granting institutions increased from 44 to 58 percent of institutions.

In 1998 and 1999, 46 percent of research-performing institutions are scheduled to start new S&E repair/renovation projects costing over $100,000. This proportion is less than the proportion of institutions that started repair/renovation projects in 1986 and 1987 (56 percent).

A separate analysis of the 383 institutions that were in both the 1996 and 1998 samples reveals that 151 or 79 percent of all research-performing institutions that had scheduled new repair/renovation projects costing over $100,000 for 1996 or 1997 actually undertook them (table 4-6).[22] The top 100 institutions' actions were more consistent with their plans to repair/renovate new S&E research facilities than that of the other types of institutions. Overall, 126 or 86 percent of doctorate-granting institutions acted in accordance with their plans, as did 74 or 96 percent of top 100 institutions and 52 or 74 percent of other doctorate-granting institutions.

[22] Because the analysis is limited to the subset of research-performing institutions that were in both the 1996 and 1998 samples, the results do not generalize to the population of research-performing institutions.

Table 4-5. Trends in the percentage of institutions starting projects to repair/renovate science and engineering research facilities by institution type: 1986–99

Institution type	1986–87	1988–89	1990–91	1992–93	1994–95*	1996–97	(scheduled) 1998–99
Total	56	48	47	45	45	52	46
Doctorate-granting	78	71	74	61	61	67	63
Top 100 in research expenditures	96	85	91	90	88	92	85
Other	44	63	65	48	49	58	54
Nondoctorate-granting	28	20	14	25	24	32	24

*Some 1994–95 values have been revised from the 1996 report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 4-6. Number of institutions starting science and engineering research facilities repair/renovation (R/R) projects costing more than $100,000 and whether repair/renovation was scheduled by institution type: 1996–97

Institution type	Number of institutions that scheduled R/R	Number of institutions that scheduled R/R and actually started R/R	Number of institutions that did not schedule R/R	Number of institutions that did not schedule R/R but started R/R
Total	191	151	193	64
Doctorate-granting	147	126	110	48
Top 100 in research expenditures	77	74	22	17
Other	70	52	88	31
Nondoctorate-granting	44	26	82	16

NOTE: Components may not sum to totals due to rounding. Includes only the 383 institutions that were in both the 1996 and 1998 samples.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1996 and 1998 Surveys of Scientific and Engineering Research Facilities at Colleges and Universities.

It is also worth noting that 64 or 33 percent of institutions that had not scheduled repair/renovation projects for 1996 and 1997, did, in fact, start new projects in 1996 and 1997. Overall, 48 or 44 percent of doctorate-granting institutions began repair/renovation projects that were not reported as scheduled, with 17 or 77 percent of top 100 institutions doing so.

Fields in Which Repair/Renovation Projects Started

Since 1986–87 there has been some change in the proportion of institutions starting new repair/renovation projects costing over $100,000 in specific S&E fields (table 4-7). The proportion of institutions starting repair/renovation projects declined in two fields:

- In engineering, the proportion of institutions decreased from 42 to 35 percent; and
- In the medical sciences in medical schools, the proportion of institutions decreased from 54 to 41 percent.

The proportion of institutions starting repair/renovation projects increased in two fields:

- In the physical sciences, the proportion of institutions increased from 22 to 31 percent; and
- In the medical sciences outside medical schools, the proportion of institutions increased from 12 to 25 percent.

In four fields, the proportion of institutions starting repair/renovation projects increased from the last survey period:

- In the biological sciences outside medical schools, the proportion of institutions increased from 22 to 29 percent;
- In the physical sciences, the proportion of institutions increased from 24 to 31 percent;
- In the social sciences, the proportion of institutions increased from 7 to 12 percent; and
- In the medical sciences outside medical schools, the proportion of institutions increased from 16 to 25 percent.

In one field, the medical sciences in medical schools, the proportion declined from 57 to 41 percent.

The proportion of institutions scheduled to start new repair/renovation projects costing over $100,000 in 1998 and 1999 is expected to change over 1996–97 levels in four fields:

- In the biological sciences outside medical schools, the proportion of institutions is expected to decrease from 29 to 21 percent;
- In the physical sciences, the proportion of institutions is expected to decrease from 31 to 22 percent;

Table 4-7. Trends in the percentage of institutions starting projects to repair/renovate science and engineering research facilities by field: 1986–99

Field	1986–87	1988–89	1990–91	1992–93	1994–95[1]	1996–97	(scheduled) 1998–99
Total	56	48	47	45	45	52	46
Biological sciences—							
inside medical schools	45	41	46	39	47	51	33
outside medical schools	23	24	22	22	22	29	21
Physical sciences	22	23	22	22	24	31	22
Psychology	9	4	10	4	5	8	11
Social sciences	8	5	--[2]	5	7	12	12
Mathematics	8	8	4	2	3	3	3
Computer sciences	15	5	10	6	6	5	12
Earth, atmospheric, and ocean sciences	13	9	13	13	11	12	12
Engineering	42	37	24	30	29	35	28
Agricultural sciences	33	25	27	18	28	25	19
Medical sciences—							
inside medical schools	54	44	62	61	57	41	34
outside medical schools	12	12	22	16	16	25	21

[1] Some 1994–95 values have been revised since the 1996 report.

[2] Psychology and social sciences were not differentiated in the questionnaire item for the 1990–91 period.

NOTE: As used here, repair/renovation projects are limited to those with prorated costs of $100,000 or more for affected research space. Percentages are based on the number of institutions with existing research space or planned repair/renovation projects in a given field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- In the biological sciences in medical schools, the proportion of institutions is expected to decrease from 51 to 33 percent; and
- In psychology, the proportion of institutions is expected to increase from 8 to 11 percent.

Funds Committed to S&E Research Facilities Repair/Renovation Projects in Different Fields

Five fields account for more than three quarters (76 percent) of the $1.3 billion committed to the repair/renovation of S&E research facilities by research-performing institutions in fiscal years 1996 and 1997; three of these fields are in the biomedical sciences:

- The physical sciences—research-performing institutions committed $244 million;
- Engineering—research-performing institutions committed $208 million;
- The biological sciences outside medical schools—research-performing institutions committed $200 million;
- The medical sciences in medical schools—research-performing institutions committed $196 million; and
- The biological sciences in medical schools—research-performing institutions committed $164 million (table 4-8).

The amount of funds committed to new repair/renovation projects increased in three fields since 1986–87:

- In the physical sciences, funds increased from $139 million to $244 million (a 76-percent increase);
- In the earth, atmospheric, and ocean sciences, funds increased from $27 million to $52 million (a 93-percent increase); and

Table 4-8. Trends in funds committed to repair/renovate science and engineering research facilities for projects costing over $100,000 by field: 1986–99

Field	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97	(scheduled) 1998–99
	In millions of constant 1997 dollars						
Total	1,108	1,243	982	955	1,116	1,325	1,580
Biological sciences—							
inside medical schools	102	94	146	132	107	164	93
outside medical schools	193	155	160	123	134	200	280
Physical sciences	139	203	179	153	203	244	241
Psychology	18	14	37	12	30	65	33
Social sciences	47	11	-- *	12	42	40	124
Mathematics	5	14	6	2	6	5	51
Computer sciences	23	12	25	4	8	12	95
Earth, atmospheric, and ocean sciences	27	22	19	36	37	52	54
Engineering	186	445	97	158	158	208	198
Agricultural sciences	26	28	41	16	76	50	26
Medical sciences—							
inside medical schools	230	198	197	267	238	196	282
outside medical schools	69	30	62	32	62	76	77
Other sciences	40	20	6	8	13	11	24

* Psychology and social sciences were not differentiated in the 1990–91 survey.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- In the biological sciences in medical schools, funds increased from $102 million to $164 million (a 61-percent increase).

At the same time, funds decreased by 48 percent in the computer sciences, from $23 million to $12 million, and by 15 percent in the medical sciences in medical schools, from $230 million to $196 million.

Since the last survey period, the amount of funds committed to the repair/renovation of S&E research facilities increased in four fields and decreased in one. Funds increased in the following fields:

- In the biological sciences outside medical schools, funds increased from $134 million to $200 million (a 49-percent increase);
- In the computer sciences, funds increased from $8 million to $12 million (a 50-percent increase);
- In the earth, atmospheric, and ocean sciences, funds increased from $37 million to $52 million (a 41-percent increase); and
- In engineering, funds increased from $158 million to $208 million (a 32-percent increase).

The medical sciences in medical schools was the only field to experience a decrease in repair/renovation funds since the last survey. Institutions' financial commitment to this field declined by 18 percent, from $238 million to $196 million.

In 1998 and 1999, funds committed to new repair/renovation projects are scheduled to increase over 1996–97 levels in five fields, with allocated funds expected to more than triple in three fields:

- In mathematics, funds are scheduled to increase from $5 million to $51 million (a 920-percent increase);
- In the computer sciences, funds are scheduled to increase from $12 million to $95 million (a 692-percent increase);
- In the social sciences, funds are scheduled to increase from $40 million to $124 million (a 210-percent increase);
- In the medical sciences in medical schools, funds are scheduled to increase from $196 million to $282 million (a 44-percent increase); and
- In the biological sciences outside medical schools, funds are scheduled to increase from $200 million to $280 million (a 40-percent increase).

At the same time, funds are expected to decrease in only one field, the biological sciences in medical schools. Institutions are scheduled to commit 43 percent fewer funds to this field in 1998 and 1999 than they did in 1996 and 1997 (a decrease from $164 million to $93 million).

Funds Committed to Nonfixed Equipment Costing Over $1 Million in Repair/Renovation Projects

In 1996 and 1997, nine doctorate-granting institutions (4 top 100 institutions and 5 other doctorate-granting institutions) committed a total of $30.9 million to nonfixed equipment costing $1 million or more in their new S&E repair/renovation projects. This is 63 percent more than they committed to nonfixed equipment costing over $1 million in their S&E construction projects (see table 3-9).

These repair/renovation commitments occurred in only six fields (biological sciences inside and outside medical schools, medical sciences inside and outside medical schools, the physical sciences and engineering).[23] These 1996 and 1997 commitments at the nine doctorate-granting institutions represent 62 percent of total repair/renovation commitments in these fields:

- In the biological sciences outside medical schools, the amount of funds committed by two institutions to nonfixed equipment costing over $1 million accounted for 80 percent of all repair/renovation commitments in this field;
- In the physical sciences, the amount of funds committed by two institutions to this type of equipment accounted for 38 percent of all repair/renovation commitments in this field;
- In engineering, the amount of funds committed by three institutions to this type of equipment accounted for 26 percent of all repair/renovation commitments in this field;
- In the medical sciences in medical schools, the amount of funds committed by three institutions to this type of equipment accounted for 45 percent of all repair/renovation commitments in this field;
- In the biological sciences in medical schools, the amount of funds committed by two institutions to this type of equipment accounted for 34 percent of all repair/renovation commitments in this field; and
- In the medical sciences outside medical schools, the amount of funds committed by one institution to this type of equipment accounted for 11 percent of all repair/renovation commitments in this field.

[23] Some institutions committed funds to nonfixed equipment costing over $1 million in more than one field.

Chapter 5—Sources of Funds for S&E Research Facilities Projects

Highlights

- Science and engineering facilities construction starts at research-performing institutions totaled $3.1 billion in fiscal years 1996 and 1997. Institutions provided $1.9 billion or 60 percent of these funds from their combined pool of internal sources—private donations, institutional funds, tax-exempt bonds, other debt sources, and other sources; State and local governments provided $967 million or 31 percent of these funds; and the Federal Government provided $271 million or 9 percent of these funds (table 5-1).

- S&E facilities repair/renovation starts for projects costing over $100,000 at research-performing institutions totaled $1.3 billion in fiscal years 1996 and 1997. Institutions provided $866 million or 65 percent of these funds from their combined pool of internal sources; State and local governments provided $338 million or 26 percent of these funds, and the Federal Government provided $121 million or 9 percent of these funds (table 5-4).

- State and local governments were the single largest source of funds for construction and repair/renovation projects at public institutions, while institutions' internal sources were the single largest source of funds for these projects at private institutions (table 5-8).

Introduction

Research-performing institutions have spent several billion dollars on new science and engineering construction and repair/renovation projects in each biennial period surveyed. This chapter examines how research-performing higher education institutions financed S&E capital projects between 1990 and 1997.

Institutional respondents were asked to report sources of funds for S&E construction and repair/renovation projects costing over $100,000. Possible funding sources included the Federal Government, State or local governments, and such institutional sources as private donations, institutional funds, tax-exempt bonds, debt financing, and other sources. (See Item 5 of the survey in Appendix C.)

Considerable diversity in the source of Federal, State, and local funds for S&E construction and repair/renovation projects is possible. Federal funding, for instance, can include specific facilities support programs administered by the National Institutes of Health (NIH). Federal funding also might include nonpeer-reviewed projects that are specified individually through Congressional legislation rather than specific agency programs. Overlap between the funding categories is possible. For example, indirect costs included as institutional funds can come from Federal, State, and local governments, as well as from industry.

The dollar and relative contributions from the different sources of funds to construction and repair/renovation projects are presented in two ways in the tables. The first section of each table presents the three major sources of funds: Federal Government, State and local governments, and total internal sources. Total internal sources is the sum of all the financial resources an institution can commit to construction and repair/renovation projects—private donations, institutional funds, tax-exempt bonds, other debt financing, and other miscellaneous sources. The second section of each table presents these internal sources separately, with their dollar and relative contributions shown as a proportion of total internal sources.

Because of the support that State governments provide to public higher education, the control of the institution becomes relevant to discussions of the funding of capital projects involving S&E research facilities. Therefore, this chapter distinguishes between public and private institutions: 365 or 55 percent of the research-performing institutions are publicly controlled and 295 or 45 percent of the institutions are privately controlled.

This year, for the first time, institutions were asked to identify the indirect costs recovered from Federal grants and/or contracts that were included in "institutional funds,"

if institutional funds were a source of funds for any S&E research facilities construction or repair/renovation projects costing over $100,000.

Findings

Sources of Funds for the Construction of S&E Research Facilities

Construction starts at research-performing colleges and universities totaled $3.1 billion in fiscal years 1996 and 1997. Construction funds came primarily from institutions' internal sources. All told, institutions provided $1.9 billion or 60 percent of all funds used in new construction (table 5-1a). The majority of these funds (93 percent) came from three internal sources: private donations ($597 million), institutional funds ($593 million), and tax-exempt bonds ($553 million) (table 5-1b).

The amount of funds committed to new construction projects in 1996 and 1997 ($3.1 billion) is substantially lower than the amount committed in 1990 and 1991 ($3.5 billion). Between 1990–91 and the current survey, the dollar and relative contributions changed as follows:

- The dollar contribution from the Federal Government decreased by $295 million (from $566 million to $271 million), and its relative contribution decreased from 16 to 9 percent of all construction funds;
- The dollar contribution from State and local governments decreased by $169 million (from $1,136 million to $967 million), while their relative contribution did not change; and
- The dollar contribution from internal sources did not change substantially; however, the relative contribution increased from 52 to 60 percent of all construction funds.

Table 5-1. Trends in the sources of funds for construction of science and engineering research facilities: 1990–97

	5-1a. All sources				5-1b. Internal sources					
	Dollar contribution				Dollar contribution					
All institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Fiscal years										
1990–91	3,535	566	1,136	1,833	1,833	419	468	864	42	39
1992–93	3,207	524	1,105	1,579	1,579	343	427	707	44	57
1994–95	2,920	218	1,246	1,456	1,456	380	466	450	154	7
1996–97	3,110	271	967	1,873	1,873	597	593	553	107	23
	Relative contribution				Relative contribution					
All institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	Percentage				Percentage					
Fiscal years										
1990–91	100	16	32	52	100	23	26	47	2	2
1992–93	100	16	34	49	100	22	27	45	3	4
1994–95	100	7	43	50	100	26	32	31	11	0
1996–97	100	9	31	60	100	32	32	30	6	1

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

The dollar contributions in four of the five individual internal sources of funds changed as well:

- Private donations increased by $178 million (from $419 million to $597 million);
- Institutional funds increased by $125 million (from $468 million to $593 million);
- Tax-exempt bonds decreased by $311 million (from $864 million to $553 million); and
- Other debt sources increased by $65 million (from $42 million to $107 million).

Changes in the relative contribution from each internal source mirrored the changes in the dollar contributions described previously.

Between the last survey period (1994–95) and the current one, there were no substantial changes in the dollar or relative contributions from the Federal Government for new construction projects. However, funds from State and local governments declined by $279 million (from $1,246 million to $967 million), while their relative contribution declined from 43 to 31 percent of all construction funds. Funds from internal sources increased by $417 million (from $1,456 million to $1,873 million), while their relative contribution increased from 50 to 60 percent of all construction funds. This growth stemmed primarily from changes in three internal sources:

- The dollar contribution from private donations increased by $217 million (from $380 million to $597 million);
- The dollar contribution from institutional funds increased by $127 million (from $466 million to $593 million); and
- The dollar contribution from other debt sources decreased by $47 million (from $154 million to $107 million).

Sources of Funds for the Construction of S&E Research Facilities at Public Institutions

Public, research-performing institutions committed a total of $2 billion from all sources to the construction of new S&E research facilities in 1996 and 1997. State and local governments were the largest source of these funds ($940 million or 47 percent of total funds). The second largest source of funds came from institutions' internal sources ($847 million or 43 percent of total public construction funds) (table 5-2). The majority of these funds (92 percent) came from three sources: private donations ($267 million), tax-exempt bonds ($260 million), and institutional funds ($249 million) (table 5-2).

Between 1990 and 1991 and the current survey period, the amount of funds public institutions committed to new construction projects declined by $411 million (from $2.4 billion to $2.0 billion in constant dollars). While the dollar contribution from State and local governments did not change substantially during this time period, the dollar contribution from the Federal Government declined by $260 million (from $461 million to $201 million). At the same time, the Federal Government's relative contribution declined from 19 to 10 percent of all new construction funds. In addition, the relative contribution by State and local governments increased from 40 to 47 percent of all construction funds.

Although the total amount of funds committed to new construction projects at public institutions did not change between the last survey period (1994–95) and the current one, the contributions from all three sources did:

- The Federal Government's dollar contribution increased by $79 million (from $122 million to $201 million), while its relative contribution increased from 6 to 10 percent of all construction funds;
- State and local governments' dollar contribution decreased by $289 million (from $1,229 million to $940 million), while their relative contribution decreased from 62 to 47 percent of all construction funds; and
- Funds from internal sources increased by $222 million (from $625 million to $847 million), while their relative contribution increased from 32 to 43 percent of all construction funds.

In the current survey period, the different types of public, research-performing institutions funded the construction of new S&E research facilities from the different sources as follows:

- The public, top 100 institutions committed a total of $1,344 million to the construction of new S&E research facilities. Ten percent of these funds ($129 million) came from the Federal Government, 49 percent ($654 million) came from State and local governments, and 42 percent ($561 million) came from internal sources;

Table 5-2. Trends in the sources of funds for the construction of science and engineering research facilities at public institutions by institution type: 1990–97

Public institutions	5-2a. All sources				5-2b. Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu-tional funds	Tax-exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Total										
1990–91	2,400	461	962	977	977	165	321	473	9	8
1992–93	2,300	372	1,060	868	868	174	226	445	18	4
1994–95	1,975	122	1,229	625	625	131	150	323	14	7
1996–97	1,989	201	940	847	847	267	249	260	54	17
Top 100 in research expenditures										
1990–91	1,604	182	680	741	741	143	251	330	9	8
1992–93	1,651	246	645	760	760	144	169	428	18	2
1994–95	1,299	114	647	539	539	92	138	288	14	7
1996–97	1,344	129	654	561	561	190	213	136	21	1
Other doctorate-granting										
1990–91	661	272	271	118	118	22	70	26	0	0
1992–93	549	119	329	101	101	30	57	14	0	0
1994–95	366	5	275	85	85	39	11	35	0	0
1996–97	468	69	209	190	190	72	37	67	0	15
Nondoctorate-granting										
1990–91	135	7	10	118	118	0	0	118	0	0
1992–93	99	7	86	6	6	0	0	4	0	2
1994–95	310	3	306	1	1	0	1	0	0	0
1996–97	176	3	77	96	96	5	0	57	33	1
	Relative contribution				Relative contribution					
Public institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu-tional funds	Tax-exempt bonds	Other debt	Other Sources
	Percentage				Percentage					
Total										
1990–91	100	19	40	41	100	17	33	48	1	1
1992–93	100	16	46	38	100	20	26	51	2	0
1994–95	100	6	62	32	100	21	24	52	2	1
1996–97	100	10	47	43	100	32	29	31	6	2
Top 100 in research expenditures										
1990–91	100	11	42	46	100	19	34	45	1	1
1992–93	100	15	39	46	100	19	22	56	2	0
1994–95	100	9	50	41	100	17	26	53	3	1
1996–97	100	10	49	42	100	34	38	24	4	0
Other doctorate-granting										
1990–91	100	41	41	18	100	19	59	22	0	0
1992–93	100	22	60	18	100	30	57	13	0	0
1994–95	100	1	75	23	100	46	13	41	0	0
1996–97	100	15	45	40	100	38	19	35	0	8
Nondoctorate-granting										
1990–91	100	5	8	87	100	0	0	100	0	0
1992–93	100	7	87	6	100	0	4	67	0	30
1994–95	100	1	99	0	100	0	100	0	0	0
1996–97	100	1	44	55	100	5	0	59	35	1

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The public, other doctorate-granting institutions committed a total of $468 million to new construction. Fifteen percent of these funds ($69 million) came from the Federal Government, 45 percent ($209 million) came from State and local governments, and 40 percent ($190) came from internal sources; and

- The public, nondoctorate-granting institutions committed a total of $176 million to new construction. One percent of these funds ($3 million) came from the Federal Government, 44 percent ($77 million) came from State and local governments, and 55 percent ($96 million) came from internal sources.

Sources of Funds for the Construction of S&E Research Facilities at Private Institutions

Private, research-performing institutions committed a total of $1.1 billion to the construction of new S&E research facilities in 1996 and 1997. Unlike public colleges and universities, which relied most heavily on funds from State and local governments (table 5-2), private institutions derived most of their construction funds from internal sources ($1.0 billion or 91 percent of total private construction funds) (table 5-3a). The majority of these funds (94 percent) came from three sources: institutional funds ($344 million), private donations ($329 million), and tax-exempt bonds ($293 million) (table 5-3b). Funds from State and local governments accounted for only 2 percent ($26 million) of all S&E construction funds committed by private institutions.

There were few substantial changes in the amount of funds in constant dollars that private, research-performing institutions committed to new S&E construction projects between the current survey period and all prior ones. However, the relative contribution from State and local governments and from internal sources changed between 1990 and 1991 and the current survey period as did the dollar contribution from State and local governments:

- State and local governments' dollar contribution decreased by $149 million (from $175 million to $26 million), while their relative contribution decreased from 15 to 2 percent of all construction funds; and

- Institutions' relative contribution from internal sources increased from 75 to 91 percent of all construction funds.

In the current survey period, the different types of private, research-performing institutions committed funds to the construction of new S&E research facilities as follows:

- The private, top 100 institutions committed a total of $710 million to the construction of new S&E research facilities. Five percent of these funds ($32 million) came from the Federal Government, 1 percent ($10 million) came from State and local governments, and 94 percent ($668 million) came from internal sources;

- The private, other doctorate-granting institutions committed a total of $321 million to new construction. Twelve percent of these funds ($38 million) came from the Federal Government, 2 percent ($8 million) came from State and local governments, and 86 percent ($276 million) came from internal sources; and

- The private, nondoctorate-granting institutions committed a total of $91 million to new construction. They received no construction funds from the Federal Government, while 10 percent ($9 million) of their construction funds came from State and local governments, and 90 percent ($82 million) came from internal sources.

Sources of Funds for the Repair/Renovation of S&E Research Facilities

Repair/renovation starts for projects costing over $100,000 at research-performing colleges and universities totaled $1.3 billion in fiscal years 1996 and 1997. The main source of repair/renovation funds came from the combined pool of internal sources. Institutions provided $866 million or 65 percent of all funds used in new repair/renovation projects (table 5-4a). The majority of these funds (83 percent) came from two internal sources: institutional funds ($579 million) and private donations ($141 million) (table 5-4b).

Between 1990–91 and the current survey period, the amount of funds that research-performing institutions committed to new repair/renovation projects increased

Table 5-3. Trends in the sources of funds for the construction of science and engineering research facilities at private institutions by institution type: 1990–97

Private institutions	5-3a. All sources				5-3b. Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Total										
1990–91	1,136	105	175	856	856	254	147	391	33	31
1992–93	907	152	44	711	711	169	201	262	26	53
1994–95	944	96	17	831	831	249	316	127	139	0
1996–97	1,122	70	26	1,025	1,025	329	344	293	52	7
Top 100 in research expenditures										
1990–91	798	47	174	577	577	230	59	224	33	31
1992–93	663	4	39	619	619	144	182	215	26	53
1994–95	818	93	10	716	716	163	306	111	136	0
1996–97	710	32	10	668	668	177	337	103	45	7
Other doctorate-granting										
1990–91	321	52	1	267	267	18	84	166	0	0
1992–93	238	147	5	86	86	21	18	47	0	0
1994–95	88	1	8	79	79	70	6	0	4	0
1996–97	321	38	8	276	276	79	7	182	8	0
Nondoctorate-granting										
1990–91	17	6	0	11	11	5	4	2	0	0
1992–93	7	1	0	5	5	4	0	0	0	0
1994–95	38	2	0	36	36	17	4	15	0	0
1996–97	91	0	9	82	82	74	0	8	0	0
	Relative contribution				Relative contribution					
Private institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	Percentage				Percentage					
Total										
1990–91	100	9	15	75	100	30	17	46	4	4
1992–93	100	17	5	78	100	24	28	37	4	7
1994–95	100	10	2	88	100	30	38	15	17	0
1996–97	100	6	2	91	100	32	34	29	5	1
Top 100 in research expenditures										
1990–91	100	6	22	72	100	40	10	39	6	5
1992–93	100	1	6	93	100	23	29	35	4	9
1994–95	100	11	1	87	100	23	43	16	19	0
1996–97	100	5	1	94	100	26	50	15	7	1
Other doctorate-granting										
1990–91	100	16	0	83	100	7	31	62	0	0
1992–93	100	62	2	36	100	24	21	54	0	0
1994–95	100	1	9	90	100	88	8	0	5	0
1996–97	100	12	2	86	100	29	2	66	3	0
Nondoctorate-granting										
1990–91	100	34	0	66	100	48	39	13	0	0
1992–93	100	22	0	78	100	87	7	7	0	0
1994–95	100	6	0	94	100	47	11	43	0	0
1996–97	100	0	10	90	100	90	0	10	0	0

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 5-4. Trends in the sources of funds for the repair/renovation of science and engineering research facilities: 1990–97

	5-4a. All sources				5-4b. Internal sources					
	Dollar contribution				Dollar contribution					
All institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Fiscal years										
1990–91	981	58	289	634	634	119	422	79	10	4
1992–93	952	64	288	600	600	83	377	91	31	18
1994–95	1,116	117	280	719	719	117	456	53	83	10
1996–97	1,325	121	338	866	866	141	579	85	36	26
	Relative contribution				Relative contribution					
All institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	Percentage				Percentage					
Fiscal years										
1990–91	100	6	29	65	100	19	67	12	1	1
1992–93	100	7	30	63	100	14	63	15	5	3
1994–95	100	10	25	64	100	16	63	7	12	1
1996–97	100	9	26	65	100	16	67	10	4	3

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction. As used here, repair/renovation projects are limited to those with prorated costs of more than $100,000 for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

by $344 million (from $981 million to $1,325 million). During this time period, the dollar and relative contributions from State and local governments did not change, while the contributions from the Federal Government and from internal sources changed as follows:

- The Federal Government's dollar contribution increased by $63 million (from $58 million to $121 million), while its relative contribution increased from 6 to 9 percent of all repair/ renovation funds; and
- Institutions' dollar contribution from internal sources increased by $232 million (from $634 million to $866 million), while the relative contribution remained constant at 65 percent.

Changes also occurred between the first survey period and the current one in institutions' contribution of funds to S&E facilities repair/renovation projects from two internal sources:

- The dollar contribution from institutional funds increased by $157 million (from $422 million to $579 million), while the relative contribution remained constant at 67 percent; and
- The dollar contribution from other debt sources increased by $26 million (from $10 million to $36 million), while the relative contribution increased from 1 to 4 percent of all institutional sources.

Between the last survey period (1994–95) and the current one, the amount of funds research-performing institutions committed to new repair/renovation projects increased by $209 million (from $1,116 million to $1,325 million). Funds from internal sources increased by $147 million (from $719 million to $866 million), while the Federal Government's and State and local governments' dollar contributions did not change substantially.

Three internal sources showed substantial changes in their dollar contributions between 1994–95 and the current survey period:

- The dollar contribution from institutional funds increased by $123 million (from $456 million to $579 million);
- The dollar contribution from tax-exempt bonds increased by $32 million (from $53 million to $85 million); and
- The dollar contribution from other debt sources decreased by $47 million (from $83 million to $36 million).

Despite these changes, other debt sources was the only internal source whose relative contribution changed substantially. Its relative contribution declined from 12 to 4 percent of all institutional repair/renovation funds.

In both time periods, internal sources accounted for almost two thirds of all repair/renovation funds, the contribution from State and local governments accounted for approximately a quarter of all funds, and the contribution from the Federal Government remained near 10 percent.

Sources of Funds for the Repair/Renovation of S&E Research Facilities at Public Institutions

Public, research-performing institutions committed $670 million to S&E repair/renovation projects costing over $100,000 in 1996 and 1997. State and local governments were the largest source of these funds ($328 million or 49 percent). Internal sources ranked second ($269 million or 40 percent of total funds) (table 5-5a). Two thirds of these funds (67 percent) came from institutional funds ($180 million) (table 5-5b).

Between 1990–91 and the current survey period, the amount of funds public institutions committed to new repair/renovation projects increased by $136 million (from $534 million to $670 million). Funds from the Federal Government and internal sources changed substantially between these time periods:

- The Federal Government's dollar contribution increased by $43 million (from $29 million to $72 million); and
- Institutions' dollar contribution from internal sources increased by $42 million (from $227 million to $269 million).

Similar changes occurred between the last survey period (1994–95) and the current one. The total amount of funds public institutions committed to new repair/renovation projects increased by $147 million (from $523 million to $670 million). Funds from the Federal Government and internal sources increased by $31 million and $55 million, respectively, but there were no changes in their relative contributions.

In the current survey period, different types of public, research-performing institutions funded S&E facilities repair/renovation projects as follows:

- The public, top 100 institutions committed a total of $404 million to new S&E repair/renovation projects. Seven percent of these funds ($29 million) came from the Federal Government, 45 percent ($180 million) came from State and local governments, and 48 percent ($195 million) came from internal sources;
- The public, other doctorate-granting institutions committed a total of $177 million to new S&E repair/renovation projects. Seventeen percent of these funds ($29 million) came from the Federal Government, 47 percent ($83 million) came from State and local governments, and 36 percent ($64 million) came from internal sources; and
- The public, nondoctorate-granting institutions committed a total of $89 million to new S&E repair/renovation projects. Sixteen percent of these funds ($14 million) came from the Federal Government, 73 percent ($65 million) came from State and local governments, and 11 percent ($10 million) came from internal sources.

Sources of Funds for the Repair/Renovation of S&E Research Facilities at Private Institutions

Private, research-performing institutions committed a total of $655 million to S&E repair/renovation projects costing over $100,000 in 1996 and 1997. Unlike public colleges and universities, which relied most heavily on funds from State and local governments, private institutions derived most of their repair/renovation funds from

Table 5-5. Trends in the sources of funds for the repair/renovation of science and engineering research facilities at public institutions by institution type: 1990–97

Public institutions	5-5a. All sources				5-5b. Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Total										
1990–91	534	29	278	227	227	52	160	14	0	1
1992–93	593	39	270	284	284	28	176	64	2	14
1994–95	523	41	268	214	214	17	170	19	1	7
1996–97	670	72	328	269	269	38	180	25	0	26
Top 100 in research expenditures										
1990–91	390	15	171	204	204	52	139	13	0	1
1992–93	453	14	184	255	255	28	152	59	2	13
1994–95	368	25	188	155	155	7	127	15	1	6
1996–97	404	29	180	195	195	34	133	12	0	15
Other doctorate-granting										
1990–91	122	13	88	21	21	0	19	2	0	0
1992–93	126	21	77	28	28	0	23	4	0	0
1994–95	107	9	47	51	51	10	36	4	0	1
1996–97	177	29	83	64	64	3	42	9	0	10
Nondoctorate-granting										
1990–91	21	1	19	2	2	0	2	0	0	0
1992–93	14	4	10	1	1	0	1	0	0	0
1994–95	48	7	34	7	7	0	7	0	0	0
1996–97	89	14	65	10	10	2	4	5	0	0
	Relative contribution				Relative contribution					
Public institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	Percentage				Percentage					
Total										
1990–91	100	5	52	43	100	23	70	6	0	0
1992–93	100	7	46	48	100	10	62	22	1	5
1994–95	100	8	51	41	100	8	79	9	0	3
1996–97	100	11	49	40	100	14	67	9	0	10
Top 100 in research expenditures										
1990–91	100	4	44	52	100	25	68	6	0	0
1992–93	100	3	41	56	100	11	60	23	1	5
1994–95	100	7	51	42	100	4	82	10	1	4
1996–97	100	7	45	48	100	17	69	6	0	8
Other doctorate-granting										
1990–91	100	11	72	17	100	0	92	8	0	0
1992–93	100	17	61	22	100	1	83	15	0	0
1994–95	100	8	44	48	100	19	71	8	0	2
1996–97	100	17	47	36	100	4	66	14	0	16
Nondoctorate-granting										
1990–91	100	4	88	8	100	0	100	0	0	0
1992–93	100	26	69	5	100	0	100	0	0	0
1994–95	100	15	70	15	100	3	97	0	0	0
1996–97	100	16	73	11	100	15	40	45	0	0

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction. As used here, repair/renovation projects are limited to those with prorated costs of more than $100,000 for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

internal sources ($597 million or 91 percent of total repair/renovation funds) (table 5-6a). The majority of these funds (84 percent) came from two sources: institutional funds ($399 million) and private donations ($102 million) (table 5-6b). Funds from State and local governments account for only 1 percent ($10 million) of all S&E repair/renovation funds committed by private institutions.

The amount of funds private, research-performing institutions committed to new S&E repair/renovation projects between 1990 and 1991 and the current survey period increased by $208 million (from $447 million to $655 million). In addition, changes occurred in the contributions from the different funding sources:

- The Federal Government's dollar contribution increased by $19 million (from $29 million to $48 million), while its relative contribution did not change substantially;
- State and local governments' dollar contribution did not change substantially, but their relative contribution decreased from 3 to 1 percent of all repair/renovation funds; and
- Institutions' dollar contribution from internal sources increased by $190 million (from $407 million to $597 million), while their relative contribution remained constant at 91 percent.

Between the last survey period (1994–95) and the current one, the mix of funds committed to S&E repair/renovation projects changed as follows:

- The Federal Government's dollar contribution decreased by $28 million (from $76 million to $48 million), while its relative contribution decreased from 13 to 7 percent of all repair/renovation funds;
- State and local governments' dollar contribution decreased by $2 million (from $12 million to $10 million), while their relative contribution did not change substantially; and
- Institutions' dollar contribution from internal sources did not change substantially, while their relative contribution increased from 85 to 91 percent of all repair/renovation funds.

In the current survey period, different types of private, research-performing institutions funded new S&E facilities repair/renovation projects as follows:

- The private, top 100 institutions committed a total of $453 million to new S&E repair/renovation projects. Five percent of these funds ($23 million) came from the Federal Government, 2 percent ($8 million) came from State and local governments, and 93 percent ($422 million) came from internal sources;
- The private, other doctorate-granting institutions committed a total of $108 million to new S&E repair/renovation projects. Fourteen percent of these funds ($15 million) came from the Federal Government, 1 percent ($2 million) came from State and local governments, and 84 percent ($92 million) came from internal sources; and
- The private, nondoctorate-granting institutions committed a total of $93 million to new S&E repair/renovation projects. Eleven percent of these funds ($11 million) came from the Federal Government, no funds came from State and local governments, and 89 percent of funds ($83 million) came from internal sources.

Amount of Indirect Costs Recovered from Federal Grants Committed to Construction and Repair/Renovation Projects

The institutions in the sample were asked if they could identify the amount of indirect costs they recovered from Federal grants and/or contracts included in institutional funds for projects costing over $100,000. Of the 236 institutions that used institutional funds for construction and/or repair/renovation projects, 69 institutions reported they could identify the amount of Federal indirect costs they recovered. The following discussion is limited to these 69 institutions.

Overall, these institutions used more than twice as many Federal funds recovered from indirect costs to fund repair/renovation projects ($19 million) than they did to fund construction projects ($9 million). These sums represent 3.3 percent of institutional funds allocated to repair/renovation and 1.5 percent of institutional funds allocated to construction (table 5-7).

Table 5-6. Trends in the sources of funds for the repair/renovation of science and engineering research facilities at private institutions by institution type: 1990–97

Private institutions	5-6a. All sources				5-6b. Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Total										
1990–91	447	29	11	407	407	67	262	65	10	3
1992–93	359	25	17	317	317	54	201	28	29	5
1994–95	593	76	12	506	506	100	287	34	82	3
1996–97	655	48	10	597	597	102	399	59	35	0
Top 100 in research expenditures										
1990–91	362	23	11	328	328	56	202	58	10	2
1992–93	257	13	9	235	235	42	138	22	29	5
1994–95	429	31	11	386	386	74	220	25	67	1
1996–97	453	23	8	422	422	44	318	27	33	0
Other doctorate-granting										
1990–91	69	6	0	63	63	8	52	3	0	1
1992–93	79	5	8	65	65	5	56	4	0	0
1994–95	132	43	0	89	89	8	64	2	13	2
1996–97	108	15	2	92	92	6	75	9	2	0
Nondoctorate-granting										
1990–91	16	0	0	16	16	4	9	4	0	0
1992–93	23	7	0	16	16	8	7	2	0	0
1994–95	33	2	1	30	30	18	3	7	3	0
1996–97	93	11	0	83	83	52	7	24	0	0
	Relative contribution				Relative contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
Private institutions	Percentage				Percentage					
Total										
1990–91	100	6	3	91	100	17	64	16	2	1
1992–93	100	7	5	88	100	17	63	9	9	2
1994–95	100	13	2	85	100	20	57	7	16	1
1996–97	100	7	1	91	100	17	67	10	6	0
Top 100 in research expenditures										
1990–91	100	6	3	91	100	17	62	18	3	1
1992–93	100	5	3	92	100	18	59	9	12	2
1994–95	100	7	3	90	100	19	57	6	17	0
1996–97	100	5	2	93	100	10	75	6	8	0
Other doctorate-granting										
1990–91	100	9	0	91	100	12	82	4	0	1
1992–93	100	7	11	83	100	8	86	6	0	0
1994–95	100	32	0	67	100	9	72	2	14	2
1996–97	100	14	1	84	100	6	81	9	2	0
Nondoctorate-granting										
1990–91	100	0	0	100	100	23	53	24	0	0
1992–93	100	29	0	71	100	48	41	11	0	0
1994–95	100	5	2	93	100	58	10	23	8	0
1996–97	100	11	0	89	100	63	8	29	0	0

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction. As used here, repair/renovation projects are limited to those with prorated costs of more than $100,000 for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Doctorate-granting institutions were the only institutions to use Federal funds recovered from indirect costs for construction. The top 100 institutions used $3 million, which accounted for 0.6 percent of the institutional funds they allocated to construction. Other doctorate-granting institutions used $6 million in Federal funds recovered from indirect costs for construction, which accounted for 14.0 percent of the institutional funds they allocated to construction.

All three types of institutions used Federal funds recovered from indirect costs for repair/renovation projects. The top 100 institutions used $9 million, which accounted for 2.0 percent of the institutional funds they allocated to repair/renovation projects, while the nondoctorate-granting institutions used $1 million, or 9.1 percent of their institutional funds allocated to repair/renovation projects. Other doctorate-granting institutions used $10 million in Federal funds recovered from indirect costs, which accounted for 8.5 percent of the institutional funds they allocated to repair/renovation projects costing over $100,000.

Summary of Major Sources of Funds

Table 5-8 summarizes the major sources of funds for S&E construction and repair/renovation projects by institution type and sector. Both types of public, doctorate-granting institutions received the largest portion of their S&E construction and repair/renovation funds from State and local governments. Public, nondoctorate-granting institutions also received a large portion of their S&E repair/renovation funds from State and local governments, but the major source of their construction funds came from internal sources (55 percent). The single largest source of these funds (59 percent) came from tax-exempt bonds.

By contrast, all types of private institutions derived over 80 percent of both their S&E construction and S&E repair/renovation funds from internal sources. Overall, institutional funds were the largest single source of these funds for construction (34 percent of all internal sources) and for repair/renovation (67 percent of all internal sources). However, the largest internal source of funds varied by institution type:

- Among top 100 institutions, institutional funds were the largest internal source of construction funds (50 percent of all internal sources) and repair/renovation funds (75 percent of all internal sources);
- Among other doctorate-granting institutions, tax-exempt bonds were the largest internal source of construction funds (66 percent of all internal sources), while institutional funds were the largest internal source of repair/renovation funds (81 percent of all internal sources); and
- Among nondoctorate-granting institutions, private donations were the largest internal source of construction funds (90 percent of all internal sources) and repair/renovation funds (63 percent of all internal sources).

Table 5-7. Indirect costs recovered from Federal grants and/or contracts included in institutional funds for science and engineering construction and repair/renovation: 1996–97

Institution type	Construction			Repair/Renovation		
	Indirect costs	Total institutional funds	Indirect costs as percent of institutional funds	Indirect costs	Total institutional funds	Indirect costs as percent of institutional funds
	In millions of dollars					
Total						
Doctorate-granting	9	593	1.5	19	568	3.3
Top 100 in research expenditures	3	549	0.6	9	451	2.0
Other	6	43	14.0	10	117	8.5
Nondoctorate-granting	0	0	0.0	1	11	9.1

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data, which do not appear in the table.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 5-8. Major sources of funds for construction and repair/renovation of science and engineering research facilities at public and private institutions: 1996–97

Public institutions	Construction			Repair/renovation		
	Major source	Dollars in millions	Percent of total funds	Major source	Dollars in millions	Percent of total funds
Total	State/local governments	940	47	State/local governments	328	49
Top 100 in research expenditures	State/local governments	653	49	State/local governments	180	45
Other doctorate-granting	State/local governments	209	45	State/local governments	83	47
Nondoctorate-granting	Internal sources	96	55	State/local governments	65	73
	(Tax-exempt bonds)	(57)	(59)			
Private institutions	**Major source**	**Dollars in millions**	**Percent of total funds**	**Major source**	**Dollars in millions**	**Percent of total funds**
Total	Internal sources	1,025	91	Internal sources	597	91
	(Institutional funds)	(344)	(34)	(Institutional funds)	(399)	(67)
Top 100 in research expenditures	Internal sources	668	94	Internal sources	422	93
	(Institutional funds)	(337)	(50)	(Institutional funds)	(318)	(75)
Other doctorate-granting	Internal sources	276	86	Internal sources	92	84
	(Tax-exempt bonds)	(182)	(66)	(Institutional funds)	(75)	(81)
Nondoctorate-granting	Internal sources	82	90	Internal sources	83	89
	(Private donations)	(74)	(90)	(Private donations)	(52)	(63)

NOTE: Sources and figures in parentheses are subsets of the preceding source.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Chapter 6—Deferred Construction and Repair/Renovation

Highlights

- In 1998, 54 percent of research-performing institutions reported that science and engineering research space construction or repair/renovation projects were needed but not funded.
- The cost of these deferred projects was $11.4 billion. Sixty-one percent of deferred capital project needs were for construction and 39 percent were for repair/renovation (table 6-1).
- The top 100 institutions accounted for 63 percent of the total deferred costs, other doctorate-granting institutions accounted for 30 percent, and nondoctorate-granting accounted for 7 percent (table 6-1).
- Seventy-six percent ($8.7 billion) of total deferred capital project costs were included in institutional plans (table 6-1).
- The largest deferred project costs reported by research-performing institutions were for the physical sciences, $2.5 billion, and for the biological sciences outside of medical schools, $2.1 billion (table 6-3).
- Total deferred S&E research facilities needs ($11.4 billion) combined with deferred central campus infrastructure needs ($767 million) result in an estimate of $12.2 billion in total deferred S&E-related construction and repair/renovation project costs. This 1998 estimate of deferred costs represents an increase of $1.7 billion in adjusted dollars over deferred cost estimates in 1996.

Introduction

Of central importance to the National Science Foundation's Survey of Scientific and Engineering Research Facilities at Colleges and Universities is determining the needs of research-performing institutions either for additional science and engineering research space or for the repair/renovation of existing space. The original mandate to conduct this biennial survey states:

> *The National Science Foundation is authorized to design, establish, and maintain a data collection and analysis capability in the Foundation for the purpose of identifying and assessing the research facilities needs of universities and colleges.* (42 U.S.C. 1886)

This chapter provides one way of estimating need. It reports the costs of deferred projects for construction and repair/renovation that are necessary to meet existing S&E research commitments but that are not funded.

Like the 1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities, the 1998 survey included a question designed to determine construction and repair/renovation costs that institutions had deferred. Institutions reported separately those construction and repair/renovation costs for projects that were included in an institutional plan and those not included in an institutional plan.

Four criteria were used to define deferred projects (see Item 7 of the survey in Appendix C):

- The project must be necessary to meet the current S&E research program commitments;
- The project was not scheduled for fiscal year 1998 or 1999;
- The project was not funded; and
- The project was neither for the purpose of developing new programs nor for expanding faculty beyond what is required to fulfill current S&E research program commitments.

Institutions also were asked to report their deferred central campus infrastructure construction and repair/renovation needs. These deferred needs were defined using the same criteria as for facilities, and institutions were asked to report separately those deferred needs in institutional plans and those not in such plans. Central campus infrastructure was defined as those systems that exist between the buildings of a campus and the non-architectural elements of campus design.

Findings

Deferred Capital Projects for S&E Research Facilities

In 1998, 54 percent of research-performing institutions reported construction or repair/renovation projects, or both, that were needed but not funded. Two years earlier, a similar proportion of institutions, 55 percent, reported some type of deferred capital project. The vast majority of institutions (87 percent) that had deferred projects had included at least some of these projects in an approved institutional plan. Forty-four percent of the colleges and universities that reported deferred projects also identified projects that were not included in an approved institutional plan.[24]

The total estimated cost for deferred S&E research construction and repair/renovation projects in 1998 was $11.4 billion. This total includes both projects that were in institutional plans and those that were not (table 6-1).

Slightly over three quarters of the total deferred capital project costs reported by institutions (76 percent or $8.7 billion) were included in institutional plans. Both types of doctorate-granting institutions reported that about 75 percent of their deferred capital project costs were included in an institutional plan; nondoctorate-granting institutions reported that 90 percent of their deferred capital project costs were included in plans. While 84 percent of all deferred construction project costs were included in institutional plans, 65 percent of deferred repair/renovation project costs were a part of overall institutional plans.

Overall, 61 percent of all deferred capital project needs, both those included in institutional plans and those not included, were for construction. The estimated cost for these projects totaled $7.0 billion. All types of institutions reported greater deferred construction costs than repair/renovation costs. However, construction costs included in institutional plans exceeded repair/renovation costs included in plans in all types of institutions, while deferred repair/renovation costs not in plans were greater than construction costs not in plans.

The top 100 institutions accounted for 63 percent of the total deferred need, both those in and not in plans. Other doctorate-granting institutions accounted for 30 percent of the total deferred costs. Nondoctorate-granting institutions accounted for 7 percent of the total deferred capital project costs (table 6-1).

[24] The 1996 data are from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 6-1.

Table 6-1. Estimated costs for deferred capital projects to construct or repair/renovate science and engineering (S&E) research facilities by institution type, project type, and whether the project was included in an institutional plan: 1998

	Included in institutional plans			Not Included in institutional plans			
Institution type	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	Subtotal	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	Subtotal	Total
	In millions of dollars						
Total	5,857	2,834	8,691	1,142	1,548	2,690	11,381
Doctorate-granting	5,405	2,546	7,950	1,118	1,487	2,605	10,555
Top 100 in research expenditures	3,685	1,714	5,399	731	1,025	1,755	7,154
Other	1,719	832	2,552	388	462	849	3,401
Nondoctorate-granting	452	288	740	24	61	85	826

NOTE: Components may not sum to totals due to rounding.

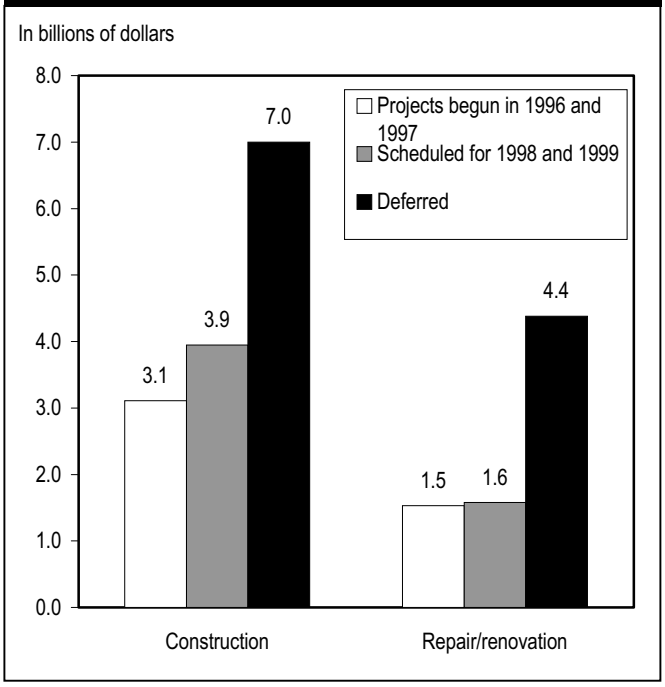
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Deferred Project Costs and Capital Project Commitments

Comparing estimated deferred project costs to the costs of capital projects begun in 1996 and 1997 and those scheduled for 1998 and 1999 provides a perspective on the magnitude of estimated deferred need. Deferred construction costs ($7.0 billion) are approximately equal to the combined construction begun in 1996 and 1997 ($3.1 billion) and construction scheduled for the following two fiscal years ($3.9 billion). Deferred repair/renovation costs ($4.4 billion) exceed the combined repair/renovation commitments for 1996 and 1997 ($1.5 billion) and those scheduled for 1998 and 1999 ($1.6 billion) (figure 6-1).

Excluding estimated deferred costs not included in institutional plans still results in deferred need estimates that exceed the actual cost of project starts for 1996 and 1997. This is the case for both deferred construction projects and deferred repair/renovation projects.

Figure 6-1. Cost of construction and repair/renovation of science and engineering research facilities begun in 1996 and 1997, scheduled for 1998 and 1999, and deferred costs in 1998 and 1999



NOTE: Includes all construction projects costing more than $100,000 and repair/renovation projects costing more than $100,000. Repair/renovation projects begun in 1996 or 1997 also include all projects costing more than $5,000.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Deferred Need Estimates

Between 1996 and 1998, deferred capital project costs increased from $9.9 billion to $11.4 billion, a 15-percent increase in adjusted dollars (table 6-1).[25] Overall, the other doctorate-granting institutions reported the largest overall increase in deferred capital project costs, a 69-percent increase.

The largest relative increase in deferred costs during this time period occurred for repair/renovation projects not included in institutional plans, from $0.9 billion to $1.5 billion. This represents a 67-percent increase. Deferred S&E research construction projects included in institutional plans increased 20 percent, from $4.9 billion to $5.9 billion.

Changes in the portion of deferred construction and repair/renovation need that is included in institutional plans can be compared for three survey periods, 1994,[26] 1996, and 1998 (table 6-2). Across all types of institutions, the estimated cost of deferred construction and repair/renovation projects increased from $6.5 billion in 1994 to $8.7 billion in 1998. The deferred need estimates of doctorate-granting institutions included in institutional plans increased from $6.0 billion in 1994 to $8.0 billion in 1998, a 31-percent increase.

In absolute dollars, estimated deferred construction projects increased $1.2 billion, or 27 percent. In relative terms, estimated deferred repair/renovation projects increased more than construction projects, $899 million, or 46 percent.

Deferred Needs by S&E Field

Total deferred project costs were highest for the physical sciences, $2.5 billion (table 6-3). Total deferred project costs of $2.1 billion were reported for the biological sciences outside of medical schools. These two fields alone account for approximately 40 percent of all deferred capital project costs. The deferred project costs for two additional fields (engineering and the medical sciences in medical schools) exceed $1 billion. These four fields represent 66 percent of all deferred capital projects. Institutions reported the lowest deferred costs for capital projects in mathematics and other sciences, $182 and $188 million, respectively.

[25] Ibid.

[26] The 1994 survey only asked about deferred projects that were included in institutional plans.

Table 6-2. Trends in deferred need estimates included in institutional plans for science and engineering construction and repair/renovation: 1994, 1996, and 1998

Institution type	1994 Construction	1994 Repair/ renovation	1994 Total	1996 Construction	1996 Repair/ renovation	1996 Total	1998 Construction	1998 Repair/ renovation	1998 Total
	In millions of constant 1997 dollars								
Total	4,614	1,935	6,548	4,884	2,943	7,827	5,857	2,834	8,691
Doctorate-granting:	4,387	1,662	6,049	4,544	2,632	7,176	5,405	2,546	7,951
Top 100 in research expenditures	3,218	1,199	4,418	3,671	1,744	5,415	3,685	1,714	5,399
Other	1,169	463	1,631	872	888	1,760	1,719	832	2,551
Nondoctorate-granting	227	272	499	340	311	651	452	288	740

NOTE: Components may not sum to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 6-3. The cost of deferred capital projects to construct or repair/renovate science and engineering (S&E) research facilities by field, type of project, and whether the project was included in an institutional plan: 1998

Institution type	Included in institutional plans: To construct new S&E research facilities	Included in institutional plans: To repair/ renovate existing S&E research facilities	Not included in institutional plans: To construct new S&E research facilities	Not included in institutional plans: To repair/ renovate existing S&E research facilities	Total
	In millions of dollars				
Total	5,590	2,674	1,102	1,474	10,840
Biological sciences—					
inside medical schools	267	160	40	74	540
outside medical schools	976	505	273	348	2,101
Physical sciences	1,339	596	212	305	2,453
Psychology	107	71	30	33	242
Social sciences	136	110	44	67	357
Mathematics	83	75	5	19	182
Computer sciences	198	25	38	35	297
Earth, atmospheric, and ocean sciences	327	106	71	42	545
Engineering	878	556	166	144	1,744
Agricultural sciences	422	165	64	117	768
Medical sciences—					
inside medical schools	689	274	109	184	1,256
outside medical schools	333	129	71	174	707
Other sciences	102	62	18	6	188

NOTE: Components may not sum to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Deferred Capital Projects for Central Campus Infrastructure

The facilities in which S&E research is conducted are supported by a campus infrastructure of walkways and roads, wiring for telecommunications and electricity, sewers and drains, air handling, waste storage and disposal, and the like. It is difficult to establish how much of this central campus infrastructure supports the work of S&E research and how much supports other academic and nonacademic needs.

In 1998, research-performing institutions estimated deferred construction and repair/renovation costs affecting their central campus infrastructure to be $2.6 billion (table 6-4). Over three-fourths (77 percent) of the total deferred cost to either construct or repair/renovate the central campus infrastructure was included in institutional plans. The percentage of total deferred costs included in institutional plans ranged from 65 percent at nondoctorate-granting institutions to 79 percent at other doctorate-granting institutions.

The estimated $2.6 billion in deferred central campus infrastructure costs is in addition to the $11.4 billion in deferred costs for construction and repair/renovation identified above. Because 59 percent of all academic space is devoted to S&E, and 50 percent of that space is research space (see table 1-2), a conservative prorated estimate of S&E research needs for central campus infrastructure is $767 million ($2.6 billion x .59 x .50). It should be noted that: (1) S&E research is probably more demanding of central campus infrastructure than other space, and (2) it is more difficult to prorate infrastructure costs than research facilities costs. Thus, $767 million should be interpreted as a conservative estimate of the S&E research infrastructure deferred project costs.

Combining this $767 million for campus infrastructure costs with the $11.4 billion in deferred S&E research capital projects noted above, the total deferred S&E research facilities and infrastructure needs of colleges and universities is estimated to be $12.2 billion.[27] This overall estimate of deferred need represents an increase of $1.7 billion over 1994–95 levels.[28]

[27] This estimate of deferred need, along with all others reported in this chapter, is potentially a lower estimate than would be derived from responses to other types of questions and calculations. By limiting the concept of need to current "research program commitments," respondents were forced to consider only those R&D activities that were budgeted, approved, and funded. Such boundaries precluded institutions from reporting desired space in fields in which they did not currently have a research program. Calculations based on broader definitions of need would yield higher estimates.

[28] These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, page 6-11. The values presented here have been adjusted for inflation.

Table 6-4. The cost of deferred capital projects to construct or repair/renovate central campus infrastructure by institution type, type of project, and whether the project was included in an institutional plan: 1998

	Included in institutional plans			Not included in institutional plans			
Institution type	To construct new central campus infrastructure	To repair/ renovate existing central campus infrastructure	Subtotal	To construct new central campus infrastructure	To repair/ renovate existing central campus infrastructure	Subtotal	Total
	In millions of dollars						
Total	634	1,374	2,008	210	380	589	2,597
Doctorate-granting	560	1,297	1,857	209	300	509	2,366
Top 100 in research expenditures	349	820	1,169	149	177	325	1,495
Other	211	477	688	60	123	184	871
Nondoctorate-granting	74	77	151	1	80	80	231

NOTE: Components may not sum to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Chapter 7—Minority-Serving Institutions

Highlights

- The 80 research-performing, minority-serving institutions (institutions designated as Historically Black Colleges and Universities (HBCUs), institutions whose enrollments are at least 25 percent black but are not HBCUs, and institutions whose enrollments are at least 25 percent Hispanic) represent 12 percent of all research-performing institutions and contain 3 percent, or 3.9 million net assignable square feet, of the total science and engineering research space (table 7-1).

- At least 60 percent of the minority-serving institutions reported that the amount of S&E research space they had was inadequate for current research commitments in eight fields: engineering; psychology; the social sciences; the physical sciences; the computer sciences; the biological sciences outside medical schools; the earth, atmospheric, and ocean sciences; and the medical sciences outside medical schools (table 7-2).

- Twenty-four percent of the minority-serving institutions began new S&E research construction projects in fiscal years 1996 and 1997 totaling approximately $120 million. Thirty percent of these institutions began new repair/renovation projects totaling about $36 million (table 7-3).

- The amount of S&E research space in a group of 29 HBCUs that have been in the study sample since 1988 increased from 1.1 million NASF in 1988 to 1.9 million NASF in 1998 (table 7-5).

- Construction activity at the 29 original HBCUs increased considerably between the 1994–95 and 1996–97 fiscal years, from 4 HBCUs starting construction projects totaling $3.5 million dollars to 11 institutions starting such projects at a cost of $64.3 million (table 7-6).

Introduction

Since its inception, the Survey of Scientific and Engineering Research Facilities at Colleges and Universities has included a sample of HBCUs. These institutions have been recognized for their contributions to the education of black students in general and for their role in preparing students for science and engineering careers. NSF has recognized the growth in minority enrollments in higher education overall and, thus, added two other types of minority-serving institutions to the 1998 sample. The inclusion of non-HBCU-Black institutions acknowledges the fact that there are many colleges and universities that enroll large percentages of black students but are not designated as HBCUs. Non-HBCU-Black institutions are defined as colleges and universities whose enrollments are at least 25 percent black. Similarly, as Hispanic enrollments in higher education increase, there is a need to examine institutions serving these students. Hispanic-serving Institutions (HSIs) are defined as colleges and universities whose enrollments are at least 25 percent Hispanic. The group of minority-serving institutions varies in size and focus; it is composed of both nondoctorate and doctorate-granting institutions, and includes one of the top 100 research-performing institutions.[29]

In prior years, only HBCUs were included in the sample, and trend data were reported for these institutions. Because non-HBCU-black institutions and HSIs are included in the sample for the first time, no trends can be reported for the full group of minority-serving institutions. Trend data are presented for a group of 29 larger HBCUs that have been part of the sample since 1988.

[29] Although the importance of institutions that serve Asian-American students as well as institutions that serve students from more than one ethnic group is recognized (see Merisotis and O'Brien, *Minority Serving Institutions: Distinct Purposes, Common Goals*, 1998), this chapter only examines minority-serving institutions that enroll large percentages of specific groups of students, black or Hispanic.

Findings

S&E Space in Minority-Serving Institutions

The 80 research-performing, minority-serving institutions had 28 million net assignable square feet of space in all academic fields in 1998; 44 percent of this space (12.4 million NASF) was in science and engineering fields. About 31 percent of the S&E space was research space (3.9 million NASF). Research-performing, minority-serving institutions represent 12 percent of all research-performing institutions and contain 3 percent of all S&E research space (table 7-1):

- HBCUs represent 71 percent of all research-performing, minority-serving institutions and contain 61 percent of all the S&E research space in these institutions;
- Non-HBCU-Black institutions represent 16 percent of the research-performing, minority-serving institutions and contain 11 percent of the S&E research space in these institutions; and
- Hispanic-serving institutions represent 13 percent of the research-performing, minority-serving institutions and contain 28 percent of the S&E research space in these institutions.

Minority-serving institutions were most likely to have S&E research space in the biological sciences outside medical schools; 93 percent of these colleges and universities reported research space in this field. Eighty-four percent of the minority-serving institutions reported S&E research space in the physical sciences. The percent of minority-serving institutions reporting S&E research space in other fields drops to 50 percent for the computer sciences and 48 percent for psychology.

Although only 40 percent of minority-serving institutions reported S&E research space in engineering, this field contained more space than any other single field, 960 thousand NASF. The agricultural sciences followed with another 710 thousand NASF of research space. It should be noted that engineering and the agricultural sciences are more space intensive than other S&E fields. These fields represent relatively larger proportions of S&E research space in all research-performing institutions.

Adequacy of the Amount of S&E Research Space and Its Condition in Minority-Serving Institutions

At least 60 percent of minority-serving institutions reported that the amount of S&E research space was inadequate for meeting current research commitments in eight fields (table 7-2):

- Engineering—69 percent;
- Psychology—67 percent;
- Physical sciences—66 percent;
- Computer sciences—66 percent;
- Biological sciences outside medical schools—65 percent;
- Social sciences—65 percent;
- Earth, atmospheric, and ocean sciences—61 percent; and
- Medical sciences outside medical schools—61 percent.

Minority-serving institutions reported that 38 percent (1.5 million NASF) of their current research space was suitable for use in the most scientifically sophisticated research and another 44 percent (1.7 million NASF) was effective for most uses, but needs limited repair/renovation. Seventeen percent (0.7 million NASF) of the current S&E research space was rated as requiring either major renovation or replacement (see table 7-1 for amount of current research space).

New S&E Facilities Construction and Repair/Renovation Projects at Minority-Serving Institutions

In fiscal years 1996 and 1997, almost a quarter (24 percent) of all minority-serving, research-performing institutions initiated new S&E research facilities construction projects costing over $100,000. These construction projects are expected to yield close to 0.5 million NASF of new research space at a cost of $120 million. In terms of space and dollars, the S&E construction activity at minority-serving institutions represents approximately 4 percent of all S&E research construction activity started in 1996 and 1997 (table 7-3).

Table 7-1. Amount of instructional and research space and the percentage of institutions with science and engineering (S&E) research space by field in minority-serving institutions: 1998

Indicator	HBCUs	Non-HBCU-Black institutions	Hispanic-serving institutions	All minority-serving institutions	All institutions
Number of institutions	57	13	10	80	660
Amount of instructional and research space [NASF in thousands]					
Total instructional and research space (all fields)	18,326	2,707	6,949	27,982	487,656
Total instructional and research space (S&E fields)	8,734	1,283	2,359	12,376	286,239
Total S&E research space	2,339	426	1,092	3,857	143,288
Percentage of institutions with S&E research space by field					
Biological sciences—					
inside medical schools	5	20	0	7	19
outside medical schools	96	70	100	93	84
Physical sciences	83	80	100	84	83
Psychology	50	30	61	48	70
Social sciences	51	20	26	43	63
Mathematics	48	30	36	43	60
Computer sciences	48	60	49	50	56
Earth, atmospheric, and ocean sciences	29	20	49	30	53
Engineering	33	30	87	40	44
Agricultural sciences	32	0	36	27	16
Medical sciences—					
inside medical schools	5	10	0	6	19
outside medical schools	28	20	0	23	40
Other sciences	11	10	36	14	23
Amount of S&E research space by S&E field [NASF in thousands]					
Biological sciences—					
inside medical schools	181	96	0	277	11,642
outside medical schools	305	66	148	519	19,425
Physical sciences	321	58	164	543	18,191
Psychology	31	18	26	75	3,360
Social sciences	56	17	6	79	4,620
Mathematics	31	3	16	50	889
Computer sciences	65	18	30	114	2,018
Earth, atmospheric, and ocean sciences	57	8	17	82	7,524
Engineering	388	23	549	960	22,833
Agricultural sciences	635	0	75	710	24,607
Medical sciences—					
inside medical schools	87	40	0	127	18,128
outside medical schools	95	24	0	119	7,001
Other sciences	86	56	60	202	3,050

KEY: NASF = net assignable square feet.
HBCU = Historically Black Colleges or Universities.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 7-2. Adequacy of the amount of science and engineering (S&E) research space and its condition by field in minority-serving institutions: 1998

Indicator	HBCU's	Non-HBCU-Black institutions	Hispanic-serving institutions	All minority-serving institutions	All institutions
Number of institutions	57	13	10	80	660
Adequacy of current amount of S&E research space [percentage of institutions reporting current space not sufficient]					
Total	88	70	100	87	83
Biological sciences—					
inside medical schools	--	--	--	36	70
outside medical schools	68	50	61	65	64
Physical sciences	73	50	51	66	64
Psychology	76	--	21	67	51
Social sciences	62	--	--	65	61
Mathematics	46	--	--	44	44
Computer sciences	72	50	--	66	56
Earth, atmospheric, and ocean sciences	72	--	--	61	62
Engineering	74	--	59	69	60
Agricultural sciences	48	--	--	46	55
Medical sciences—					
inside medical schools	--	--	--	--	67
outside medical schools	52	--	--	61	54
Condition of existing S&E research space [percentage of research space]					
Suitable for use in the most sophisticated scientific research	35	51	41	38	39
Effective for most levels of research in the field, but may need limited repair/renovation	48	38	37	44	38
Requires major renovation to be used effectively	15	9	18	15	18
Requires replacement	1	2	4	2	5

KEY: -- = number of institutions with nonmissing data is less than 5. These institutions are included in the total.
HBCU = Historically Black Colleges or Universities.

NOTE: Components may not add to totals due to rounding. Percentages are based on the number of institutions that have existing and/or needed research space in a given field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Across all minority-serving institutions, State and local governments were the largest source of funds for construction projects. However, this results from the fact that the HBCUs dominate this group in terms of number of institutions, and three quarters (76 percent) of their construction funding came from State and local governments. The one project reported by non-HBCU-black institutions was funded by internal sources (institutional funds in particular) and HSIs funded their S&E research construction primarily with funds from internal sources (63 percent—all of which was derived from other debt financing) and the Federal Government (37 percent).

In fiscal years 1996 and 1997, 30 percent of all research-performing, minority-serving institutions began repair/renovation projects. These projects affect 602 thousand NASF and were expected to cost about $36 million. This repair/renovation activity would thus alter approximately 16 percent of all S&E research space in minority-serving institutions and represents 4 percent of all repair/renovation activity in research-performing institutions (table 7-1).

State and local governments were the primary source of funding for repair/renovation projects for all minority-serving institutions. This results from the fact that this

Table 7-3. Construction and repair/renovation of science and engineering research facilities and sources of funds in minority-serving institutions: 1996–97

Indicator	HBCUs	Non-HBCU-minority serving institutions	All minority-serving institutions	All institutions
Number of institutions	57	23	80	660
Construction projects: 1996–97 fiscal years				
Number of institutions with projects >$100,000	14	5	19	197
S&E research space to be constructed [NASF in thousands]	347	148	495	11,101
Total cost [in thousands of dollars]	66,241	53,758	119,999	3,110,318
Repair/renovation projects: 1996–97 fiscal years				
Number of institutions with projects >$100,000	15	9	24	343
S&E research space to be repaired or renovated [NASF in thousands]	150	452	602	15,058
Total cost [in thousands of dollars]	13,178	22,882	36,060	1,324,524

KEY: NASF = net assignable square feet.
HBCU = Historically Black Colleges or Universities.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

source dominated the funding at both non-HBCU-Black institutions and HSIs. HBCUs funded repair/renovation projects primarily with funds from internal sources; 47 percent of their funding for these projects were derived from this source, institutional funds, in particular.

Minority-Serving Institutions' Need for S&E Research Facilities

In 1998, minority-serving institutions reported $420 million in combined capital projects (construction and repair/renovation) and central campus infrastructure projects that had to be deferred because of insufficient funds. This represents approximately 3 percent of all deferred projects reported by research-performing institutions. HBCUs accounted for 79 percent of the deferred costs at minority-serving institutions (table 7-4).

Construction and repair/renovation projects represent 86 percent of the total deferred S&E capital project costs ($363 million). Construction projects account for 71 percent of the total deferred capital project costs (both those in and not in institutional plans).

Central campus infrastructure projects represent 14 percent of the total deferred projects ($57 million). Construction projects account for 24 percent of all deferred central campus infrastructure projects and repair/renovation projects account for 76 percent of these projects.

A Look at HBCUs Over Time

Since the inception of the facilities survey, NSF has collected data from a continuing group of 29 HBCUs that reported separately budgeted research and development expenditures in 1988. In 1992, NSF identified an additional 41 HBCUs that had separately budgeted R&D expenditures. Only those institutions with S&E research space were retained in the sample each year. Since that time, the facilities survey has included both the original group of 29 HBCUs as well as all other HBCUs that report any R&D expenditures.

This section examines changes over time in S&E research facilities for the original group of 29 HBCUs, hereafter called, "the 29 original HBCUs."

Amount and Distribution of S&E Research Space

The amount of S&E research space in the 29 original HBCUs increased by 70 percent, from 1.1 million NASF in 1988 to 1.9 million NASF in 1998. The amount of

Table 7-4. The cost of deferred construction and repair/renovation projects by project type and whether the project is included in institutional plans in minority-serving institutions: 1998

Indicator	HBCUs	Non-HBCU-Black institutions	Hispanic-serving institutions	All minority-serving institutions	All institutions
Number of institutions	57	13	10	80	660
Deferred S&E capital projects [in thousands of dollars]					
Total	297,088	6,325	59,171	362,584	11,380,790
Included in institutional plans	274,783	5,155	56,600	336,538	8,690,853
Construction	242,671	5,070	0	247,741	5,856,685
Repair/renovation	32,112	85	56,600	88,796	2,834,167
Not included in institutional plans	22,305	1,170	2,572	26,047	2,689,937
Construction	7,706	1,170	1,543	10,419	1,142,157
Repair/renovation	14,599	0	1,029	15,627	1,547,780
Deferred central campus infrastructure projects [in thousands of dollars]					
Total	33,882	0	23,143	57,025	2,597,305
Included in institutional plans	33,251	0	3,857	37,108	2,007,813
Construction	13,475	0	0	13,475	633,967
Repair/renovation	19,776	0	3,857	23,634	1,373,846
Not included in institutional plans	631	0	19,286	19,916	589,492
Construction	207	0	0	207	209,502
Repair/renovation	424	0	19,286	19,709	379,991
Total deferred costs	330,970	6,325	82,314	419,609	13,978,095

KEY: S&E = science and engineering.
HBCU = Historically Black Colleges or Universities.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

space increased the most in absolute terms during this time period in the two fields that also currently have the most S&E research space (table 7-5):

- In engineering, the amount of research space more than doubled, from 152 thousand NASF to 363 thousand NASF; and
- In the agricultural sciences, the amount of research space increased from 259 thousand NASF to 471 thousand NASF.

Over the decade, S&E research space also increased in every field except for the computer sciences and the medical sciences in medical schools, which experienced declines in research space as follows:

- In the medical sciences in medical schools, the amount of research space declined from 141 thousand NASF to 87 thousand NASF; and
- In the computer sciences, the amount of research space declined from 43 thousand NASF to 40 thousand NASF.

Between the last survey period (1996) and the current one, the amount of S&E research space at the 29 original HBCUs increased by 5 percent or 88 thousand NASF. While almost half the S&E fields experienced slight increases in research space, only psychology did not experience any growth, and two fields experienced declines:

- In the social sciences, the amount of research space declined from 56 thousand NASF to 46 thousand; and
- In mathematics, the amount of research space declined from 24 thousand NASF to 20 thousand NASF.

Table 7-5. Trends in the amount of science and engineering research space by field in the 29 original Historically Black Colleges and Universities (HBCUs): 1988–98

Field	1988	1990	1992	1994	1996	1998
	NASF in thousands					
Number of research-performing HBCUs	29	29	29	28*	29	29
Total	1,112	1,440	1,782	1,759	1,797	1,885
Biological sciences–						
inside medical schools	91	121	121	159	150	181
outside medical schools	141	170	254	250	208	216
Physical sciences	179	190	235	212	229	234
Psychology	14	19	16	18	16	16
Social sciences	28	47	57	43	56	46
Mathematics	12	26	29	19	24	20
Computer sciences	43	30	42	31	36	40
Earth, atmospheric, and ocean sciences	10	26	35	27	42	43
Engineering	152	167	285	315	349	363
Agricultural sciences	259	433	414	470	451	471
Medical sciences—						
inside medical schools	141	158	160	69	84	87
outside medical schools	37	50	133	134	63	82
Other sciences	4	4	0	12	88	86

* One HBCU did not report R&D expenditures in 1994. Its research space was not included in the totals.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Construction of S&E Research Space

In fiscal years 1996 and 1997, 11 of the 29 original HBCUs initiated S&E research facilities construction projects. This is the same number of institutions that reported new construction starts in 1986 and 1987. However, in the intervening years, the number of institutions starting such projects was lower, particularly in the 1992–93 and 1994–95 periods, when 4 of the 29 original HBCUs began new construction projects (table 7-6).

In fiscal years 1996 and 1997, the 29 original HBCUs committed $64.3 million to new construction projects costing over $100,000. These projects will result in 335 thousand NASF of new S&E research space, which is the equivalent of 18 percent of existing research space (see table 7-5). Particularly noteworthy is the increase in construction between the last survey period (fiscal years 1994 and 1995) and the current one (fiscal years 1996 and 1997). While the number of institutions starting new construction projects almost tripled from 4 institutions to 11, the amount of research space under construction increased almost 5-fold (from 68 thousand NASF to 335 thousand NASF) and the amount of funds committed to new construction projects increased 18-fold (from $3.5 million to $64.3 million).

The Repair/Renovation of S&E Research Facilities

Unlike construction starts, fewer of the 29 original HBCUs began S&E repair/renovation projects costing over $100,000 in 1996 and 1997 than in any other survey period, except for 1990 and 1991. In both of these survey periods, 5 of the 29 original HBCUs reported new S&E repair/renovation projects. The amount of funds these institutions committed to these projects in 1996 and 1997 ($7.6 million) is also less than in any prior survey period.

Table 7-6. Science and engineering research facility construction and repair/renovation projects at the 29 original Historically Black Colleges and Universities (HBCUs) project characteristics: 1986–97

Capital project activity	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97
Construction projects:						
Number of HBCUs with projects	11	10	6	4	4	11
Total estimated completion cost [in millions of dollars]	95.5	68.3	27.0	9.8	3.5	64.3
NASF [in thousands]	481	319	328	88	68	335
Repair/renovation projects costing over $100,000:						
Number of HBCUs with projects	13	10	5	11	7	5
Total estimated completion cost [in millions of dollars]	18.8	26.2	13.9	9.9	22.7	7.6
NASF [in thousands]	137	308	129	106	343	114
Repair/renovation projects costing $5,000–$100,000:						
Number of HBCUs with projects	--	--	10	13	11	13
Total estimated completion cost [in millions of dollars]	--	--	0.7	3.8	0.8	1.4

KEY: NASF = net assignable square feet.
-- = data were not collected.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Almost half (13) of the 29 original HBCUs began S&E repair/renovation projects costing between $5,000 and $100,000 in 1996 and 1997; the same number that began them in 1992 and 1993, but fewer than in 1994 and 1995 (11 institutions). These 13 institutions committed $1.4 million to these types of repair/renovation projects, bringing total repair/renovation commitments in 1996 and 1997 by the 29 original HBCUs to $9.0 million (table 7-6).

Sources of Funds for S&E Construction and Repair/Renovation Projects

Between 1986–87 and 1992–93, the Federal Government was the largest source of construction funds for the 29 original HBCUs. In 1994–95 and 1996–97, funds from State and local governments exceeded those from the Federal Government. Even though the Federal Government's dollar contribution increased between 1994–95 and 1996–97, its relative contribution in 1996–97 (7 percent) was the smallest it has been since the survey began. By contrast, State and local governments' dollar and relative contributions in 1996–97 were the largest they have been since the survey began—$50.5 million and 79 percent, respectively (table 7-7).

The source of funds for S&E repair/renovation projects at the 29 original HBCUs has varied more over time than funds for construction projects. The Federal Government was the largest source of funds for these projects in 4 out of 6 survey periods, and its relative contribution has been in decline since 1992–93 (from 57 percent of all repair/renovation funds in 1992–93 to 29 percent in 1996–97). The continuous increase in the relative contribution from internal sources over the last three survey periods, despite fluctuations in the dollar contribution from this source of funds, parallels a decline in the relative contribution of Federal funds to repair/renovate S&E facilities. In 1988–89, institutions contributed 1 percent of all repair/ renovation funds from internal sources; by 1996–97 their relative contribution had risen to 47 percent—and this was the largest source of funds for repair/renovation projects during this time period (table 7-8).

Table 7-7. Sources of funds for science and engineering research facility construction projects at the 29 original Historically Black Colleges and Universities (HBCUs): 1986–97

Fiscal years	All sources				Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
1986–87	95.5	43.5	34.3	17.8	17.8	14.8	3.1	0.0	0.0	0.0
1988–89	68.3	43.4	14.3	10.7	10.7	9.5	1.1	0.0	0.0	0.0
1990–91	27.0	14.5	7.6	5.0	5.0	0.0	5.0	0.0	0.0	0.0
1992–93*	9.8	7.4	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994–95	3.5	1.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996–97	64.3	4.6	50.5	9.2	9.2	3.0	1.5	3.6	0.0	1.0
	Relative contribution				Relative contribution					
Fiscal years	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
	Percentage				Percentage					
1986–87	100	46	36	19	100	83	17	0	0	0
1988–89	100	64	21	16	100	90	10	0	0	0
1990–91	100	54	28	19	100	0	100	0	0	0
1992–93*	100	76	23	0	100	0	0	0	0	0
1994–95	100	39	61	0	100	0	0	0	0	0
1996–97	100	7	79	14	100	33	17	40	0	11

* One of the HBCUs had no S&E research space.

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Findings are limited to projects with estimated total cost at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 7-8. Sources of funds for science and engineering research facility repair/renovation projects at the 29 original Historically Black Colleges and Universities (HBCUs): 1986–97

	All sources				Internal sources					
	Dollar contribution				Dollar contribution					
Fiscal years	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu-tional funds	Tax-exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
1986–87	18.8	11.6	6.5	0.7	0.7	0.7	0.0	0.0	0.0	0.0
1988–89[1]	26.2	16.0	9.9	0.2	0.2	0.1	0.1	0.0	0.0	0.0
1990–91	13.9	4.2	9.6	0.2	0.2	0.1	0.1	0.0	0.0	0.0
1992–93[2]	9.9	5.7	2.4	2.1	2.1	1.9	0.1	0.0	0.0	0.0
1994–95	22.7	10.8	6.8	5.3	5.3	0.0	2.7	0.0	2.5	0.0
1996–97	7.6	2.2	1.8	3.6	3.6	0.0	3.6	0.0	0.0	0.0
	Relative contribution				Relative contribution					
Fiscal years	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu-tional funds	Tax-exempt bonds	Other debt	Other sources
	Percentage				Percentage					
1986–87	100	62	35	4	100	100	0	0	0	0
1988–89	100	61	38	1	100	50	50	0	0	0
1990–91	100	30	69	2	100	50	50	0	0	0
1992–93[2]	100	57	24	21	100	94	6	0	0	0
1994–95	100	47	30	23	100	0	52	0	48	0
1996–97	100	29	24	47	100	0	100	0	0	0

[1] 1988–89 total has been revised since 1996 report.

[2] One of the HBCUs had no S&E research space.

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Findings are limited to projects with estimated total cost at completion of $100,000 or more for research space. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

CHAPTER 8—ANIMAL RESEARCH FACILITIES

HIGHLIGHTS

- Eighty-three percent of all research-performing institutions had laboratory animal facilities in 1998 (table 8-1).
- Institutions reported a total of 11.9 million net assignable square feet of animal research space. This represents 8 percent of all science and engineering research space. The percentage is similar across the three types of research-performing institutions (table 8-1).
- The distribution of animal research space parallels the distribution of S&E research space. Seventy-one percent of all S&E research space and 72 percent of all animal research space is located in the top 100 institutions; 24 percent of all S&E research space and 23 percent of all animal research space is located in other doctorate-granting institutions, and 5 percent of each type of space is located in nondoctorate-granting institutions (tables 8-1 and 1-1).
- Institutions with animal research space reported that 75 percent (8.9 million NASF) of that space was at the lowest Federal biosafety level, Level 1. Another 23 percent (2.7 million NASF) was at Level 2, while 3 percent (0.4 million NASF) was at Level 3. No research-performing academic institution had S&E research space at Level 4 (i.e., for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure) (table 8-3).
- Five percent of the institutions with animal research facilities are scheduled to start construction on a half million NASF of animal research space in 1998 and 1999. They are scheduled to commit $162.1 million to these projects (tables 8-4 and 8-5).

INTRODUCTION

Scientists in the fields of biology, agriculture, psychology, and medicine often use animals in their research. Issues related to the housing of animals and the laboratories in which animal research is conducted are examined in this chapter. Institutions estimated the amount of animal housing space and animal laboratory space to arrive at a total amount of animal research space. They were asked to include as laboratory animal facilities both departmental and central facilities that are subject to government and State policies and regulations concerning the humane care and use of laboratory animals. Not included were agricultural buildings that did not directly support research or that were not subject to government regulations, nor were areas for the veterinary treatment of animals. In addition, institutions provided estimates of the amount of animal research space scheduled for construction and repair/renovation in 1998 and 1999. Scheduled expenditures on these items were provided for construction and repair/renovation projects costing over $100,000. (See Item 8 of the survey in Appendix C.)

The 1996 survey addressed biosafety issues by asking respondents to state the amount of net assignable square feet that:

A fully meets government regulations.

B needs limited repair/renovation to meet government regulations.

C needs major repair/renovation or replacement to meet government regulations.

In the 1998 survey, the question was changed to capture directly the amount of space that met the Federal Government's recommended biosafety levels for Animal Biological Safety:[30]

A ***Level 1*** practices, safety equipment, and facilities are appropriate for undergraduate and secondary educational training and teaching laboratories, and for other facilities in which work is done with defined and characterized strains of viable microorganisms not known to cause disease in healthy adult humans.

[30] The descriptions of the levels were taken from *Biosafety in Microbiological and Biomedical Laboratories*, 3rd Edition, 1993. Washington, DC: U.S. Government Printing Office, 1993.

B ***Level 2*** practices, equipment, and facilities are applicable to clinical, diagnostic, teaching and other facilities in which work is done with the broad spectrum of indigenous moderate-risk agents present in the community and associated with human disease of varying severity.

C ***Level 3*** practices, safety equipment, and facilities are applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection.

D ***Level 4*** practices, safety equipment, and facilities are applicable for work with dangerous and exotic agents, which pose a high individual risk of life-threatening disease, which may be transmitted via the aerosol route, and for which there is no available vaccine or therapy.

As a result of the change in the biosafety questions, issues pertaining to biosafety in the 1996 survey and the 1998 survey cannot be compared.

Findings

Amount of Space Devoted to Animal Research

In 1998, 546 of the 660 research-performing institutions (83 percent) had laboratory animal facilities. The doctorate-granting institutions were more likely than the nondoctorate-granting institutions to have such facilities (86 percent compared with 78 percent), with almost all of the top 100 institutions (97 percent) having them (table 8-1).

Institutions reported a total of 11.9 million net assignable square feet of animal research space. Most of that space (95 percent or 11.2 million NASF) was located in the doctorate-granting institutions. The distribution of animal research space paralleled the distribution of science and engineering research space (see table 1-1):

- The top 100 institutions accounted for 71 percent of all S&E research space (101 million NASF) and 72 percent of all animal research space (8.5 million NASF);

Table 8-1. Amount and distribution of space for laboratory animal facilities by institution type: 1998

	Institutions with laboratory animal facilities		Total animal research space		
Institution type	Number	Percentage of institutions	NASF [in millions]	Percentage of total animal research NASF	Percentage of total S&E research space*
Total	546	83	11.9	100	8.3
Doctorate-granting	325	86	11.2	95	8.2
Top 100 in research expenditures	97	97	8.5	72	8.4
Other	228	82	2.7	23	7.7
Nondoctorate-granting	221	78	0.6	5	8.6

* These percents were derived by dividing animal research space by total S&E research space (table 1-1).

KEY: NASF = net assignable square feet.
S&E = science and engineering.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The other doctorate-granting institutions accounted for 24 percent of all S&E research space (35 million NASF) and 23 percent of all animal research space (2.7 million NASF); and
- The nondoctorate-granting institutions accounted for 5 percent of all S&E research space (7 million NASF) and 5 percent of all animal research space (0.6 million NASF).

These 11.9 million NASF of animal research space represent 8.3 percent of all S&E research space. This percentage is similar across the three types of research-performing institutions (range: 7.7 to 8.6 percent). Further, this proportion remained constant overall and at each type of institution between 1994–95[31] and 1996–97, indicating that animal research space is growing at the same rate as S&E research space.

Overall, almost three quarters (72 percent) of the total amount of animal research space (8.6 million NASF) was used to house laboratory animals, and slightly more than one quarter (28 percent or 3.3 million NASF) was designated as animal laboratory space. The amount of animal housing space as a percent of total S&E research space was relatively constant at about 6 percent across institution types (range: 5.8 to 6.2 percent). Similarly, the amount of animal laboratory space as a percent of total S&E research space was also relatively constant at slightly more than 2 percent across institution types (range: 2.1 to 2.6 percent) (table 8-2).

Distribution of Animal Research Space at Colleges and Universities by Biosafety Level

Institutions with animal research space reported that 75 percent (8.9 million NASF) of that space was at Federal biosafety Level 1 (i.e., acceptable for work with microorganisms not known to cause disease in healthy humans). Another 23 percent (2.7 million NASF) was at Level 2 (i.e., acceptable for work with moderate-risk agents present in the community and associated with human disease of varying severity), and 3 percent (0.4 million NASF) was at Level 3 (i.e., acceptable for work with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection). No research-performing academic institution had S&E research space at Level 4 (i.e., acceptable for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure) (table 8-3).

[31] These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 9-1.

Table 8-2. Amount and distribution of animal housing space and laboratory animal space by institution type: 1998

Institution type	Animal housing space: NASF [in millions]	Animal housing space: Percentage of total animal research NASF	Animal housing space: Percentage of total S&E research space[1]	Animal laboratory space: NASF [in millions]	Animal laboratory space: Percentage of total animal research NASF	Animal laboratory space: Percentage of total S&E research space[2]
Total	8.6	72	6.0	3.3	28	2.3
Doctorate-granting	8.1	72	6.0	3.1	28	2.3
Top 100 in research expenditures	6.1	72	6.0	2.4	28	2.4
Other	2.0	75	5.8	0.7	27	2.1
Nondoctorate-granting	0.4	73	6.2	0.2	30	2.6

[1] These percentages were derived by dividing animal housing space by total S&E research space (table 1-1).

[2] These percentages were derived by dividing animal laboratory space by total S&E research space (table 1-1).

KEY: NASF = net assignable square feet.
S&E = science and engineering.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 8-3. Percentage of animal research space at each animal biological safety level by institution type: 1998

Institution type	Animal biological safety level			
	Level 1[1]	Level 2[2]	Level 3[3]	Level 4[4]
Total	75	23	3	0
Doctorate-granting	74	24	3	0
Top 100 in research expenditures	72	25	3	0
Other	80	18	2	0
Nondoctorate-granting	93	7	0	0

[1] Acceptable for work with microorganisms not known to cause disease in healthy humans.

[2] Acceptable for work with moderate-risk agents present in the community and associated with human disease of varying severity.

[3] Acceptable for work with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection.

[4] Acceptable for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

The doctorate-granting institutions had a greater amount of animal research space at the higher biosafety levels, Levels 2 and 3 (27 percent or 3 million NASF), than the nondoctorate-granting institutions (7 percent or 42,000 NASF). In fact, the nondoctorate-granting institutions had no animal research space at Level 3 and less than 10 percent at Level 2.

Amount of Animal Research Space Scheduled for Construction and Repair/Renovation

The research-performing institutions are scheduled to start construction on 492 thousand NASF of animal research space in 1998 and 1999. This is 3 percent of all S&E construction scheduled to start in 1998 and 1999 (14.6 million NASF) (Appendix table E3-2) and is 24 percent or 153 thousand NASF less new animal research space than was scheduled to be constructed in 1996 and 1997[32] (645 thousand NASF) (table 8-4):

Table 8-4. Amount of laboratory animal space scheduled for construction and repair/renovation: 1998–99

Institution type	Construction	Repair/renovation
	NASF in thousands	
Total	492	303
Doctorate-granting	440	292
Top 100 in research expenditures	329	193
Other	112	99
Nondoctorate-granting	52	12

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The top 100 institutions account for 67 percent (329 thousand NASF) of the animal facilities construction scheduled to begin in 1998 and 1999;
- The other doctorate-granting institutions account for 23 percent (112 thousand NASF) of the animal facilities construction scheduled to begin in 1998 and 1999; and
- The nondoctorate-granting institutions account for 11 percent (52 thousand NASF) of the animal facilities construction scheduled to begin in 1998 and 1999.

The research-performing institutions are scheduled to begin repair/renovation projects that will affect 303 thousand NASF of animal research space in 1998 and 1999. This is less than 2 percent of all S&E repair/renovation projects scheduled to start in 1998 and 1999 (15.6 million NASF) (Appendix table E4-2) and is 43 percent or 229 thousand NASF less animal research space than was scheduled to be affected by new repair/renovation projects begun in 1996 and 1997[33] (532 thousand NASF):

- The top 100 institutions account for 64 percent (193 thousand NASF) of the animal facilities repair/renovation projects scheduled to begin in 1998 and 1999;

[32] These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 9-5.

[33] Ibid.

- The other doctorate-granting institutions account for 32 percent (99 thousand NASF) of the animal facilities repair/renovation projects scheduled to begin in 1998 and 1999; and

- The nondoctorate-granting institutions account for 4 percent (12 thousand NASF) of the animal facilities repair/renovation projects scheduled to begin in 1998 and 1999.

These decreases in scheduled construction and scheduled repair/renovation of animal research space may be less a decline in facilities expansion and upgrading than a return to normal levels. It is possible that the 1996 survey captured the tail end of an unusual amount of activity among institutions as they strove to bring their animal research facilities into conformance with stricter animal welfare regulations that were established between 1989 and 1994 and which required institutions to upgrade their facilities. There has also been a movement to centralize animal research space such that animal research space is often shared by several departments instead of being dispersed throughout the institution.[34]

Funds Scheduled for the Construction and Repair/Renovation of Animal Research Space

Overall, 35 of the research-performing institutions (5.3 percent of all research performing institutions) are scheduled to start construction on animal research facilities in 1998 and 1999, and 56 of the research-performing institutions (10.2 percent of those with animal research facilities) are scheduled to start repair/renovation projects. The distribution of these scheduled projects among institution types is as follows:

- Among the top 100 institutions, 21 institutions had scheduled construction projects and 34 institutions had scheduled repair/renovation projects;

- Among the other doctorate-granting institutions, 9 institutions had scheduled construction projects and 16 institutions had scheduled repair/renovation projects; and

- Among nondoctorate-granting institutions, 5 institutions had scheduled construction projects and 6 institutions had scheduled repair/renovation projects (table 8-5).

Although fewer institutions were scheduled to start animal research facilities construction projects in 1998 and 1999 than were scheduled to start repair/renovation projects, they were scheduled to commit more than three times as many funds to construction projects ($162.1 million) as they were scheduled to commit to repair/renovation projects ($45.1 million).

The amount of funds scheduled to be committed to the construction of new animal facilities in 1998 and 1999 ($162.1 million) was not substantially different from the amount of funds that were scheduled to be committed to the construction of new animal facilities in 1996 and 1997 ($164.1 million).[35] These funds represented 4 percent of total funds committed to all new S&E construction scheduled to begin in 1998 and 1999 ($3,949 million) (see tables 3-4 and 8-5):

- The top 100 institutions accounted for 73 percent ($119.1 million) of all funds scheduled to be committed to new animal facilities construction projects;

- The other doctorate-granting institutions accounted for 15 percent ($24.3 million) of all funds scheduled to be committed to new animal facilities construction projects; and

- The nondoctorate-granting institutions accounted for 11 percent ($18.6 million) of all funds scheduled to be committed to new animal facilities construction projects.

The amount of funds scheduled to be committed to new animal facilities repair/renovation projects in 1998 and 1999 ($45.1 million) was considerably less (46 percent or $38.2 million) than was scheduled to be committed to new animal facilities repair/renovation projects in 1996 and 1997 ($83.3 million).[36] These funds represented 3 percent of the total funds committed to all new S&E repair/renovation projects scheduled to begin in 1998 and 1999 ($1,580 million) (see table 4-4):

[34] This information was provided by Barbara Rick, Executive Director, National Association for Biomedical Research.

[35] These data come from National Science Foundation/ Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 9-4. These values have not been adjusted for inflation because they were scheduled for the 1996 and 1997 fiscal years.

[36] These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 9-4.

Table 8-5. Number and percentage of institutions and the amount of funds scheduled for the construction and repair/renovation of laboratory animal facilities: 1998–99

Institution type	Scheduled construction			Scheduled repair/renovation		
	Number of institutions	Percentage of institutions[1]	Cost [In millions of dollars]	Number of institutions	Percentage of institutions[2]	Cost [In millions of dollars]
Total	35	5.3	162.1	56	10.2	45.1
Doctorate-granting	30	8.1	143.4	50	15.3	43.2
Top 100 in research expenditures	21	21.0	119.1	34	35.1	34.9
Other	9	3.4	24.3	16	6.9	8.3
Nondoctorate-granting	5	1.7	18.6	6	2.7	1.9

[1] Percentages are based on all institutions (see table 1-1 for the number of institutions in each category).

[2] Percentages are based on those institutions with animal research space (see table 8-1 for the number of institutions in each category).

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The top 100 institutions accounted for 77 percent ($34.9 million) of all funds scheduled to be committed to animal facilities repair/renovation projects;
- The other doctorate-granting institutions accounted for 18 percent ($8.3 million) of all funds scheduled to be committed to animal facilities repair/renovation projects; and
- The nondoctorate-granting institutions accounted for 4 percent ($1.9 million) of all funds scheduled to be committed to animal facilities repair/renovation projects.

CHAPTER 9—BIOMEDICAL RESEARCH FACILITIES

HIGHLIGHTS

- In 1998, the Nation's 908 biomedical research-performing institutions had 73.3 million net assignable square feet of biomedical research space. Slightly more than half of all the biomedical research space (53 percent or 38.9 million NASF) was in the biological sciences; the other 47 percent or 34.4 million NASF was in the medical sciences (table 9-1).
- Overall, 65 percent of institutions with research space in the biological sciences and 52 percent of institutions with research space in the medical sciences reported that the amount of biomedical research space they had was inadequate to meet their current research commitments (table 9-2).
- In fiscal years 1996 and 1997, 172 biomedical research-performing institutions started construction on 7.4 million NASF of biomedical research space. They committed $2.2 billion to new construction projects costing over $100,000 (table 9-3).
- In fiscal years 1996 and 1997, 379 biomedical research-performing institutions started repair/renovation projects on 9.0 million NASF of biomedical research space. They committed $770 million to new repair/renovation projects costing over $100,000 (table 9-4).
- In 1998, biomedical research-performing institutions reported $5.6 billion in combined capital projects (construction and repair renovation) that had to be deferred because of insufficient funds. Construction projects account for 64 percent ($3.6 billion) of the total deferred capital project costs (both included and not included in an institutional plan) (table 9-7).

INTRODUCTION

Biomedical research facilities are a critical component of the Nation's science and engineering research system. Consequently, NSF and the National Institutes of Health (NIH) have collected data on the amount, quality, and condition of research space in the biological and medical sciences in the Nation's biomedical research-performing institutions since the inception of the *Facilities* survey in 1986. These research facilities are not only located at academic institutions, but also in research hospitals and nonprofit research organizations.

This chapter looks at the top 50 academic institutions in science and engineering research expenditures instead of the top 100. In addition, because of their importance in producing black biomedical researchers and physicians, the 29 original HBCUs are pulled out for separate analysis.

Colleges and universities with an affiliated medical school are counted as both a college or university and as a medical school in all tables reporting the number of institutions. Their biological and medical science research space—existing, needed, constructed, deferred, and repaired/renovated—and the associated expenditures are divided between the college or university and the medical school categories depending on whether the research space or capital project was designated as inside or outside a medical school. That is, while the institution is counted twice, its research space and associated costs are not.

Several tables present the survey results for the biological and medical sciences separately. The "biological sciences" includes all institutions with research space inside or outside of medical schools. Similarly, "medical sciences" includes all institutions with research space inside or outside of medical schools.

FINDINGS

AMOUNT OF BIOMEDICAL RESEARCH SPACE

In 1998, the Nation's 908 biomedical research-performing institutions had 73.3 million net assignable square feet of biomedical research space. This is 9 percent or 5.9 million NASF more than they had in 1996 and 41 percent or 21.4 million NASF more than they had a decade ago (table 9-1).

Slightly more than half of all the biomedical research space (53 percent or 38.9 million NASF) was in the biological sciences; the other 47 percent or 34.4 million

Table 9-1. Amount of biomedical research space by institution type and field: 1988–98

Indicator	Academic institutions				Research organizations	Hospitals	All institutions		
	Colleges/universities			Medical schools[3]			Total	Field	
	Top 50	Other doctorate-granting	Non-doctorate-granting					Biological sciences	Medical sciences
Number of biomedical institutions, 1998[1]	49[2]	273	246	145	171	125	908	752	503
Amount of research space [NASF in millions]									
1988	10.2	10.0	1.1	21.9	4.4	4.2	51.9	28.2	23.7
1990	10.4	10.9	1.3	23.3	4.8	4.5	55.2	31.0	24.3
1992	10.7	11.3	1.6	26.8	5.1	4.6	59.7	32.4	27.3
1994	10.9	10.6	1.0	27.7	6.4	5.4	62.5	34.1	28.4
1996	12.2	12.1	1.7	28.5	6.6	6.2	67.4	35.9	31.5
1998	12.9	11.6	1.9	29.8	9.5	7.6	73.3	38.9	34.4

[1] The number of institutions across institution types does not sum to grand totals because many institutions contain both a college/university and a medical school. In grand totals, medical schools are counted as separate institutions only if they are not affiliated with a college or university.

[2] Among the top 50 research-performing institutions, one is a medical school and is included in the count for medical schools.

[3] The number of medical schools is based on the sum of the weights of institutions with medical school research space. Medical schools were not an explicit strata in the sampling scheme. Thus, this number may not reflect the actual number of medical schools in the universe.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

NASF was in the medical sciences. The amount of research space in each field grew by 10.7 million NASF over the decade, with the biological sciences experiencing a 38-percent increase in research space (from 28.2 million to 38.9 million NASF) and the medical sciences experiencing a 45-percent increase (from 23.7 million to 34.4 million NASF).

More than three quarters of all the biomedical research space (77 percent or 56.2 million NASF) was located in academic institutions. Slightly more than half of this space (29.8 million NASF) was located in medical schools, with the remaining 26.4 million NASF located in research-performing colleges and universities. Nonprofit research organizations accounted for 13 percent (9.5 million NASF) of all biomedical research space, while research hospitals accounted for 10 percent (7.6 million NASF).

Between 1988 and 1998, every type of institution, except research hospitals, experienced an appreciable increase in biomedical research space:

- At the top 50 institutions, the amount of biomedical research space increased by 26 percent (from 10.2 million to 12.9 million NASF);
- At other doctorate-granting institutions, the amount of biomedical research space increased by 16 percent (from 10.0 million to 11.6 million NASF);
- At nondoctorate-granting institutions, the amount of biomedical research space increased by 73 percent (from 1.1 million to 1.9 million NASF);
- At medical schools, the amount of biomedical research space increased by 36 percent (from 21.9 million to 29.8 million NASF); and
- At nonprofit research organizations, the amount of biomedical research space increased by 116 percent (from 4.4 million to 9.5 million NASF).

Adequacy of the Amount of Biomedical Research Space and Its Condition

Overall, 65 percent of institutions with research space in the biological sciences and 52 percent of institutions with research space in the medical sciences reported that the amount of biomedical research space they had was inadequate to meet their current research commitments:

- Among colleges and universities, 64 percent rated their biological sciences research space as inadequate, while 54 percent rated their medical sciences research space as inadequate;
- Among medical schools, 70 percent rated their biological sciences research space as inadequate, while 67 percent rated their medical sciences research space as inadequate;
- Among nonprofit research organizations, 73 percent rated their biological sciences research space as inadequate, while 27 percent rated their medical sciences research space as inadequate; and
- Among research hospitals, 26 percent rated their biological sciences research space as inadequate, while 52 percent rated their medical sciences research space as inadequate (table 9-2).

The percentage of institutions with biomedical research space reporting inadequate amounts of research space in the biological sciences increased between 1996 and 1998 from 47 to 65 percent of institutions. During this time period, the percentage of institutions reporting inadequate amounts of research space in the biological sciences increased at three types of institutions: colleges and universities, medical schools, and nonprofit research organizations. By contrast, the percentage of institutions reporting inadequate amounts of research space in the medical sciences remained essentially the same between 1996 (51 percent) and 1998 (52 percent).

Overall, the institutions reported that they needed an additional 9.0 million NASF of research space in the biological sciences or 23 percent more than they had in order to meet their research commitments. At the same time, they reported that they needed an additional 7.1 million NASF of research space in the medical sciences or 21 percent more than they had:

- Colleges and universities reported needing 25 percent more research space in the biological sciences (4.8 million NASF) and 27 percent more research space in the medical sciences (1.9 million NASF);
- Medical schools reported needing 21 percent more research space in the biological sciences (2.5 million NASF) and 22 percent more research space in the medical sciences (4.0 million NASF);
- Nonprofit research organizations reported needing 22 percent more research space in the biological sciences (1.4 million NASF) and 18 percent more research space in the medical sciences (0.6 million NASF); and
- Research hospitals reported needing 19 percent more research space in the biological sciences (0.3 million NASF) and 10 percent more research space in the medical sciences (0.6 million NASF).

Less than half (48 percent or 18.7 million NASF) of research space in the biological sciences was rated as "suitable for the most scientifically competitive research," and less than half (43 percent or 14.8 million NASF) of research space in the medical sciences was rated this way. The percentage of the different types of institutions rating their research space as being in the highest quality condition is as follows (see table E9-1 for total NASF by field by institution type):

- Colleges and universities rated 40 percent (7.6 million NASF) of research space in the biological sciences and 32 percent (2.2 million NASF) of research space in the medical sciences as suitable for the most scientifically sophisticated research;
- Medical schools rated 49 percent (5.9 million NASF) of research space in the biological sciences and 44 percent (7.7 million NASF) of research space in the medical sciences as being in this condition;
- Nonprofit research organizations rated 67 percent (4.3 million NASF) of research space in the biological sciences and 65 percent (2.1 million NASF) of research space in the medical sciences as being in this condition;

Table 9-2. Adequacy of the amount of biomedical research space and its condition by institution type and field: 1988–98

	Biological sciences					Medical sciences				
		Academic institutions		Research organi-zations			Academic Institutions		Research organi-zations	
	Total	Colleges/ universities	Medical schools[1]		Hospitals	Total	Colleges/ universities	Medical schools[2]		Hospitals
Number of biomedical institutions with existing or nonexistent but needed research space, 1998[1].....	764	569	127	98	44	521	269	127	98	92
Adequacy of current amount of research space [percentage of institutions reporting current space inadequate]										
1988.....	45	46	49	37	43	41	40	47	23	44
1990.....	41	43	54	14	30	44	47	59	9	39
1992.....	32	37	36	13	8	31	36	42	14	22
1994.....	32	43	43	13	30	41	43	49	29	42
1996.....	47	53	46	32	14	51	57	66	26	32
1998.....	65	64	70	73	26	52	54	67	27	52
Amount of research space needed [NASF in millions]										
Total research space	38.9	19.4	11.6	6.4	1.5	34.4	7.0	18.1	3.2	6.1
Additional research space needed.....	9.0	4.8	2.5	1.4	0.3	7.1	1.9	4.0	0.6	0.6
Percentage of current research space needed.....	23	25	21	22	19	21	27	22	18	10
Condition of existing research space [percentage of research space]										
Suitable for use in the most competitive scientific research.....	48	40	49	67	56	43	32	44	65	44
Effective for most uses but not the most sophisticated.....	31	36	35	15	25	34	43	31	28	37
Requires major renovation to be used effectively....	17	20	14	14	17	18	21	20	6	14
Requires replacement.....	4	5	2	4	2	5	4	6	1	5

[1] The number of institutions across institution types does not sum to grand totals because many institutions contain both a college/university and a medical school. In grand totals, medical schools are counted as separate institutions only if they are not affiliated with a college or university.

[2] The number of medical schools is based on the sum of the weights of institutions with medical school research space. Medical schools were not an explicit strata in the sampling scheme. Thus, this number may not reflect the actual number of medical schools in the universe.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- Research hospitals rated 56 percent (0.8 million NASF) of research space in the biological sciences and 44 percent (2.7 million NASF) of research space in the medical sciences as being in this condition. By contrast, 21 percent (8.2 million NASF) of research space in the biological sciences was rated as needing major renovation or replacement, while 23 percent (7.9 million NASF) of research space in the medical sciences was rated as being in this condition (see table E9-1 for total NASF by field by institution);
- Colleges and universities rated 25 percent (4.8 million NASF) of research space in the biological sciences and 25 percent (1.8 million NASF) of research space in the medical sciences as needing major renovation or replacement;

- Medical schools rated 16 percent (1.9 million NASF) of research space in the biological sciences and 26 percent (4.7 million NASF) of research space in the medical sciences as being in this condition;
- Nonprofit research organizations rated 18 percent (1.2 million NASF) of research space in the biological sciences and 7 percent (0.2 million NASF) of research space in the medical sciences as being in this condition; and
- Research hospitals rated 19 percent (0.3 million NASF) of research space in the biological sciences and 19 percent (1.2 million NASF) of research space in the medical sciences as being in this condition.

Construction of Biomedical Research Space

In fiscal years 1996 and 1997, 172 biomedical research-performing institutions started construction on 7.4 million NASF of research space. During this time period, 116 institutions started construction on 3.5 million NASF of research space in the biological sciences, while 81 institutions started construction on 3.9 million NASF of research space in the medical sciences (table 9-3). Construction projects were started at the different types of biomedical research-performing institutions as follows:

- Among colleges and universities, 89 institutions started construction on 1.9 million NASF of biomedical research space;
- Among medical schools, 47 institutions started construction on 3.4 million NASF of biomedical research space;
- Among nonprofit research organizations, 40 institutions started construction on 1.7 million NASF of biomedical research space; and
- Among research hospitals, 4 institutions started construction on 0.4 million NASF of biomedical research space.

Between 1994–95 and 1996–97, the amount of biomedical research space under construction increased by 74 percent or 3.1 million NASF (from 4.3 million to 7.4 million NASF). During this time period, the medical sciences experienced an appreciable increase of 76 percent (1.7 million NASF) of research space under construction (from 2.2 million to 3.9 million NASF). Among the different institution types, colleges and universities and medical schools experienced a substantial increase in biomedical research space under construction:

- At colleges and universities, the amount of biomedical research space under construction increased by 38 percent or 0.5 million NASF (from 1.4 million to 1.9 million NASF); and
- At medical schools, the amount of biomedical research space under construction increased by 48 percent or 1.1 million NASF (from 2.3 million to 3.4 million NASF).

In fiscal years 1998 and 1999, 203 biomedical research-performing institutions were scheduled to start construction on 10.7 million NASF of biomedical research space. During this time period, 155 institutions were scheduled to start construction on 7.4 million NASF of research space in the biological sciences, while 80 institutions were scheduled to start construction on 3.3 million NASF of research space in the medical sciences.

Construction projects were scheduled to start at the different types of biomedical research-performing institutions as follows:

- Among colleges and universities, 87 institutions were scheduled to begin construction on 3.3 million NASF of biomedical research space;
- Among medical schools, 45 institutions were scheduled to begin construction on 4.3 million NASF of biomedical research space;
- Among nonprofit research organizations, 64 institutions were scheduled to begin construction on 2.4 million NASF of biomedical research space; and
- Among hospitals, 23 institutions were scheduled to being construction on 0.7 million NASF of biomedical research space.

In fiscal years 1996 and 1997, biomedical research-performing institutions committed $2.2 billion to new construction projects costing over $100,000, an increase of 40 percent or $634 million over 1994–95 levels. Slightly more than half of these funds (53 percent or $1.2 billion) were committed to construction projects in the medical sciences, the remaining 47 percent or $1.0 billion were committed to construction projects in the biological sciences.

Table 9-3. Trends in the number of institutions starting biomedical research space construction projects costing more than $100,000, the amount of space constructed, and the cost of construction, by institution type, field, and fiscal year of project start: 1988–98

Fiscal Years	Institution type				All institutions		
	Academic institutions					Field	
	Colleges/ universities	Medical schools[2]	Research organizations	Hospitals	Total	Biological sciences	Medical sciences
Number of institutions starting construction[1]							
1988–89	94	46	18	10	158	--	--
1990–91	82	78	11	9	150	--	--
1992–93	63	54	13	16	151	--	--
1994–95	50	34	11	22	109	--	--
1996–97	89	47	40	4	172	116	81
1998–99 (scheduled)	87	45	64	23	203	155	80
Amount of new research space under construction [NASF in thousands]							
1988–89	1,855	2,660	245	1,057	5,817	2,853	2,982
1990–91	2,431	3,714	547	490	7,183	3,114	4,069
1992–93	1,838	4,175	483	513	7,010	2,686	4,324
1994–95	1,416	2,272	239	333	4,261	2,048	2,213
1996–97	1,949	3,353	1,742	354	7,398	3,496	3,903
1998–99 (scheduled)	3,312	4,340	2,386	678	10,715	7,382	3,333
Cost of new construction projects costing over $100,000 [in millions of constant 1997 dollars]							
1988–89	559	945	94	250	1,849	849	1,000
1990–91	715	1,231	140	193	2,280	1,090	1,189
1992–93	516	1,347	206	301	2,367	909	1,459
1994–95	537	792	71	205	1,605	879	726
1996–97	663	963	450	163	2,239	1,042	1,197
1998–99 (scheduled)	1,018	1,210	707	289	3,224	2,094	1,130

[1] The number of institutions across institution types does not sum to grand totals because many institutions contain both a college/university (exclusive of a medical school) and a medical school. In grand totals, medical schools are counted as separate institutions only if they are not part of larger universities.

[2] The number of medical schools is based on the sum of the weights of institutions with medical school research space. Medical schools were not an explicit strata in the sampling scheme. Thus, this number may not reflect the actual number of medical schools in the universe.

KEY: -- = data unavailable.
NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Among the different institution types, only medical schools committed substantially more funds to new construction projects in 1996 and 1997 ($963 million) than they did in fiscal years 1994 and 1995 ($792 million). However, the amount of funds they committed to new construction projects in fiscal years 1996 and 1997 is not substantially different than the amount of funds they committed to these types of projects a decade ago ($945 million).

In fiscal years 1998 and 1999, biomedical research-performing institutions were scheduled to commit $3.2 billion to new construction projects costing over $100,000. This is an increase of 44 percent or $985 million over 1996–97 levels.

Among the different institution types, only colleges and universities are scheduled to commit substantially more funds to new construction projects in fiscal years

1998 and 1999 ($1.0 billion) than they did in fiscal years 1996 and 1997 ($663 million). This is an increase of 54 percent or $355 million.

Repair/Renovation of Biomedical Research Space

In fiscal years 1996 and 1997, 379 biomedical research-performing institutions started repair/renovation projects on 9.0 million NASF of biomedical research space (table 9-4). This represents 21 percent more space under repair/renovation than under construction (see table 9-3). During this time period, 282 institutions began repair/renovation projects on 5.5 million NASF of research space in the biological sciences, while 172 institutions began repair/renovation projects on 3.5 million NASF of research space in the medical sciences.

Between 1994–95 and 1996–97, the amount of biomedical research space repaired or renovated increased by 26 percent or 1.8 million NASF (from 7.1 million to 9.0 million NASF). During this time period, the biological sciences experienced an appreciable increase of 94 percent (2.7 million NASF) of research space under repair/renovation. Among the different institution types, only colleges and universities experienced a substantial increase in the amount of new repair/renovation projects between 1994–95 and 1996–97. The amount of biomedical research space repaired or renovated at colleges and universities increased by 36 percent or 0.8 million NASF (from 2.4 million to 3.2 million NASF).

In fiscal years 1998 and 1999, 251 biomedical research-performing institutions were scheduled to begin repair/renovation projects on 7.7 million NASF of biomedical research space. During this time period, 174 institutions were scheduled to start repair/renovation projects on 4.5 million NASF of research space in the biological sciences, while 130 institutions were scheduled to start repair/renovation projects on 3.2 million NASF of research space in the medical sciences.

In fiscal years 1996 and 1997, biomedical research-performing institutions committed $770 million to new repair/renovation projects costing over $100,000. This was 66 percent or $1.5 billion less than they committed to new construction projects in 1996 and 1997 (see table 9-3). Slightly more than half of these funds (54 percent or $415 million) were committed to repair/renovation projects in the biological sciences, while the remaining 46 percent or $355 million were committed to repair/renovation projects in the medical sciences.

Overall, the amount of funds scheduled to be committed to new repair/renovation projects in 1998 and 1999 was not substantially different from the amount of funds they committed to these types of projects in 1996 and 1997.

In fiscal years 1998 and 1999, biomedical research-performing institutions were scheduled to commit $831 million to new repair/renovation projects. This was 74 percent less than they were scheduled to commit to new construction projects (see table 9-3). Slightly more than half of these funds (51 percent or $424 million) were scheduled to be committed to repair/renovation projects in the biological sciences, the remaining 49 percent ($407 million) were scheduled to be committed to repair/renovation projects in the medical sciences.

Sources of Funds for the Construction of Research Facilities at Biomedical Research-Performing Institutions

In fiscal years 1996 and 1997, State and local governments and debt financing each provided 27 percent of funds for all new science and engineering construction projects costing over $100,000 at biomedical research-performing institutions.[37] Institutional funds and private donations were the source for 19 and 18 percent, respectively, of funds for new construction projects, while the Federal Government contributed 8 percent of all construction funds (see table 9-5).

The largest source(s) of funds for new science and engineering construction projects at the different types of institutions was as follows:

- Colleges and universities derived the majority of their science and engineering construction funds from two sources—37 percent from State and local governments and 21 percent of from debt financing;
- Medical schools derived the majority of their construction funds from three sources—28 percent from institutional funds, 26 percent from State and local governments, and 22 percent from private donations;

[37] Sources of funds were not reported by field. Consequently, the distribution of construction funds across the various sources is for the biomedical fields and all other science and engineering fields (see Chapter 5).

Table 9-4. Trends in the number of institutions starting biomedical research facilities repair/renovation projects costing more than $100,000, the amount of space affected, and the cost of repair/renovation, by institution type, field, and fiscal year of project start: 1988–98

Fiscal Years	Institution type				All institutions		
	Academic institutions					Field	
	Colleges/ universities	Medical schools[2]	Research organizations	Hospitals	Total	Biological sciences	Medical sciences
Number of institutions starting repair/renovation projects[1]							
1988–89	132	76	34	39	241	--	--
1990–91	118	109	45	34	255	--	--
1992–93	121	89	30	34	228	--	--
1994–95	126	86	36	28	231	--	--
1996–97	199	92	76	49	379	282	172
1998–99 (scheduled)	162	62	28	22	251	174	130
Repair/renovation of research space [NASF in thousands]							
1988–89	2,910	2,856	355	333	6,454	3,854	2,600
1990–91	1,682	2,745	516	543	5,486	2,874	2,612
1992–93	1,588	2,542	268	770	5,168	2,848	2,320
1994–95	2,366	3,880	345	540	7,131	2,836	4,295
1996–97	3,207	3,703	1,683	376	8,969	5,498	3,471
1998–99 (scheduled)	4,332	2,759	215	397	7,702	4,523	3,180
Cost of repair/renovation projects costing over $100,000 [in millions of constant 1997 dollars]							
1988–89	228	292	37	92	649	337	419
1990–91	224	344	36	60	664	349	313
1992–93	156	399	43	151	749	409	340
1994–95	196	345	33	137	711	324	387
1996–97	277	360	81	52	770	415	355
1998–99 (scheduled)	357	376	48	50	831	424	407

[1] The number of institutions across institution types does not sum to grand totals because many institutions contain both a college/university (exclusive of a medical school) and a medical school. In grand totals, medical schools are counted as separate institutions only if they are not part of larger universities.

[2] The number of medical schools is based on the sum of the weights of institutions with medical school research space. Medical schools were not an explicit strata in the sampling scheme. Thus, this number may not reflect the actual number of medical schools in the universe.

KEY: -- = data unavailable.
NASF = net assignable square feet

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- Nonprofit research organizations derived the majority of their construction funds from two sources—49 percent from debt financing and 23 percent from State and local governments; and
- Research hospitals derived the majority of their construction funds from one source—91 percent from debt financing.

Sources of Funds for the Repair/Renovation of Research Facilities at Biomedical Research-Performing Institutions

In fiscal years 1996 and 1997, institutional funds were the largest source of funds (50 percent) for new science and engineering repair/renovation projects costing over

Table 9-5. Source of funds for the construction of research facilities at institutions with biomedical research space by year of project start and institution type: 1990–97

Source of funds and year of project start	All biomedical institutions	Institution type: Colleges and universities	Medical schools	Research organizations	Hospitals
Dollar contribution [in millions of constant 1997 dollars]					
1990–91	2,280	715	1,231	140	193
1992–93	2,367	516	1,347	206	301
1994–95	1,605	537	792	71	205
1996–97	2,239	663	963	450	163
Relative contribution [percentage of total cost]					
Federal Government:					
1990–91	13	19	11	15	0
1992–93	13	14	19	7	1
1994–95	5	4	6	0	0
1996–97	8	11	7	2	0
State and local governments:					
1990–91	21	29	22	2	0
1992–93	24	26	38	0	6
1994–95	35	49	22	0	0
1996–97	27	37	26	23	0
Private donations:					
1990–91	18	10	18	12	46
1992–93	13	12	7	22	16
1994–95	11	9	13	4	17
1996–97	18	16	22	19	4
Debt financing:*					
1990–91	28	30	28	46	0
1992–93	31	23	29	56	43
1994–95	30	26	36	49	61
1996–97	27	21	16	49	91
Institutional funds:					
1990–91	19	8	20	25	54
1992–93	16	21	7	15	7
1994–95	18	11	22	47	22
1996–97	19	14	28	7	5
Other:					
1990–91	1	4	1	0	0
1992–93	3	4	0	0	27
1994–95	0	1	0	0	0
1996–97	1	0	1	0	0

* Category includes tax-exempt bonds and other debt financing as reported in the questionnaire.

NOTES: Components may not add to totals due to rounding. Sources of funds information is not collected by field. Thus, the percentage of funds from each source is based on all S&E expenditures not just expenditures in biomedical fields. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Current dollars have been adjusted to constant 1997 dollars using the Bureau of Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

$100,000 at biomedical research-performing institutions.[38] State and local governments were the second largest source of funds (22 percent). Private donations and debt financing each accounted for 9 percent of funds for new repair/renovation projects, while the Federal Government contributed 8 percent of all repair/renovation funds (table 9-6).

The largest source(s) of funds for new science and engineering repair/renovation projects at the different types of institutions was as follows:

- Colleges and universities derived the majority of their science and engineering repair/renovation funds from two sources—45 percent from institutional funds and 26 percent from State and local governments;
- Medical schools derived the majority of their repair/renovation funds from two sources—56 percent from institutional funds and 19 percent from State and local governments;
- Nonprofit research organizations derived the majority of their repair/renovation funds from two sources—53 percent from institutional funds and 21 percent from private donations; and
- Research hospitals derived the majority of their repair/renovation funds from one source—89 percent from institutional funds.

Biomedical Research-Performing Institutions' Need for Research Facilities

In 1998, biomedical research-performing institutions reported $5.6 billion in combined capital projects (construction and repair renovation) that had to be deferred because of insufficient funds. Construction projects accounted for 64 percent ($3.6 billion) of the total deferred capital project costs (both included and not included in an institutional plan) (table 9-7).

Academic institutions accounted for 82 percent ($4.6 billion) of the total deferred costs, whereas nonprofit research organizations accounted for 10 percent ($587 million) and research hospitals account for 7 percent ($419 million).

More than half (61 percent or $2.8 billion) of the deferred costs in academic institutions was at colleges and universities, while the remaining 39 percent or $1.8 billion was at medical schools. Among colleges and universities, the deferred need was distributed as follows:

- The top 50 academic institutions accounted for $1.4 billion or 49 percent of the deferred need at colleges and universities;
- Other doctorate-granting institutions accounted for $1.2 billion or 43 percent of the deferred need; and
- Nondoctorate-granting institutions accounted for $0.2 billion or 9 percent of the deferred need.

More than half of the total deferred capital project costs (56 percent or $3.1 billion) were for projects in the biological sciences, while the remaining 44 percent or $2.5 billion in deferred costs were for projects in the medical sciences. Construction projects (both included and not included in an institutional plan) accounted for 62 percent of the deferred costs in the biological sciences ($1.9 billion) and 67 percent of the deferred costs in the medical sciences ($1.7 billion).

Biomedical Research Facilities at Historically Black Colleges and Universities

The Historically Black Colleges and Universities had 1.6 percent (2.34 million NASF) of all the science and engineering research space in the Nation's research-performing institutions in 1998 (143.3 million NASF) and 1.2 percent (670 thousand NASF) of all the biomedical sciences research space (56.2 million NASF). Overall, 73 percent (490 thousand NASF) of the HBCUs' biomedical sciences research space was in the biological sciences, the other 28 percent (190 thousand NASF) was in the medical sciences. The HBCUs' biomedical sciences research space was distributed unequally across institution types. More than half of the HBCUs' biomedical research space (60 percent or 400 thousand NASF) was located in colleges and universities, while the other 40 percent or 270 thousand NASF was located in medical schools (table 9-8).

Overall, 71 percent of the HBCUs with existing or needed research space in the biomedical sciences reported that the amount of research space they had was inadequate

[38] Ibid.

Table 9-6. Source of funds for the repair/renovation of research facilities at institutions with biomedical research space by year of project start and institution type: 1990–97

Source of funds and year of project start	All biomedical institutions	Institution type: Colleges and universities	Medical schools	Research organizations	Hospitals
Dollar contribution [in millions of constant 1997 dollars]					
1990–91	664	224	344	36	60
1992–93	749	156	399	43	151
1994–95	711	196	345	33	137
1996–97	770	277	360	81	52
Relative contribution [percentage of total cost]					
Federal Government:					
1990–91	5	4	5	19	3
1992–93	5	6	7	4	2
1994–95	8	8	7	2	1
1996–97	8	8	6	16	1
State and local governments:					
1990–91	20	33	18	0	2
1992–93	20	25	26	0	2
1994–95	14	15	14	7	0
1996–97	22	26	19	2	0
Private donations:					
1990–91	14	16	15	8	6
1992–93	8	10	9	15	2
1994–95	15	14	11	10	32
1996–97	9	9	8	21	10
Debt financing:*					
1990–91	10	2	14	16	8
1992–93	15	23	7	0	32
1994–95	13	14	16	28	8
1996–97	9	9	10	8	0
Institutional funds:					
1990–91	51	45	48	57	81
1992–93	50	35	48	81	62
1994–95	46	45	51	47	39
1996–97	50	45	56	53	89
Other:					
1990–91	0	0	0	0	0
1992–93	2	1	3	0	0
1994–95	3	4	0	6	21
1996–97	2	2	2	0	0

* Category includes tax-exempt bonds and other debt financing as reported in the questionnaire.

NOTES: Components may not add to totals due to rounding. Sources of funds information is not collected by field. Thus, the percentage of funds from each source is based on all S&E expenditures not just expenditures in biomedical fields. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Current dollars have been adjusted to constant 1997 dollars using the Bureau of Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 9-7. Estimated costs for deferred capital projects to construct or repair/renovate biomedical research facilities by institution type, type of project, and whether project was included in an institutional plan: 1998

Institution type	Included in institutional plans			Not included in institutional plans			Total
	To construct new research facilities	To repair/ renovate existing research facilities	Subtotal	To construct new research facilities	To repair/ renovate existing research facilities	Subtotal	
	In millions of dollars						
Total	2,680	1,177	3,857	917	836	1,753	5,610
Academic institutions	2,265	1,067	3,332	493	780	1,272	4,604
Colleges/universities	1,309	634	1,943	344	521	865	2,808
Top 50	605	296	901	200	261	461	1,362
Other doctorate-granting	564	246	810	140	253	393	1,204
Nondoctorate-granting	140	92	232	4	7	11	243
Medical schools	955	434	1,389	149	258	407	1,796
Research organizations	178	78	256	314	17	331	587
Hospitals	238	32	270	110	40	150	419
Field							
Biological sciences	1,398	747	2,144	529	448	977	3,121
Medical sciences	1,283	431	1,714	388	388	776	2,490

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

to meet their current biomedical research commitments. Sixty-seven percent of all academic institutions reported inadequate amounts of biomedical research space.

With respect to the condition of their biomedical research space, the HBCUs rated 47 percent (315 thousand NASF) of their biomedical research space as "suitable for the most scientifically sophisticated research," whereas 45 percent of the biomedical research space at all academic institutions was rated this way. By contrast, the HBCUs rated 8 percent (54 thousand NASF) of their biomedical research space as needing major repair/renovation or replacement, whereas 21 percent of the biomedical research space at all academic institutions was reported as being in this condition.

In fiscal years 1996 and 1997, 6 HBCUs began construction on 111 thousand NASF of biomedical research space at an expected completion cost of $31 million. In 1998 and 1999, 8 HBCUs were scheduled to begin construction on 139 thousand NASF of biomedical research space at an expected completion cost of $40 million.

Similarly, in fiscal years 1996 and 1997, 8 HBCUs began new repair/renovation projects on 93 thousand NASF of biomedical research space at an expected completion cost of $6.0 million. In 1998 and 1999, 6 HBCUs were scheduled to begin new repair/renovation projects on 223 thousand NASF of biomedical research space at an expected completion cost of $8.9 million.

Animal Research Facilities at Biomedical Research-Performing Institutions

In 1998, 700 of the 908 biomedical research-performing institutions (77 percent) had animal laboratory facilities. While 85 percent of the academic

Table 9-8. Amount, condition, adequacy, construction, and repair/renovation of biomedical research facilities at Historically Black Colleges and Universities (HBCUs) compared to all academic institutions: 1998

Indicator	HBCUs	All academic institutions*
Number of institutions	57	660
Amount of S&E research space [NASF in millions]		
All S&E fields	2.34	143.3
Biomedical sciences, total	0.67	56.2
Colleges and universities	0.40	26.4
Biological sciences	0.31	19.4
Medical sciences	0.10	7.0
Medical schools	0.27	29.8
Biological sciences	0.18	11.6
Medical sciences	0.09	18.1
Adequacy of current amount of biomedical research space [percentage of institutions]		
Sufficient to support needs of current biomedical research program commitments	29	33
Not sufficient to support needs of current biomedical research program commitments	71	67
Condition of existing biomedical research space [percentage of space]		
Suitable for use in the most sophisticated scientific research	47	45
Effective for most uses but may need limited repair	45	33
Requires major repair/renovation to be used effectively	7	17
Requires replacement	1	4
Construction projects: fiscal years 1996–97		
Number of institutions with projects >$100,000	6	128
Biomedical research space to be constructed [NASF in thousands]	111	5,303
Expected cost [in thousands of dollars]	31,258	1,625,638
Sources of funds for all construction projects [percentage of total cost]		
Federal Government	7	9
State and local governments	76	31
Private donations	5	19
Institutional funds	2	19
Debt financing	7	21
Other	3	1
Scheduled construction projects: fiscal years 1998–99		
Number of institutions planning projects >$100,000	8	117
Biomedical research space to be constructed [NASF in thousands]	139	7,652
Expected cost [in thousands of dollars]	40,195	2,227,605
Repair/renovation projects: fiscal years 1996–97		
Number of institutions with projects >$100,000	8	244
Biomedical research space to be repaired or renovated [NASF in thousands]	93	6,897
Expected cost [in thousands of dollars]	6,042	637,046
Scheduled repair/renovation projects: fiscal years 1998–99		
Number of institutions planning projects >$100,000	6	189
Biomedical research space to be repaired or renovated [NASF in thousands]	223	7,927
Expected cost [in thousands of dollars]	8,850	732,933

* Includes all academic institutions, with and without biomedical research space.

KEY: NASF = net assignable square feet.
S&E = science and engineering

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

institutions and 80 percent of the research hospitals had animal laboratory facilities, less than half (46 percent) of the nonprofit research organizations had such facilities (table 9-9).

The biomedical research-performing institutions reported a total of 14 million NASF of animal research space at biomedical research-performing institutions. Most of that space (83 percent or 12 million NASF) was located in the academic institutions. The nonprofit research organizations accounted for 12 percent of all the animal research space (1.7 million NASF), while the research-performing hospitals account for 5 percent (0.7 million NASF). The majority of animal research space (71 percent or 10 million NASF) was animal housing space, the remaining 29 percent (4 million NASF) was animal research space.

Institutions with animal research space reported that 69 percent (9.8 million NASF) of that space was at Federal biosafety Level 1 (i.e., acceptable for work with microorganisms not known to cause disease in healthy humans). Another 28 percent (4.0 million NASF) of that space was at Level 2 (i.e., acceptable for work with moderate-risk agents present in the community and associated with human disease of varying severity), and 4 percent (0.6 million NASF) was at Level 3 (i.e., acceptable for work with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection). No biomedical research-performing institution had animal research space at Level 4 (i.e., acceptable for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure).

Overall, 88 biomedical research-performing institutions were scheduled to start construction on 1.2 million NASF of animal research facilities at an estimated cost of $462 million in 1998 and 1999. The scheduled construction projects across institution types were as follows:

- Among academic institutions, 35 institutions were scheduled to start construction on 492 thousand NASF of animal research space at an estimated cost of $162 million in 1998 and 1999;
- Among nonprofit research organizations, 45 institutions were scheduled to start construction on 422 thousand NASF of animal research space at an estimated cost of $143 million 1998 and 1999; and
- Among research hospitals, 8 institutions were scheduled to start construction on 242 thousand NASF of animal research space at an estimated cost of $157 million in 1998 and 1999.

Similarly, 69 biomedical research-performing institutions were scheduled to start repair/renovation projects on 350 thousand NASF of animal research space at an estimated cost of $69 million in 1998 and 1999. The scheduled repair/renovation projects across institutions types were as follows:

- Among academic institutions, 56 institutions were scheduled to start repair/renovation projects on 303 thousand NASF of animal research space at an estimated cost of $45 million in 1998 and 1999;
- Among nonprofit research organizations, 6 institutions were scheduled to start repair/renovation projects on 28 thousand NASF of animal research space at an estimated cost of $7 million 1998 and 1999; and
- Among research hospitals, 7 institutions were scheduled to start repair/renovation projects on 20 thousand NASF of animal research space at an estimated cost of $18 million in 1998 and 1999.

Table 9-9. Amount, biosafety level, and scheduled construction and repair/renovation of animal research space at institutions with biomedical research space by institution type: 1998

Indicator	All biomedical institutions[5]	Institution type		
		Academic institutions[6]	Research organizations	Hospitals
Number of biomedical institutions, 1998	908	612	171	125
Number of biomedical institutions with animal research facilities, 1998	700	522	78	100
Total animal research space [NASF in thousands]	14,227	11,829	1,674	723
Animal housing space	10,161	8,532	1,149	480
Animal laboratory space	4,066	3,297	526	243
Percentage of animal research space at each biological safety level				
Level 1[1]	69	75	33	55
Level 2[2]	28	23	61	34
Level 3[3]	4	3	6	11
Level 4[4]	0	0	0	0
Scheduled construction of animal research space: 1998–99				
Number of biomedical institutions with scheduled construction	88	35	45	8
Amount of animal research space scheduled to be constructed [NASF in thousands]	1,156	492	422	242
Estimated cost of construction of animal research space [in millions of current dollars]	462	162	143	157
Scheduled repair/renovation of animal research space: 1998–99				
Number of biomedical institutions with scheduled repair/renovations costing over $100,000	69	56	6	7
Amount of animal research space scheduled to be repaired or renovated [NASF in thousands]	350	303	28	20
Estimated cost of repair/renovation of animal research space [in millions of current dollars]	69	45	7	18

[1] Acceptable for work with microorganisms not known to cause disease in healthy humans.

[2] Acceptable for work with moderate-risk agents present in the community and associated with human disease of varying severity.

[3] Acceptable for work with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection.

[4] Acceptable for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure.

[5] Includes only institutions with biomedical research space.

[6] Includes colleges, universities, and medical schools.

KEY: NASF = net assignable square feet.

NOTES: Components may not add to totals due to rounding. Animal research space was reported in total, not separately for each science and engineering field. Therefore, the animal space figures apply to all science and engineering fields, not solely to biomedical fields.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

National Science Foundation
Rita R. Colwell
Director

Directorate for Social, Behavioral, and Economic Sciences
Norman M. Bradburn
Director

Division of Science Resources Studies
Lynda T. Carlson — *Division Director*
Mary J. Frase — *Deputy Director*

Ronald S. Fecso
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Program Director

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Arlington, VA 22230
Telephone: (703) 292-8780
Fax: (703) 292-9592
email: srsweb@nsf.gov

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- Jaleh Daie, Professor of Botany, University of Wisconsin-Madison
- William A. Daigneau, Associate Vice President and Chief Facilities Officer, University of Texas—MD Anderson Cancer Center
- John Daniel, Professor of Sociology, Howard University
- Bruce Gillars, Manager, Space Planning/ Management, University of Utah
- David A. Goodwin, Director of Capital Budgeting, Virginia Commonwealth University
- Robert McGhee, Institute Architect and Senior Facilities Officer, Howard Hughes Institute
- Alexander McQuilkin, Associate Vice President, Facilities, Chapman University
- Julie T. Norris, Director, Office of Sponsored Programs, Massachusetts Institute of Technology
- Earl S. Richardson, President, Morgan State University
- Patricia Seller-Wolff, Associate, Kirksey and Partners Architects
- James E. Swartz, Vice President for Academic Affairs, Dean of the College, and Professor of Chemistry, Grinnell College
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Overview: Scientific and Engineering Research Facilities at Colleges and Universities: 1998

Introduction

The availability, condition, and adequacy of the physical facilities needed to conduct science and engineering (S&E) research at our Nation's colleges, universities, and biomedical research institutions have long been a concern of policy makers, higher education administrators, scientists, and engineers. In particular, questions about the following critical issues have been raised:

- How much space is there for conducting S&E research?
- Is this enough space to meet the Nation's S&E research needs?
- What is the condition of this space?
- How much new S&E space needs to be constructed? How much of the existing S&E space needs repair or renovation?
- How much construction and repair/renovation is taking place and what does it cost?
- How do colleges, universities, and biomedical institutions fund these capital projects?
- How has the situation changed over the past decade?

Educators and policy makers have been particularly concerned about the quantity and quality of S&E research space at nondoctorate-granting institutions (those dedicated primarily to undergraduate education), minority-serving institutions (those with relatively large percentages of minority students), and biomedical institutions. These institutions contribute to the scientific enterprise by providing students with the science and engineering education necessary to pursue advanced education and training as well as research and teaching careers in science and engineering.

In the mid-1980s, both the U.S. House of Representatives and the Senate held hearings at which experts testified about the seriousness of the condition of the Nation's S&E research facilities. As a result, Congress mandated that the National Science Foundation (NSF) collect and analyze data that address a range of S&E research facilities issues. The mandate states:

> *The National Science Foundation is authorized to design, establish, and maintain a data collection and analysis capability in the Foundation for the purpose of identifying and assessing the research facilities needs of universities and colleges. The needs of universities by major field of science and engineering, for construction and modernization of research laboratories, including fixed equipment and major research equipment, shall be documented. University expenditures for the construction and modernization of research facilities, the sources of funds, and other appropriate data shall be collected and analyzed. The Foundation, in conjunction with other appropriate Federal agencies, shall report the results to Congress. The first report shall be submitted to Congress by September 1, 1986 (42 U.S.C. 1886).*

On a biennial basis since 1986, NSF has collected data on S&E research facilities in the Nation's research-performing colleges, universities, and biomedical institutions. This overview presents the major findings from the 1998 survey and provides a summary of changes that have taken place between the 1988 and 1998 surveys. A brief description of the study's methods precedes a discussion of its major findings.

Survey Methods

The 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities was mailed to 465 institutions. In February, 1998, surveys were mailed to 365 academic institutions. In June, 1998, surveys were mailed to 50 nonprofit research organizations and 50 research hospitals. The sample of academic institutions represents 660 colleges and universities that either had research and development (R&D) expenditures

of $50,000 or more in 1993, or were minority-serving institutions that had any R&D expenditures in that year. The sample of 100 nonprofit research organizations and research hospitals represents the 301 National Institutes of Health (NIH) 1997 grant recipients.

Of the 660 research-performing academic institutions, 57 percent were doctorate-granting and 43 percent were nondoctorate-granting.[1] In Chapters 1 through 8, the doctorate-granting academic institutions are categorized into two groups: "top 100" and "other doctorate-granting" institutions. The top 100 institutions are the 100 academic institutions that had the largest R&D expenditures in 1993 and the other doctorate-granting institutions represent the remaining 278 doctorate-granting academic institutions. In Chapter 9, *Biomedical Research Facilities*, the academic institutions are categorized differently. The 50 academic institutions that had the largest R&D expenditures in 1993 are referred to as the "top 50," and the remaining 328 academic institutions are referred to as "other-doctorate granting" institutions. In addition, academic institutions that had any research space or capital projects in the biological or medical sciences inside medical schools were identified as "medical schools."

In 1998, respondents could complete the survey either electronically over the Internet[2] or on paper. Institutions that participated in the 1996 survey were sent a computer-generated "facsimile" of their previous responses. Extensive telephone follow-up elicited a high response rate and reduced the number of items that respondents had initially omitted or responded to inconsistently. In all, 304, or 87 percent of all qualified academic institutions, including all of the "top 100," and 83, or 87 percent of all qualified research hospitals and nonprofit research organizations completed the survey. Of these 387 institutions, 53 percent responded via the Internet and 47 percent completed the paper version of the survey. (See Appendix A, "Technical Notes," for a detailed description of the sampling procedures and data-collection methods.)

How Much S&E Research Space Do Colleges and Universities Have?

In 1998, the Nation's colleges and universities had 488 million net assignable square feet (NASF)[3] of academic space. Fifty-nine percent of this space, 286 million NASF, was dedicated to instruction and research in science and engineering. Half of this S&E space, 143 million NASF, was devoted specifically to research (table 1).

[1] Throughout this report, these institutions are referred to as 'research-performing' institutions. Except where explicitly stated otherwise, the statistics presented in the report are for the weighted values of all institutions represented in the sample.

[2] In 1996, a Windows-based disk version of the survey was provided as an option.

[3] Net assignable square feet is defined as the sum of all areas, in square feet, on all floors of a building assigned to, or available to be assigned to, an occupant for specific use.

Table 1. Amount of space by institution type: 1998

Institution type	Number of institutions	Instructional and research space in all academic fields	Instructional and research space in S&E fields	Research space in S&E fields
		NASF in millions		
Total	660	488	286	143
Doctorate-granting	378	416	261	136
Top 100 in research expenditures	100	252	177	101
Other	278	164	84	35
Nondoctorate-granting	282	72	25	7

KEY: S&E = science and engineering.
NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

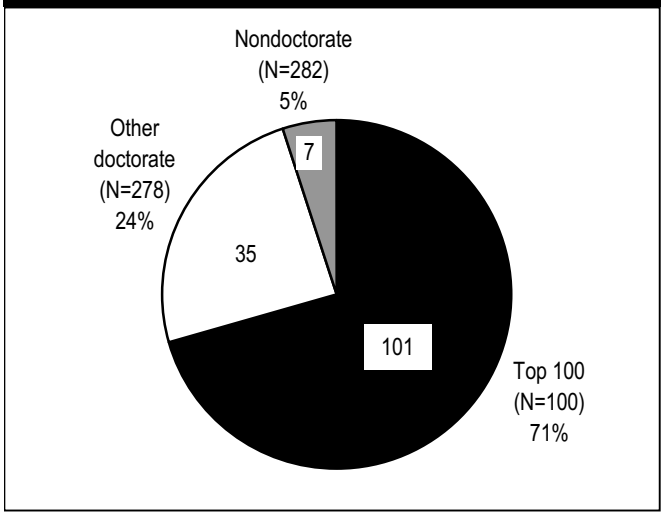
The Nation's S&E research space was distributed across the three types of research-performing institutions as follows (figure 1):

- The top 100 institutions, which represent 15 percent of all research-performing institutions, occupied 71 percent of this space (101 million NASF);
- The other doctorate-granting institutions, which represent 42 percent of all research-performing institutions, occupied 24 percent of this space (35 million NASF); and
- The nondoctorate-granting institutions, which represent 43 percent of all research-performing institutions, occupied 5 percent of this space (7 million NASF).

It should also be noted that while the top 100 institutions represent 15 percent of the total number of research-performing institutions, they accounted for 80 percent of all R&D expenditures[4] in 1996. Thus, the proportion of S&E research space that they occupy, 71 percent, is roughly proportional to their share of total R&D expenditures.

[4] The 1998 expenditures data were not available at the time this report was written. The most recent expenditure data, 1996, were therefore used. National Science Foundation, *Academic Research and Development Expenditures: Fiscal Year, 1996.*

Figure 1. Amount of science and engineering research space by institution type: 1998 [NASF in millions]



KEY: NASF = net assignable square feet.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Almost three quarters (72 percent or 103 million NASF) of the Nation's S&E research space is concentrated in five fields (table 2):

- The agricultural sciences—17 percent or 25 million NASF;
- Engineering—16 percent or 23 million NASF;
- The biological sciences outside medical schools—13 percent or 19 million NASF;
- The physical sciences—13 percent or 18 million NASF; and

Table 2. Existing and needed science and engineering research space by field: 1998

Field	Number of institutions with space*	Existing NASF [In millions]	Percentage of institutions reporting inadequate space	Additional NASF needed [In millions]
Total	660	143	83	29
Biological sciences—				
inside medical schools	127	12	70	3
outside medical schools	569	19	64	5
Physical sciences	556	18	64	4
Psychology	474	3	51	1
Social sciences	428	5	61	1
Mathematics	416	1	44	0
Computer sciences	395	2	56	1
Earth, atmospheric, and ocean sciences	365	8	62	2
Engineering	305	23	60	4
Agricultural sciences	108	25	55	2
Medical sciences—				
outside medical schools	280	7	54	2
inside medical schools	127	18	67	4
Other sciences	149	3	44	1

* Includes only institutions reporting existing and/or needed research space in the specified field.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The medical sciences in medical schools—13 percent or 18 million NASF.

Is the Amount of S&E Research Space Adequate for Current Research Commitments?

In light of their current research commitments, more than half of all institutions reported inadequate amounts of space in every S&E field except mathematics, where 44 percent of the institutions indicated that the amount of research space was inadequate (table 2). At least 60 percent of all research-performing institutions reported that their research space was inadequate in each of the following seven S&E fields:

- The biological sciences in medical schools—70 percent of institutions reported having inadequate space;[5]
- The medical sciences in medical schools—67 percent of institutions;
- The biological sciences outside medical schools—64 percent of institutions;
- The physical sciences—64 percent of institutions;
- The earth, atmospheric, and ocean sciences—62 percent of institutions;
- The social sciences—61 percent of institutions; and
- Engineering—60 percent of institutions.

To meet their current research commitments, the research-performing institutions reported that they needed an additional 29 million NASF of S&E research space, or 20 percent more than they currently have. Three million or more NASF of research space were needed in each of the following five S&E fields (table 2):

- The biological sciences outside medical schools (5 million NASF);
- The physical sciences (4 million NASF);
- Engineering (4 million NASF);
- The medical sciences in medical schools (4 million NASF); and
- The biological sciences in medical schools (3 million NASF).

What is the Condition of the Nation's S&E Research Space?

Over a third (39 percent or 56 million NASF) of S&E research space at research-performing institutions was rated as "suitable for the most scientifically competitive research" (see Chapter 2). However, the research-performing institutions classified 18 percent (26 million NASF) of their research space as needing major renovation and another 5 percent (7 million NASF) as needing replacement. Thus, almost one quarter (23 percent) of all S&E research space requires either major renovation or replacement. Fields with the greatest amount of research space needing major renovation or replacement include:

- The agricultural sciences (7.5 million NASF);
- The biological sciences outside medical schools (4.8 million NASF);
- The medical sciences in medical schools (4.6 million NASF);
- Engineering (4.3 million NASF); and
- The physical sciences (3.9 million NASF).

How Much Construction and Repair/Renovation Has Been Deferred?

In 1998, 54 percent of research-performing institutions reported that they had to defer needed S&E construction or repair/renovation projects that would support their current research program commitments because of insufficient funds. The vast majority of institutions that had deferred projects (87 percent) had included at least some of these projects in an approved institutional plan.

[5] Reported percentages of institutions include only those that had or needed research space in the field. For example, there were 127 institutions with or needing biological science research space in medical schools (table 2), of which 70 percent (89) reported having inadequate space. By comparison, 569 institutions reported having or needing research space in the biological sciences outside of medical schools. Sixty-four percent of these institutions, or 364, indicated that the amount of space in this field was inadequate.

The total estimated cost for deferred S&E research construction and repair/renovation projects (both in and not in an institutional plan) was $11.4 billion in 1998. Deferred construction projects accounted for $7.0 billion (61 percent) of these costs, while deferred repair/renovation projects accounted for the other $4.4 billion (39 percent) (see Chapter 6).

Deferred construction costs exceeded $1 billion in each of three fields. Institutions reported deferred repair/renovation costs in excess of $500 million in the same three fields. These fields and the deferred costs are:

- The physical sciences: $1.6 billion in deferred construction and $901 million in deferred repair/renovation;
- The biological sciences outside medical schools: $1.2 billion in deferred construction and $853 million in deferred repair/renovation; and
- Engineering: $1.0 billion in deferred construction and $700 million in deferred repair/renovation.

How Much S&E Construction and Repair/Renovation Did Institutions Start in 1996 and 1997?

New construction projects begun in 1996 and 1997 are expected to produce 11.1 million NASF of new S&E research space. This space is the equivalent of about 8 percent of existing research space.[6] Similarly, new repair/renovation projects begun in 1996 and 1997 are expected to upgrade 15.1 million NASF, about 11 percent of existing research space (see Chapter 3 and Appendix E).

In 1996 and 1997, institutions were less likely to start new construction projects than they were to start repair/renovation projects. Overall, one third of institutions (30 percent) started new S&E construction projects in 1996 and 1997 and over half (52 percent) started repair/renovation projects (table 3).

Institutions were most likely to start construction projects in the following fields:

- The medical sciences in medical schools—33 percent of institutions;[7] and
- The agricultural sciences—28 percent of institutions.

Similarly, institutions were most likely to start repair/renovation projects that cost over $100,000 in the following fields:

- The biological sciences in medical schools—51 percent of institutions;
- The medical sciences in medical schools—41 percent of institutions;
- Engineering—35 percent of institutions; and
- The physical sciences—31 percent of institutions.

How Much Are S&E Construction and Repair/Renovation Projects Expected to Cost?

New construction projects begun in 1996 and 1997 are expected to cost $3.1 billion. Projects scheduled to begin in 1998 and 1999 are expected to cost another $3.9 billion. Institutions reported an additional $7.0 billion of estimated deferred construction costs. Similarly, new repair/renovation projects costing over $100,000 begun in 1996 and 1997 are expected to cost $1.3 billion and projects costing less than $100,000 are expected to cost $0.2 billion, for a total of $1.5 billion in repair/renovation projects in 1996 and 1997. Repair/renovation projects costing more than $100,000 scheduled to begin in 1998 and 1999 are expected to cost $1.6 billion. Institutions estimated deferred repair/renovation costs totaling $4.4 billion (figure 2).

[6] Because some newly constructed S&E research space replaces existing space, the reader is cautioned against adding NASF under construction to existing NASF to obtain a total NASF once construction is completed. In addition, it should not be assumed that space being constructed is necessarily the same space that institutions report as needed in any given field in 1998.

[7] Percentages are reported only for those institutions that have or plan to construct research space in a given S&E field.

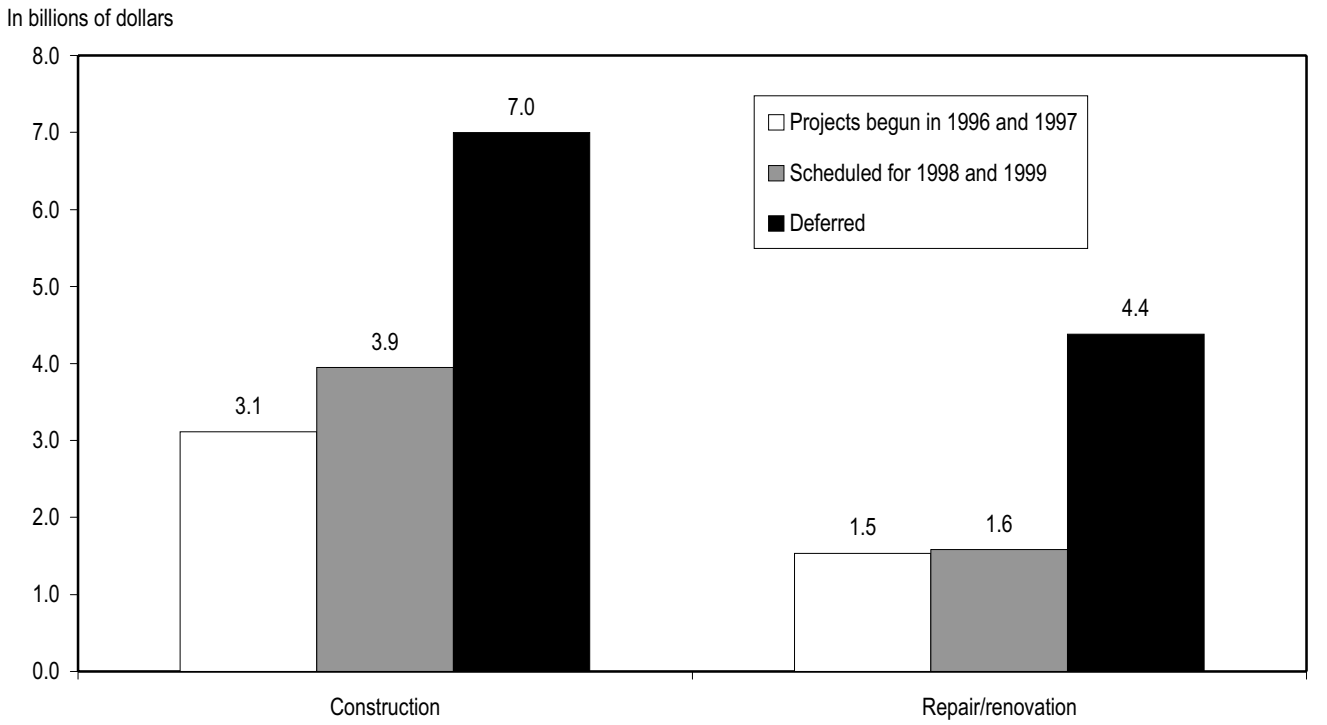
Table 3. Construction and repair/renovation activity by science and engineering field: 1996–97

Field	Percentage of institutions starting new construction	Cost of new construction [In millions of dollars]	Percentage of institutions starting repair/renovation	Cost of repair/renovation [In millions of dollars]
Total	30	3,110	52	1,325
Biological sciences—				
inside medical schools	14	178	51	164
outside medical schools	13	404	29	200
Physical sciences	11	381	31	244
Psychology	4	77	8	65
Social sciences	5	75	12	40
Mathematics	1	9	3	5
Computer sciences	4	21	5	12
Earth, atmospheric, and ocean sciences	11	172	12	52
Engineering	11	332	35	208
Agricultural sciences	28	273	25	50
Medical sciences—				
inside medical schools	33	784	41	196
outside medical schools	9	259	25	76
Other sciences	10	145	17	11

NOTE: Components may not add due to rounding. Percentages are based on the number of institutions with existing research space or planned construction or repair/renovation of research space in a given field. Only projects costing $100,000 or more.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Figure 2. Costs of construction and repair/renovation of science and engineering research facilities begun in 1996 and 1997, scheduled for 1998 and 1999, and deferred costs in 1998–99



SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Four fields account for more than half (61 percent) of the $3.1 billion committed to the construction of new research space started in 1996 and 1997 (table 3).

- The medical sciences in medical schools ($784 million);
- The biological sciences outside medical schools ($404 million);
- The physical sciences ($381 million); and
- Engineering ($332 million).

Five fields account for more than three quarters (76 percent) of the $1.3 billion committed to the repair/renovation of research space:

- The physical sciences ($244 million);
- Engineering ($208 million);
- The biological sciences outside medical schools ($200 million);
- The medical sciences in medical schools ($196 million); and
- The biological sciences in medical schools ($164 million).

How are Colleges and Universities Funding S&E Capital Projects?

Overall, the research-performing institutions derived their S&E capital projects funds from three major sources: the Federal Government, state and local governments, and internal sources. Internal sources consist of private donations, tax-exempt bonds, other debt sources, and other sources (table 4).

Although more than twice as many dollars from each source were allocated to construction project expenses ($3.1 billion) than to repair/renovation project expenses from projects costing over $100,000 ($1.3 billion), the funds were drawn from each source in similar proportions, regardless of the type of project. Internal sources were the largest source of funds for both types of projects:

- Internal sources accounted for 60 percent ($1,873 million) of all construction funds and 65 percent ($866 million) of all repair/renovation funds;
- State and local governments accounted for 31 percent ($967 million) of all construction funds and 26 percent ($338 million) of all repair/renovation funds; and
- The Federal Government directly accounted for 9 percent of all construction funds ($271 million) and 9 percent ($121 million) of all repair/renovation funds. Additionally, some Federal funding comes through overheads on grants and/or contracts from the Federal Government. These overhead payments are used to defray the indirect costs of conducting federally funded research and are counted as institutional funding.

The relative distribution of the three sources of funds for S&E construction and repair/renovation projects differed between the public and private research-performing institutions. The relative distribution of construction funds between institution types is as follows (figure 3):

- Internal sources accounted for 43 percent ($847 million) of all construction funds at public institutions and 91 percent ($1,025 million) at private institutions;

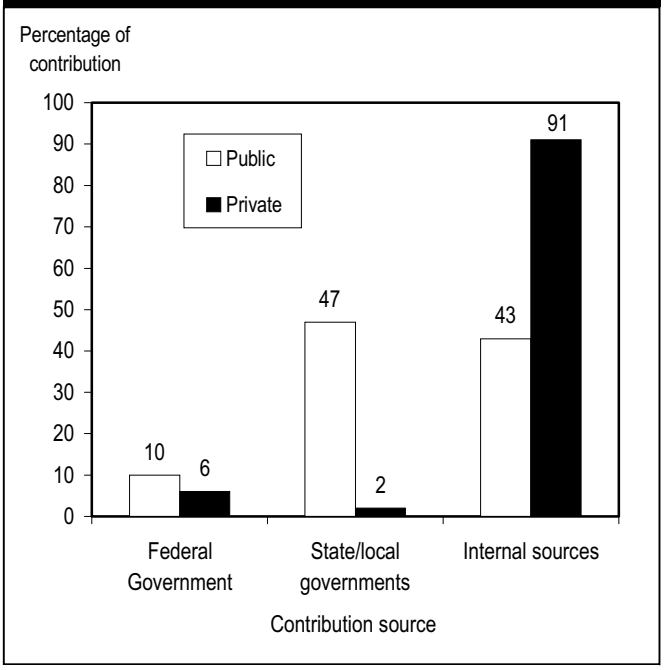
Table 4. Source of funds to construct and repair/renovate science and engineering research space: 1996–97

Source of funds	Percentage of funds for new construction	Percentage of funds for repair/renovation
Total sources	100	100
Federal Government	9	9
State/local government	31	26
Internal sources	60	65
Total costs [In billions of dollars]	3.1	1.3

NOTE: Components may not add to totals due to rounding. Only projects costing $100,000 or more.

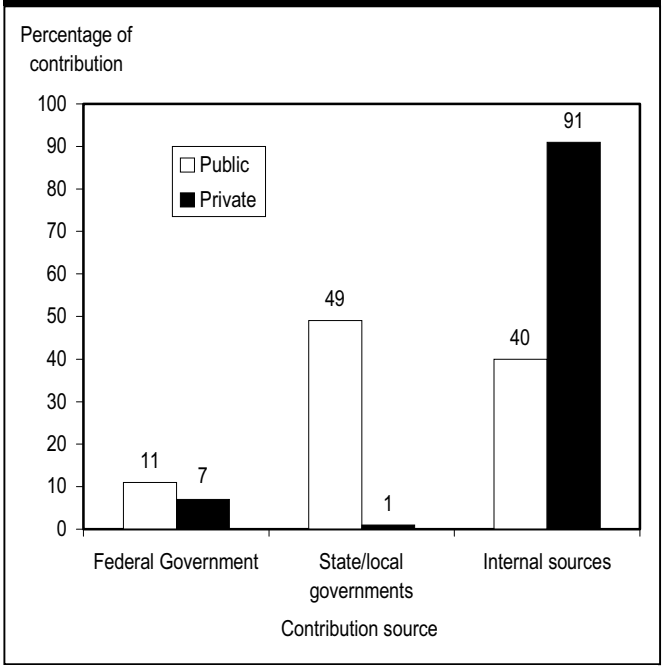
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Figure 3. Source of funds for the construction of science and engineering research space by control of institution: 1996–97



NOTE: Components may not add to totals due to rounding.
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Figure 4. Source of funds for the repair/renovation of science and engineering research space by control of institution: 1996–97



NOTE: Percentages may not add to 100 due to rounding.
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- State and local governments accounted for 47 percent ($940 million) of all construction funds at public institutions and 2 percent ($26 million) at private institutions; and
- The Federal Government accounted for 10 percent ($201 million) of all construction funds at public institutions and 6 percent ($70 million) of all construction funds at private institutions.

The relative distribution of repair/renovation funds between institution types is as follows (figure 4):

- Internal sources accounted for 40 percent ($269 million) of all repair/renovation funds at public institutions and 91 percent ($597 million) at private institutions;
- State and local governments accounted for 49 percent ($328 million) of all repair/renovation funds at public institutions and 1 percent ($10 million) at private institutions; and
- The Federal Government accounted for 11 percent ($72 million) of all repair/renovation funds at public institutions and 7 percent ($48 million) at private institutions.

What is the State of S&E Research Space at Minority-Serving Institutions?

Since its inception, the Survey of Scientific and Engineering Research Facilities at Colleges and Universities has included a subset of Historically Black Colleges and Universities (HBCUs). These institutions have been recognized for their contributions to the education of black students in general and for their role in preparing students for science and engineering careers. NSF has recognized the growth in minority enrollments in higher education overall and, thus, added two other types of minority-serving institutions to the 1998 sample. The inclusion of non-HBCU-Black institutions acknowledges the fact that there are many colleges and universities that enroll large percentages of black students but are not designated as HBCUs. Similarly, as Hispanic enrollments in higher education increase, there is a need to examine institutions serving these students. The group of minority-serving institutions varies in size and focus; it is composed of both nondoctorate and doctorate-granting institutions,

and includes one of the top 100 research-performing institutions. Below is a summary of some of the key characteristics of minority-serving institutions:

- **Number of institutions:** The Nation's 660 research-performing institutions include 57 HBCUs, 13 non-HBCU-Black-serving institutions, and 10 Hispanic-serving institutions. These 80 institutions comprise 12 percent of all research-performing institutions.

- **Amount of S&E research space:** The minority-serving institutions contain 3.9 million NASF of S&E research space, or 3 percent of the total amount of research space across all research-performing institutions.

- **S&E research space by field:** Four fields account for 71 percent of all the S&E research space in minority-serving institutions: engineering, 960 thousand NASF; the agricultural sciences, 710 thousand NASF; the physical sciences, 543 thousand NASF; and the biological sciences outside of medical schools, 519 thousand NASF.

- **Adequacy of amount of space:** At least 60 percent of the minority-serving institutions report inadequate amounts of S&E research space in eight fields: engineering; psychology; the physical sciences; the computer sciences; the biological sciences outside of medical schools; the social sciences; the earth, atmospheric, and ocean sciences; and the medical sciences outside medical schools.

- **Condition of research space:** Seventeen percent of the S&E research space (0.7 million NASF) in minority-serving institutions is reported to require either major renovation or replacement.

- **Construction activity:** Twenty-four percent of the minority-serving institutions started S&E construction projects in either 1996 or 1997. The cost of these projects at the time they were started was $120 million. The cost of these projects represented 4 percent of the total S&E construction costs undertaken at all research-performing institutions.

- **Repair/renovation activity:** Twenty-nine percent of the minority-serving institutions started S&E repair/renovation projects in either 1996 or 1997. The cost of these projects at the time they were started was approximately $36 million. The cost of these projects represented 3 percent of the total across all research-performing institutions.

- **Sources of funding:** State and local governments were the primary funding source for both construction and repair/renovation projects over $100,000 in minority-serving institutions, followed by internal sources (table 5).

How Much Animal Research Space do the Nation's Colleges and Universities Have?

The 83 percent of research-performing institutions that have animal laboratory facilities reported a total of 11.9 million NASF of animal research space. This represents 8 percent of all S&E research space.

The distribution of animal research space across types of institutions parallels the distribution of all S&E research space. In addition, the proportion of animal research space as a part of all S&E research space is roughly 8 percent at each type of institution:

- The top 100 institutions occupy 71 percent (101 million NASF) of all S&E research space and have 72 percent (8.5 million NASF) of all animal research space;

Table 5. Source of funds to construct and repair/renovate science and engineering research space at minority-serving institutions: 1996–97

Source of funds	Percentage of funds for new construction	Percentage of funds for repair/renovation
Total sources	100	100
Federal Government	21	17
State/local governments	42	63
Internal sources	37	20
Total costs [In millions of dollars]	120	36

NOTE: Components may not add to totals due to rounding. Only projects costing $100,000 or more.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The other doctorate-granting institutions occupy 24 percent (35 million NASF) of all S&E research space and have 23 percent (2.7 million NASF) of all animal research space; and

- The nondoctorate-granting institutions occupy 5 percent (7 million NASF) of all S&E research space and have 5 percent (0.6 million NASF) of all animal research space.

What is the State of the Nation's Biomedical Research Facilities?

Biomedical research facilities are a critical component of the Nation's science and engineering research system. This report assesses the amount, quality, and condition of biomedical research space at the Nation's biomedical research-performing institutions. Below is a summary of some of the key characteristics of these institutions.

The Nation has 908 biomedical research-performing institutions. These include 612 academic institutions (colleges, universities, and medical schools), 171 nonprofit research organizations, and 125 research hospitals.

The biomedical research-performing institutions had 73.3 million NASF of biomedical research space in 1998. Slightly more than half of this space (53 percent or 38.9 million NASF) was in the biological sciences; the other 47 percent or 34.4 million NASF was in the medical sciences. More than three quarters of the biomedical research space (77 percent or 56.2 million NASF) was located in academic institutions. Nonprofit research organization accounted for 13 percent (9.5 million NASF) of all biomedical research space, while research hospitals accounted for 10 percent (7.6 million NASF). The HBCUs had 1.2 percent (670 thousand NASF) of all the biomedical research space in the Nation's biomedical research-performing institutions: 73 percent of this space (490 thousand NASF) was in the biological sciences; 28 percent (190 thousand NASF) was in the medical sciences.

Overall, 65 percent of institutions with existing or needed research space in the biological sciences and 52 percent of institutions with existing or needed research space in the medical sciences reported that the amount of biomedical research space they had was inadequate to meet their research commitments. Similarly, 71 percent of the HBCUs with existing or needed research space in the biomedical sciences reported that the amount of space they had was inadequate to meet their current biomedical research commitments.

In order to meet their current research commitments, the biomedical institutions reported that they needed an additional 9.0 million NASF of research space in the biological sciences or 23 percent more than they currently have. At the same time, they reported that they needed an additional 7.1 million NASF of research space in the medical sciences or 21 percent more than they currently have.

In fiscal years 1996 and 1997, 172 biomedical research-performing institutions started construction on 7.4 million NASF of research space: 116 institutions started construction on 3.5 million NASF of research space in the biological sciences; 81 institutions started construction on 3.9 million NASF of research space in the medical sciences.

In fiscal years 1996 and 1997, 379 biomedical research institutions started repair/renovation projects on 9.0 million NASF of biomedical research space: 282 institutions began repair/renovation projects on 5.5 million NASF of research space in the biological sciences; 172 institutions began repair/renovation projects on 3.5 million NASF of research space in the medical sciences. The biomedical research-performing institutions reported $5.6 billion in construction and repair/renovation projects that had to be deferred because of insufficient funds. Construction projects account for 64 percent ($3.6 billion) of the total deferred capital project costs.

In 1998, 700 of the 908 biomedical research-performing institutions (77 percent) had animal laboratory facilities. These institutions reported a total of 14 million NASF of animal research space. Most of this space (83 percent or 12 million NASF) was located in academic institutions.

Looking Back Over the Decade

The 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities provides an opportunity to examine the status of the Nation's S&E

research facilities over a ten-year period.[8] While some aspects of facilities (e.g., the amount of space) have changed gradually and steadily over the decade, other aspects (e.g., construction and repair/renovation starts) have tended to fluctuate over this period.[9]

Amount of Research Space

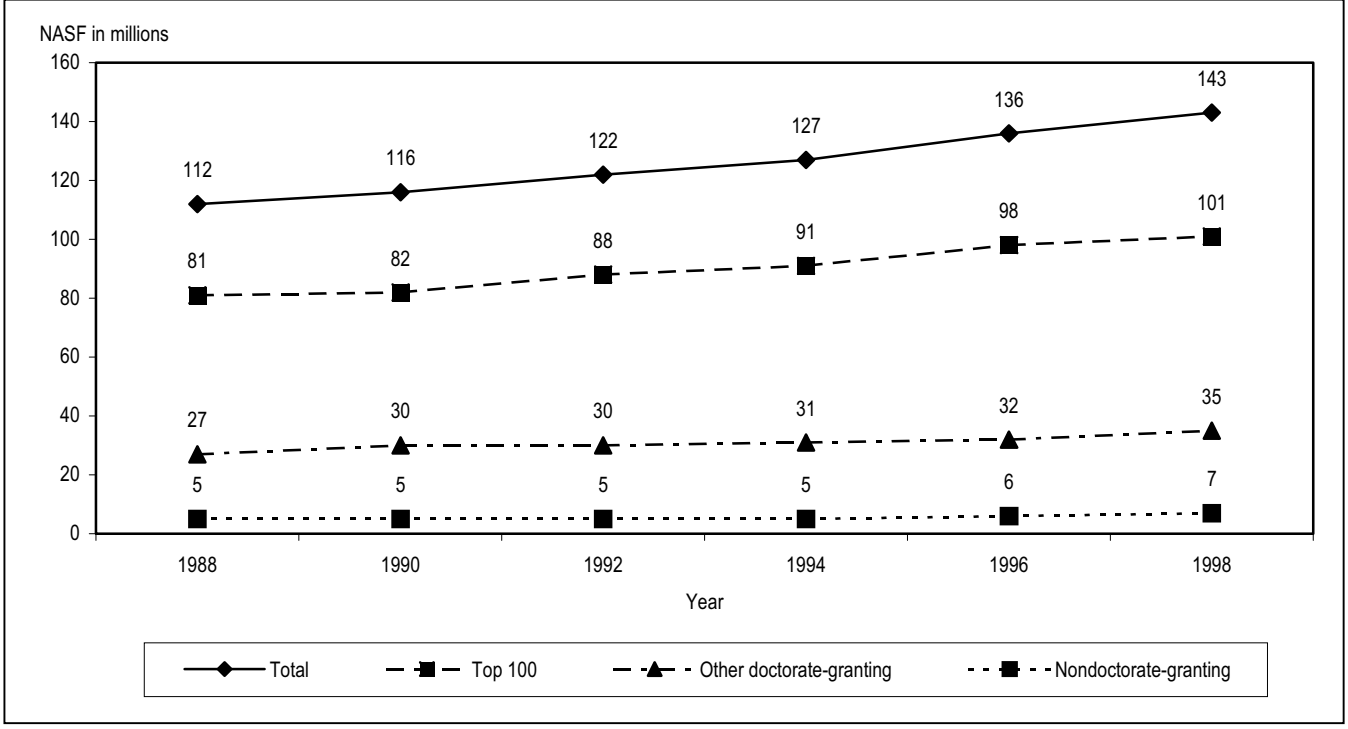
The amount of S&E research space in the Nation's research-performing colleges and universities has grown continuously over the decade. In 1988, there were 112 million NASF of research space. Ten years later, there were 143 million NASF, a 28-percent increase. Doctorate-granting institutions account for most of the growth in actual S&E research space over this period (figure 5):

- At the top 100 institutions, S&E research space increased by 25 percent or 20 million NASF (from 81 million NASF to 101 million NASF);
- At other doctorate-granting institutions, S&E research space increased by 30 percent or 8 million NASF (from 27 million NASF to 35 million NASF); and
- At nondoctorate-granting institutions, S&E research space increased by 40 percent or 2 million NASF (from 5 million NASF to 7 million NASF).

[8] While the Survey of Scientific and Engineering Research Facilities at Colleges and Universities has collected data on a number of the same issues over time, modifications to individual questions have occurred and new questions that address issues that arose between survey periods have been added. It should also be noted that the institutions sampled change over time, particularly for the other doctorate-granting and nondoctorate-granting groups. In addition, the classification of some institutions changed, e.g., institutions that did not grant doctorate degrees in one period did so at a later period. The sampling frame, however, has always reflected those institutions with R&D expenditures of $50,000 or more and, starting in 1992, Historically Black Colleges and Universities with any R&D expenditure.

[9] We limit our discussion to changes over time where the 1986–87 estimate falls outside the 1996–97 estimate's 95 percent confidence interval.

Figure 5. Trends in the amount of science and engineering research space by institution type: 1988–98



KEY: NASF = net assignable square feet.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; and *Scientific and Engineering Research Facilities at Colleges and Universities: 1996,* table 1-3, p 1-6.

Increases in the amount of S&E research space in the individual S&E fields were gradual and fairly even across fields.

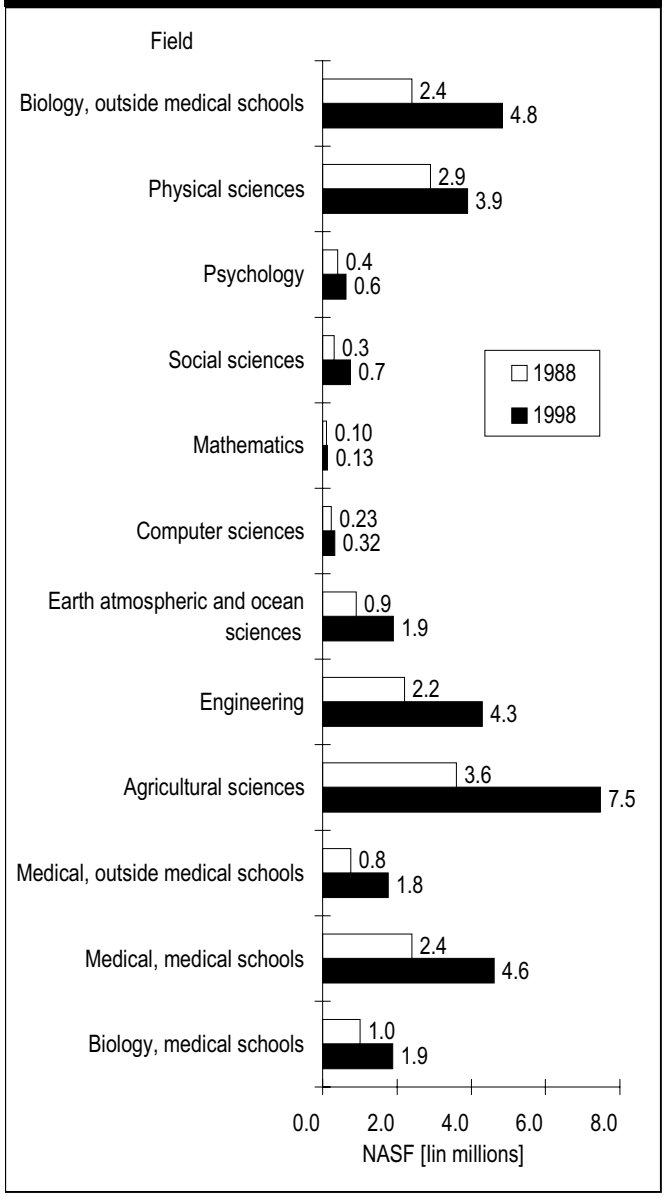
The Condition of S&E Research Space

In 1988, 24 percent of all research space was rated as "suitable for the most scientifically competitive research," whereas in 1998, 39 percent of all of research space was rated as being in this highest quality condition (see Appendix E). The amount of research space reported to need major renovation or replacement to meet current research commitments also has increased continuously, from 16 to 23 percent, over the past ten years. In 1988, 17.7 million NASF of all S&E research space required repair or renovation compared with 33.0 million NASF in 1998.

In this ten-year period, the amount of research space requiring renovation or replacement has increased in every S&E field. In eight out of the twelve fields, the amount of research space in this condition has nearly doubled over the decade (figure 6):[10]

- The social sciences research space in need of renovation or replacement increased from 0.3 million NASF to 0.7 million NASF;
- The medical sciences outside medical schools: from 0.8 million NASF to 1.8 million NASF;
- The earth, atmospheric, and ocean sciences: from 0.9 million NASF to 1.9 million NASF;
- The agricultural sciences: from 3.6 million NASF to 7.5 million NASF;
- The biological sciences outside medical schools: from 2.4 million NASF to 4.8 million NASF;
- The biological sciences in medical schools: from 1.0 million NASF to 1.9 million NASF;
- The medical sciences in medical schools: from 2.4 million NASF to 4.6 million NASF; and
- Engineering: from 2.2 million NASF to 4.3 million NASF.

Figure 6. Amount of science and engineering research space needing major renovation or replacement by field: 1988 and 1998



KEY: NASF = net assignable square feet.

SOURCE: National Science Foundation/Division of Science Resources Studies (SRS), 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; and *Scientific and Engineering Research Facilities at Colleges and Universities: 1996,* table 2-3, p 2-6.

New Construction and Repair/Renovation Projects

The amount of new research space under construction and the amount of research space affected by repair/renovation projects have fluctuated over time. In 1996 and 1997, research-performing institutions began construction on 11.1 million NASF; in 1986 and 1987, con-

[10] Due to differences in the standard errors of each estimate, changes over time of the same magnitude may not have the same interpretation.

struction was begun on 9.9 million NASF. The amount of S&E research space affected by new repair/renovation projects in 1996 and 1997 was 15.1 million NASF; the amount of research space repaired or renovated in 1986 and 1987 was 13.4 million NASF (see Appendix E).

Overall, the proportion of institutions (30 percent) starting construction projects in 1996 and 1997 is less than the proportion (37 percent) that started construction projects ten years earlier, in 1986 and 1987. The proportion of institutions beginning new construction projects in two fields changed over the decade:

- Engineering decreased from 28 percent of institutions to 11 percent; and
- The agricultural sciences decreased from 38 percent of institutions to 28 percent.

The proportion of institutions (52 percent) starting new repair/renovation projects in 1996 and 1997 was similar to the proportion (56 percent) that started repair/renovation projects in 1986 and 1987. However, a change in the proportion of institutions beginning new repair/renovation projects over the decade occurred in four fields:

- The physical sciences increased from 22 percent of institutions to 31 percent;
- Engineering decreased from 42 percent of institutions to 35 percent;
- The medical sciences outside medical schools increased from 12 percent of institutions to 25 percent; and
- The medical sciences in medical schools decreased from 54 percent of institutions to 41 percent.

The Cost of Construction and Repair/Renovation Projects

The total costs of new construction and repair/renovation projects have fluctuated over time. However, in 1996 and 1997, research-performing institutions committed 15 percent more funds (in inflation-adjusted dollars) for capital projects costing over $100,000 than they did a decade ago. In 1986 and 1987, they committed $2.7 billion to new construction projects compared with $3.1 billion in 1996 and 1997; and $1.1 billion to repair/renovation compared with $1.3 billion in 1996 and 1997[11] (figure 7).

Although the amount of funds committed to new construction projects costing over $100,000 has varied over time by field, construction expenditures approximately doubled or more in three fields since 1986–87:

- In mathematics, the amount of funds increased $7 million, from $2 million to $9 million;
- In the earth, atmospheric, and ocean sciences, the amount of funds increased $97 million, from $75 million to $172 million; and
- In the medical sciences in medical schools, the amount of funds for new construction projects increased $385 million, from $399 million to $784 million.

The amount of funds committed to repair/renovation projects costing over $100,000 has also varied over time by field. The repair/renovation expenditures increased in four fields:

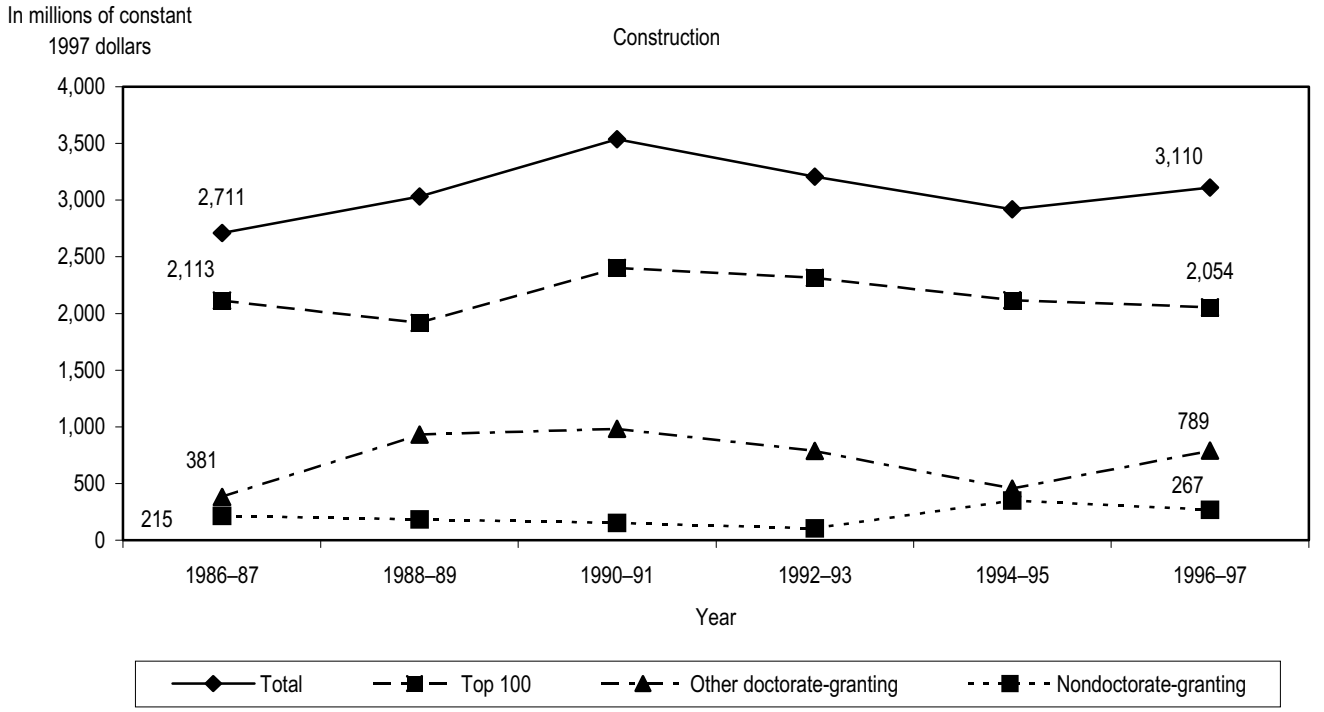
- In psychology, the amount of funds committed to repair/renovation projects increased $47 million, from $18 million to $65 million;
- In the earth, atmospheric, and ocean sciences, the amount of funds increased $25 million, from $27 million to $52 million;
- In the physical sciences, the amount of funds increased $105 million, from $139 million to $244 million; and
- In the biological sciences in medical schools, the amount of funds increased $62 million, from $102 million to $164 million.

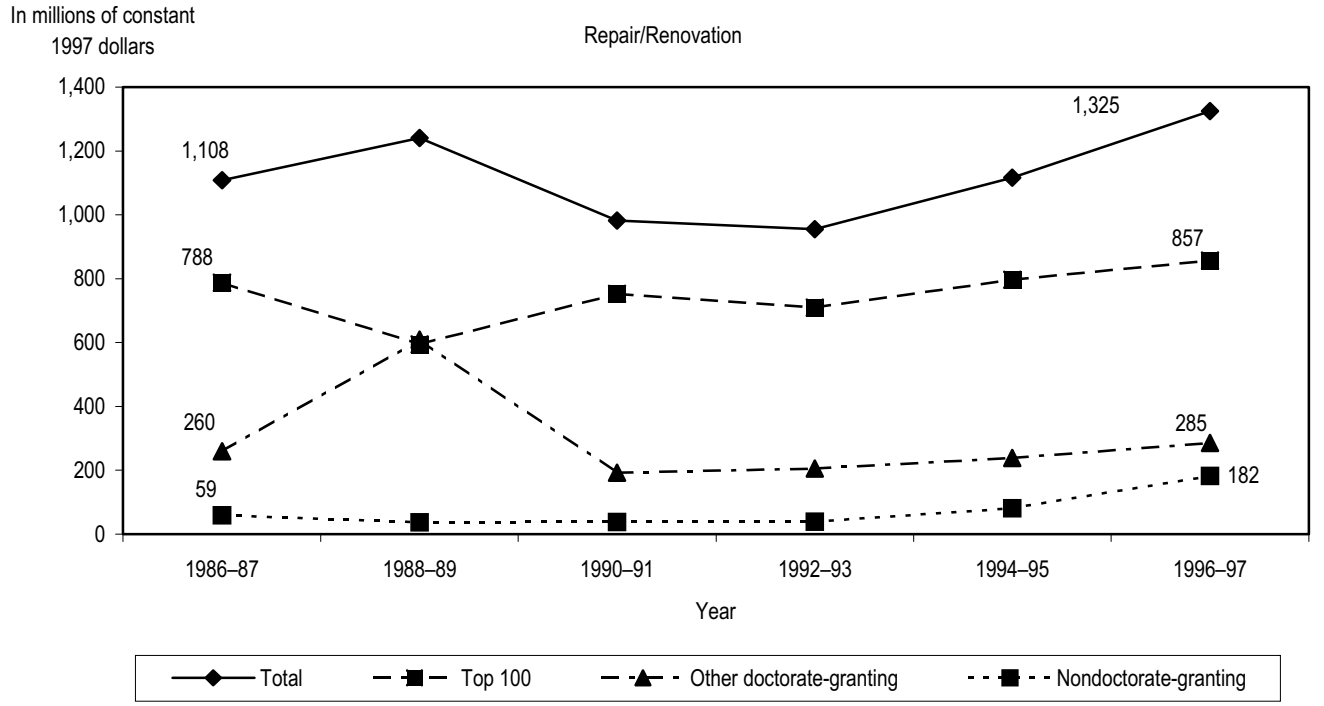
Sources of Funds

The first survey period for which data are presented in this report on the different sources of funds committed to new construction and repair/renovation

[11] All dollar figures are adjusted to 1997 levels using the U.S. Bureau of the Census' Composite Fixed Price Index for Construction.

Figure 7. Trends in expenditures on science and engineering research space construction and repair/renovation starts by institution type: 1986–97





NOTE: All dollar figures are adjusted to 1997 levels using the U.S. Bureau of the Census' Composite Fixed Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; and *Scientific and Engineering Research Facilities at Colleges and Universities: 1996,* table 3-2, p 3-5.

projects is 1990 and 1991. In 1990 and 1991, institutions provided 55 percent ($2.47 billion) of the $4.52 billion committed to the construction and repair/renovation of S&E research facilities costing over $100,000. State and local governments provided 32 percent ($1.43 billion) of the total combined funds, and the Federal Government provided 14 percent ($0.61 billion).

In 1996 and 1997, institutions provided 62 percent ($2.74 billion) of the $4.4 billion committed to the construction and repair/renovation of S&E research facilities costing over $100,000 ($4.44 billion). State and local governments provided 29 percent ($1.31 billion) and the Federal Government provided 9 percent ($0.39 billion).

INTRODUCTION

BACKGROUND

Since 1986, and every two years thereafter, the National Science Foundation (NSF) has collected data on issues related to science and engineering research facilities in U.S. colleges and universities. The Survey of Scientific and Engineering Research Facilities at Colleges and Universities, which is co-sponsored by the National Institutes of Health (NIH), provides information on the availability and condition of S&E research space, the extent to which colleges, universities, nonprofit biomedical research organizations, and research hospitals construct facilities and repair existing space, the funding of this activity, and the need for additional S&E research space.

The impetus for this effort stems from hearings held in both the U.S. House of Representatives and the Senate in the mid-1980s. These hearings concluded that the condition of S&E research facilities in our Nation's higher education institutions posed a "serious and ongoing problem." Very little data were available to evaluate either the extent of the problem or the likelihood of the problem continuing.

Recognizing the need for information on the amount and quality of S&E research space, Congress mandated NSF to collect this information and report it to Congress:

> *The National Science Foundation is authorized to design, establish, and maintain a data collection and analysis capability in the Foundation for the purpose of identifying and assessing the research facilities needs of universities and colleges. The needs of universities by major field of science and engineering, for construction and modernization of research laboratories, including fixed equipment and major research equipment, shall be documented. University expenditures for the construction and modernization of research facilities, the sources of funds, and other appropriate data shall be collected and analyzed. The Foundation, in conjunction with other appropriate Federal agencies, shall report the results to the Congress. The first report shall be submitted to the Congress by September 1, 1986 (42 U.S.C. 1886).*

NSF submitted the first report to Congress in 1986, and additional reports were submitted every two years thereafter. In each of those years, surveys were conducted to provide NSF with the information Congress requested. The 1998 report summarizes the findings of the 1998 survey, and it compares results with previous survey cycles.

THE SURVEY AND ITS DESIGN

The 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities collected data to address a number of questions regarding S&E research space, including:

- How much S&E research space is available in our Nation's colleges, universities, nonprofit biomedical research organizations, and research hospitals?
- Is the current amount of S&E research space sufficient?
- What is the condition of existing S&E research space?
- To what extent are colleges, universities, nonprofit biomedical research organizations, and research hospitals constructing S&E research space?
- To what extent are colleges, universities, nonprofit biomedical research organizations, and research hospitals repairing and renovating their existing S&E research space?
- Where is funding for the construction and repair of S&E research space coming from?
- How much additional S&E research space is needed and how much existing space needs to be repaired or renovated?

Since the survey was initiated in 1986, attention has focused on providing Congress with trends on S&E research facilities issues. Slight changes have been made to the survey in each of the data collection cycles. In 1998, for the first time, institutions were asked to estimate

their financial commitments to nonfixed equipment costing $1 million or more in S&E construction and repair/renovation projects. Institutions were also asked to identify the amount of indirect costs recovered from Federal grants and/or contracts that was included in "institutional funds."

In addition, the 1998 survey modified the wording of some questions as well as some possible response options. These changes were made in response to new concerns of NSF as well as concerns of institutional respondents and advisory panel members representing the higher education community. (Specific changes are noted at the beginning of each chapter.)

Academic Institutions

The sample for the 1998 survey was designed to provide efficient and unbiased estimates of the amount of S&E research space in colleges and universities and to retain comparability with the 1992, 1994, and 1996 sampling procedures. The 1998 sample, like the 1996 sample, represents all institutions with more than $50,000 in research and development (R&D) expenditures as well as Historically Black Colleges and Universities (HBCUs) with any R&D expenditures. In addition, the 1998 sample included for the first time non-HBCU-Black institutions and Hispanic-serving institutions (HSIs) with any R&D expenditures. At these institutions, undergradutate enrollment was at least 25 percent of the respective minority populations. The final 1998 sample of 350 colleges and universities represents the universe of 660 research-performing academic institutions. (See Appendix A, "Technical Notes," for a more complete discussion of sampling procedure.) The sample included the following types of colleges and universities:

- All of the top 100 colleges and universities in terms of R&D expenditures (n=100);
- Other public, doctorate-granting universities (n=47);
- Other private, doctorate-granting universities (n=42);
- Public, nondoctorate-granting institutions (n=41);
- Private, nondoctorate-granting institutions (n=41);
- HBCUs that have been in the sample since 1988 (n=29);
- Additional HBCUs (n=28);
- Non-HBCU-Black institutions (n=13); and
- Hispanic-serving institutions (n=9).

The 1998 survey was mailed to all sampled institutions in February 1998. The Windows-based disk version of the survey, which had been developed for the 1996 survey, was converted to an Internet survey. Survey Coordinators received both a paper copy and Internet Survey Instructions, including a log-in name and password, in the survey mailing.

Institutions that participated in the 1996 survey also were sent a computer-generated "facsimile" of their previous responses. Extensive telephone follow-up elicited a high response rate and reduced the number of items that respondents had initially omitted or responded to inconsistently. In all, 304, or 87 percent of all sampled institutions completed the survey. Of those, 160, or 53 percent responded via the Internet and 47 percent filled out the paper version of the survey.

Research Organizations and Hospitals

A sample of nonprofit biomedical research organizations and research hospitals that received extramural research funding from NIH in fiscal year 1997 was also drawn. The final sample included 49 hospitals and 46 research organizations. They represent the universe of 125 hospitals and 171 nonprofit research organizations. These institutions, along with academic institutions that had research space in the biomedical sciences, are referred to as "biomedical institutions" throughout this report.

Survey packets were mailed to the NIH survey coordinators at each site on a rolling basis, beginning in June, 1998. The survey packets included a cover letter, the questionnaire, a facsimile copy of their 1996 survey responses, and instructions for using the Internet survey with their unique log-in password. In all, 87 percent of the sample of nonprofit research organizations and research hospitals completed the survey. Of those, 45, or 54 percent responded via the Internet and 46 percent filled out the paper version of the survey.

THE REPORT

Each chapter in the 1998 report is structured as follows:

- ***Highlights***—a summary of key findings;
- ***Introduction***—a rationale for the chapter with a description of the question or questions that the chapter focuses on along with a brief discussion of data limitations or interpretations; and
- ***Findings***—a discussion of the current situation, changes since the first survey period for which data were available, and changes since the last survey period, along with supporting tables and figures.

Most chapters present differences by type of institution and S&E field. The categories used to define type of institution in Chapters 1 through 8 are:

- Doctorate-granting, which includes
  - The top 100 institutions in R&D expenditures
  - The other doctorate-granting institutions not in the top 100
- Nondoctorate-granting

This survey and report, includes the following S&E fields:

- Engineering
- Physical sciences
- Earth, atmospheric, and ocean sciences
- Mathematics
- Computer sciences
- Agricultural sciences
- Biological sciences outside medical schools
- Biological sciences in medical schools
- Medical sciences outside medical schools
- Medical sciences in medical schools
- Psychology
- Social sciences

Chapter 1 presents findings on the amount of research space in S&E fields at research-performing institutions. Chapter 2 examines assessments of the adequacy of the amount of existing S&E research space relative to current research commitments, as well as its condition. Chapter 3 provides costs for new S&E research facilities construction projects. Similarly, Chapter 4 provides costs for new S&E research facilities repair/renovation projects. Chapter 5 examines the sources of funds for the capital projects described in Chapters 3 and 4.

Chapter 6 examines institutions' need for additional S&E research space, as well as their need for the repair/renovation of existing space. Chapter 7 profiles S&E research space at minority-serving institutions. Chapter 8 presents data on animal research facilities.

The final chapter, Chapter 9, assesses the amount, quality, and condition of research facilities in the Nation's biomedical research-performing institutions. These are institutions with research space in the biological or medical sciences inside or outside of medical schools. The categories used to define types of institutions are:

- Academic institutions
  - Colleges and universities
    - The top 50 institutions in R&D expenditures
    - The other doctorate-granting institutions not in the top 50
    - Nondoctorate-granting institutions
  - Medical schools
- Nonprofit research organizations
- Research hospitals

There are six appendices:

- Appendix A, "Technical Notes," presents additional details about the study design and methodology;
- Appendix B, "List of Sampled Institutions," provides the names of all the academic institutions, nonprofit biomedical research organizations, and research hospitals in the sample;

- Appendix C, "Survey Questionnaire," provides the paper copy of the 1998 survey instrument;
- Appendix D, "Reference List," contains the full citation for all references used in this report;
- Appendix E, "Detailed Statistical Tables," presents additional tables not included in the chapters; and
- Appendix F, "Glossary," presents explanation of terms and phrases used in this report.

Data Considerations

Data collection for this report took place in early 1998. Information about new construction and repair/renovation projects was collected for fiscal years 1996 and 1997. Information about the amount, quality, and condition of S&E research space is reported in terms of its status at the time the survey was completed (1998). Information about construction and repair/renovation projects scheduled for the next two fiscal years is reported for 1998 and 1999. Net assignable square feet (NASF) is the measure of space used in this report. It is the sum of all areas, in square feet, on all floors of a building assigned to, or available to, an occupant for specific use.

It should be noted that the Survey of Scientific and Engineering Research Facilities only collects information on the total NASF of science and engineering research space and the total amount of dollars colleges, universities, nonprofit biomedical research organizations, and research hospitals commit to all S&E construction and repair/renovation projects costing over $100,000 in each of the S&E fields. The Facilities Survey does *not* collect data on the total gross square footage or the cost of construction or repair/renovation of *buildings*. (See Appendix A, "Technical Notes," for further information on how NASF and the cost of construction and repair/renovation projects were prorated.)

Tables that report costs or funds committed over time are presented in constant 1997 dollars, with current dollar tables found in Appendix E. The 1994 report was the first report to present trends in constant dollars. Thus, constant dollar figures in the reports from 1994 on cannot be compared directly. (Refer to Appendix A for more detailed discussion of the inflator and price index.) In addition, tables that analyze differences among S&E fields have been limited to only those institutions that have research space in those fields.

In order to control for sampling error, this year for the first time, all trend data and group differences were analyzed using a 95-percent confidence interval. Note that because of the small sample size of nondoctorate-granting institutions and research hospitals, and the often small sample size of institutions with research space in some of the science and engineering fields, what appear to be large year-to-year changes are often not statistically distinguishable because of the large sampling error associated with them. In addition, a coefficient of variation of 25 percent or less was allowed. Consequently, any change between the current survey period and any prior one that fell within the 95-percent confidence interval or whose coefficient of variation was greater than 25 percent is not discussed. Also not discussed are differences between prior time periods (e.g., 1992 compared with 1994), because the confidence interval data for those time periods were unavailable.

Taken as a whole, the information prepared for this report will shed light upon the amount, quality, and condition of science and engineering research space in the Nation's colleges, universities, nonprofit biomedical research organizations, and research hospitals.

ACRONYMS

HBCUs	Historically Black Colleges and Universities
HSIs	Hispanic-serving Institutions
NASF	Net assignable square feet
NIH	National Institutes of Health
NSF	National Science Foundation
R&D	Research and development
S&E	Science and engineering

Chapter 1—Amount and Distribution of Research Space

Highlights

- In 1998, the science and engineering fields occupied 286 million net assignable square feet in the Nation's research-performing colleges and universities. Half of this space, 143 million NASF, was devoted to research (table 1-1).
- Fifty-nine percent of the total academic space in the Nation's research-performing institutions was allocated to S&E fields in 1998 (table 1-2).
- The top 100 universities in research and development expenditures accounted for 71 percent of all S&E research space in 1998 (table 1-1), and 80 percent of all R&D dollars in 1996 (the most recent year for which data were available).
- Between 1988 and 1998, the amount of S&E research space increased by 28 percent, from 112 million to 143 million NASF (table 1-3).
- In 1998, 84 percent of all research-performing institutions had S&E research space in the biological sciences outside of medical schools, and 83 percent had S&E research space in the physical sciences. Only 16 percent of the research-performing institutions had S&E research space in the agricultural sciences (table 1-5).
- The amount of research space in engineering and the agricultural sciences increased the most (7 million NASF each) over the last decade (table 1-6).

Introduction

How much space is available for scientific and engineering research in the Nation's colleges and universities? Has the space increased since 1988, the first year in which NSF conducted the facilities survey? How is the space distributed among different science and engineering fields? This chapter compares the amount of S&E research space in different types of colleges and universities and in different S&E fields and examines changes in the amount of space available for S&E research since 1988.

This chapter is based on responses to Items 1a and 1b of the survey (see Appendix C). Item 1a collects data on space for each of the S&E fields in units of net assignable square feet. NASF is defined as the sum of all areas (in square feet) on all floors assignable to, or available to be assigned to, an occupant for specific use, such as instruction or research. Two categories of S&E space are included:

- ***Instructional and research NASF.*** This includes all space used for academic purposes; it includes space that is used for instruction and space that is used for research.
- ***Research NASF.*** This is space that is used only for research; it does not include space that is used for instruction.

Respondents were asked to consider several issues in determining the amount of space their college or university devotes to S&E research:

- ***Space may be used for more than one purpose or be shared by more than one field.*** Examples include a laboratory that is used for research only part of the time or a building that is shared by two or more fields. For multipurpose or shared space, the survey asks respondents to prorate the space. For instance, if a laboratory is used for research 30 percent of the time, respondents should consider 30 percent of the laboratory's NASF to be research space. If mathematics and computer sciences use the same laboratory, the space reported for each field should reflect the amount prorated by the amount of time that field uses the space.
- ***Some fields require more research space than others.*** More research space in a field does not necessarily indicate that that field has sufficient space for conducting research. For instance, research in the agricultural sciences requires considerably more space than research in mathematics.

- ***Some space reported as under construction may be included in current space estimates.*** Research space under construction during the 1996 or 1997 fiscal years (see Item 4a) may or may not be included in estimates of existing research space if that space was completed and occupied before the fall of 1997.

FINDINGS

AMOUNT OF S&E SPACE

In 1998, the Nation's 660 research-performing academic institutions had a total of 488 million net assignable square feet of academic space in all fields (table 1-1). The doctorate-granting universities accounted for 85 percent of this space (416 million NASF) and the nondoctorate-granting institutions accounted for the remaining 15 percent (72 million NASF). The top 100 institutions in research expenditures had 16 million or 7 percent more NASF than the other 560 research-performing colleges and universities (other doctorate-granting and nondoctorate-granting) combined. In other words, although the top 100 institutions constitute only 15 percent of all research-performing colleges and universities, they account for 52 percent of the space in all academic fields (252 million NASF).

The top 100 universities also devoted more of their academic space to S&E than either the other doctorate-granting institutions or the nondoctorate-granting institutions. Whereas the top 100 universities devoted 70 percent of all academic space (instructional and research) to S&E, the other doctorate-granting and nondoctorate-granting institutions dedicated 51 and 35 percent, respectively (table 1-2; figure 1-1).

AMOUNT OF S&E SPACE USED FOR RESEARCH

In 1998, 59 percent of the total academic space at the Nation's research-performing institutions was allocated to S&E fields (table 1-2). Half of all space in the S&E fields (143 million NASF) was devoted to S&E research:

- The top 100 universities devoted the largest share of their S&E space to research, 57 percent;
- Other doctorate-granting universities dedicated 41 percent of their S&E space to research; and
- Nondoctorate-granting institutions dedicated 29 percent of their S&E space to research.

The distribution of S&E research space in research-performing colleges and universities is roughly proportional to the distribution of research and development expenditures. In 1996, the most recent year for which data were available, the top 100 universities accounted for 80 percent of all R&D expenditures[12] and 71 percent of the total S&E research space in 1998 (table 1-1).

[12] National Science Foundation/Division of Science Resources Studies, *Academic Research and Development Expenditures: Fiscal Year 1996*, NSF 98-304.

Table 1-1. Amount of instructional and research space by institution type: 1998

Institution type	Number of institutions	Instructional and research space in all academic fields	Instructional and research space in S&E fields	Research space in S&E fields
		NASF in millions		
Total	660	488	286	143
Doctorate-granting	378	416	261	136
Top 100 in research expenditures	100	252	177	101
Other	278	164	84	35
Nondoctorate-granting	282	72	25	7

KEY: S&E = science and engineering.
NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

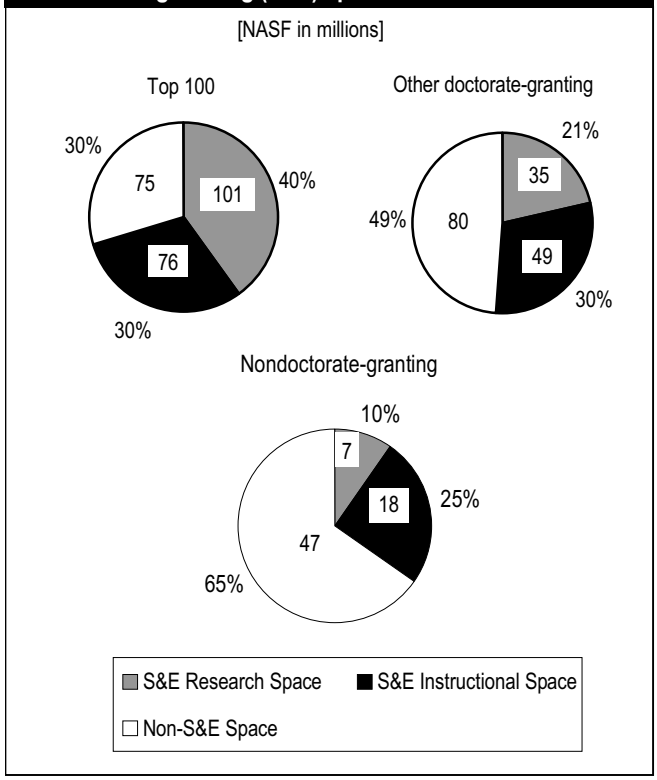
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 1-2. Science and engineering research space utilization by institution type: 1998

Institution type	S&E space: As a percentage of total academic space	Research space: As a percentage of total S&E space	Research space: As a percentage of total academic space
Total	59	50	29
Doctorate-granting:			
Top 100 in research expenditures	70	57	40
Other	51	41	21
Nondoctorate-granting	35	29	10

KEY: S&E = science and engineering.
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Figure 1-1. Amount and percent of science and engineering (S&E) space and non-S&E



KEY: NASF = net assignable square feet.
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Changes in the Amount of S&E Research Space

Over the last decade, the amount of S&E research space has increased steadily, from 112 million NASF in 1988 to 143 million NASF in 1998 (table 1-3). This change represents a 28-percent increase.

Most of the increase in the amount of research space resulted from steady growth at the top 100 institutions. S&E research space at these institutions increased by 25 percent or 20 million NASF—from 81 million NASF in 1988 to 101 million in 1998. The increase in the amount of research space at other doctorate-granting and nondoctorate-granting institutions was smaller—8 million NASF and 2 million NASF, respectively. It is important to note, however, that although the increases these institutions experienced are smaller in absolute terms than that of the top 100 institutions, the relative proportional increase is larger, a 30-percent increase for the other doctorate-granting institutions and a 40-percent increase for the nondoctorate-granting institutions.

Table 1-3. Trends in the amount of science and engineering research space by institution type: 1988–98

Institution type	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	112	116	122	127	136	143
Doctorate-granting	107	111	117	122	131	136
Top 100 in research expenditures	81	82	88	91	98	101
Other	27	30	30	31	32	35
Nondoctorate-granting	5	5	5	5	6	7

KEY: NASF = net assignable square feet.
NOTE: Components may not add to totals due to rounding.
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Amount of Leased S&E Space

In 1998, research-performing colleges and universities leased 6.1 million NASF, or 4 percent of their total S&E research space (table 1-4). This represents a 61-percent increase in leased S&E research space since 1988 when 3.8 million NASF of research space was leased. The top 100 institutions leased the most space: 4.8 million NASF (5 percent of their total S&E research space). Although not addressed in the survey, there are a number of possible explanations for why institutions lease rather than build or purchase S&E research space: an unanticipated need for space that cannot be met with existing facilities; a short-term need that does not warrant the construction of new space or the conversion of existing space; research projects that the institution considers low priority; and insufficient funds to construct new S&E research space.

Table 1-4. Trends in the amount of leased science and engineering research space by institution type: 1988–98

Institution type	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	3.8	3.6	4.8	4.4	5.5	6.1
Doctorate-granting	3.8	3.5	4.7	4.3	5.4	6.0
Top 100 in research expenditures	2.8	2.6	3.5	3.7	4.5	4.8
Other	0.9	0.9	1.2	0.6	0.9	1.2
Nondoctorate-granting*	0.0	0.0	0.0	0.0	0.0	0.1

*Nondoctorate-granting values for 1988–96 have been revised from the 1996 report.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Distribution of Research Space Across S&E Fields

In 1998, a majority of institutions had S&E research space in seven of the S&E fields. These fields include:

- The biological sciences outside of medical schools (84 percent);
- The physical sciences (83 percent);
- Psychology (70 percent);
- The social sciences (63 percent);
- Mathematics (60 percent);
- The computer sciences (56 percent); and
- The earth, atmospheric, and ocean sciences (53 percent) (table 1-5).

While only 44 percent of all research-performing institutions reported S&E research space in engineering and only 16 percent reported research space in the agricultural sciences, the total amount of research space in these two fields—23 million NASF and 25 million NASF, respectively (see table 1-6)—is greater than that in any other field.

About one fifth of all research-performing institutions reported S&E research space in medical schools, both in the biological sciences (19 percent) and the medical sciences (19 percent). Among the top 100 institutions, 62 percent reported research space in the medical sciences in medical schools, and 53 percent reported research space in the biological sciences in medical schools, whereas among the other doctorate-granting institutions, 23 percent reported research space in the medical sciences in medical schools and 26 percent reported research space in the biological sciences in medical schools. By contrast, nondoctorate-granting institutions had virtually no research space in medical schools.[13]

[13] One nondoctorate-granting institution reported space in the biological sciences in a medical school. This institution conducts research and grants masters' degrees through an arrangement with another university that has a medical school.

Table 1-5. Percentage of institutions with science and engineering research space by institution type and field: 1998

Field	Total	Institution type: Doctorate-granting: Top 100 in research expenditures	Institution type: Doctorate-granting: Other	Institution type: Nondoctorate-granting
Number of institutions	660	100	278	282
	Percentage			
Biological sciences—				
inside medical schools	19	53	26	--
outside medical schools	84	94	78	87
Physical sciences	83	89	78	85
Psychology	70	86	59	76
Social sciences	63	89	57	59
Mathematics	60	82	54	58
Computer sciences	56	76	51	53
Earth, atmospheric, and ocean sciences	53	85	51	43
Engineering	44	86	47	26
Agricultural sciences	16	40	10	14
Medical sciences—				
inside medical schools	19	62	23	--
outside medical schools	40	75	41	26
Other sciences	23	36	21	19

KEY: -- = no institutions had space in this field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

S&E Research Space by Field

Increases in research space in any single field tended to be gradual over the decade from 1988–98. Research space in engineering and the agricultural sciences grew the most (7 million NASF each), followed by the medical sciences in medical schools and the biological sciences in medical schools (4 million NASF each) (table 1-6).

The distribution of research space across the S&E fields approximated the distribution of R&D expenditures across the same fields. The life sciences occupied 56 percent of the S&E research space in 1998 and accounted for 55 percent of 1996 R&D expenditures in 1996.[14] Similarly, psychology and other sciences each occupied 2 percent of the S&E research space, and each accounted for 2 percent of R&D expenditures (table 1-7).

[14] The 1998 expenditure data were not available at the time this report was written. The most recent expenditure data, 1996, were therefore used. National Science Foundation/Division of Science Resources Studies, *Academic Research and Development Expenditures: Fiscal Year, 1996*, NSF 98-304.

Table 1-6. Trends in the amount of science and engineering research space by field: 1988–98

Field	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	112	116	122	127	136	143
Biological sciences—						
inside medical schools	8	9	11	11	11	12
outside medical schools	16	18	17	17	19	19
Physical sciences	16	16	16	17	18	18
Psychology	3	3	3	3	3	3
Social sciences	3	3	3	3	4	5
Mathematics	1	1	1	1	1	1
Computer sciences	1	1	2	2	2	2
Earth, atmospheric, and ocean sciences	6	6	7	7	7	8
Engineering	16	17	18	21	22	23
Agricultural sciences	18	21	20	20	22	25
Medical sciences—						
inside medical schools	14	15	16	17	18	18
outside medical schools	5	5	6	6	7	7
Other sciences	4	2	2	2	2	3

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 1-7. Comparison of the distribution of 1996 research and development (R&D) expenditures and 1998 science and engineering (S&E) research space by field

	1996 R&D expenditures		1998 S&E research space	
Field	Distribution [Percent]	Dollars [In millions]	Distribution [Percent]	NASF [In millions]
Total	100	22,995	100	143
Engineering	16	3,675	16	23
Physical sciences	10	2,260	13	18
Earth, atmospheric, and ocean sciences	6	1,478	5	8
Mathematics	1	289	1	1
Computer science	3	702	1	2
Life sciences	55	12,697	56	81
Psychology	2	372	2	3
Social sciences	5	1,104	3	5
Other sciences	2	419	2	3

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Life sciences includes the biological sciences and the medical sciences, inside and outside of medical schools, and the agricultural sciences.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; and *Academic Research and Development Expenditures: Fiscal Year 1996.*

Chapter 2—Adequacy of the Amount of Research Space and Its Condition

Highlights

- In light of their current research commitments, more than half of all institutions reported inadequate amounts of research space in every science and engineering field except mathematics, where 44 percent of the institutions indicated that their research space was inadequate (table 2-1).
- In order to meet their current research commitments, the research-performing institutions reported that they needed an additional 28.5 million net assignable square feet of science and engineering research space, or 20 percent more than they currently have (tables 2-2 and 2-3).
- Eighteen percent of all S&E research space (26 million NASF) was considered to require major renovation. An additional 5 percent of all S&E research space (7 million NASF) was considered to require replacement (table 2-4).
- Since 1988, the amount of research space requiring major renovation or replacement has increased in 11 of the 12 S&E fields included in the survey. Five of these fields (the social sciences; the medical sciences outside medical schools; the earth, atmospheric, and ocean sciences; the agricultural sciences; and the biological sciences outside medical schools) have experienced a 100-percent or more increase in the amount of research space in this condition (table 2-5).

Introduction

Information focused solely on the amount of science and engineering research space and its growth or decline over time is insufficient for understanding whether there is enough space to conduct research in general, and whether the condition of that space is suitable for conducting particularly sophisticated research. Respondents' assessments of both the quantity and quality of existing research space at their institutions from 1988–98 are examined in this chapter.

Respondents were asked to rate the adequacy of the amount of research space in each field at their institution by choosing one of the following categories (see Item 2 of the survey in Appendix C):

A Adequate amount of space: sufficient to support all the needs of your current S&E research program commitments in the field;

B Inadequate amount of space: not sufficient to support the needs of your current S&E research program commitments in the field; or nonexistent, but needed; or

NA Not applicable or no space needed in this field.

They were also asked to report in either net assignable square feet or in percents the amount of additional space needed to support current program commitments.

For each field, respondents indicated the condition of research space by reporting the percentage of space falling into one of the following categories (see Item 3 of the survey in Appendix C):

A Suitable for the most scientifically competitive research in the field;

B Effective for most levels of research in the field, but may need limited repair/renovation;

C Requires major renovation to be used effectively;

D Requires replacement; or

NA Not applicable or no research space in that field.

Measures of the adequacy of the amount of S&E research space and the condition of this space in each S&E field are based upon the assessments of several different individuals, including the survey coordinator at the institution, as well as deans and other administrators. These questions elicit more subjective responses than do other survey items.

Tables that analyze differences among S&E fields have been limited to only those institutions that had research space or reported a need for additional research space in those fields.

Findings

Adequacy of the Amount of S&E Research Space for Current Research Commitments

Institutions assessed the adequacy of the amount of science and engineering research space for each field for which they had research space. They assessed this space relative to their current research commitments. At least half of all institutions reported inadequate amounts of space in every field except mathematics, where 44 percent of the institutions indicated that their research space was inadequate (table 2-1). Regardless of institution type, the amount of existing S&E research space in every field was rated as inadequate by 40 percent or more of the institutions that had space in that field.

In four fields, more than 70 percent of the top 100 institutions indicated that the amount of existing research space was inadequate to meet their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In engineering, 78 percent of the top 100 institutions reported that their existing research space was inadequate;
- In the biological sciences outside medical schools, 74 reported that their research space was inadequate;
- In the medical sciences in medical schools, 73 percent reported that their research space was inadequate; and
- In the physical sciences, 71 percent reported that their research space was inadequate.

Table 2-1. Percentage of institutions reporting inadequate amounts of science and engineering research space by institution type and field: 1998

Field	Total	Institution type: Doctorate-granting: Top 100 in research expenditures	Institution type: Doctorate-granting: Other	Institution type: Nondoctorate-granting
Any field	83	92	80	83
Biological sciences—				
inside medical schools	70	62	78	--
outside medical schools	64	74	56	67
Physical sciences	64	71	55	69
Psychology	51	59	56	45
Social sciences	61	65	60	59
Mathematics	44	47	41	45
Computer sciences	56	63	47	60
Earth, atmospheric, and ocean sciences	62	61	61	63
Engineering	60	78	52	54
Agricultural sciences	55	65	53	47
Medical sciences—				
inside medical schools	67	73	62	--
outside medical schools	54	68	48	51

KEY: -- = number of institutions with nonmissing data less than 5. These institutions are included in the total.

NOTE: Includes only institutions that reported existing and/or needed research space in that field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

In four fields, 60 percent or more of other doctorate-granting institutions indicated the amount of existing research space they had was inadequate for meeting their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In the biological sciences in medical schools, 78 percent of other doctorate-granting institutions reported that their existing research space was inadequate;
- In the medical sciences in medical schools, 62 percent reported that their research space was inadequate;
- In the earth, atmospheric, and ocean sciences, 61 percent reported that their research space was inadequate; and
- In the social sciences, 60 percent reported that their research space was inadequate.

Finally, in four fields, 60 percent or more of nondoctorate-granting institutions reported that the amount of research space was inadequate for their current research commitments. These fields and the percent of institutions reporting inadequate amounts of space are as follows:

- In the physical sciences, 69 percent of nondoctorate-granting institutions reported that their research space was inadequate;
- In the biological sciences outside medical schools, 67 percent reported that their research space was inadequate;
- In the earth, atmospheric, and ocean sciences, 63 percent reported that their research space was inadequate; and
- In the computer sciences, 60 percent reported that their research space was inadequate.

Overall, a larger proportion of top 100 institutions (92 percent) reported inadequate amounts of research space in at least one field than did other doctorate-granting institutions (80 percent) and nondoctorate-granting institutions (83 percent). In engineering an appreciably larger proportion of top 100 institutions (78 percent) reported inadequate amounts of research space than either other doctorate-granting institutions (52 percent) or nondoctorate-granting institutions (54 percent).

Need for Additional S&E Research Space

The research-performing institutions reported that they needed an additional 28.5 million net assignable square feet of S&E research space, or 20 percent more than they had in order to meet their research commitments. The amount and proportion of need varied by field (table 2-2). Mathematics needed the least amount of additional research space (0.2 million NASF), while the biological sciences outside medical schools needed the most (4.8 million NASF). Other fields needing more than 2 million additional NASF of research space include:

- Engineering (4.0 million NASF);
- The medical sciences in medical schools (4.0 million NASF);
- The physical sciences (3.7 million NASF);

Table 2-2. Amount and percentage of total science and engineering (S&E) research space needed by field: 1998

Field	Total S&E research NASF	Additional NASF needed	Percentage needed
	NASF in millions		
Total	143	28.5	20
Biological sciences—			
inside medical schools	12	2.5	21
outside medical schools	19	4.8	25
Physical sciences	18	3.7	20
Psychology	3	0.7	25
Social sciences	5	1.3	26
Mathematics	1	0.2	24
Computer sciences	2	0.8	40
Earth, atmospheric, and ocean sciences	8	1.5	20
Engineering	23	4.0	17
Agricultural sciences	25	2.4	10
Medical sciences—			
inside medical schools	18	4.0	22
outside medical schools	7	1.9	27
Other sciences	3	0.6	21

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Includes only institutions that reported existing and/or needed research space in that field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The biological sciences in medical schools (2.5 million NASF); and
- The agricultural sciences (2.4 million NASF).

A slightly different picture emerges when institutions' need for additional space is assessed as a proportion of their current amount of space. The agricultural sciences needed the smallest relative increment in research space (10 percent), while the computer sciences needed the largest relative increment (40 percent).

This need for space was not distributed equally across institution types (table 2-3). The top 100 institutions had the smallest relative need for additional research space (18 percent more), but they needed the greatest amount of space (18.6 million NASF). By contrast, the nondoctorate-granting institutions had the greatest relative need for additional research space (42 percent more), but needed the least amount of space (2.9 million NASF). The other doctorate-granting institutions fell in between. They needed 20 percent more space or 6.9 million NASF.

Condition of S&E Research Space

Over a third (39 percent or 56 million NASF) of the S&E research space at research-performing institutions was rated as "suitable for the most scientifically competitive research." The proportion of research space in this condition did not differ among the different types of research-performing institutions. The top 100 institutions rated 39 percent or 39 million NASF of their research space this way. Similarly, other doctorate-granting institutions reported that 41 percent or 14 million NASF of their research space was in the highest quality condition, and the nondoctorate-granting institutions reported that 32 percent or 2 million NASF of their research space was in this condition (table 2-4).

The research-performing colleges and universities classified a total of 18 percent (26 million NASF) of their S&E research space as requiring major renovation. The proportion of research space requiring renovation was greater at the top 100 institutions than at other doctorate-granting institutions (19 percent or 19 million NASF

Table 2-3. Amount and percentage of total science and engineering (S&E) research space needed by institution type: 1998

Institution type	Total S&E research NASF	Additional NASF needed	Percentage needed
	NASF in millions		
Total	143	28.5	20
Doctorate-granting	136	26	19
Top 100 in research expenditures	101	19	18
Other	35	7	20
Nondoctorate-granting	7	3	42

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 2-4. Institutional assessment of the quality and condition of science and engineering research space by institution type: 1998

Institution type	Suitable for the most scientifically competitive research in the field	Effective for most levels of research	Requires major renovation	Requires replacement
	Percentage of space			
Total	39	38	18	5
Doctorate-granting	40	38	18	5
Top 100 in research expenditures	39	37	19	5
Other	41	41	15	4
Nondoctorate-granting	32	37	26	5

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

compared with 15 percent or 5 million NASF). Nondoctorate institutions reported that 26 percent of their research space required major renovation.

There was general consistency among the different types of institutions regarding the proportion of S&E research space requiring replacement: 5 percent of the S&E research space at the top 100 and nondoctorate-granting institutions (5 million and 0.4 million NASF, respectively) was assessed as needing replacement, and 4 percent of S&E research space at other doctorate-granting institutions (1 million NASF) needed replacement.

Amount of S&E Research Space in Each Field Requiring Either Major Renovation or Replacement

Research-performing institutions reported 33.0 million NASF of S&E research space in need of major renovation or replacement in 1998. This represents almost one quarter (23 percent) of all S&E research space. The amount of research space in this condition has increased continuously since 1988, when 17.7 million NASF (16 percent) of all S&E research space needed major renovation or replacement.

Consistent with all previous surveys, in 1998, the agricultural sciences was again the field with the greatest amount of research space in need of major renovation or replacement. Of the 25 million NASF of S&E research space in the agricultural sciences (table 1-6), almost a third (7.5 million NASF or 30 percent) was assessed as requiring major renovation or replacement (table 2-5). This relatively large need is concentrated in a small number of institutions. Only 16 percent of all research-performing institutions have research space in the agricultural sciences (table 1-5), and more than half of these institutions (55 percent) reported inadequate research space in this field (table 2-1).

At the time of the survey, the research-performing institutions indicated that more than 3 million NASF of research space in four other fields required major renovation or replacement:

- The biological sciences outside of medical schools contained 4.8 million NASF in need of major renovation or replacement;
- The medical sciences in medical schools contained 4.6 million NASF of research space in this condition;
- Engineering contained 4.3 million NASF; and
- The physical sciences contained 3.9 million NASF.

Since 1988, the amount of research space requiring major renovation or replacement has increased in all but one S&E field (mathematics). Five fields have experienced an increase of 100 percent or more in the amount of research space in this condition over the decade:[15]

- The social sciences have experienced a 147-percent increase in research space in need of renovation or replacement (from 0.30 million NASF to 0.74 million NASF);
- The medical sciences outside medical schools have experienced a 125-percent increase in research space in this condition (from 0.8 million NASF to 1.8 million NASF);
- The earth, atmospheric, and ocean sciences have experienced a 111-percent increase (from 0.9 million NASF to 1.9 million NASF);
- The agricultural sciences have experienced a 108-percent increase (from 3.6 million NASF to 7.5 million NASF); and
- The biological sciences outside medical schools have experienced a 100-percent increase (from 2.4 million NASF to 4.8 million NASF).

Two other fields have experienced a near doubling of research space in need of major renovation or replacement since 1988. In engineering, research space in this condition grew from 2.2 million NASF to 4.3 million NASF (a 95-percent increase), while research space in this condition in the medical sciences in medical schools grew from 2.4 million NASF to 4.6 million NASF (a 92-percent increase).

[15] Data in table 2-5 have been rounded to one decimal place. In order to calculate meaningful percent changes over time, data in the text for some fields are presented as rounded to the second decimal place.

Table 2-5. Trends in the amount of science and engineering research space requiring major renovation or replacement by field: 1988–98

Field	1988	1990	1992	1994	1996	1998
	NASF in millions					
Total	17.7	18.0	19.4	21.7	25.2	33.0
Biological sciences—						
inside medical schools	1.0	1.2	1.6	1.6	1.6	1.9
outside medical schools	2.4	2.5	2.6	3.2	3.4	4.8
Physical sciences	2.9	2.7	2.4	3.1	3.4	3.9
Psychology	0.4	0.4	0.3	0.4	0.4	0.6
Social sciences	0.3	0.3	0.4	0.3	0.5	0.7
Mathematics	0.1	0.1	0.1	0.1	0.1	0.1
Computer sciences	0.2	0.1	0.1	0.1	0.2	0.3
Earth, atmospheric, and						
ocean sciences	0.9	0.9	0.8	1.3	1.3	1.9
Engineering	2.2	2.6	2.3	3.2	4.0	4.3
Agricultural sciences	3.6	4.6	5.2	4.4	5.3	7.5
Medical sciences—						
inside medical schools	2.4	1.9	2.7	2.9	3.6	4.6
outside medical schools	0.8	0.9	1.0	1.0	1.5	1.8

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. The total includes other sciences.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Between the last survey (1996) and the current one, the amount of research space requiring major renovation or replacement increased by 40 percent or more in six fields:[16]

- In the computer sciences, it increased by 100 percent (from 0.16 million NASF to 0.32 million NASF);
- In psychology, it increased by 55 percent (from 0.40 million NASF to 0.62 million NASF);
- In the social sciences, it increased by 48 percent (from 0.50 million NASF to 0.74 million NASF);
- In the earth, atmospheric, and ocean sciences, it increased by 46 percent (from 1.3 million NASF to 1.9 million NASF);
- In the agricultural sciences, it increased by 42 percent (from 5.3 million NASF to 7.5 million NASF); and
- In the biological sciences outside medical schools, it increased by 41 percent (from 3.4 million NASF to 4.8 million NASF).

[16] Ibid.

CHAPTER 3—THE CONSTRUCTION OF S&E RESEARCH SPACE

HIGHLIGHTS

- In fiscal years 1996 and 1997, research-performing institutions began construction on 11.1 million net assignable square feet of science and engineering research space. This space is 17 percent more than was started in 1994 and 1995 (9.5 million NASF) (table 3-1).
- Research-performing institutions committed $3.1 billion to the construction of new S&E research facilities in fiscal years 1996 and 1997. This is 15 percent more (in constant dollars) than they committed to new construction a decade ago (table 3-2).
- Almost one third (30 percent) of all research-performing colleges and universities initiated new S&E research space construction projects during fiscal years 1996 and 1997 (table 3-5).
- Four fields account for more than half (61 percent) of the $3.1 billion committed to the construction of new research facilities in 1996 and 1997. These fields are the medical sciences in medical schools ($784 million), the biological sciences outside medical schools ($404 million), the physical sciences ($381 million), and engineering ($332 million) (table 3-8).
- For fiscal years 1998 and 1999, research-performing institutions are scheduled to commit $3.9 billion to construct S&E research facilities and one tenth of that amount ($396 million) to construct central campus infrastructure (table 3-4).

INTRODUCTION

This chapter discusses the state of recently initiated construction of new science and engineering research facilities in research-performing colleges and universities. The term "construction" in this chapter and throughout this report refers to the building of facilities that currently do not exist.

Institutions were asked to estimate the research-related costs and space for construction projects costing over $100,000 begun during fiscal years 1996 and 1997, and to make the same estimates for projects scheduled for fiscal years 1998 and 1999. Project start-up was defined as the fiscal year in which construction began or was expected to begin. In the case of multiyear projects, total project costs were allocated to the fiscal year in which the construction began. Note, however, that the costs and parameters of multiyear projects can change between the time a project begins and the time it is completed.

The reported financial commitments, defined as the costs to complete a project, include planning, site preparation, construction, fixed equipment, and building infrastructure. It should be noted that fluctuations in funds committed to construction from one year to another can result from large projects at a small number of institutions. Given the costs of constructing S&E research facilities, a large increase could reflect a new building on one or two campuses. Indeed, this is often the case for the nondoctorate-granting institutions.

Institutions were also asked to report planned expenditures for central campus infrastructure (see Item 6 of the survey in Appendix C). Central campus infrastructure was defined as those systems that exist between the buildings of a campus and the nonarchitectural elements of campus design. Examples included central wiring for telecommunications systems, waste storage and disposal facilities, electrical wiring between buildings, central heating and air exchange systems, drains, sewers, roadways, walkways, and parking systems. Plumbing, lighting, wiring, air exchange systems, and the like that exist within a building or within five feet of the building foundation were considered building infrastructure and were excluded from this definition of central campus infrastructure.

In 1998, for the first time, institutions were asked to list separately any nonfixed equipment costing $1 million or more that was included as part of their new construction costs for fiscal years 1996 and 1997. If a project were to

serve both research and nonresearch purposes, respondents were asked to prorate the construction costs and space estimates so that the research-related portion of the costs was reflected (see Items 4a, 4b, and 4c of the survey in Appendix C).

Findings

Amount of New S&E Research Space Under Construction

New construction projects initiated in 1996 and 1997 are expected to produce 11.1 million net assignable square feet of new science and engineering research space. This is a 17-percent increase in new research space under construction compared with new construction projects begun in 1994 and 1995 (9.5 million NASF) (table 3-1). These 11.1 million NASF are the equivalent of 8 percent of existing research space (143.3 million NASF).

Doctorate-granting institutions initiated the greatest amount of square footage of new facilities construction, 89 percent or 9.9 million NASF. This square footage is a 12-percent increase over 1994–95 levels (8.8 million NASF). The top 100 institutions account for 70 percent (6.9 million NASF) of the new construction projects begun at doctorate-granting institutions.

Funds Committed to the Construction of S&E Research Space

Research-performing institutions committed $3.1 billion to the construction of S&E research space in 1996 and 1997. This is 15 percent or $399 million more (in constant dollars) than they committed to new construction a decade ago (table 3-2; figure 3-1).

The doctorate-granting institutions committed more funds to new construction in 1996 and 1997 than they did a decade ago, with the largest increases occurring at the other doctorate-granting institutions. Between 1986–87 and 1996–97:

- Doctorate-granting institutions committed $348 million or 14 percent more funds to new construction;
  - Top 100 institutions committed $59 million or 3 percent fewer funds; and
  - Other doctorate-granting institutions committed $408 million or 107 percent more funds.

Table 3-1. Trends in the amount of science and engineering research space under construction for projects costing more than $100,000 by institution type: 1986–97

Institution type	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97
	NASF in thousands					
Total	9,922	10,647	11,433	12,405	9,521	11,101
Doctorate-granting	8,908	9,840	11,022	12,014	8,818	9,914
Top 100 in research expenditures	7,261	6,073	6,972	8,197	6,426	6,944
Other	1,647	3,767	4,050	3,818	2,391	2,970
Nondoctorate-granting	1,014	807	411	391	703	1,187

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. The reader is cautioned against summing the NASF constructed over time or adding the amount of newly constructed space to existing space. The data collected do not indicate whether newly constructed space replaces existing NASF or whether new space provides additional S&E resources for the institution.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

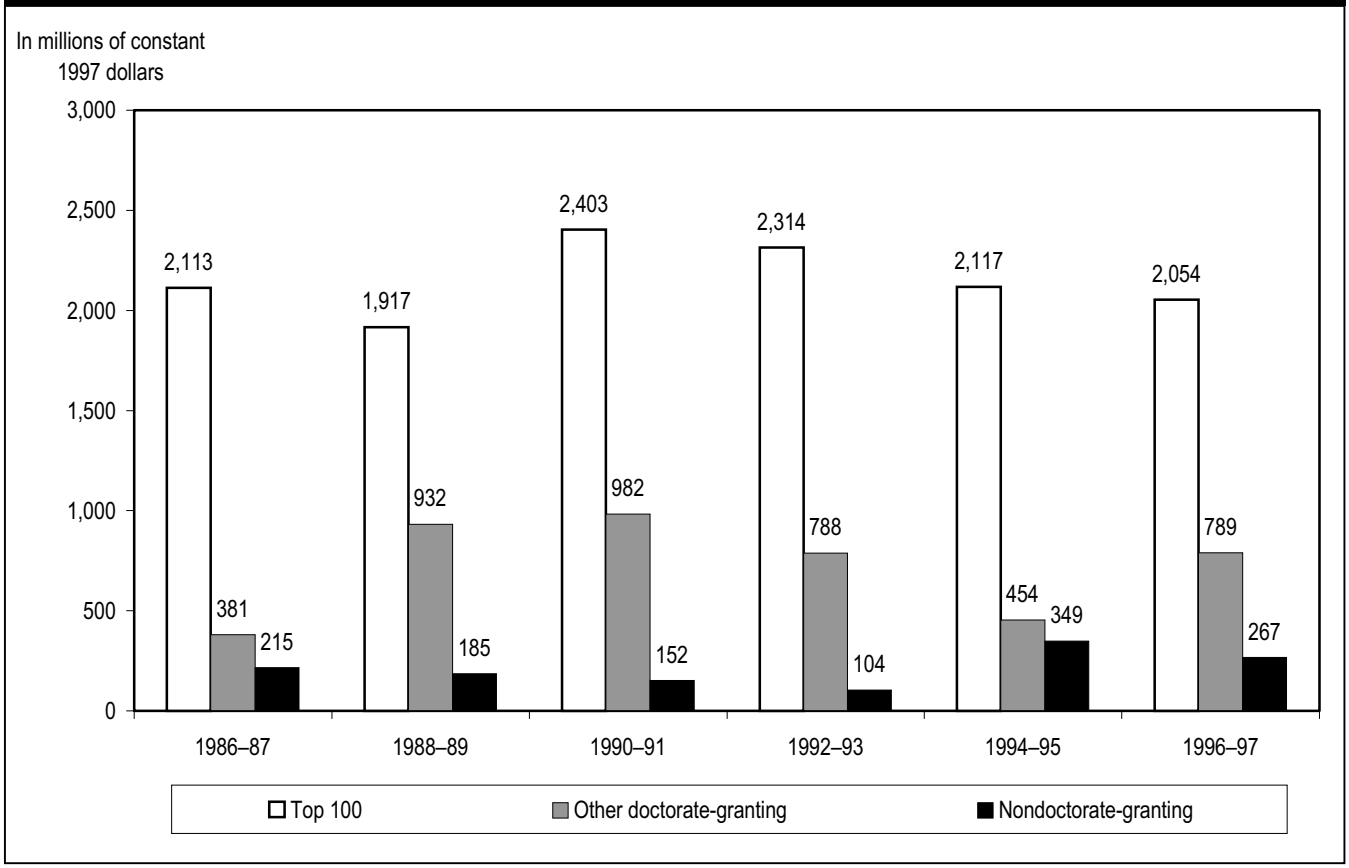
Table 3-2. Trends in funds committed to construct science and engineering research facilities for projects costing more than $100,000 by institution type: 1986–97

Institution type	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97
	In millions of constant 1997 dollars					
Total	2,711	3,032	3,537	3,207	2,920	3,110
Doctorate-granting	2,495	2,849	3,383	3,102	2,571	2,843
Top 100 in research expenditures	2,113	1,917	2,403	2,314	2,117	2,054
Other	381	932	982	788	454	789
Nondoctorate-granting	215	185	152	104	349	267

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universitites.

Figure 3-1. Trends in science and engineering construction expenditures by type of institution: 1986–97



NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Overall, in 1996 and 1997, a subset of 383 research-performing institutions that were in both the 1996 and 1998 samples committed close to what, in the 1996 survey, they anticipated committing to new construction projects in 1996 or 1997 (table 3-3).[17] They were scheduled to commit $2,828 million and actually committed $2,801 million, a difference of $27 million or 1 percent. The doctorate-granting institutions were most consistent with their earlier plans:

- Doctorate-granting institutions committed $44 million or 2 percent fewer funds than they had scheduled;
  - The top 100 institutions committed $23 million or 1 percent fewer funds than they had scheduled; and
  - Other doctorate-granting institutions committed $21 million or 3 percent fewer funds than they had scheduled.

Table 3-3. Scheduled and actual construction expenditures for projects costing more than $100,000 for science and engineering research space by institution type: 1996–97

Institution type	Number of institutions	1996–97 (scheduled)	1996–97 (actual)
		In millions of dollars	
Total	383	2,828	2,801
Doctorate-granting	257	2,726	2,682
Top 100 in research expenditures	99	2,077	2,054
Other	158	649	628
Nondoctorate-granting	126	103	119

NOTE: Components may not add to totals due to rounding. Includes only institutions that were in both the 1996 and 1998 samples.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1996 and 1998 Surveys of Scientific and Engineering Research Facilities at Colleges and Universities.

Funds Scheduled for the Construction of S&E Research Space and Central Campus Infrastructure

For fiscal years 1998 and 1999, research-performing institutions are scheduled to commit $3.9 billion to begin construction on new S&E research space. If all this construction were to occur, it would represent a 27-percent ($839 million) increase over the amount the research-performing institutions committed to new S&E construction begun in 1996 or 1997 ($3.1 billion).

This anticipated increase is greater in relative terms among nondoctorate-granting institutions than among the different types of doctorate-granting institutions. Anticipated increases in financial commitments to new S&E construction projects between the current survey period and the next are as follows:

- Doctorate-granting institutions plan to commit 23 percent or $651 million more to new S&E construction projects in 1998 and 1999 than they did in 1996 and 1997;
  - Top 100 institutions plan to commit 24 percent or $483 million more;
  - Other doctorate-granting institutions plan to commit 21 percent or $168 million more; and
- Nondoctorate-granting institutions plan to commit 70 percent or $188 million more to new S&E construction projects (tables 3-4 and 3-2).

Research-performing institutions are scheduled to commit another $396 million to new central campus infrastructure construction projects in 1998 and 1999. These funds are distributed among the institution types as follows:

- Doctorate-granting institutions plan to commit 91 percent or $359 million of all new central campus infrastructure funds;
  - Top 100 institutions plan to commit 75 percent or $297 million of these funds;
  - Other doctorate-granting institutions plan to commit 16 percent or $62 million of these funds; and

[17] The scheduled 1996–97 data come from National Science Foundation/Division of Science Resources Studies, *1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.* Because this analysis is limited to the subset of research-performing institutions that were in both the 1996 and 1998 samples, the results do not generalize to the population of research-performing institutions.

- Nondoctorate-granting institutions plan to commit 9 percent or $37 million of these funds.

Colleges and Universities Starting S&E Construction Projects

In fiscal years 1996 and 1997, 30 percent of all research-performing institutions initiated new S&E construction projects. This proportion is less than in fiscal years 1986–87 through 1992–93 when a larger proportion of institutions started new S&E construction projects.

A larger proportion of doctorate-granting institutions began S&E construction in these years than began construction projects in 1996 and 1997 (38 percent). The proportion of nondoctorate-granting institutions starting new S&E construction projects in fiscal years 1996 and 1997 (19 percent) is not appreciably different from any year except 1988–89, when 32 percent of nondoctorate-granting institutions started new S&E construction projects (table 3-5).

Table 3-4. Funds scheduled for construction of science and engineering (S&E) research space and central campus infrastructure for projects costing more than $100,000 by institution type: 1998–99

Institution type	Scheduled construction		
	S&E research space	Central campus infrastructure	Total*
	In millions of dollars		
Total	3,949	396	4,344
Doctorate-granting	3,494	359	3,853
Top 100 in research expenditures	2,537	297	2,834
Other	957	62	1,019
Nondoctorate-granting	455	37	492

*This is the total of scheduled S&E research space and central campus infrastructure construction. It does not represent total scheduled construction across all science and nonscience disciplines.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

In 1998 and 1999, 31 percent of research-performing institutions are scheduled to start new S&E construction projects. Only the top 100 institutions anticipated a change in the percentage of institutions scheduled to start new S&E construction projects. If the top 100 institutions act in accordance with their plans, 64 percent of them will start new construction projects in 1998 and 1999. This represents a 4-percentage point drop from 1996 and 1997 when 68 percent of these institutions started new projects.

A separate analysis (table 3-6) of the 383 institutions that were in both the 1996 and 1998 samples reveals that 104 or 71 percent of all research-performing institutions that had scheduled new construction for 1996 or 1997 actually undertook it.[18] The actions of the top 100 institutions were more consistent with their plans than that of the other types of institutions. Overall, 91 or 74 percent of all doctorate-granting institutions that had scheduled construction acted in accordance with their plans, as did:

- 55 or 89 percent of top 100 institutions;
- 36 or 59 percent of other doctorate-granting institutions; and
- 14 or 58 percent of nondoctorate-granting institutions.

[18] Because this analysis is limited to the subset of research-performing institutions that were in both the 1996 and 1998 samples, the results do not generalize to the population of research-performing institutions.

Table 3-5. Trends in the percentage of institutions starting projects to construct science and engineering research facilities costing more than $100,000 by institution type: 1986–99

Institution type	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97	(scheduled) 1998–99
	Percentage						
Total	37	44	37	33	29	30	31
Doctorate-granting	47	53	57	44	42	38	38
Top 100 in research expenditures	72	71	81	79	75	68	64
Other	34	44	45	28	26	27	29
Nondoctorate-granting	25	32	12	15	13	19	21

NOTE: As used here, capital projects are construction projects with prorated costs of $100,000 or more for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 3-6. Number of institutions starting science and engineering research facilities construction projects costing more than $100,000 and whether construction was scheduled by institution type: 1996–97

Institution type	Number of institutions that scheduled construction	Number of institutions that scheduled construction and actually started construction	Number of institutions that did not schedule construction	Number of institutions that did not schedule construction but started construction
Total	147	104	236	29
Doctorate-granting	123	91	134	28
Top 100 in research expenditures	62	55	37	13
Other	61	36	97	15
Nondoctorate-granting	24	14	103	1

NOTE: Components may not sum to totals due to rounding. Includes only 383 institutions that were in both the 1996 and 1998 samples.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1996 and 1998 Surveys of Scientific and Engineering Research Facilities at Colleges and Universities.

It is also worth noting that 29 or 12 percent of institutions that had not scheduled construction for 1996 or 1997, did, in fact, start new construction projects during that period. Overall, 28 or 21 percent of doctorate-granting institutions that had not scheduled any construction projects began construction projects; 13 or 35 percent of the top 100 institutions that had not scheduled construction projects did so.

Fields In Which Construction Projects Started

Overall, the proportion of institutions that began new S&E construction projects declined by 7-percentage points over the decade, from 37 to 30 percent of institutions. Two fields registered an appreciable change during this time period:

- In engineering, the proportion of institutions starting new construction projects decreased from 28 to 11 percent; and
- In the agricultural sciences, the proportion of institutions starting new construction projects decreased from 38 to 28 percent (table 3-7).

Only one field registered an appreciable increase in the proportion of institutions starting new construction since the last survey period. The proportion of institutions starting new construction projects in the biological sciences outside medical schools increased from 9 percent of institutions to 13 percent.

Finally, the proportion of institutions scheduled to start new construction projects in the various S&E fields in 1998 and 1999 is expected to decline appreciably from 1996–97 levels in one field. The proportion of institutions scheduled to start new construction projects in the medical sciences in medical schools is expected to decrease from 33 to 20 percent of institutions.

Funds Committed to S&E Research Space Construction Projects in Different Fields

Four fields account for more than half (61 percent) of the $3.1 billion committed to the construction of new S&E research space by research-performing institutions in fiscal years 1996 and 1997:

- The medical sciences in medical schools account for $784 million;
- The biological sciences outside medical schools account for $404 million;

Table 3-7. Trends in the percentage of institutions starting projects to construct science and engineering research facilities costing more than $100,000 by field: 1986–99

Field	1986–87	1988–89	1990–91	1992–93	1994–95[1]	1996–97	(scheduled) 1998–99
	Percentage						
Total	37	44	37	33	29	30	31
Biological sciences—							
inside medical schools	20	26	33	20	10	14	22
outside medical schools	9	19	10	10	8	13	12
Physical sciences	9	15	11	9	9	11	14
Psychology	5	3	7	2	2	4	5
Social sciences	5	4	--[2]	3	4	5	4
Mathematics	1	2	4	2	1	1	5
Computer sciences	8	6	7	4	1	4	3
Earth, atmospheric, and ocean sciences	9	6	15	9	5	11	9
Engineering	28	18	16	17	14	11	14
Agricultural sciences	38	33	30	27	23	28	20
Medical sciences—							
inside medical schools	32	23	41	33	26	33	20
outside medical schools	7	5	13	11	6	9	11

[1] Some 1994–95 values have been revised from the 1996 report.

[2] Psychology and the social sciences were not differentiated in the questionnaire item for the 1990–91 period.

NOTE: Percentages are based on the number of institutions with existing research space and/or planned construction of research space in a given field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The physical sciences account for $381 million; and
- Engineering accounts for $332 million (table 3-8).

In addition to these four fields, research-performing institutions committed more than $100 million to construct new research space in five other fields:

- The agricultural sciences account for $273 million;
- The medical sciences outside of medical schools account for $259 million;
- The biological sciences in medical schools account for $178 million;
- The earth, atmospheric, and ocean sciences account for $172 million; and
- The other sciences account for $145 million.

The amount of funds committed to the construction of new research space more than doubled in three fields since the last survey:

- In the earth, atmospheric, and ocean sciences, funds increased from $35 million to $172 million (a 391-percent increase);
- In mathematics, funds increased from $2 million to $9 million (a 350-percent increase); and
- In the medical sciences outside medical schools, funds increased from $129 million to $259 million (a 101-percent increase).

The amount of funds committed for the construction of new research space declined by 25 percent or more in three fields since the last survey:

- In the computer sciences, from $49 million to $21 million (a 57-percent decrease);

Table 3-8. Trends in funds committed to construct science and engineering research facilities for projects costing more than $100,000 by field: 1986–99

Field	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97	(scheduled) 1998–99
	In millions of constant 1997 dollars						
Total	2,711	3,032	3,537	3,207	2,920	3,110	3,949
Biological sciences—							
inside medical schools	184	223	453	389	238	178	597
outside medical schools	428	487	536	333	409	404	812
Physical sciences	241	494	511	384	449	381	525
Psychology	31	31	43	18	44	77	91
Social sciences	51	59	-- *	51	118	75	81
Mathematics	2	11	15	12	2	9	19
Computer sciences	81	80	47	54	49	21	27
Earth, atmospheric, and ocean sciences	75	100	202	140	35	172	235
Engineering	568	478	469	326	607	332	528
Agricultural sciences	198	187	208	239	158	273	169
Medical sciences—							
inside medical schools	399	722	779	957	554	784	613
outside medical schools	268	75	179	183	129	259	206
Other sciences	184	87	95	117	129	145	46

* Psychology and the social sciences were not differentiated in the questionnaire item for the 1990–91 period.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- In engineering, from $607 million to $332 million (a 45-percent decrease); and
- In the biological sciences in medical schools from $238 million to $178 million (a 25-percent decrease).

In 1998 and 1999, funds committed to new construction are scheduled to more than double in three fields:

- In the biological sciences in medical schools, funds are expected to increase from $178 million to $597 million (a 235-percent increase);
- In mathematics, funds are expected to increase from $9 million to $19 million (a 111-percent increase); and
- In the biological sciences outside medical schools, funds are expected to increase from $404 million to $812 million (a 101-percent increase).

At the same time, funds committed to new construction are scheduled to decrease by at least 20 percent in four fields:

- In other sciences, from $145 million to $46 million (a 68-percent decrease);
- In the agricultural sciences, from $273 million to $169 million (a 38-percent decrease);
- In the medical sciences in medical schools, from $784 million to $613 million (a 22-percent decrease); and
- In medical sciences outside medical schools, from $259 million to $206 million (a 20-percent decrease).

Funds Committed to Nonfixed Equipment Costing Over $1 Million in New Construction Projects

In 1996 and 1997, 10 doctorate-granting institutions (4 top 100 institutions and 6 other doctorate-granting institutions) committed $18.9 million to nonfixed equipment costing $1 million or more in their new S&E construction projects. These commitments occurred in only four fields and represented 11 percent of total construction commitments in those fields:

- In the biological sciences outside medical schools, the amount of funds committed by two institutions to nonfixed equipment costing over $1 million accounted for 8 percent of all construction commitments in this field;
- In the physical sciences, the amount of funds committed by three institutions to this type of equipment accounted for 9 percent of all construction commitments in this field;
- In engineering, the amount of funds committed by two institutions to this type of equipment accounted for 17 percent of all construction commitments in this field; and
- In the medical sciences outside medical schools, the amount of funds committed by two institutions to this type of equipment accounted for 15 percent of all construction commitments in this field.

Chapter 4—The Repair/Renovation of S&E Research Facilities

Highlights

- In fiscal years 1996 and 1997, research-performing institutions committed $1.5 billion to the repair/renovation of science and engineering research facilities. This is 22 percent more (in constant dollars) than they committed to new repair/renovation projects in 1994 and 1995 ($1.3 billion) (table 4-1).
- More than half (52 percent) of all research-performing colleges and universities undertook some type of repair/renovation project costing over $100,000 during fiscal years 1996 and 1997 (table 4-5).
- In the current survey period, financial commitments to repair/renovation projects accounted for 33 percent of total capital project expenditures, up from 25 percent in fiscal years 1990 and 1991 (table 4-3).
- Five fields account for more than three quarters (76 percent) of the $1.3 billion committed to the repair/renovation of research facilities costing over $100,000 in 1996 and 1997. These fields are the physical sciences ($244 million), engineering ($208 million), the biological sciences outside medical schools ($200 million), the medical sciences in medical schools ($196 million), and the biological sciences in medical schools ($164 million) (table 4-8).
- For fiscal years 1998 and 1999, research-performing institutions are scheduled to commit $1.6 billion to S&E repair/renovation projects costing more than $100,000 and $983 million to central campus infrastructure repair/ renovation projects costing more than $100,000 (table 4-4).

Introduction

After years of deferring building repair projects, many of the Nation's colleges and universities have begun pushing aggressively to fund improvements to college facilities.[19] In this chapter, we examine the extent to which research-performing colleges and universities were engaged in the repair/renovation of science and engineering research facilities in 1996 and 1997 and the fields in which this activity occurred.

As was the case for construction in Chapter 3, institutions were asked to estimate the research-related costs and space for repair/renovation projects begun during fiscal years 1996 and 1997, and to make the same estimates for projects scheduled to begin in fiscal years 1998 and 1999. The project start-up time was defined as the fiscal year in which actual work began (or was expected to begin). In the case of projects conducted over multiple years, total project costs were allocated to the fiscal year in which the repair/renovation began. Note, however, that the costs and parameters of multiyear projects can change between the time a project begins and the time it is completed.

The reported financial commitments, defined as the cost to complete a project, included planning, site preparation, fixed equipment, and building infrastructure. Projects costing over $100,000 and those costing between $5,000 and $100,000 were reported separately.

It should be noted that fluctuations in repair/ renovation spending from one year to another can result from large projects at a small number of institutions. Given the costs of repairing/renovating S&E research facilities, a large increase could reflect a big project on one or two campuses. Indeed, this is often the case for the nondoctorate-granting institutions.

This year, for the first time, institutions were asked to report any nonfixed equipment costing $1 million or more that was included as part of their repair/renovation costs for fiscal years 1996 and 1997. If a project were to serve both research and nonresearch purposes, repair/ renovation costs and space estimates were to be prorated to reflect the research-related portion of the cost and space (see Items 4a, 4b, and 4c in Appendix C).

[19] Peter Schmidt. (1998, June 12). A building boom for public colleges. *The Chronicle of Higher Education*, A29-A30.

Findings

Funds Committed to the Repair/Renovation of S&E Research Facilities

Research-performing institutions committed a total of $1.5 billion to the repair/renovation of science and engineering research facilities in 1996 and 1997. This is 22 percent more (in constant dollars) than they committed to new repair/renovation projects in the last survey period ($1.3 billion).

Between fiscal years 1994 and 1995 and fiscal years 1996 and 1997, doctorate-granting institutions and nondoctorate-granting institutions increased the amount of funds committed to new repair/renovation projects:

- Doctorate-granting institutions committed $166 million or 14 percent more funds;
  - The top 100 institutions committed $78 million or 9 percent more funds; and
- Nondoctorate-granting institutions committed $107 million or 122 percent more funds (table 4-1).

Financial commitments to repair/renovation projects costing over $100,000 constituted 86 percent of all repair/renovation funds in 1996 and 1997. Funds committed to these types of repair/renovation projects increased by 19 percent since the last survey (from $1,116 million to $1,325 million). Funds for projects costing over $100,000 increased at doctorate-granting institutions and nondoctorate-granting institutions during both of these time periods (figure 4-1):

Table 4-1. Trends in funds committed to repair/renovate science and engineering research facilities by institution type and cost of project: 1986–97

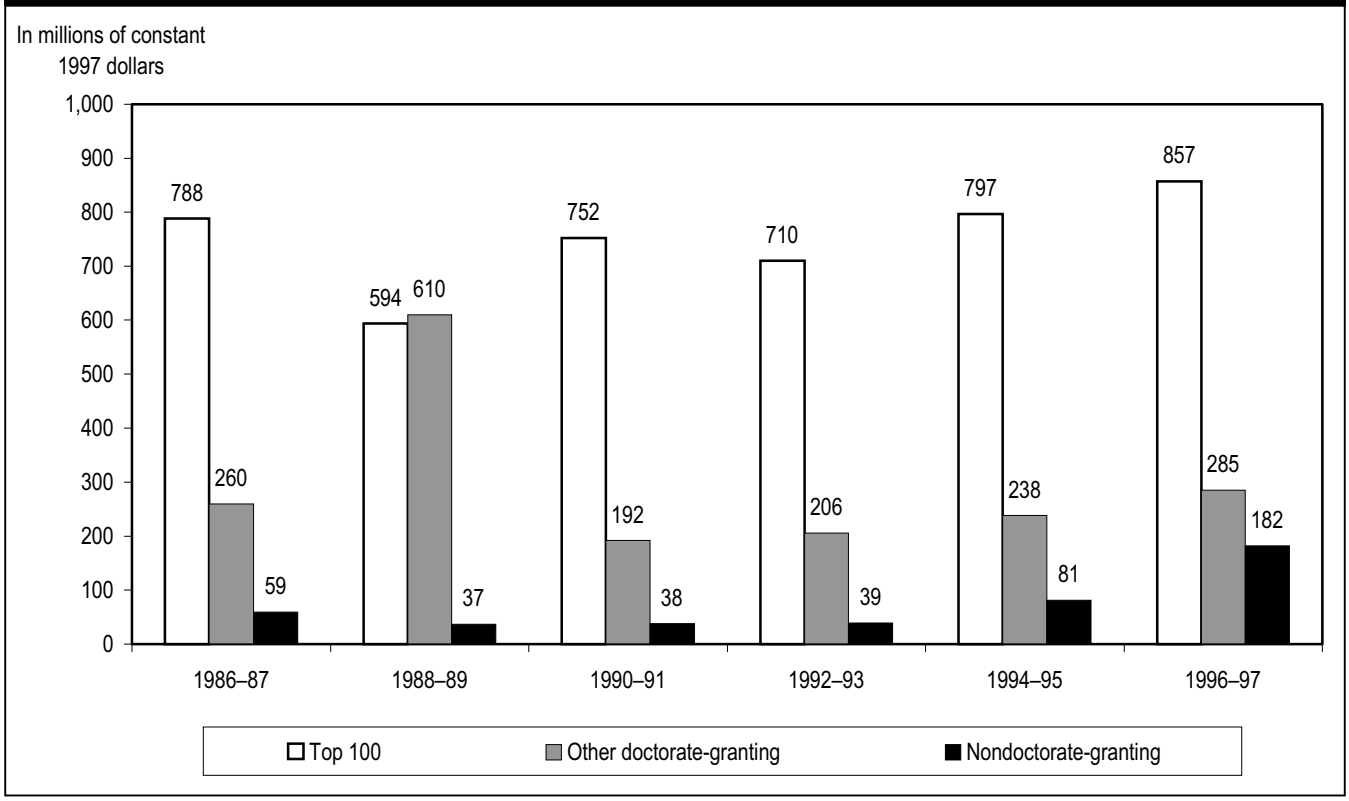
Institution type	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97
	In millions of constant 1997 dollars					
Total						
Total cost	--	--	1,155	1,230	1,259	1,532
Over $100,000	1,108	1,243	982	955	1,116	1,325
Under $100,000	--	--	173	275	142	208
Doctorate-granting						
Total cost	--	--	1,112	1,153	1,171	1,337
Over $100,000	1,048	1,205	944	916	1,035	1,142
Under $100,000	--	--	168	237	136	195
Top 100 in research expenditures						
Total cost	--	--	867	915	904	982
Over $100,000	788	594	752	710	797	857
Under $100,000	--	--	115	205	108	125
Other						
Total cost	--	--	245	238	267	355
Over $100,000	260	610	192	206	238	285
Under $100,000	--	--	53	33	28	70
Nondoctorate-granting						
Total cost	--	--	43	77	88	195
Over $100,000	59	37	38	39	81	182
Under $100,000	--	--	5	38	6	13

KEY: -- = Data were not collected.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Figure 4-1. Trends in funds committed to science and engineering research facilities repair/renovation projects costing more than $100,000 by institution type: 1986–97



NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- At doctorate-granting institutions, the funds for projects costing over $100,000 increased by $107 million or 10 percent since the last survey (from $1,035 million to $1,142 million);
  - At the top 100 institutions, the funds for these projects increased by $60 million or 8 percent since the last survey (from $797 million to $857 million); and
  - At nondoctorate-granting institutions, the funds for these projects increased by $101 million or 125 percent since the last survey (from $81 million to $182 million).

Total funds committed to new repair/renovation projects costing less than $100,000 increased by 46 percent since the last survey, from $142 million to $208 million. In 1996 and 1997, these less expensive projects accounted for 14 percent of all funds committed to new repair/renovation projects. Since the last survey, all institution types increased their allocations to these kinds of projects (table 4-1):

- Doctorate-granting institutions increased their allocations by $59 million or 43 percent (from $136 million to $195 million);
  - The top 100 institutions increased their allocations by $17 million or 16 percent (from $108 million to $125 million);
  - Other doctorate-granting institutions increased their allocations by $42 million or 150 percent (from $28 million to $70 million); and
- Nondoctorate-granting institutions increased their allocations by $7 million or 117 percent (from $6 million to $13 million).

A subset of 383 research-performing institutions were in both the 1996 and 1998 samples. These institutions actually committed in fiscal years 1996 and 1997 close to the amounts that in the 1996 survey they had estimated they would commit to new repair/renovation projects costing over $100,000; they would start in 1996 and 1998.[20] They were scheduled to commit $1,188 million and actually committed $1,145 million, a difference of $43 million or 4 percent. The doctorate granting institutions committed fewer funds than they had planned:

- Doctorate-granting institutions committed $48 million or 4 percent fewer funds than they had scheduled;
  - The top 100 institutions committed $42 million or 5 percent fewer funds than they had scheduled; and
  - Other doctorate-granting institutions committed $6 million or 3 percent fewer funds than they had scheduled (table 4-2).

Table 4-2. Scheduled and actual repair/renovation commitments for projects costing more than $100,000 for science and engineering research space by institution type: 1996–97

Institution type	Number of institutions	1996–97 (scheduled)	1996–97 (actual)
		In millions of dollars	
Total	383	1,188	1,145
Doctorate-granting	257	1,098	1,050
Top 100 in research expenditures	99	898	856
Other	158	200	194
Nondoctorate-granting	126	89	95

NOTE: Components may not add to totals due to rounding. Includes only institutions in both the 1996 and 1998 samples.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1996 and 1998 Surveys of Scientific and Engineering Research Facilities at Colleges and Universities.

[20] The scheduled 1996–97 data come from National Science Foundation/Division of Science Resources Studies, 1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities. Because this analysis is limited to the subset of research-performing institutions that were in both the 1996 and 1998 samples, the results do not generalize to the population of research-performing institutions.

Funds Committed to Repair/Renovation Projects as a Proportion of Total Capital Projects

The share of total capital project funds committed to initiate the repair/renovation of S&E research space has risen in each survey period since data were first collected on this topic in 1990–91.[21] In the 1990–91 period, total financial commitments to repair/renovation projects—both under and over $100,000—represented 25 percent of all capital project commitments. In the most recent survey period (1996–97), these commitments grew to 33 percent of all capital projects (table 4-3).

Between 1990–91 and 1996–97, the proportion of funds committed to new repair/renovation projects as a function of total capital projects increased substantially at the following types of institutions:

- Doctorate-granting institutions' proportion of repair/renovation commitments increased from 25 percent of all capital projects to 32 percent;
  - The top 100 institutions' proportion increased from 27 to 32 percent; and
- Nondoctorate-granting institutions' proportion increased from 22 to 42 percent.

Between the last survey period (1994–95) and the current one, the proportion of funds committed to new repair/renovation projects as a function of total capital projects by the nondoctorate-granting institutions increased from 20 to 42 percent. However, the proportion of funds committed by these institutions has fluctuated by roughly 20 percentage points from survey period to survey period.

Funds Scheduled for the Repair/Renovation of S&E Research Facilities and Central Campus Infrastructure

For fiscal years 1998 and 1999, research-performing institutions are scheduled to commit $1.6 billion to S&E repair/renovation projects costing over $100,000. Most of this repair/renovation is scheduled to occur among the doctorate-granting institutions, the top 100 institutions in particular. Doctorate-granting institutions plan to commit 23 percent or $257 million more to new repair/renovation

[21] Trends are reported from the 1990 and 1991 fiscal years because this was the first time period for which institutions reported repair/renovation expenses for projects costing over $100,000 and for projects costing less than $100,000.

Table 4-3. Funds committed to science and engineering repair/renovation as a percentage of total capital project expenditures by institution type: 1990–97

Institution type	1990–91 Total capital projects	1990–91 Repair/ renovation	1990–91 Repair/ renovation as percent of total	1992–93 Total capital projects	1992–93 Repair/ renovation	1992–93 Repair/ renovation as percent of total
	In millions of dollars			In millions of dollars		
Total	4,693	1,155	25	4,437	1,230	28
Doctorate-granting	4,495	1,112	25	4,255	1,153	27
Top 100 in research expenditures	3,271	867	27	3,228	915	28
Other	1,227	245	20	1,027	238	23
Nondoctorate-granting	195	43	22	181	77	42
	1994–95*			1996–97		
Total	4,179	1,259	28	4,644	1,532	33
Doctorate-granting	3,742	1,171	31	4,181	1,337	32
Top 100 in research expenditures	3,022	904	30	3,036	982	32
Other	721	267	37	1,145	355	31
Nondoctorate-granting	437	88	20	463	195	42

*Some 1994–95 values have been revised since the 1996 report.

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

projects in fiscal years 1998 and 1999 than they did in 1996 and 1997 (from $1.1 billion to $1.4 billion). Top 100 institutions plan to commit 19 percent or $166 million more (from $857 million to $1,023 million) (tables 4-4 and 4-1).

Research-performing institutions are scheduled to commit $983 million to new central campus infrastructure repair/renovation projects in 1998 and 1999. These funds are distributed among the institution types as follows:

- Doctorate-granting institutions plan to commit $936 million to new central campus infrastructure projects; this represents 95 percent of these funds;
  - The top 100 institutions plan to commit $612 million or 62 percent of these funds;
  - Other doctorate-granting institutions plan to commit $325 million or 33 percent of these funds; and

Table 4-4. Funds scheduled for the repair/renovation of science and engineering (S&E) research facilities and central campus infrastructure by institution type: 1998–99

Institution type	Scheduled repair/renovation: S&E research space	Central campus infrastructure	Total
	In millions of dollars		
Total	1,580	983	2,563
Doctorate-granting	1,399	936	2,336
Top 100 in research expenditures	1,023	612	1,635
Other	376	325	700
Nondoctorate-granting	181	46	227

NOTE: Components may not add to totals due to rounding. As used here, repair/renovation projects are limited to those with prorated costs at $100,000 or more for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- Nondoctorate-granting institutions plan to commit $46 million or 5 percent of these funds.

Overall, research-performing institutions are scheduled to commit fewer funds to new S&E facilities repair/renovation projects as they are scheduled to commit to new S&E construction projects ($1.6 billion versus $3.9 billion). By contrast, research-performing institutions are scheduled to commit more than twice as much to new central campus infrastructure repair/renovations projects in 1998 and 1999 as they are scheduled to commit to new central campus infrastructure construction projects ($983 million versus $396 million). (See table 3-4 for funds committed to scheduled construction of research facilities and central campus infrastructure.)

Colleges and Universities Starting S&E Repair/Renovation Projects

In 1996 and 1997, slightly over half (52 percent) of all research-performing institutions reported that they initiated repair/renovation projects costing over $100,000 (table 4-5). More institutions started new repair/renovation projects in 1996 and 1997 than started new construction projects (52 percent compared with 30 percent). (See table 3-5 for the proportion of institutions starting construction projects.)

In 1986–87, a higher proportion of doctorate-granting institutions in general, and top 100 institutions in particular, started repair/renovation projects than began them in the current survey period (1996–97), while a lower proportion of other doctorate-granting institutions started new construction projects:

- The proportion of doctorate-granting institutions beginning repair/renovation projects declined from 78 to 67 percent of institutions;
  - The proportion of top 100 institutions declined from 96 to 92 percent of institutions; and
  - The proportion of other doctorate-granting institutions increased from 44 to 58 percent of institutions.

In 1998 and 1999, 46 percent of research-performing institutions are scheduled to start new S&E repair/renovation projects costing over $100,000. This proportion is less than the proportion of institutions that started repair/renovation projects in 1986 and 1987 (56 percent).

A separate analysis of the 383 institutions that were in both the 1996 and 1998 samples reveals that 151 or 79 percent of all research-performing institutions that had scheduled new repair/renovation projects costing over $100,000 for 1996 or 1997 actually undertook them (table 4-6).[22] The top 100 institutions' actions were more consistent with their plans to repair/renovate new S&E research facilities than that of the other types of institutions. Overall, 126 or 86 percent of doctorate-granting institutions acted in accordance with their plans, as did 74 or 96 percent of top 100 institutions and 52 or 74 percent of other doctorate-granting institutions.

[22] Because the analysis is limited to the subset of research-performing institutions that were in both the 1996 and 1998 samples, the results do not generalize to the population of research-performing institutions.

Table 4-5. Trends in the percentage of institutions starting projects to repair/renovate science and engineering research facilities by institution type: 1986–99

Institution type	1986–87	1988–89	1990–91	1992–93	1994–95*	1996–97	(scheduled) 1998–99
Total	56	48	47	45	45	52	46
Doctorate-granting	78	71	74	61	61	67	63
Top 100 in research expenditures	96	85	91	90	88	92	85
Other	44	63	65	48	49	58	54
Nondoctorate-granting	28	20	14	25	24	32	24

*Some 1994–95 values have been revised from the 1996 report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 4-6. Number of institutions starting science and engineering research facilities repair/renovation (R/R) projects costing more than $100,000 and whether repair/renovation was scheduled by institution type: 1996–97

Institution type	Number of institutions that scheduled R/R	Number of institutions that scheduled R/R and actually started R/R	Number of institutions that did not schedule R/R	Number of institutions that did not schedule R/R but started R/R
Total	191	151	193	64
Doctorate-granting	147	126	110	48
Top 100 in research expenditures	77	74	22	17
Other	70	52	88	31
Nondoctorate-granting	44	26	82	16

NOTE: Components may not sum to totals due to rounding. Includes only the 383 institutions that were in both the 1996 and 1998 samples.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1996 and 1998 Surveys of Scientific and Engineering Research Facilities at Colleges and Universities.

It is also worth noting that 64 or 33 percent of institutions that had not scheduled repair/renovation projects for 1996 and 1997, did, in fact, start new projects in 1996 and 1997. Overall, 48 or 44 percent of doctorate-granting institutions began repair/renovation projects that were not reported as scheduled, with 17 or 77 percent of top 100 institutions doing so.

Fields in Which Repair/Renovation Projects Started

Since 1986–87 there has been some change in the proportion of institutions starting new repair/renovation projects costing over $100,000 in specific S&E fields (table 4-7). The proportion of institutions starting repair/renovation projects declined in two fields:

- In engineering, the proportion of institutions decreased from 42 to 35 percent; and
- In the medical sciences in medical schools, the proportion of institutions decreased from 54 to 41 percent.

The proportion of institutions starting repair/renovation projects increased in two fields:

- In the physical sciences, the proportion of institutions increased from 22 to 31 percent; and
- In the medical sciences outside medical schools, the proportion of institutions increased from 12 to 25 percent.

In four fields, the proportion of institutions starting repair/renovation projects increased from the last survey period:

- In the biological sciences outside medical schools, the proportion of institutions increased from 22 to 29 percent;
- In the physical sciences, the proportion of institutions increased from 24 to 31 percent;
- In the social sciences, the proportion of institutions increased from 7 to 12 percent; and
- In the medical sciences outside medical schools, the proportion of institutions increased from 16 to 25 percent.

In one field, the medical sciences in medical schools, the proportion declined from 57 to 41 percent.

The proportion of institutions scheduled to start new repair/renovation projects costing over $100,000 in 1998 and 1999 is expected to change over 1996–97 levels in four fields:

- In the biological sciences outside medical schools, the proportion of institutions is expected to decrease from 29 to 21 percent;
- In the physical sciences, the proportion of institutions is expected to decrease from 31 to 22 percent;

Table 4-7. Trends in the percentage of institutions starting projects to repair/renovate science and engineering research facilities by field: 1986–99

Field	1986–87	1988–89	1990–91	1992–93	1994–95[1]	1996–97	(scheduled) 1998–99
Total	56	48	47	45	45	52	46
Biological sciences—							
inside medical schools	45	41	46	39	47	51	33
outside medical schools	23	24	22	22	22	29	21
Physical sciences	22	23	22	22	24	31	22
Psychology	9	4	10	4	5	8	11
Social sciences	8	5	--[2]	5	7	12	12
Mathematics	8	8	4	2	3	3	3
Computer sciences	15	5	10	6	6	5	12
Earth, atmospheric, and ocean sciences	13	9	13	13	11	12	12
Engineering	42	37	24	30	29	35	28
Agricultural sciences	33	25	27	18	28	25	19
Medical sciences—							
inside medical schools	54	44	62	61	57	41	34
outside medical schools	12	12	22	16	16	25	21

[1] Some 1994–95 values have been revised since the 1996 report.

[2] Psychology and social sciences were not differentiated in the questionnaire item for the 1990–91 period.

NOTE: As used here, repair/renovation projects are limited to those with prorated costs of $100,000 or more for affected research space. Percentages are based on the number of institutions with existing research space or planned repair/renovation projects in a given field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- In the biological sciences in medical schools, the proportion of institutions is expected to decrease from 51 to 33 percent; and
- In psychology, the proportion of institutions is expected to increase from 8 to 11 percent.

Funds Committed to S&E Research Facilities Repair/Renovation Projects in Different Fields

Five fields account for more than three quarters (76 percent) of the $1.3 billion committed to the repair/renovation of S&E research facilities by research-performing institutions in fiscal years 1996 and 1997; three of these fields are in the biomedical sciences:

- The physical sciences—research-performing institutions committed $244 million;
- Engineering—research-performing institutions committed $208 million;
- The biological sciences outside medical schools—research-performing institutions committed $200 million;
- The medical sciences in medical schools—research-performing institutions committed $196 million; and
- The biological sciences in medical schools—research-performing institutions committed $164 million (table 4-8).

The amount of funds committed to new repair/renovation projects increased in three fields since 1986–87:

- In the physical sciences, funds increased from $139 million to $244 million (a 76-percent increase);
- In the earth, atmospheric, and ocean sciences, funds increased from $27 million to $52 million (a 93-percent increase); and

Table 4-8. Trends in funds committed to repair/renovate science and engineering research facilities for projects costing over $100,000 by field: 1986–99

Field	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97	(scheduled) 1998–99
	In millions of constant 1997 dollars						
Total	1,108	1,243	982	955	1,116	1,325	1,580
Biological sciences—							
inside medical schools	102	94	146	132	107	164	93
outside medical schools	193	155	160	123	134	200	280
Physical sciences	139	203	179	153	203	244	241
Psychology	18	14	37	12	30	65	33
Social sciences	47	11	-- *	12	42	40	124
Mathematics	5	14	6	2	6	5	51
Computer sciences	23	12	25	4	8	12	95
Earth, atmospheric, and ocean sciences	27	22	19	36	37	52	54
Engineering	186	445	97	158	158	208	198
Agricultural sciences	26	28	41	16	76	50	26
Medical sciences—							
inside medical schools	230	198	197	267	238	196	282
outside medical schools	69	30	62	32	62	76	77
Other sciences	40	20	6	8	13	11	24

* Psychology and social sciences were not differentiated in the 1990–91 survey.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- In the biological sciences in medical schools, funds increased from $102 million to $164 million (a 61-percent increase).

At the same time, funds decreased by 48 percent in the computer sciences, from $23 million to $12 million, and by 15 percent in the medical sciences in medical schools, from $230 million to $196 million.

Since the last survey period, the amount of funds committed to the repair/renovation of S&E research facilities increased in four fields and decreased in one. Funds increased in the following fields:

- In the biological sciences outside medical schools, funds increased from $134 million to $200 million (a 49-percent increase);
- In the computer sciences, funds increased from $8 million to $12 million (a 50-percent increase);
- In the earth, atmospheric, and ocean sciences, funds increased from $37 million to $52 million (a 41-percent increase); and
- In engineering, funds increased from $158 million to $208 million (a 32-percent increase).

The medical sciences in medical schools was the only field to experience a decrease in repair/renovation funds since the last survey. Institutions' financial commitment to this field declined by 18 percent, from $238 million to $196 million.

In 1998 and 1999, funds committed to new repair/renovation projects are scheduled to increase over 1996–97 levels in five fields, with allocated funds expected to more than triple in three fields:

- In mathematics, funds are scheduled to increase from $5 million to $51 million (a 920-percent increase);
- In the computer sciences, funds are scheduled to increase from $12 million to $95 million (a 692-percent increase);
- In the social sciences, funds are scheduled to increase from $40 million to $124 million (a 210-percent increase);
- In the medical sciences in medical schools, funds are scheduled to increase from $196 million to $282 million (a 44-percent increase); and
- In the biological sciences outside medical schools, funds are scheduled to increase from $200 million to $280 million (a 40-percent increase).

At the same time, funds are expected to decrease in only one field, the biological sciences in medical schools. Institutions are scheduled to commit 43 percent fewer funds to this field in 1998 and 1999 than they did in 1996 and 1997 (a decrease from $164 million to $93 million).

Funds Committed to Nonfixed Equipment Costing Over $1 Million in Repair/Renovation Projects

In 1996 and 1997, nine doctorate-granting institutions (4 top 100 institutions and 5 other doctorate-granting institutions) committed a total of $30.9 million to nonfixed equipment costing $1 million or more in their new S&E repair/renovation projects. This is 63 percent more than they committed to nonfixed equipment costing over $1 million in their S&E construction projects (see table 3-9).

These repair/renovation commitments occurred in only six fields (biological sciences inside and outside medical schools, medical sciences inside and outside medical schools, the physical sciences and engineering).[23] These 1996 and 1997 commitments at the nine doctorate-granting institutions represent 62 percent of total repair/renovation commitments in these fields:

- In the biological sciences outside medical schools, the amount of funds committed by two institutions to nonfixed equipment costing over $1 million accounted for 80 percent of all repair/renovation commitments in this field;
- In the physical sciences, the amount of funds committed by two institutions to this type of equipment accounted for 38 percent of all repair/renovation commitments in this field;
- In engineering, the amount of funds committed by three institutions to this type of equipment accounted for 26 percent of all repair/renovation commitments in this field;
- In the medical sciences in medical schools, the amount of funds committed by three institutions to this type of equipment accounted for 45 percent of all repair/renovation commitments in this field;
- In the biological sciences in medical schools, the amount of funds committed by two institutions to this type of equipment accounted for 34 percent of all repair/renovation commitments in this field; and
- In the medical sciences outside medical schools, the amount of funds committed by one institution to this type of equipment accounted for 11 percent of all repair/renovation commitments in this field.

[23] Some institutions committed funds to nonfixed equipment costing over $1 million in more than one field.

Chapter 5—Sources of Funds for S&E Research Facilities Projects

Highlights

- Science and engineering facilities construction starts at research-performing institutions totaled $3.1 billion in fiscal years 1996 and 1997. Institutions provided $1.9 billion or 60 percent of these funds from their combined pool of internal sources—private donations, institutional funds, tax-exempt bonds, other debt sources, and other sources; State and local governments provided $967 million or 31 percent of these funds; and the Federal Government provided $271 million or 9 percent of these funds (table 5-1).

- S&E facilities repair/renovation starts for projects costing over $100,000 at research-performing institutions totaled $1.3 billion in fiscal years 1996 and 1997. Institutions provided $866 million or 65 percent of these funds from their combined pool of internal sources; State and local governments provided $338 million or 26 percent of these funds, and the Federal Government provided $121 million or 9 percent of these funds (table 5-4).

- State and local governments were the single largest source of funds for construction and repair/renovation projects at public institutions, while institutions' internal sources were the single largest source of funds for these projects at private institutions (table 5-8).

Introduction

Research-performing institutions have spent several billion dollars on new science and engineering construction and repair/renovation projects in each biennial period surveyed. This chapter examines how research-performing higher education institutions financed S&E capital projects between 1990 and 1997.

Institutional respondents were asked to report sources of funds for S&E construction and repair/renovation projects costing over $100,000. Possible funding sources included the Federal Government, State or local governments, and such institutional sources as private donations, institutional funds, tax-exempt bonds, debt financing, and other sources. (See Item 5 of the survey in Appendix C.)

Considerable diversity in the source of Federal, State, and local funds for S&E construction and repair/renovation projects is possible. Federal funding, for instance, can include specific facilities support programs administered by the National Institutes of Health (NIH). Federal funding also might include nonpeer-reviewed projects that are specified individually through Congressional legislation rather than specific agency programs. Overlap between the funding categories is possible. For example, indirect costs included as institutional funds can come from Federal, State, and local governments, as well as from industry.

The dollar and relative contributions from the different sources of funds to construction and repair/renovation projects are presented in two ways in the tables. The first section of each table presents the three major sources of funds: Federal Government, State and local governments, and total internal sources. Total internal sources is the sum of all the financial resources an institution can commit to construction and repair/renovation projects—private donations, institutional funds, tax-exempt bonds, other debt financing, and other miscellaneous sources. The second section of each table presents these internal sources separately, with their dollar and relative contributions shown as a proportion of total internal sources.

Because of the support that State governments provide to public higher education, the control of the institution becomes relevant to discussions of the funding of capital projects involving S&E research facilities. Therefore, this chapter distinguishes between public and private institutions: 365 or 55 percent of the research-performing institutions are publicly controlled and 295 or 45 percent of the institutions are privately controlled.

This year, for the first time, institutions were asked to identify the indirect costs recovered from Federal grants and/or contracts that were included in "institutional funds,"

if institutional funds were a source of funds for any S&E research facilities construction or repair/renovation projects costing over $100,000.

Findings

Sources of Funds for the Construction of S&E Research Facilities

Construction starts at research-performing colleges and universities totaled $3.1 billion in fiscal years 1996 and 1997. Construction funds came primarily from institutions' internal sources. All told, institutions provided $1.9 billion or 60 percent of all funds used in new construction (table 5-1a). The majority of these funds (93 percent) came from three internal sources: private donations ($597 million), institutional funds ($593 million), and tax-exempt bonds ($553 million) (table 5-1b).

The amount of funds committed to new construction projects in 1996 and 1997 ($3.1 billion) is substantially lower than the amount committed in 1990 and 1991 ($3.5 billion). Between 1990–91 and the current survey, the dollar and relative contributions changed as follows:

- The dollar contribution from the Federal Government decreased by $295 million (from $566 million to $271 million), and its relative contribution decreased from 16 to 9 percent of all construction funds;
- The dollar contribution from State and local governments decreased by $169 million (from $1,136 million to $967 million), while their relative contribution did not change; and
- The dollar contribution from internal sources did not change substantially; however, the relative contribution increased from 52 to 60 percent of all construction funds.

Table 5-1. Trends in the sources of funds for construction of science and engineering research facilities: 1990–97

	5-1a. All sources				5-1b. Internal sources					
	Dollar contribution				Dollar contribution					
All institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Fiscal years										
1990–91	3,535	566	1,136	1,833	1,833	419	468	864	42	39
1992–93	3,207	524	1,105	1,579	1,579	343	427	707	44	57
1994–95	2,920	218	1,246	1,456	1,456	380	466	450	154	7
1996–97	3,110	271	967	1,873	1,873	597	593	553	107	23
	Relative contribution				Relative contribution					
All institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	Percentage				Percentage					
Fiscal years										
1990–91	100	16	32	52	100	23	26	47	2	2
1992–93	100	16	34	49	100	22	27	45	3	4
1994–95	100	7	43	50	100	26	32	31	11	0
1996–97	100	9	31	60	100	32	32	30	6	1

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

The dollar contributions in four of the five individual internal sources of funds changed as well:

- Private donations increased by $178 million (from $419 million to $597 million);
- Institutional funds increased by $125 million (from $468 million to $593 million);
- Tax-exempt bonds decreased by $311 million (from $864 million to $553 million); and
- Other debt sources increased by $65 million (from $42 million to $107 million).

Changes in the relative contribution from each internal source mirrored the changes in the dollar contributions described previously.

Between the last survey period (1994–95) and the current one, there were no substantial changes in the dollar or relative contributions from the Federal Government for new construction projects. However, funds from State and local governments declined by $279 million (from $1,246 million to $967 million), while their relative contribution declined from 43 to 31 percent of all construction funds. Funds from internal sources increased by $417 million (from $1,456 million to $1,873 million), while their relative contribution increased from 50 to 60 percent of all construction funds. This growth stemmed primarily from changes in three internal sources:

- The dollar contribution from private donations increased by $217 million (from $380 million to $597 million);
- The dollar contribution from institutional funds increased by $127 million (from $466 million to $593 million); and
- The dollar contribution from other debt sources decreased by $47 million (from $154 million to $107 million).

Sources of Funds for the Construction of S&E Research Facilities at Public Institutions

Public, research-performing institutions committed a total of $2 billion from all sources to the construction of new S&E research facilities in 1996 and 1997. State and local governments were the largest source of these funds ($940 million or 47 percent of total funds). The second largest source of funds came from institutions' internal sources ($847 million or 43 percent of total public construction funds) (table 5-2). The majority of these funds (92 percent) came from three sources: private donations ($267 million), tax-exempt bonds ($260 million), and institutional funds ($249 million) (table 5-2).

Between 1990 and 1991 and the current survey period, the amount of funds public institutions committed to new construction projects declined by $411 million (from $2.4 billion to $2.0 billion in constant dollars). While the dollar contribution from State and local governments did not change substantially during this time period, the dollar contribution from the Federal Government declined by $260 million (from $461 million to $201 million). At the same time, the Federal Government's relative contribution declined from 19 to 10 percent of all new construction funds. In addition, the relative contribution by State and local governments increased from 40 to 47 percent of all construction funds.

Although the total amount of funds committed to new construction projects at public institutions did not change between the last survey period (1994–95) and the current one, the contributions from all three sources did:

- The Federal Government's dollar contribution increased by $79 million (from $122 million to $201 million), while its relative contribution increased from 6 to 10 percent of all construction funds;
- State and local governments' dollar contribution decreased by $289 million (from $1,229 million to $940 million), while their relative contribution decreased from 62 to 47 percent of all construction funds; and
- Funds from internal sources increased by $222 million (from $625 million to $847 million), while their relative contribution increased from 32 to 43 percent of all construction funds.

In the current survey period, the different types of public, research-performing institutions funded the construction of new S&E research facilities from the different sources as follows:

- The public, top 100 institutions committed a total of $1,344 million to the construction of new S&E research facilities. Ten percent of these funds ($129 million) came from the Federal Government, 49 percent ($654 million) came from State and local governments, and 42 percent ($561 million) came from internal sources;

Table 5-2. Trends in the sources of funds for the construction of science and engineering research facilities at public institutions by institution type: 1990–97

Public institutions	5-2a. All sources				5-2b. Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu-tional funds	Tax-exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Total										
1990–91	2,400	461	962	977	977	165	321	473	9	8
1992–93	2,300	372	1,060	868	868	174	226	445	18	4
1994–95	1,975	122	1,229	625	625	131	150	323	14	7
1996–97	1,989	201	940	847	847	267	249	260	54	17
Top 100 in research expenditures										
1990–91	1,604	182	680	741	741	143	251	330	9	8
1992–93	1,651	246	645	760	760	144	169	428	18	2
1994–95	1,299	114	647	539	539	92	138	288	14	7
1996–97	1,344	129	654	561	561	190	213	136	21	1
Other doctorate-granting										
1990–91	661	272	271	118	118	22	70	26	0	0
1992–93	549	119	329	101	101	30	57	14	0	0
1994–95	366	5	275	85	85	39	11	35	0	0
1996–97	468	69	209	190	190	72	37	67	0	15
Nondoctorate-granting										
1990–91	135	7	10	118	118	0	0	118	0	0
1992–93	99	7	86	6	6	0	0	4	0	2
1994–95	310	3	306	1	1	0	1	0	0	0
1996–97	176	3	77	96	96	5	0	57	33	1
	Relative contribution				Relative contribution					
Public institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu-tional funds	Tax-exempt bonds	Other debt	Other Sources
	Percentage				Percentage					
Total										
1990–91	100	19	40	41	100	17	33	48	1	1
1992–93	100	16	46	38	100	20	26	51	2	0
1994–95	100	6	62	32	100	21	24	52	2	1
1996–97	100	10	47	43	100	32	29	31	6	2
Top 100 in research expenditures										
1990–91	100	11	42	46	100	19	34	45	1	1
1992–93	100	15	39	46	100	19	22	56	2	0
1994–95	100	9	50	41	100	17	26	53	3	1
1996–97	100	10	49	42	100	34	38	24	4	0
Other doctorate-granting										
1990–91	100	41	41	18	100	19	59	22	0	0
1992–93	100	22	60	18	100	30	57	13	0	0
1994–95	100	1	75	23	100	46	13	41	0	0
1996–97	100	15	45	40	100	38	19	35	0	8
Nondoctorate-granting										
1990–91	100	5	8	87	100	0	0	100	0	0
1992–93	100	7	87	6	100	0	4	67	0	30
1994–95	100	1	99	0	100	0	100	0	0	0
1996–97	100	1	44	55	100	5	0	59	35	1

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The public, other doctorate-granting institutions committed a total of $468 million to new construction. Fifteen percent of these funds ($69 million) came from the Federal Government, 45 percent ($209 million) came from State and local governments, and 40 percent ($190) came from internal sources; and

- The public, nondoctorate-granting institutions committed a total of $176 million to new construction. One percent of these funds ($3 million) came from the Federal Government, 44 percent ($77 million) came from State and local governments, and 55 percent ($96 million) came from internal sources.

Sources of Funds for the Construction of S&E Research Facilities at Private Institutions

Private, research-performing institutions committed a total of $1.1 billion to the construction of new S&E research facilities in 1996 and 1997. Unlike public colleges and universities, which relied most heavily on funds from State and local governments (table 5-2), private institutions derived most of their construction funds from internal sources ($1.0 billion or 91 percent of total private construction funds) (table 5-3a). The majority of these funds (94 percent) came from three sources: institutional funds ($344 million), private donations ($329 million), and tax-exempt bonds ($293 million) (table 5-3b). Funds from State and local governments accounted for only 2 percent ($26 million) of all S&E construction funds committed by private institutions.

There were few substantial changes in the amount of funds in constant dollars that private, research-performing institutions committed to new S&E construction projects between the current survey period and all prior ones. However, the relative contribution from State and local governments and from internal sources changed between 1990 and 1991 and the current survey period as did the dollar contribution from State and local governments:

- State and local governments' dollar contribution decreased by $149 million (from $175 million to $26 million), while their relative contribution decreased from 15 to 2 percent of all construction funds; and

- Institutions' relative contribution from internal sources increased from 75 to 91 percent of all construction funds.

In the current survey period, the different types of private, research-performing institutions committed funds to the construction of new S&E research facilities as follows:

- The private, top 100 institutions committed a total of $710 million to the construction of new S&E research facilities. Five percent of these funds ($32 million) came from the Federal Government, 1 percent ($10 million) came from State and local governments, and 94 percent ($668 million) came from internal sources;

- The private, other doctorate-granting institutions committed a total of $321 million to new construction. Twelve percent of these funds ($38 million) came from the Federal Government, 2 percent ($8 million) came from State and local governments, and 86 percent ($276 million) came from internal sources; and

- The private, nondoctorate-granting institutions committed a total of $91 million to new construction. They received no construction funds from the Federal Government, while 10 percent ($9 million) of their construction funds came from State and local governments, and 90 percent ($82 million) came from internal sources.

Sources of Funds for the Repair/Renovation of S&E Research Facilities

Repair/renovation starts for projects costing over $100,000 at research-performing colleges and universities totaled $1.3 billion in fiscal years 1996 and 1997. The main source of repair/renovation funds came from the combined pool of internal sources. Institutions provided $866 million or 65 percent of all funds used in new repair/renovation projects (table 5-4a). The majority of these funds (83 percent) came from two internal sources: institutional funds ($579 million) and private donations ($141 million) (table 5-4b).

Between 1990–91 and the current survey period, the amount of funds that research-performing institutions committed to new repair/renovation projects increased

Table 5-3. Trends in the sources of funds for the construction of science and engineering research facilities at private institutions by institution type: 1990–97

Private institutions	5-3a. All sources				5-3b. Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Total										
1990–91	1,136	105	175	856	856	254	147	391	33	31
1992–93	907	152	44	711	711	169	201	262	26	53
1994–95	944	96	17	831	831	249	316	127	139	0
1996–97	1,122	70	26	1,025	1,025	329	344	293	52	7
Top 100 in research expenditures										
1990–91	798	47	174	577	577	230	59	224	33	31
1992–93	663	4	39	619	619	144	182	215	26	53
1994–95	818	93	10	716	716	163	306	111	136	0
1996–97	710	32	10	668	668	177	337	103	45	7
Other doctorate-granting										
1990–91	321	52	1	267	267	18	84	166	0	0
1992–93	238	147	5	86	86	21	18	47	0	0
1994–95	88	1	8	79	79	70	6	0	4	0
1996–97	321	38	8	276	276	79	7	182	8	0
Nondoctorate-granting										
1990–91	17	6	0	11	11	5	4	2	0	0
1992–93	7	1	0	5	5	4	0	0	0	0
1994–95	38	2	0	36	36	17	4	15	0	0
1996–97	91	0	9	82	82	74	0	8	0	0
	Relative contribution				Relative contribution					
Private institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	Percentage				Percentage					
Total										
1990–91	100	9	15	75	100	30	17	46	4	4
1992–93	100	17	5	78	100	24	28	37	4	7
1994–95	100	10	2	88	100	30	38	15	17	0
1996–97	100	6	2	91	100	32	34	29	5	1
Top 100 in research expenditures										
1990–91	100	6	22	72	100	40	10	39	6	5
1992–93	100	1	6	93	100	23	29	35	4	9
1994–95	100	11	1	87	100	23	43	16	19	0
1996–97	100	5	1	94	100	26	50	15	7	1
Other doctorate-granting										
1990–91	100	16	0	83	100	7	31	62	0	0
1992–93	100	62	2	36	100	24	21	54	0	0
1994–95	100	1	9	90	100	88	8	0	5	0
1996–97	100	12	2	86	100	29	2	66	3	0
Nondoctorate-granting										
1990–91	100	34	0	66	100	48	39	13	0	0
1992–93	100	22	0	78	100	87	7	7	0	0
1994–95	100	6	0	94	100	47	11	43	0	0
1996–97	100	0	10	90	100	90	0	10	0	0

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 5-4. Trends in the sources of funds for the repair/renovation of science and engineering research facilities: 1990–97

	5-4a. All sources				5-4b. Internal sources					
	Dollar contribution				Dollar contribution					
All institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Fiscal years										
1990–91	981	58	289	634	634	119	422	79	10	4
1992–93	952	64	288	600	600	83	377	91	31	18
1994–95	1,116	117	280	719	719	117	456	53	83	10
1996–97	1,325	121	338	866	866	141	579	85	36	26
	Relative contribution				Relative contribution					
All institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	Percentage				Percentage					
Fiscal years										
1990–91	100	6	29	65	100	19	67	12	1	1
1992–93	100	7	30	63	100	14	63	15	5	3
1994–95	100	10	25	64	100	16	63	7	12	1
1996–97	100	9	26	65	100	16	67	10	4	3

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction. As used here, repair/renovation projects are limited to those with prorated costs of more than $100,000 for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

by $344 million (from $981 million to $1,325 million). During this time period, the dollar and relative contributions from State and local governments did not change, while the contributions from the Federal Government and from internal sources changed as follows:

- The Federal Government's dollar contribution increased by $63 million (from $58 million to $121 million), while its relative contribution increased from 6 to 9 percent of all repair/ renovation funds; and
- Institutions' dollar contribution from internal sources increased by $232 million (from $634 million to $866 million), while the relative contribution remained constant at 65 percent.

Changes also occurred between the first survey period and the current one in institutions' contribution of funds to S&E facilities repair/renovation projects from two internal sources:

- The dollar contribution from institutional funds increased by $157 million (from $422 million to $579 million), while the relative contribution remained constant at 67 percent; and
- The dollar contribution from other debt sources increased by $26 million (from $10 million to $36 million), while the relative contribution increased from 1 to 4 percent of all institutional sources.

Between the last survey period (1994–95) and the current one, the amount of funds research-performing institutions committed to new repair/renovation projects increased by $209 million (from $1,116 million to $1,325 million). Funds from internal sources increased by $147 million (from $719 million to $866 million), while the Federal Government's and State and local governments' dollar contributions did not change substantially.

Three internal sources showed substantial changes in their dollar contributions between 1994–95 and the current survey period:

- The dollar contribution from institutional funds increased by $123 million (from $456 million to $579 million);
- The dollar contribution from tax-exempt bonds increased by $32 million (from $53 million to $85 million); and
- The dollar contribution from other debt sources decreased by $47 million (from $83 million to $36 million).

Despite these changes, other debt sources was the only internal source whose relative contribution changed substantially. Its relative contribution declined from 12 to 4 percent of all institutional repair/renovation funds.

In both time periods, internal sources accounted for almost two thirds of all repair/renovation funds, the contribution from State and local governments accounted for approximately a quarter of all funds, and the contribution from the Federal Government remained near 10 percent.

Sources of Funds for the Repair/Renovation of S&E Research Facilities at Public Institutions

Public, research-performing institutions committed $670 million to S&E repair/renovation projects costing over $100,000 in 1996 and 1997. State and local governments were the largest source of these funds ($328 million or 49 percent). Internal sources ranked second ($269 million or 40 percent of total funds) (table 5-5a). Two thirds of these funds (67 percent) came from institutional funds ($180 million) (table 5-5b).

Between 1990–91 and the current survey period, the amount of funds public institutions committed to new repair/renovation projects increased by $136 million (from $534 million to $670 million). Funds from the Federal Government and internal sources changed substantially between these time periods:

- The Federal Government's dollar contribution increased by $43 million (from $29 million to $72 million); and
- Institutions' dollar contribution from internal sources increased by $42 million (from $227 million to $269 million).

Similar changes occurred between the last survey period (1994–95) and the current one. The total amount of funds public institutions committed to new repair/renovation projects increased by $147 million (from $523 million to $670 million). Funds from the Federal Government and internal sources increased by $31 million and $55 million, respectively, but there were no changes in their relative contributions.

In the current survey period, different types of public, research-performing institutions funded S&E facilities repair/renovation projects as follows:

- The public, top 100 institutions committed a total of $404 million to new S&E repair/renovation projects. Seven percent of these funds ($29 million) came from the Federal Government, 45 percent ($180 million) came from State and local governments, and 48 percent ($195 million) came from internal sources;
- The public, other doctorate-granting institutions committed a total of $177 million to new S&E repair/renovation projects. Seventeen percent of these funds ($29 million) came from the Federal Government, 47 percent ($83 million) came from State and local governments, and 36 percent ($64 million) came from internal sources; and
- The public, nondoctorate-granting institutions committed a total of $89 million to new S&E repair/renovation projects. Sixteen percent of these funds ($14 million) came from the Federal Government, 73 percent ($65 million) came from State and local governments, and 11 percent ($10 million) came from internal sources.

Sources of Funds for the Repair/Renovation of S&E Research Facilities at Private Institutions

Private, research-performing institutions committed a total of $655 million to S&E repair/renovation projects costing over $100,000 in 1996 and 1997. Unlike public colleges and universities, which relied most heavily on funds from State and local governments, private institutions derived most of their repair/renovation funds from

Table 5-5. Trends in the sources of funds for the repair/renovation of science and engineering research facilities at public institutions by institution type: 1990–97

Public institutions	5-5a. All sources				5-5b. Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Total										
1990–91	534	29	278	227	227	52	160	14	0	1
1992–93	593	39	270	284	284	28	176	64	2	14
1994–95	523	41	268	214	214	17	170	19	1	7
1996–97	670	72	328	269	269	38	180	25	0	26
Top 100 in research expenditures										
1990–91	390	15	171	204	204	52	139	13	0	1
1992–93	453	14	184	255	255	28	152	59	2	13
1994–95	368	25	188	155	155	7	127	15	1	6
1996–97	404	29	180	195	195	34	133	12	0	15
Other doctorate-granting										
1990–91	122	13	88	21	21	0	19	2	0	0
1992–93	126	21	77	28	28	0	23	4	0	0
1994–95	107	9	47	51	51	10	36	4	0	1
1996–97	177	29	83	64	64	3	42	9	0	10
Nondoctorate-granting										
1990–91	21	1	19	2	2	0	2	0	0	0
1992–93	14	4	10	1	1	0	1	0	0	0
1994–95	48	7	34	7	7	0	7	0	0	0
1996–97	89	14	65	10	10	2	4	5	0	0
	Relative contribution				Relative contribution					
Public institutions	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	Percentage				Percentage					
Total										
1990–91	100	5	52	43	100	23	70	6	0	0
1992–93	100	7	46	48	100	10	62	22	1	5
1994–95	100	8	51	41	100	8	79	9	0	3
1996–97	100	11	49	40	100	14	67	9	0	10
Top 100 in research expenditures										
1990–91	100	4	44	52	100	25	68	6	0	0
1992–93	100	3	41	56	100	11	60	23	1	5
1994–95	100	7	51	42	100	4	82	10	1	4
1996–97	100	7	45	48	100	17	69	6	0	8
Other doctorate-granting										
1990–91	100	11	72	17	100	0	92	8	0	0
1992–93	100	17	61	22	100	1	83	15	0	0
1994–95	100	8	44	48	100	19	71	8	0	2
1996–97	100	17	47	36	100	4	66	14	0	16
Nondoctorate-granting										
1990–91	100	4	88	8	100	0	100	0	0	0
1992–93	100	26	69	5	100	0	100	0	0	0
1994–95	100	15	70	15	100	3	97	0	0	0
1996–97	100	16	73	11	100	15	40	45	0	0

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction. As used here, repair/renovation projects are limited to those with prorated costs of more than $100,000 for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

internal sources ($597 million or 91 percent of total repair/renovation funds) (table 5-6a). The majority of these funds (84 percent) came from two sources: institutional funds ($399 million) and private donations ($102 million) (table 5-6b). Funds from State and local governments account for only 1 percent ($10 million) of all S&E repair/renovation funds committed by private institutions.

The amount of funds private, research-performing institutions committed to new S&E repair/renovation projects between 1990 and 1991 and the current survey period increased by $208 million (from $447 million to $655 million). In addition, changes occurred in the contributions from the different funding sources:

- The Federal Government's dollar contribution increased by $19 million (from $29 million to $48 million), while its relative contribution did not change substantially;
- State and local governments' dollar contribution did not change substantially, but their relative contribution decreased from 3 to 1 percent of all repair/renovation funds; and
- Institutions' dollar contribution from internal sources increased by $190 million (from $407 million to $597 million), while their relative contribution remained constant at 91 percent.

Between the last survey period (1994–95) and the current one, the mix of funds committed to S&E repair/renovation projects changed as follows:

- The Federal Government's dollar contribution decreased by $28 million (from $76 million to $48 million), while its relative contribution decreased from 13 to 7 percent of all repair/renovation funds;
- State and local governments' dollar contribution decreased by $2 million (from $12 million to $10 million), while their relative contribution did not change substantially; and
- Institutions' dollar contribution from internal sources did not change substantially, while their relative contribution increased from 85 to 91 percent of all repair/renovation funds.

In the current survey period, different types of private, research-performing institutions funded new S&E facilities repair/renovation projects as follows:

- The private, top 100 institutions committed a total of $453 million to new S&E repair/renovation projects. Five percent of these funds ($23 million) came from the Federal Government, 2 percent ($8 million) came from State and local governments, and 93 percent ($422 million) came from internal sources;
- The private, other doctorate-granting institutions committed a total of $108 million to new S&E repair/renovation projects. Fourteen percent of these funds ($15 million) came from the Federal Government, 1 percent ($2 million) came from State and local governments, and 84 percent ($92 million) came from internal sources; and
- The private, nondoctorate-granting institutions committed a total of $93 million to new S&E repair/renovation projects. Eleven percent of these funds ($11 million) came from the Federal Government, no funds came from State and local governments, and 89 percent of funds ($83 million) came from internal sources.

Amount of Indirect Costs Recovered from Federal Grants Committed to Construction and Repair/Renovation Projects

The institutions in the sample were asked if they could identify the amount of indirect costs they recovered from Federal grants and/or contracts included in institutional funds for projects costing over $100,000. Of the 236 institutions that used institutional funds for construction and/or repair/renovation projects, 69 institutions reported they could identify the amount of Federal indirect costs they recovered. The following discussion is limited to these 69 institutions.

Overall, these institutions used more than twice as many Federal funds recovered from indirect costs to fund repair/renovation projects ($19 million) than they did to fund construction projects ($9 million). These sums represent 3.3 percent of institutional funds allocated to repair/renovation and 1.5 percent of institutional funds allocated to construction (table 5-7).

Table 5-6. Trends in the sources of funds for the repair/renovation of science and engineering research facilities at private institutions by institution type: 1990–97

Private institutions	5-6a. All sources				5-6b. Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
Total										
1990–91	447	29	11	407	407	67	262	65	10	3
1992–93	359	25	17	317	317	54	201	28	29	5
1994–95	593	76	12	506	506	100	287	34	82	3
1996–97	655	48	10	597	597	102	399	59	35	0
Top 100 in research expenditures										
1990–91	362	23	11	328	328	56	202	58	10	2
1992–93	257	13	9	235	235	42	138	22	29	5
1994–95	429	31	11	386	386	74	220	25	67	1
1996–97	453	23	8	422	422	44	318	27	33	0
Other doctorate-granting										
1990–91	69	6	0	63	63	8	52	3	0	1
1992–93	79	5	8	65	65	5	56	4	0	0
1994–95	132	43	0	89	89	8	64	2	13	2
1996–97	108	15	2	92	92	6	75	9	2	0
Nondoctorate-granting										
1990–91	16	0	0	16	16	4	9	4	0	0
1992–93	23	7	0	16	16	8	7	2	0	0
1994–95	33	2	1	30	30	18	3	7	3	0
1996–97	93	11	0	83	83	52	7	24	0	0
	Relative contribution				Relative contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu- tional funds	Tax- exempt bonds	Other debt	Other sources
Private institutions	Percentage				Percentage					
Total										
1990–91	100	6	3	91	100	17	64	16	2	1
1992–93	100	7	5	88	100	17	63	9	9	2
1994–95	100	13	2	85	100	20	57	7	16	1
1996–97	100	7	1	91	100	17	67	10	6	0
Top 100 in research expenditures										
1990–91	100	6	3	91	100	17	62	18	3	1
1992–93	100	5	3	92	100	18	59	9	12	2
1994–95	100	7	3	90	100	19	57	6	17	0
1996–97	100	5	2	93	100	10	75	6	8	0
Other doctorate-granting										
1990–91	100	9	0	91	100	12	82	4	0	1
1992–93	100	7	11	83	100	8	86	6	0	0
1994–95	100	32	0	67	100	9	72	2	14	2
1996–97	100	14	1	84	100	6	81	9	2	0
Nondoctorate-granting										
1990–91	100	0	0	100	100	23	53	24	0	0
1992–93	100	29	0	71	100	48	41	11	0	0
1994–95	100	5	2	93	100	58	10	23	8	0
1996–97	100	11	0	89	100	63	8	29	0	0

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction. As used here, repair/renovation projects are limited to those with prorated costs of more than $100,000 for affected research space.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Doctorate-granting institutions were the only institutions to use Federal funds recovered from indirect costs for construction. The top 100 institutions used $3 million, which accounted for 0.6 percent of the institutional funds they allocated to construction. Other doctorate-granting institutions used $6 million in Federal funds recovered from indirect costs for construction, which accounted for 14.0 percent of the institutional funds they allocated to construction.

All three types of institutions used Federal funds recovered from indirect costs for repair/renovation projects. The top 100 institutions used $9 million, which accounted for 2.0 percent of the institutional funds they allocated to repair/renovation projects, while the nondoctorate-granting institutions used $1 million, or 9.1 percent of their institutional funds allocated to repair/renovation projects. Other doctorate-granting institutions used $10 million in Federal funds recovered from indirect costs, which accounted for 8.5 percent of the institutional funds they allocated to repair/renovation projects costing over $100,000.

Summary of Major Sources of Funds

Table 5-8 summarizes the major sources of funds for S&E construction and repair/renovation projects by institution type and sector. Both types of public, doctorate-granting institutions received the largest portion of their S&E construction and repair/renovation funds from State and local governments. Public, nondoctorate-granting institutions also received a large portion of their S&E repair/renovation funds from State and local governments, but the major source of their construction funds came from internal sources (55 percent). The single largest source of these funds (59 percent) came from tax-exempt bonds.

By contrast, all types of private institutions derived over 80 percent of both their S&E construction and S&E repair/renovation funds from internal sources. Overall, institutional funds were the largest single source of these funds for construction (34 percent of all internal sources) and for repair/renovation (67 percent of all internal sources). However, the largest internal source of funds varied by institution type:

- Among top 100 institutions, institutional funds were the largest internal source of construction funds (50 percent of all internal sources) and repair/renovation funds (75 percent of all internal sources);
- Among other doctorate-granting institutions, tax-exempt bonds were the largest internal source of construction funds (66 percent of all internal sources), while institutional funds were the largest internal source of repair/renovation funds (81 percent of all internal sources); and
- Among nondoctorate-granting institutions, private donations were the largest internal source of construction funds (90 percent of all internal sources) and repair/renovation funds (63 percent of all internal sources).

Table 5-7. Indirect costs recovered from Federal grants and/or contracts included in institutional funds for science and engineering construction and repair/renovation: 1996–97

Institution type	Construction			Repair/Renovation		
	Indirect costs	Total institutional funds	Indirect costs as percent of institutional funds	Indirect costs	Total institutional funds	Indirect costs as percent of institutional funds
	In millions of dollars					
Total						
Doctorate-granting	9	593	1.5	19	568	3.3
Top 100 in research expenditures	3	549	0.6	9	451	2.0
Other	6	43	14.0	10	117	8.5
Nondoctorate-granting	0	0	0.0	1	11	9.1

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data, which do not appear in the table.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 5-8. Major sources of funds for construction and repair/renovation of science and engineering research facilities at public and private institutions: 1996–97

Public institutions	Construction			Repair/renovation		
	Major source	Dollars in millions	Percent of total funds	Major source	Dollars in millions	Percent of total funds
Total	State/local governments	940	47	State/local governments	328	49
Top 100 in research expenditures	State/local governments	653	49	State/local governments	180	45
Other doctorate-granting	State/local governments	209	45	State/local governments	83	47
Nondoctorate-granting	Internal sources	96	55	State/local governments	65	73
	(Tax-exempt bonds)	(57)	(59)			
Private institutions	**Major source**	**Dollars in millions**	**Percent of total funds**	**Major source**	**Dollars in millions**	**Percent of total funds**
Total	Internal sources	1,025	91	Internal sources	597	91
	(Institutional funds)	(344)	(34)	(Institutional funds)	(399)	(67)
Top 100 in research expenditures	Internal sources	668	94	Internal sources	422	93
	(Institutional funds)	(337)	(50)	(Institutional funds)	(318)	(75)
Other doctorate-granting	Internal sources	276	86	Internal sources	92	84
	(Tax-exempt bonds)	(182)	(66)	(Institutional funds)	(75)	(81)
Nondoctorate-granting	Internal sources	82	90	Internal sources	83	89
	(Private donations)	(74)	(90)	(Private donations)	(52)	(63)

NOTE: Sources and figures in parentheses are subsets of the preceding source.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Chapter 6—Deferred Construction and Repair/Renovation

Highlights

- In 1998, 54 percent of research-performing institutions reported that science and engineering research space construction or repair/renovation projects were needed but not funded.
- The cost of these deferred projects was $11.4 billion. Sixty-one percent of deferred capital project needs were for construction and 39 percent were for repair/renovation (table 6-1).
- The top 100 institutions accounted for 63 percent of the total deferred costs, other doctorate-granting institutions accounted for 30 percent, and nondoctorate-granting accounted for 7 percent (table 6-1).
- Seventy-six percent ($8.7 billion) of total deferred capital project costs were included in institutional plans (table 6-1).
- The largest deferred project costs reported by research-performing institutions were for the physical sciences, $2.5 billion, and for the biological sciences outside of medical schools, $2.1 billion (table 6-3).
- Total deferred S&E research facilities needs ($11.4 billion) combined with deferred central campus infrastructure needs ($767 million) result in an estimate of $12.2 billion in total deferred S&E-related construction and repair/renovation project costs. This 1998 estimate of deferred costs represents an increase of $1.7 billion in adjusted dollars over deferred cost estimates in 1996.

Introduction

Of central importance to the National Science Foundation's Survey of Scientific and Engineering Research Facilities at Colleges and Universities is determining the needs of research-performing institutions either for additional science and engineering research space or for the repair/renovation of existing space. The original mandate to conduct this biennial survey states:

> *The National Science Foundation is authorized to design, establish, and maintain a data collection and analysis capability in the Foundation for the purpose of identifying and assessing the research facilities needs of universities and colleges.* (42 U.S.C. 1886)

This chapter provides one way of estimating need. It reports the costs of deferred projects for construction and repair/renovation that are necessary to meet existing S&E research commitments but that are not funded.

Like the 1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities, the 1998 survey included a question designed to determine construction and repair/renovation costs that institutions had deferred. Institutions reported separately those construction and repair/renovation costs for projects that were included in an institutional plan and those not included in an institutional plan.

Four criteria were used to define deferred projects (see Item 7 of the survey in Appendix C):

- The project must be necessary to meet the current S&E research program commitments;
- The project was not scheduled for fiscal year 1998 or 1999;
- The project was not funded; and
- The project was neither for the purpose of developing new programs nor for expanding faculty beyond what is required to fulfill current S&E research program commitments.

Institutions also were asked to report their deferred central campus infrastructure construction and repair/renovation needs. These deferred needs were defined using the same criteria as for facilities, and institutions were asked to report separately those deferred needs in institutional plans and those not in such plans. Central campus infrastructure was defined as those systems that exist between the buildings of a campus and the non-architectural elements of campus design.

Findings

Deferred Capital Projects for S&E Research Facilities

In 1998, 54 percent of research-performing institutions reported construction or repair/renovation projects, or both, that were needed but not funded. Two years earlier, a similar proportion of institutions, 55 percent, reported some type of deferred capital project. The vast majority of institutions (87 percent) that had deferred projects had included at least some of these projects in an approved institutional plan. Forty-four percent of the colleges and universities that reported deferred projects also identified projects that were not included in an approved institutional plan.[24]

The total estimated cost for deferred S&E research construction and repair/renovation projects in 1998 was $11.4 billion. This total includes both projects that were in institutional plans and those that were not (table 6-1).

Slightly over three quarters of the total deferred capital project costs reported by institutions (76 percent or $8.7 billion) were included in institutional plans. Both types of doctorate-granting institutions reported that about 75 percent of their deferred capital project costs were included in an institutional plan; nondoctorate-granting institutions reported that 90 percent of their deferred capital project costs were included in plans. While 84 percent of all deferred construction project costs were included in institutional plans, 65 percent of deferred repair/renovation project costs were a part of overall institutional plans.

Overall, 61 percent of all deferred capital project needs, both those included in institutional plans and those not included, were for construction. The estimated cost for these projects totaled $7.0 billion. All types of institutions reported greater deferred construction costs than repair/renovation costs. However, construction costs included in institutional plans exceeded repair/renovation costs included in plans in all types of institutions, while deferred repair/renovation costs not in plans were greater than construction costs not in plans.

The top 100 institutions accounted for 63 percent of the total deferred need, both those in and not in plans. Other doctorate-granting institutions accounted for 30 percent of the total deferred costs. Nondoctorate-granting institutions accounted for 7 percent of the total deferred capital project costs (table 6-1).

[24] The 1996 data are from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 6-1.

Table 6-1. Estimated costs for deferred capital projects to construct or repair/renovate science and engineering (S&E) research facilities by institution type, project type, and whether the project was included in an institutional plan: 1998

	Included in institutional plans			Not Included in institutional plans			
Institution type	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	Subtotal	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	Subtotal	Total
	In millions of dollars						
Total	5,857	2,834	8,691	1,142	1,548	2,690	11,381
Doctorate-granting	5,405	2,546	7,950	1,118	1,487	2,605	10,555
Top 100 in research expenditures	3,685	1,714	5,399	731	1,025	1,755	7,154
Other	1,719	832	2,552	388	462	849	3,401
Nondoctorate-granting	452	288	740	24	61	85	826

NOTE: Components may not sum to totals due to rounding.

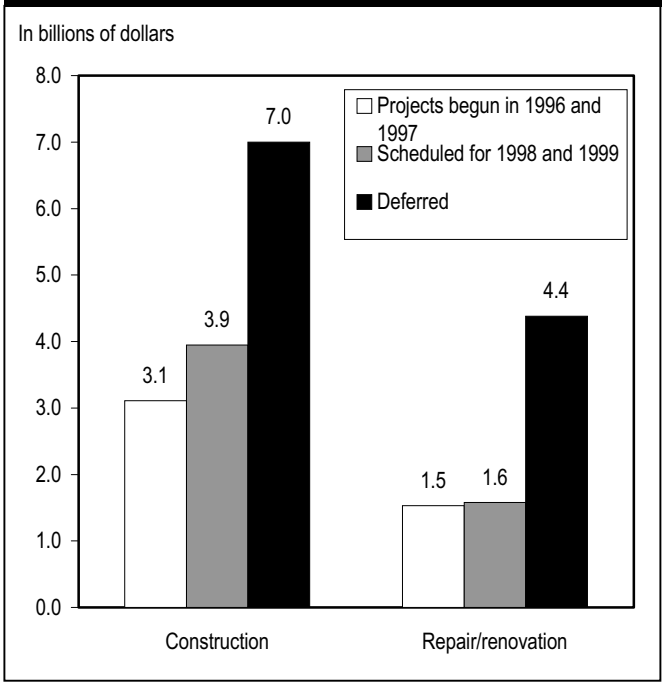
SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Deferred Project Costs and Capital Project Commitments

Comparing estimated deferred project costs to the costs of capital projects begun in 1996 and 1997 and those scheduled for 1998 and 1999 provides a perspective on the magnitude of estimated deferred need. Deferred construction costs ($7.0 billion) are approximately equal to the combined construction begun in 1996 and 1997 ($3.1 billion) and construction scheduled for the following two fiscal years ($3.9 billion). Deferred repair/renovation costs ($4.4 billion) exceed the combined repair/renovation commitments for 1996 and 1997 ($1.5 billion) and those scheduled for 1998 and 1999 ($1.6 billion) (figure 6-1).

Excluding estimated deferred costs not included in institutional plans still results in deferred need estimates that exceed the actual cost of project starts for 1996 and 1997. This is the case for both deferred construction projects and deferred repair/renovation projects.

Figure 6-1. Cost of construction and repair/renovation of science and engineering research facilities begun in 1996 and 1997, scheduled for 1998 and 1999, and deferred costs in 1998 and 1999



NOTE: Includes all construction projects costing more than $100,000 and repair/renovation projects costing more than $100,000. Repair/renovation projects begun in 1996 or 1997 also include all projects costing more than $5,000.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Deferred Need Estimates

Between 1996 and 1998, deferred capital project costs increased from $9.9 billion to $11.4 billion, a 15-percent increase in adjusted dollars (table 6-1).[25] Overall, the other doctorate-granting institutions reported the largest overall increase in deferred capital project costs, a 69-percent increase.

The largest relative increase in deferred costs during this time period occurred for repair/renovation projects not included in institutional plans, from $0.9 billion to $1.5 billion. This represents a 67-percent increase. Deferred S&E research construction projects included in institutional plans increased 20 percent, from $4.9 billion to $5.9 billion.

Changes in the portion of deferred construction and repair/renovation need that is included in institutional plans can be compared for three survey periods, 1994,[26] 1996, and 1998 (table 6-2). Across all types of institutions, the estimated cost of deferred construction and repair/renovation projects increased from $6.5 billion in 1994 to $8.7 billion in 1998. The deferred need estimates of doctorate-granting institutions included in institutional plans increased from $6.0 billion in 1994 to $8.0 billion in 1998, a 31-percent increase.

In absolute dollars, estimated deferred construction projects increased $1.2 billion, or 27 percent. In relative terms, estimated deferred repair/renovation projects increased more than construction projects, $899 million, or 46 percent.

Deferred Needs by S&E Field

Total deferred project costs were highest for the physical sciences, $2.5 billion (table 6-3). Total deferred project costs of $2.1 billion were reported for the biological sciences outside of medical schools. These two fields alone account for approximately 40 percent of all deferred capital project costs. The deferred project costs for two additional fields (engineering and the medical sciences in medical schools) exceed $1 billion. These four fields represent 66 percent of all deferred capital projects. Institutions reported the lowest deferred costs for capital projects in mathematics and other sciences, $182 and $188 million, respectively.

[25] Ibid.

[26] The 1994 survey only asked about deferred projects that were included in institutional plans.

Table 6-2. Trends in deferred need estimates included in institutional plans for science and engineering construction and repair/renovation: 1994, 1996, and 1998

Institution type	1994 Construction	1994 Repair/ renovation	1994 Total	1996 Construction	1996 Repair/ renovation	1996 Total	1998 Construction	1998 Repair/ renovation	1998 Total
	In millions of constant 1997 dollars								
Total	4,614	1,935	6,548	4,884	2,943	7,827	5,857	2,834	8,691
Doctorate-granting:	4,387	1,662	6,049	4,544	2,632	7,176	5,405	2,546	7,951
Top 100 in research expenditures	3,218	1,199	4,418	3,671	1,744	5,415	3,685	1,714	5,399
Other	1,169	463	1,631	872	888	1,760	1,719	832	2,551
Nondoctorate-granting	227	272	499	340	311	651	452	288	740

NOTE: Components may not sum to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 6-3. The cost of deferred capital projects to construct or repair/renovate science and engineering (S&E) research facilities by field, type of project, and whether the project was included in an institutional plan: 1998

Institution type	Included in institutional plans: To construct new S&E research facilities	Included in institutional plans: To repair/ renovate existing S&E research facilities	Not included in institutional plans: To construct new S&E research facilities	Not included in institutional plans: To repair/ renovate existing S&E research facilities	Total
	In millions of dollars				
Total	5,590	2,674	1,102	1,474	10,840
Biological sciences—					
inside medical schools	267	160	40	74	540
outside medical schools	976	505	273	348	2,101
Physical sciences	1,339	596	212	305	2,453
Psychology	107	71	30	33	242
Social sciences	136	110	44	67	357
Mathematics	83	75	5	19	182
Computer sciences	198	25	38	35	297
Earth, atmospheric, and ocean sciences	327	106	71	42	545
Engineering	878	556	166	144	1,744
Agricultural sciences	422	165	64	117	768
Medical sciences—					
inside medical schools	689	274	109	184	1,256
outside medical schools	333	129	71	174	707
Other sciences	102	62	18	6	188

NOTE: Components may not sum to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Deferred Capital Projects for Central Campus Infrastructure

The facilities in which S&E research is conducted are supported by a campus infrastructure of walkways and roads, wiring for telecommunications and electricity, sewers and drains, air handling, waste storage and disposal, and the like. It is difficult to establish how much of this central campus infrastructure supports the work of S&E research and how much supports other academic and nonacademic needs.

In 1998, research-performing institutions estimated deferred construction and repair/renovation costs affecting their central campus infrastructure to be $2.6 billion (table 6-4). Over three-fourths (77 percent) of the total deferred cost to either construct or repair/renovate the central campus infrastructure was included in institutional plans. The percentage of total deferred costs included in institutional plans ranged from 65 percent at nondoctorate-granting institutions to 79 percent at other doctorate-granting institutions.

The estimated $2.6 billion in deferred central campus infrastructure costs is in addition to the $11.4 billion in deferred costs for construction and repair/renovation identified above. Because 59 percent of all academic space is devoted to S&E, and 50 percent of that space is research space (see table 1-2), a conservative prorated estimate of S&E research needs for central campus infrastructure is $767 million ($2.6 billion x .59 x .50). It should be noted that: (1) S&E research is probably more demanding of central campus infrastructure than other space, and (2) it is more difficult to prorate infrastructure costs than research facilities costs. Thus, $767 million should be interpreted as a conservative estimate of the S&E research infrastructure deferred project costs.

Combining this $767 million for campus infrastructure costs with the $11.4 billion in deferred S&E research capital projects noted above, the total deferred S&E research facilities and infrastructure needs of colleges and universities is estimated to be $12.2 billion.[27] This overall estimate of deferred need represents an increase of $1.7 billion over 1994–95 levels.[28]

[27] This estimate of deferred need, along with all others reported in this chapter, is potentially a lower estimate than would be derived from responses to other types of questions and calculations. By limiting the concept of need to current "research program commitments," respondents were forced to consider only those R&D activities that were budgeted, approved, and funded. Such boundaries precluded institutions from reporting desired space in fields in which they did not currently have a research program. Calculations based on broader definitions of need would yield higher estimates.

[28] These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, page 6-11. The values presented here have been adjusted for inflation.

Table 6-4. The cost of deferred capital projects to construct or repair/renovate central campus infrastructure by institution type, type of project, and whether the project was included in an institutional plan: 1998

	Included in institutional plans			Not included in institutional plans			
Institution type	To construct new central campus infrastructure	To repair/ renovate existing central campus infrastructure	Subtotal	To construct new central campus infrastructure	To repair/ renovate existing central campus infrastructure	Subtotal	Total
	In millions of dollars						
Total	634	1,374	2,008	210	380	589	2,597
Doctorate-granting	560	1,297	1,857	209	300	509	2,366
Top 100 in research expenditures	349	820	1,169	149	177	325	1,495
Other	211	477	688	60	123	184	871
Nondoctorate-granting	74	77	151	1	80	80	231

NOTE: Components may not sum to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Chapter 7—Minority-Serving Institutions

Highlights

- The 80 research-performing, minority-serving institutions (institutions designated as Historically Black Colleges and Universities (HBCUs), institutions whose enrollments are at least 25 percent black but are not HBCUs, and institutions whose enrollments are at least 25 percent Hispanic) represent 12 percent of all research-performing institutions and contain 3 percent, or 3.9 million net assignable square feet, of the total science and engineering research space (table 7-1).

- At least 60 percent of the minority-serving institutions reported that the amount of S&E research space they had was inadequate for current research commitments in eight fields: engineering; psychology; the social sciences; the physical sciences; the computer sciences; the biological sciences outside medical schools; the earth, atmospheric, and ocean sciences; and the medical sciences outside medical schools (table 7-2).

- Twenty-four percent of the minority-serving institutions began new S&E research construction projects in fiscal years 1996 and 1997 totaling approximately $120 million. Thirty percent of these institutions began new repair/renovation projects totaling about $36 million (table 7-3).

- The amount of S&E research space in a group of 29 HBCUs that have been in the study sample since 1988 increased from 1.1 million NASF in 1988 to 1.9 million NASF in 1998 (table 7-5).

- Construction activity at the 29 original HBCUs increased considerably between the 1994–95 and 1996–97 fiscal years, from 4 HBCUs starting construction projects totaling $3.5 million dollars to 11 institutions starting such projects at a cost of $64.3 million (table 7-6).

Introduction

Since its inception, the Survey of Scientific and Engineering Research Facilities at Colleges and Universities has included a sample of HBCUs. These institutions have been recognized for their contributions to the education of black students in general and for their role in preparing students for science and engineering careers. NSF has recognized the growth in minority enrollments in higher education overall and, thus, added two other types of minority-serving institutions to the 1998 sample. The inclusion of non-HBCU-Black institutions acknowledges the fact that there are many colleges and universities that enroll large percentages of black students but are not designated as HBCUs. Non-HBCU-Black institutions are defined as colleges and universities whose enrollments are at least 25 percent black. Similarly, as Hispanic enrollments in higher education increase, there is a need to examine institutions serving these students. Hispanic-serving Institutions (HSIs) are defined as colleges and universities whose enrollments are at least 25 percent Hispanic. The group of minority-serving institutions varies in size and focus; it is composed of both nondoctorate and doctorate-granting institutions, and includes one of the top 100 research-performing institutions.[29]

In prior years, only HBCUs were included in the sample, and trend data were reported for these institutions. Because non-HBCU-black institutions and HSIs are included in the sample for the first time, no trends can be reported for the full group of minority-serving institutions. Trend data are presented for a group of 29 larger HBCUs that have been part of the sample since 1988.

[29] Although the importance of institutions that serve Asian-American students as well as institutions that serve students from more than one ethnic group is recognized (see Merisotis and O'Brien, *Minority Serving Institutions: Distinct Purposes, Common Goals*, 1998), this chapter only examines minority-serving institutions that enroll large percentages of specific groups of students, black or Hispanic.

Findings

S&E Space in Minority-Serving Institutions

The 80 research-performing, minority-serving institutions had 28 million net assignable square feet of space in all academic fields in 1998; 44 percent of this space (12.4 million NASF) was in science and engineering fields. About 31 percent of the S&E space was research space (3.9 million NASF). Research-performing, minority-serving institutions represent 12 percent of all research-performing institutions and contain 3 percent of all S&E research space (table 7-1):

- HBCUs represent 71 percent of all research-performing, minority-serving institutions and contain 61 percent of all the S&E research space in these institutions;
- Non-HBCU-Black institutions represent 16 percent of the research-performing, minority-serving institutions and contain 11 percent of the S&E research space in these institutions; and
- Hispanic-serving institutions represent 13 percent of the research-performing, minority-serving institutions and contain 28 percent of the S&E research space in these institutions.

Minority-serving institutions were most likely to have S&E research space in the biological sciences outside medical schools; 93 percent of these colleges and universities reported research space in this field. Eighty-four percent of the minority-serving institutions reported S&E research space in the physical sciences. The percent of minority-serving institutions reporting S&E research space in other fields drops to 50 percent for the computer sciences and 48 percent for psychology.

Although only 40 percent of minority-serving institutions reported S&E research space in engineering, this field contained more space than any other single field, 960 thousand NASF. The agricultural sciences followed with another 710 thousand NASF of research space. It should be noted that engineering and the agricultural sciences are more space intensive than other S&E fields. These fields represent relatively larger proportions of S&E research space in all research-performing institutions.

Adequacy of the Amount of S&E Research Space and Its Condition in Minority-Serving Institutions

At least 60 percent of minority-serving institutions reported that the amount of S&E research space was inadequate for meeting current research commitments in eight fields (table 7-2):

- Engineering—69 percent;
- Psychology—67 percent;
- Physical sciences—66 percent;
- Computer sciences—66 percent;
- Biological sciences outside medical schools—65 percent;
- Social sciences—65 percent;
- Earth, atmospheric, and ocean sciences—61 percent; and
- Medical sciences outside medical schools—61 percent.

Minority-serving institutions reported that 38 percent (1.5 million NASF) of their current research space was suitable for use in the most scientifically sophisticated research and another 44 percent (1.7 million NASF) was effective for most uses, but needs limited repair/renovation. Seventeen percent (0.7 million NASF) of the current S&E research space was rated as requiring either major renovation or replacement (see table 7-1 for amount of current research space).

New S&E Facilities Construction and Repair/Renovation Projects at Minority-Serving Institutions

In fiscal years 1996 and 1997, almost a quarter (24 percent) of all minority-serving, research-performing institutions initiated new S&E research facilities construction projects costing over $100,000. These construction projects are expected to yield close to 0.5 million NASF of new research space at a cost of $120 million. In terms of space and dollars, the S&E construction activity at minority-serving institutions represents approximately 4 percent of all S&E research construction activity started in 1996 and 1997 (table 7-3).

Table 7-1. Amount of instructional and research space and the percentage of institutions with science and engineering (S&E) research space by field in minority-serving institutions: 1998

Indicator	HBCUs	Non-HBCU-Black institutions	Hispanic-serving institutions	All minority-serving institutions	All institutions
Number of institutions	57	13	10	80	660
Amount of instructional and research space [NASF in thousands]					
Total instructional and research space (all fields)	18,326	2,707	6,949	27,982	487,656
Total instructional and research space (S&E fields)	8,734	1,283	2,359	12,376	286,239
Total S&E research space	2,339	426	1,092	3,857	143,288
Percentage of institutions with S&E research space by field					
Biological sciences—					
inside medical schools	5	20	0	7	19
outside medical schools	96	70	100	93	84
Physical sciences	83	80	100	84	83
Psychology	50	30	61	48	70
Social sciences	51	20	26	43	63
Mathematics	48	30	36	43	60
Computer sciences	48	60	49	50	56
Earth, atmospheric, and ocean sciences	29	20	49	30	53
Engineering	33	30	87	40	44
Agricultural sciences	32	0	36	27	16
Medical sciences—					
inside medical schools	5	10	0	6	19
outside medical schools	28	20	0	23	40
Other sciences	11	10	36	14	23
Amount of S&E research space by S&E field [NASF in thousands]					
Biological sciences—					
inside medical schools	181	96	0	277	11,642
outside medical schools	305	66	148	519	19,425
Physical sciences	321	58	164	543	18,191
Psychology	31	18	26	75	3,360
Social sciences	56	17	6	79	4,620
Mathematics	31	3	16	50	889
Computer sciences	65	18	30	114	2,018
Earth, atmospheric, and ocean sciences	57	8	17	82	7,524
Engineering	388	23	549	960	22,833
Agricultural sciences	635	0	75	710	24,607
Medical sciences—					
inside medical schools	87	40	0	127	18,128
outside medical schools	95	24	0	119	7,001
Other sciences	86	56	60	202	3,050

KEY: NASF = net assignable square feet.
HBCU = Historically Black Colleges or Universities.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 7-2. Adequacy of the amount of science and engineering (S&E) research space and its condition by field in minority-serving institutions: 1998

Indicator	HBCU's	Non-HBCU-Black institutions	Hispanic-serving institutions	All minority-serving institutions	All institutions
Number of institutions	57	13	10	80	660
Adequacy of current amount of S&E research space [percentage of institutions reporting current space not sufficient]					
Total	88	70	100	87	83
Biological sciences—					
inside medical schools	--	--	--	36	70
outside medical schools	68	50	61	65	64
Physical sciences	73	50	51	66	64
Psychology	76	--	21	67	51
Social sciences	62	--	--	65	61
Mathematics	46	--	--	44	44
Computer sciences	72	50	--	66	56
Earth, atmospheric, and ocean sciences	72	--	--	61	62
Engineering	74	--	59	69	60
Agricultural sciences	48	--	--	46	55
Medical sciences—					
inside medical schools	--	--	--	--	67
outside medical schools	52	--	--	61	54
Condition of existing S&E research space [percentage of research space]					
Suitable for use in the most sophisticated scientific research	35	51	41	38	39
Effective for most levels of research in the field, but may need limited repair/renovation	48	38	37	44	38
Requires major renovation to be used effectively	15	9	18	15	18
Requires replacement	1	2	4	2	5

KEY: -- = number of institutions with nonmissing data is less than 5. These institutions are included in the total.
HBCU = Historically Black Colleges or Universities.

NOTE: Components may not add to totals due to rounding. Percentages are based on the number of institutions that have existing and/or needed research space in a given field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Across all minority-serving institutions, State and local governments were the largest source of funds for construction projects. However, this results from the fact that the HBCUs dominate this group in terms of number of institutions, and three quarters (76 percent) of their construction funding came from State and local governments. The one project reported by non-HBCU-black institutions was funded by internal sources (institutional funds in particular) and HSIs funded their S&E research construction primarily with funds from internal sources (63 percent—all of which was derived from other debt financing) and the Federal Government (37 percent).

In fiscal years 1996 and 1997, 30 percent of all research-performing, minority-serving institutions began repair/renovation projects. These projects affect 602 thousand NASF and were expected to cost about $36 million. This repair/renovation activity would thus alter approximately 16 percent of all S&E research space in minority-serving institutions and represents 4 percent of all repair/renovation activity in research-performing institutions (table 7-1).

State and local governments were the primary source of funding for repair/renovation projects for all minority-serving institutions. This results from the fact that this

Table 7-3. Construction and repair/renovation of science and engineering research facilities and sources of funds in minority-serving institutions: 1996–97

Indicator	HBCUs	Non-HBCU-minority serving institutions	All minority-serving institutions	All institutions
Number of institutions	57	23	80	660
Construction projects: 1996–97 fiscal years				
Number of institutions with projects >$100,000	14	5	19	197
S&E research space to be constructed [NASF in thousands]	347	148	495	11,101
Total cost [in thousands of dollars]	66,241	53,758	119,999	3,110,318
Repair/renovation projects: 1996–97 fiscal years				
Number of institutions with projects >$100,000	15	9	24	343
S&E research space to be repaired or renovated [NASF in thousands]	150	452	602	15,058
Total cost [in thousands of dollars]	13,178	22,882	36,060	1,324,524

KEY: NASF = net assignable square feet.
HBCU = Historically Black Colleges or Universities.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

source dominated the funding at both non-HBCU-Black institutions and HSIs. HBCUs funded repair/renovation projects primarily with funds from internal sources; 47 percent of their funding for these projects were derived from this source, institutional funds, in particular.

Minority-Serving Institutions' Need for S&E Research Facilities

In 1998, minority-serving institutions reported $420 million in combined capital projects (construction and repair/renovation) and central campus infrastructure projects that had to be deferred because of insufficient funds. This represents approximately 3 percent of all deferred projects reported by research-performing institutions. HBCUs accounted for 79 percent of the deferred costs at minority-serving institutions (table 7-4).

Construction and repair/renovation projects represent 86 percent of the total deferred S&E capital project costs ($363 million). Construction projects account for 71 percent of the total deferred capital project costs (both those in and not in institutional plans).

Central campus infrastructure projects represent 14 percent of the total deferred projects ($57 million). Construction projects account for 24 percent of all deferred central campus infrastructure projects and repair/renovation projects account for 76 percent of these projects.

A Look at HBCUs Over Time

Since the inception of the facilities survey, NSF has collected data from a continuing group of 29 HBCUs that reported separately budgeted research and development expenditures in 1988. In 1992, NSF identified an additional 41 HBCUs that had separately budgeted R&D expenditures. Only those institutions with S&E research space were retained in the sample each year. Since that time, the facilities survey has included both the original group of 29 HBCUs as well as all other HBCUs that report any R&D expenditures.

This section examines changes over time in S&E research facilities for the original group of 29 HBCUs, hereafter called, "the 29 original HBCUs."

Amount and Distribution of S&E Research Space

The amount of S&E research space in the 29 original HBCUs increased by 70 percent, from 1.1 million NASF in 1988 to 1.9 million NASF in 1998. The amount of

Table 7-4. The cost of deferred construction and repair/renovation projects by project type and whether the project is included in institutional plans in minority-serving institutions: 1998

Indicator	HBCUs	Non-HBCU-Black institutions	Hispanic-serving institutions	All minority-serving institutions	All institutions
Number of institutions	57	13	10	80	660
Deferred S&E capital projects [in thousands of dollars]					
Total	297,088	6,325	59,171	362,584	11,380,790
Included in institutional plans	274,783	5,155	56,600	336,538	8,690,853
Construction	242,671	5,070	0	247,741	5,856,685
Repair/renovation	32,112	85	56,600	88,796	2,834,167
Not included in institutional plans	22,305	1,170	2,572	26,047	2,689,937
Construction	7,706	1,170	1,543	10,419	1,142,157
Repair/renovation	14,599	0	1,029	15,627	1,547,780
Deferred central campus infrastructure projects [in thousands of dollars]					
Total	33,882	0	23,143	57,025	2,597,305
Included in institutional plans	33,251	0	3,857	37,108	2,007,813
Construction	13,475	0	0	13,475	633,967
Repair/renovation	19,776	0	3,857	23,634	1,373,846
Not included in institutional plans	631	0	19,286	19,916	589,492
Construction	207	0	0	207	209,502
Repair/renovation	424	0	19,286	19,709	379,991
Total deferred costs	330,970	6,325	82,314	419,609	13,978,095

KEY: S&E = science and engineering.
HBCU = Historically Black Colleges or Universities.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

space increased the most in absolute terms during this time period in the two fields that also currently have the most S&E research space (table 7-5):

- In engineering, the amount of research space more than doubled, from 152 thousand NASF to 363 thousand NASF; and
- In the agricultural sciences, the amount of research space increased from 259 thousand NASF to 471 thousand NASF.

Over the decade, S&E research space also increased in every field except for the computer sciences and the medical sciences in medical schools, which experienced declines in research space as follows:

- In the medical sciences in medical schools, the amount of research space declined from 141 thousand NASF to 87 thousand NASF; and
- In the computer sciences, the amount of research space declined from 43 thousand NASF to 40 thousand NASF.

Between the last survey period (1996) and the current one, the amount of S&E research space at the 29 original HBCUs increased by 5 percent or 88 thousand NASF. While almost half the S&E fields experienced slight increases in research space, only psychology did not experience any growth, and two fields experienced declines:

- In the social sciences, the amount of research space declined from 56 thousand NASF to 46 thousand; and
- In mathematics, the amount of research space declined from 24 thousand NASF to 20 thousand NASF.

Table 7-5. Trends in the amount of science and engineering research space by field in the 29 original Historically Black Colleges and Universities (HBCUs): 1988–98

Field	1988	1990	1992	1994	1996	1998
	NASF in thousands					
Number of research-performing HBCUs	29	29	29	28*	29	29
Total	1,112	1,440	1,782	1,759	1,797	1,885
Biological sciences–						
inside medical schools	91	121	121	159	150	181
outside medical schools	141	170	254	250	208	216
Physical sciences	179	190	235	212	229	234
Psychology	14	19	16	18	16	16
Social sciences	28	47	57	43	56	46
Mathematics	12	26	29	19	24	20
Computer sciences	43	30	42	31	36	40
Earth, atmospheric, and ocean sciences	10	26	35	27	42	43
Engineering	152	167	285	315	349	363
Agricultural sciences	259	433	414	470	451	471
Medical sciences—						
inside medical schools	141	158	160	69	84	87
outside medical schools	37	50	133	134	63	82
Other sciences	4	4	0	12	88	86

* One HBCU did not report R&D expenditures in 1994. Its research space was not included in the totals.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Construction of S&E Research Space

In fiscal years 1996 and 1997, 11 of the 29 original HBCUs initiated S&E research facilities construction projects. This is the same number of institutions that reported new construction starts in 1986 and 1987. However, in the intervening years, the number of institutions starting such projects was lower, particularly in the 1992–93 and 1994–95 periods, when 4 of the 29 original HBCUs began new construction projects (table 7-6).

In fiscal years 1996 and 1997, the 29 original HBCUs committed $64.3 million to new construction projects costing over $100,000. These projects will result in 335 thousand NASF of new S&E research space, which is the equivalent of 18 percent of existing research space (see table 7-5). Particularly noteworthy is the increase in construction between the last survey period (fiscal years 1994 and 1995) and the current one (fiscal years 1996 and 1997). While the number of institutions starting new construction projects almost tripled from 4 institutions to 11, the amount of research space under construction increased almost 5-fold (from 68 thousand NASF to 335 thousand NASF) and the amount of funds committed to new construction projects increased 18-fold (from $3.5 million to $64.3 million).

The Repair/Renovation of S&E Research Facilities

Unlike construction starts, fewer of the 29 original HBCUs began S&E repair/renovation projects costing over $100,000 in 1996 and 1997 than in any other survey period, except for 1990 and 1991. In both of these survey periods, 5 of the 29 original HBCUs reported new S&E repair/renovation projects. The amount of funds these institutions committed to these projects in 1996 and 1997 ($7.6 million) is also less than in any prior survey period.

Table 7-6. Science and engineering research facility construction and repair/renovation projects at the 29 original Historically Black Colleges and Universities (HBCUs) project characteristics: 1986–97

Capital project activity	1986–87	1988–89	1990–91	1992–93	1994–95	1996–97
Construction projects:						
Number of HBCUs with projects	11	10	6	4	4	11
Total estimated completion cost [in millions of dollars]	95.5	68.3	27.0	9.8	3.5	64.3
NASF [in thousands]	481	319	328	88	68	335
Repair/renovation projects costing over $100,000:						
Number of HBCUs with projects	13	10	5	11	7	5
Total estimated completion cost [in millions of dollars]	18.8	26.2	13.9	9.9	22.7	7.6
NASF [in thousands]	137	308	129	106	343	114
Repair/renovation projects costing $5,000–$100,000:						
Number of HBCUs with projects	--	--	10	13	11	13
Total estimated completion cost [in millions of dollars]	--	--	0.7	3.8	0.8	1.4

KEY: NASF = net assignable square feet.
-- = data were not collected.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Almost half (13) of the 29 original HBCUs began S&E repair/renovation projects costing between $5,000 and $100,000 in 1996 and 1997; the same number that began them in 1992 and 1993, but fewer than in 1994 and 1995 (11 institutions). These 13 institutions committed $1.4 million to these types of repair/renovation projects, bringing total repair/renovation commitments in 1996 and 1997 by the 29 original HBCUs to $9.0 million (table 7-6).

Sources of Funds for S&E Construction and Repair/Renovation Projects

Between 1986–87 and 1992–93, the Federal Government was the largest source of construction funds for the 29 original HBCUs. In 1994–95 and 1996–97, funds from State and local governments exceeded those from the Federal Government. Even though the Federal Government's dollar contribution increased between 1994–95 and 1996–97, its relative contribution in 1996–97 (7 percent) was the smallest it has been since the survey began. By contrast, State and local governments' dollar and relative contributions in 1996–97 were the largest they have been since the survey began—$50.5 million and 79 percent, respectively (table 7-7).

The source of funds for S&E repair/renovation projects at the 29 original HBCUs has varied more over time than funds for construction projects. The Federal Government was the largest source of funds for these projects in 4 out of 6 survey periods, and its relative contribution has been in decline since 1992–93 (from 57 percent of all repair/renovation funds in 1992–93 to 29 percent in 1996–97). The continuous increase in the relative contribution from internal sources over the last three survey periods, despite fluctuations in the dollar contribution from this source of funds, parallels a decline in the relative contribution of Federal funds to repair/renovate S&E facilities. In 1988–89, institutions contributed 1 percent of all repair/ renovation funds from internal sources; by 1996–97 their relative contribution had risen to 47 percent—and this was the largest source of funds for repair/renovation projects during this time period (table 7-8).

Table 7-7. Sources of funds for science and engineering research facility construction projects at the 29 original Historically Black Colleges and Universities (HBCUs): 1986–97

Fiscal years	All sources				Internal sources					
	Dollar contribution				Dollar contribution					
	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
1986–87	95.5	43.5	34.3	17.8	17.8	14.8	3.1	0.0	0.0	0.0
1988–89	68.3	43.4	14.3	10.7	10.7	9.5	1.1	0.0	0.0	0.0
1990–91	27.0	14.5	7.6	5.0	5.0	0.0	5.0	0.0	0.0	0.0
1992–93*	9.8	7.4	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994–95	3.5	1.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996–97	64.3	4.6	50.5	9.2	9.2	3.0	1.5	3.6	0.0	1.0
	Relative contribution				Relative contribution					
Fiscal years	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
	Percentage				Percentage					
1986–87	100	46	36	19	100	83	17	0	0	0
1988–89	100	64	21	16	100	90	10	0	0	0
1990–91	100	54	28	19	100	0	100	0	0	0
1992–93*	100	76	23	0	100	0	0	0	0	0
1994–95	100	39	61	0	100	0	0	0	0	0
1996–97	100	7	79	14	100	33	17	40	0	11

* One of the HBCUs had no S&E research space.

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Findings are limited to projects with estimated total cost at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 7-8. Sources of funds for science and engineering research facility repair/renovation projects at the 29 original Historically Black Colleges and Universities (HBCUs): 1986–97

	All sources				Internal sources					
	Dollar contribution				Dollar contribution					
Fiscal years	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu-tional funds	Tax-exempt bonds	Other debt	Other sources
	In millions of constant 1997 dollars				In millions of constant 1997 dollars					
1986–87	18.8	11.6	6.5	0.7	0.7	0.7	0.0	0.0	0.0	0.0
1988–89[1]	26.2	16.0	9.9	0.2	0.2	0.1	0.1	0.0	0.0	0.0
1990–91	13.9	4.2	9.6	0.2	0.2	0.1	0.1	0.0	0.0	0.0
1992–93[2]	9.9	5.7	2.4	2.1	2.1	1.9	0.1	0.0	0.0	0.0
1994–95	22.7	10.8	6.8	5.3	5.3	0.0	2.7	0.0	2.5	0.0
1996–97	7.6	2.2	1.8	3.6	3.6	0.0	3.6	0.0	0.0	0.0
	Relative contribution				Relative contribution					
Fiscal years	All sources	Federal	State/ local	Internal sources	Total internal sources	Private donations	Institu-tional funds	Tax-exempt bonds	Other debt	Other sources
	Percentage				Percentage					
1986–87	100	62	35	4	100	100	0	0	0	0
1988–89	100	61	38	1	100	50	50	0	0	0
1990–91	100	30	69	2	100	50	50	0	0	0
1992–93[2]	100	57	24	21	100	94	6	0	0	0
1994–95	100	47	30	23	100	0	52	0	48	0
1996–97	100	29	24	47	100	0	100	0	0	0

[1] 1988–89 total has been revised since 1996 report.

[2] One of the HBCUs had no S&E research space.

NOTE: Components may not add to totals due to rounding. Percentages are based on unrounded data that do not appear in the table. Findings are limited to projects with estimated total cost at completion of $100,000 or more for research space. Current dollars have been adjusted to constant 1997 dollars using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

CHAPTER 8—ANIMAL RESEARCH FACILITIES

HIGHLIGHTS

- Eighty-three percent of all research-performing institutions had laboratory animal facilities in 1998 (table 8-1).
- Institutions reported a total of 11.9 million net assignable square feet of animal research space. This represents 8 percent of all science and engineering research space. The percentage is similar across the three types of research-performing institutions (table 8-1).
- The distribution of animal research space parallels the distribution of S&E research space. Seventy-one percent of all S&E research space and 72 percent of all animal research space is located in the top 100 institutions; 24 percent of all S&E research space and 23 percent of all animal research space is located in other doctorate-granting institutions, and 5 percent of each type of space is located in nondoctorate-granting institutions (tables 8-1 and 1-1).
- Institutions with animal research space reported that 75 percent (8.9 million NASF) of that space was at the lowest Federal biosafety level, Level 1. Another 23 percent (2.7 million NASF) was at Level 2, while 3 percent (0.4 million NASF) was at Level 3. No research-performing academic institution had S&E research space at Level 4 (i.e., for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure) (table 8-3).
- Five percent of the institutions with animal research facilities are scheduled to start construction on a half million NASF of animal research space in 1998 and 1999. They are scheduled to commit $162.1 million to these projects (tables 8-4 and 8-5).

INTRODUCTION

Scientists in the fields of biology, agriculture, psychology, and medicine often use animals in their research. Issues related to the housing of animals and the laboratories in which animal research is conducted are examined in this chapter. Institutions estimated the amount of animal housing space and animal laboratory space to arrive at a total amount of animal research space. They were asked to include as laboratory animal facilities both departmental and central facilities that are subject to government and State policies and regulations concerning the humane care and use of laboratory animals. Not included were agricultural buildings that did not directly support research or that were not subject to government regulations, nor were areas for the veterinary treatment of animals. In addition, institutions provided estimates of the amount of animal research space scheduled for construction and repair/renovation in 1998 and 1999. Scheduled expenditures on these items were provided for construction and repair/renovation projects costing over $100,000. (See Item 8 of the survey in Appendix C.)

The 1996 survey addressed biosafety issues by asking respondents to state the amount of net assignable square feet that:

A fully meets government regulations.

B needs limited repair/renovation to meet government regulations.

C needs major repair/renovation or replacement to meet government regulations.

In the 1998 survey, the question was changed to capture directly the amount of space that met the Federal Government's recommended biosafety levels for Animal Biological Safety:[30]

A ***Level 1*** practices, safety equipment, and facilities are appropriate for undergraduate and secondary educational training and teaching laboratories, and for other facilities in which work is done with defined and characterized strains of viable microorganisms not known to cause disease in healthy adult humans.

[30] The descriptions of the levels were taken from *Biosafety in Microbiological and Biomedical Laboratories*, 3rd Edition, 1993. Washington, DC: U.S. Government Printing Office, 1993.

B ***Level 2*** practices, equipment, and facilities are applicable to clinical, diagnostic, teaching and other facilities in which work is done with the broad spectrum of indigenous moderate-risk agents present in the community and associated with human disease of varying severity.

C ***Level 3*** practices, safety equipment, and facilities are applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection.

D ***Level 4*** practices, safety equipment, and facilities are applicable for work with dangerous and exotic agents, which pose a high individual risk of life-threatening disease, which may be transmitted via the aerosol route, and for which there is no available vaccine or therapy.

As a result of the change in the biosafety questions, issues pertaining to biosafety in the 1996 survey and the 1998 survey cannot be compared.

Findings

Amount of Space Devoted to Animal Research

In 1998, 546 of the 660 research-performing institutions (83 percent) had laboratory animal facilities. The doctorate-granting institutions were more likely than the nondoctorate-granting institutions to have such facilities (86 percent compared with 78 percent), with almost all of the top 100 institutions (97 percent) having them (table 8-1).

Institutions reported a total of 11.9 million net assignable square feet of animal research space. Most of that space (95 percent or 11.2 million NASF) was located in the doctorate-granting institutions. The distribution of animal research space paralleled the distribution of science and engineering research space (see table 1-1):

- The top 100 institutions accounted for 71 percent of all S&E research space (101 million NASF) and 72 percent of all animal research space (8.5 million NASF);

Table 8-1. Amount and distribution of space for laboratory animal facilities by institution type: 1998

	Institutions with laboratory animal facilities		Total animal research space		
Institution type	Number	Percentage of institutions	NASF [in millions]	Percentage of total animal research NASF	Percentage of total S&E research space*
Total	546	83	11.9	100	8.3
Doctorate-granting	325	86	11.2	95	8.2
Top 100 in research expenditures	97	97	8.5	72	8.4
Other	228	82	2.7	23	7.7
Nondoctorate-granting	221	78	0.6	5	8.6

* These percents were derived by dividing animal research space by total S&E research space (table 1-1).

KEY: NASF = net assignable square feet.
S&E = science and engineering.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The other doctorate-granting institutions accounted for 24 percent of all S&E research space (35 million NASF) and 23 percent of all animal research space (2.7 million NASF); and
- The nondoctorate-granting institutions accounted for 5 percent of all S&E research space (7 million NASF) and 5 percent of all animal research space (0.6 million NASF).

These 11.9 million NASF of animal research space represent 8.3 percent of all S&E research space. This percentage is similar across the three types of research-performing institutions (range: 7.7 to 8.6 percent). Further, this proportion remained constant overall and at each type of institution between 1994–95[31] and 1996–97, indicating that animal research space is growing at the same rate as S&E research space.

Overall, almost three quarters (72 percent) of the total amount of animal research space (8.6 million NASF) was used to house laboratory animals, and slightly more than one quarter (28 percent or 3.3 million NASF) was designated as animal laboratory space. The amount of animal housing space as a percent of total S&E research space was relatively constant at about 6 percent across institution types (range: 5.8 to 6.2 percent). Similarly, the amount of animal laboratory space as a percent of total S&E research space was also relatively constant at slightly more than 2 percent across institution types (range: 2.1 to 2.6 percent) (table 8-2).

Distribution of Animal Research Space at Colleges and Universities by Biosafety Level

Institutions with animal research space reported that 75 percent (8.9 million NASF) of that space was at Federal biosafety Level 1 (i.e., acceptable for work with microorganisms not known to cause disease in healthy humans). Another 23 percent (2.7 million NASF) was at Level 2 (i.e., acceptable for work with moderate-risk agents present in the community and associated with human disease of varying severity), and 3 percent (0.4 million NASF) was at Level 3 (i.e., acceptable for work with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection). No research-performing academic institution had S&E research space at Level 4 (i.e., acceptable for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure) (table 8-3).

[31] These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 9-1.

Table 8-2. Amount and distribution of animal housing space and laboratory animal space by institution type: 1998

Institution type	Animal housing space: NASF [in millions]	Animal housing space: Percentage of total animal research NASF	Animal housing space: Percentage of total S&E research space[1]	Animal laboratory space: NASF [in millions]	Animal laboratory space: Percentage of total animal research NASF	Animal laboratory space: Percentage of total S&E research space[2]
Total	8.6	72	6.0	3.3	28	2.3
Doctorate-granting	8.1	72	6.0	3.1	28	2.3
Top 100 in research expenditures	6.1	72	6.0	2.4	28	2.4
Other	2.0	75	5.8	0.7	27	2.1
Nondoctorate-granting	0.4	73	6.2	0.2	30	2.6

[1] These percentages were derived by dividing animal housing space by total S&E research space (table 1-1).

[2] These percentages were derived by dividing animal laboratory space by total S&E research space (table 1-1).

KEY: NASF = net assignable square feet.
S&E = science and engineering.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 8-3. Percentage of animal research space at each animal biological safety level by institution type: 1998

Institution type	Animal biological safety level			
	Level 1[1]	Level 2[2]	Level 3[3]	Level 4[4]
Total	75	23	3	0
Doctorate-granting	74	24	3	0
Top 100 in research expenditures	72	25	3	0
Other	80	18	2	0
Nondoctorate-granting	93	7	0	0

[1] Acceptable for work with microorganisms not known to cause disease in healthy humans.

[2] Acceptable for work with moderate-risk agents present in the community and associated with human disease of varying severity.

[3] Acceptable for work with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection.

[4] Acceptable for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

The doctorate-granting institutions had a greater amount of animal research space at the higher biosafety levels, Levels 2 and 3 (27 percent or 3 million NASF), than the nondoctorate-granting institutions (7 percent or 42,000 NASF). In fact, the nondoctorate-granting institutions had no animal research space at Level 3 and less than 10 percent at Level 2.

Amount of Animal Research Space Scheduled for Construction and Repair/Renovation

The research-performing institutions are scheduled to start construction on 492 thousand NASF of animal research space in 1998 and 1999. This is 3 percent of all S&E construction scheduled to start in 1998 and 1999 (14.6 million NASF) (Appendix table E3-2) and is 24 percent or 153 thousand NASF less new animal research space than was scheduled to be constructed in 1996 and 1997[32] (645 thousand NASF) (table 8-4):

Table 8-4. Amount of laboratory animal space scheduled for construction and repair/renovation: 1998–99

Institution type	Construction	Repair/renovation
	NASF in thousands	
Total	492	303
Doctorate-granting	440	292
Top 100 in research expenditures	329	193
Other	112	99
Nondoctorate-granting	52	12

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The top 100 institutions account for 67 percent (329 thousand NASF) of the animal facilities construction scheduled to begin in 1998 and 1999;
- The other doctorate-granting institutions account for 23 percent (112 thousand NASF) of the animal facilities construction scheduled to begin in 1998 and 1999; and
- The nondoctorate-granting institutions account for 11 percent (52 thousand NASF) of the animal facilities construction scheduled to begin in 1998 and 1999.

The research-performing institutions are scheduled to begin repair/renovation projects that will affect 303 thousand NASF of animal research space in 1998 and 1999. This is less than 2 percent of all S&E repair/renovation projects scheduled to start in 1998 and 1999 (15.6 million NASF) (Appendix table E4-2) and is 43 percent or 229 thousand NASF less animal research space than was scheduled to be affected by new repair/renovation projects begun in 1996 and 1997[33] (532 thousand NASF):

- The top 100 institutions account for 64 percent (193 thousand NASF) of the animal facilities repair/renovation projects scheduled to begin in 1998 and 1999;

[32] These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 9-5.

[33] Ibid.

- The other doctorate-granting institutions account for 32 percent (99 thousand NASF) of the animal facilities repair/renovation projects scheduled to begin in 1998 and 1999; and

- The nondoctorate-granting institutions account for 4 percent (12 thousand NASF) of the animal facilities repair/renovation projects scheduled to begin in 1998 and 1999.

These decreases in scheduled construction and scheduled repair/renovation of animal research space may be less a decline in facilities expansion and upgrading than a return to normal levels. It is possible that the 1996 survey captured the tail end of an unusual amount of activity among institutions as they strove to bring their animal research facilities into conformance with stricter animal welfare regulations that were established between 1989 and 1994 and which required institutions to upgrade their facilities. There has also been a movement to centralize animal research space such that animal research space is often shared by several departments instead of being dispersed throughout the institution.[34]

Funds Scheduled for the Construction and Repair/Renovation of Animal Research Space

Overall, 35 of the research-performing institutions (5.3 percent of all research performing institutions) are scheduled to start construction on animal research facilities in 1998 and 1999, and 56 of the research-performing institutions (10.2 percent of those with animal research facilities) are scheduled to start repair/renovation projects. The distribution of these scheduled projects among institution types is as follows:

- Among the top 100 institutions, 21 institutions had scheduled construction projects and 34 institutions had scheduled repair/renovation projects;

- Among the other doctorate-granting institutions, 9 institutions had scheduled construction projects and 16 institutions had scheduled repair/renovation projects; and

- Among nondoctorate-granting institutions, 5 institutions had scheduled construction projects and 6 institutions had scheduled repair/renovation projects (table 8-5).

Although fewer institutions were scheduled to start animal research facilities construction projects in 1998 and 1999 than were scheduled to start repair/renovation projects, they were scheduled to commit more than three times as many funds to construction projects ($162.1 million) as they were scheduled to commit to repair/renovation projects ($45.1 million).

The amount of funds scheduled to be committed to the construction of new animal facilities in 1998 and 1999 ($162.1 million) was not substantially different from the amount of funds that were scheduled to be committed to the construction of new animal facilities in 1996 and 1997 ($164.1 million).[35] These funds represented 4 percent of total funds committed to all new S&E construction scheduled to begin in 1998 and 1999 ($3,949 million) (see tables 3-4 and 8-5):

- The top 100 institutions accounted for 73 percent ($119.1 million) of all funds scheduled to be committed to new animal facilities construction projects;

- The other doctorate-granting institutions accounted for 15 percent ($24.3 million) of all funds scheduled to be committed to new animal facilities construction projects; and

- The nondoctorate-granting institutions accounted for 11 percent ($18.6 million) of all funds scheduled to be committed to new animal facilities construction projects.

The amount of funds scheduled to be committed to new animal facilities repair/renovation projects in 1998 and 1999 ($45.1 million) was considerably less (46 percent or $38.2 million) than was scheduled to be committed to new animal facilities repair/renovation projects in 1996 and 1997 ($83.3 million).[36] These funds represented 3 percent of the total funds committed to all new S&E repair/renovation projects scheduled to begin in 1998 and 1999 ($1,580 million) (see table 4-4):

[34] This information was provided by Barbara Rick, Executive Director, National Association for Biomedical Research.

[35] These data come from National Science Foundation/ Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 9-4. These values have not been adjusted for inflation because they were scheduled for the 1996 and 1997 fiscal years.

[36] These data come from National Science Foundation/Division of Science Resources Studies, *Scientific and Engineering Research Facilities at Colleges and Universities: 1996*, NSF 96-326, table 9-4.

Table 8-5. Number and percentage of institutions and the amount of funds scheduled for the construction and repair/renovation of laboratory animal facilities: 1998–99

Institution type	Scheduled construction			Scheduled repair/renovation		
	Number of institutions	Percentage of institutions[1]	Cost [In millions of dollars]	Number of institutions	Percentage of institutions[2]	Cost [In millions of dollars]
Total	35	5.3	162.1	56	10.2	45.1
Doctorate-granting	30	8.1	143.4	50	15.3	43.2
Top 100 in research expenditures	21	21.0	119.1	34	35.1	34.9
Other	9	3.4	24.3	16	6.9	8.3
Nondoctorate-granting	5	1.7	18.6	6	2.7	1.9

[1] Percentages are based on all institutions (see table 1-1 for the number of institutions in each category).

[2] Percentages are based on those institutions with animal research space (see table 8-1 for the number of institutions in each category).

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The top 100 institutions accounted for 77 percent ($34.9 million) of all funds scheduled to be committed to animal facilities repair/renovation projects;
- The other doctorate-granting institutions accounted for 18 percent ($8.3 million) of all funds scheduled to be committed to animal facilities repair/renovation projects; and
- The nondoctorate-granting institutions accounted for 4 percent ($1.9 million) of all funds scheduled to be committed to animal facilities repair/renovation projects.

CHAPTER 9—BIOMEDICAL RESEARCH FACILITIES

HIGHLIGHTS

- In 1998, the Nation's 908 biomedical research-performing institutions had 73.3 million net assignable square feet of biomedical research space. Slightly more than half of all the biomedical research space (53 percent or 38.9 million NASF) was in the biological sciences; the other 47 percent or 34.4 million NASF was in the medical sciences (table 9-1).
- Overall, 65 percent of institutions with research space in the biological sciences and 52 percent of institutions with research space in the medical sciences reported that the amount of biomedical research space they had was inadequate to meet their current research commitments (table 9-2).
- In fiscal years 1996 and 1997, 172 biomedical research-performing institutions started construction on 7.4 million NASF of biomedical research space. They committed $2.2 billion to new construction projects costing over $100,000 (table 9-3).
- In fiscal years 1996 and 1997, 379 biomedical research-performing institutions started repair/renovation projects on 9.0 million NASF of biomedical research space. They committed $770 million to new repair/renovation projects costing over $100,000 (table 9-4).
- In 1998, biomedical research-performing institutions reported $5.6 billion in combined capital projects (construction and repair renovation) that had to be deferred because of insufficient funds. Construction projects account for 64 percent ($3.6 billion) of the total deferred capital project costs (both included and not included in an institutional plan) (table 9-7).

INTRODUCTION

Biomedical research facilities are a critical component of the Nation's science and engineering research system. Consequently, NSF and the National Institutes of Health (NIH) have collected data on the amount, quality, and condition of research space in the biological and medical sciences in the Nation's biomedical research-performing institutions since the inception of the *Facilities* survey in 1986. These research facilities are not only located at academic institutions, but also in research hospitals and nonprofit research organizations.

This chapter looks at the top 50 academic institutions in science and engineering research expenditures instead of the top 100. In addition, because of their importance in producing black biomedical researchers and physicians, the 29 original HBCUs are pulled out for separate analysis.

Colleges and universities with an affiliated medical school are counted as both a college or university and as a medical school in all tables reporting the number of institutions. Their biological and medical science research space—existing, needed, constructed, deferred, and repaired/renovated—and the associated expenditures are divided between the college or university and the medical school categories depending on whether the research space or capital project was designated as inside or outside a medical school. That is, while the institution is counted twice, its research space and associated costs are not.

Several tables present the survey results for the biological and medical sciences separately. The "biological sciences" includes all institutions with research space inside or outside of medical schools. Similarly, "medical sciences" includes all institutions with research space inside or outside of medical schools.

FINDINGS

AMOUNT OF BIOMEDICAL RESEARCH SPACE

In 1998, the Nation's 908 biomedical research-performing institutions had 73.3 million net assignable square feet of biomedical research space. This is 9 percent or 5.9 million NASF more than they had in 1996 and 41 percent or 21.4 million NASF more than they had a decade ago (table 9-1).

Slightly more than half of all the biomedical research space (53 percent or 38.9 million NASF) was in the biological sciences; the other 47 percent or 34.4 million

Table 9-1. Amount of biomedical research space by institution type and field: 1988–98

Indicator	Academic institutions				Research organizations	Hospitals	All institutions		
	Colleges/universities			Medical schools[3]			Total	Field	
	Top 50	Other doctorate-granting	Non-doctorate-granting					Biological sciences	Medical sciences
Number of biomedical institutions, 1998[1]	49[2]	273	246	145	171	125	908	752	503
Amount of research space [NASF in millions]									
1988	10.2	10.0	1.1	21.9	4.4	4.2	51.9	28.2	23.7
1990	10.4	10.9	1.3	23.3	4.8	4.5	55.2	31.0	24.3
1992	10.7	11.3	1.6	26.8	5.1	4.6	59.7	32.4	27.3
1994	10.9	10.6	1.0	27.7	6.4	5.4	62.5	34.1	28.4
1996	12.2	12.1	1.7	28.5	6.6	6.2	67.4	35.9	31.5
1998	12.9	11.6	1.9	29.8	9.5	7.6	73.3	38.9	34.4

[1] The number of institutions across institution types does not sum to grand totals because many institutions contain both a college/university and a medical school. In grand totals, medical schools are counted as separate institutions only if they are not affiliated with a college or university.

[2] Among the top 50 research-performing institutions, one is a medical school and is included in the count for medical schools.

[3] The number of medical schools is based on the sum of the weights of institutions with medical school research space. Medical schools were not an explicit strata in the sampling scheme. Thus, this number may not reflect the actual number of medical schools in the universe.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

NASF was in the medical sciences. The amount of research space in each field grew by 10.7 million NASF over the decade, with the biological sciences experiencing a 38-percent increase in research space (from 28.2 million to 38.9 million NASF) and the medical sciences experiencing a 45-percent increase (from 23.7 million to 34.4 million NASF).

More than three quarters of all the biomedical research space (77 percent or 56.2 million NASF) was located in academic institutions. Slightly more than half of this space (29.8 million NASF) was located in medical schools, with the remaining 26.4 million NASF located in research-performing colleges and universities. Nonprofit research organizations accounted for 13 percent (9.5 million NASF) of all biomedical research space, while research hospitals accounted for 10 percent (7.6 million NASF).

Between 1988 and 1998, every type of institution, except research hospitals, experienced an appreciable increase in biomedical research space:

- At the top 50 institutions, the amount of biomedical research space increased by 26 percent (from 10.2 million to 12.9 million NASF);
- At other doctorate-granting institutions, the amount of biomedical research space increased by 16 percent (from 10.0 million to 11.6 million NASF);
- At nondoctorate-granting institutions, the amount of biomedical research space increased by 73 percent (from 1.1 million to 1.9 million NASF);
- At medical schools, the amount of biomedical research space increased by 36 percent (from 21.9 million to 29.8 million NASF); and
- At nonprofit research organizations, the amount of biomedical research space increased by 116 percent (from 4.4 million to 9.5 million NASF).

Adequacy of the Amount of Biomedical Research Space and Its Condition

Overall, 65 percent of institutions with research space in the biological sciences and 52 percent of institutions with research space in the medical sciences reported that the amount of biomedical research space they had was inadequate to meet their current research commitments:

- Among colleges and universities, 64 percent rated their biological sciences research space as inadequate, while 54 percent rated their medical sciences research space as inadequate;
- Among medical schools, 70 percent rated their biological sciences research space as inadequate, while 67 percent rated their medical sciences research space as inadequate;
- Among nonprofit research organizations, 73 percent rated their biological sciences research space as inadequate, while 27 percent rated their medical sciences research space as inadequate; and
- Among research hospitals, 26 percent rated their biological sciences research space as inadequate, while 52 percent rated their medical sciences research space as inadequate (table 9-2).

The percentage of institutions with biomedical research space reporting inadequate amounts of research space in the biological sciences increased between 1996 and 1998 from 47 to 65 percent of institutions. During this time period, the percentage of institutions reporting inadequate amounts of research space in the biological sciences increased at three types of institutions: colleges and universities, medical schools, and nonprofit research organizations. By contrast, the percentage of institutions reporting inadequate amounts of research space in the medical sciences remained essentially the same between 1996 (51 percent) and 1998 (52 percent).

Overall, the institutions reported that they needed an additional 9.0 million NASF of research space in the biological sciences or 23 percent more than they had in order to meet their research commitments. At the same time, they reported that they needed an additional 7.1 million NASF of research space in the medical sciences or 21 percent more than they had:

- Colleges and universities reported needing 25 percent more research space in the biological sciences (4.8 million NASF) and 27 percent more research space in the medical sciences (1.9 million NASF);
- Medical schools reported needing 21 percent more research space in the biological sciences (2.5 million NASF) and 22 percent more research space in the medical sciences (4.0 million NASF);
- Nonprofit research organizations reported needing 22 percent more research space in the biological sciences (1.4 million NASF) and 18 percent more research space in the medical sciences (0.6 million NASF); and
- Research hospitals reported needing 19 percent more research space in the biological sciences (0.3 million NASF) and 10 percent more research space in the medical sciences (0.6 million NASF).

Less than half (48 percent or 18.7 million NASF) of research space in the biological sciences was rated as "suitable for the most scientifically competitive research," and less than half (43 percent or 14.8 million NASF) of research space in the medical sciences was rated this way. The percentage of the different types of institutions rating their research space as being in the highest quality condition is as follows (see table E9-1 for total NASF by field by institution type):

- Colleges and universities rated 40 percent (7.6 million NASF) of research space in the biological sciences and 32 percent (2.2 million NASF) of research space in the medical sciences as suitable for the most scientifically sophisticated research;
- Medical schools rated 49 percent (5.9 million NASF) of research space in the biological sciences and 44 percent (7.7 million NASF) of research space in the medical sciences as being in this condition;
- Nonprofit research organizations rated 67 percent (4.3 million NASF) of research space in the biological sciences and 65 percent (2.1 million NASF) of research space in the medical sciences as being in this condition;

Table 9-2. Adequacy of the amount of biomedical research space and its condition by institution type and field: 1988–98

	Biological sciences					Medical sciences				
		Academic institutions		Research organi-zations			Academic Institutions		Research organi-zations	
	Total	Colleges/ universities	Medical schools[1]		Hospitals	Total	Colleges/ universities	Medical schools[2]		Hospitals
Number of biomedical institutions with existing or nonexistent but needed research space, 1998[1].....	764	569	127	98	44	521	269	127	98	92
Adequacy of current amount of research space [percentage of institutions reporting current space inadequate]										
1988.....	45	46	49	37	43	41	40	47	23	44
1990.....	41	43	54	14	30	44	47	59	9	39
1992.....	32	37	36	13	8	31	36	42	14	22
1994.....	32	43	43	13	30	41	43	49	29	42
1996.....	47	53	46	32	14	51	57	66	26	32
1998.....	65	64	70	73	26	52	54	67	27	52
Amount of research space needed [NASF in millions]										
Total research space	38.9	19.4	11.6	6.4	1.5	34.4	7.0	18.1	3.2	6.1
Additional research space needed.....	9.0	4.8	2.5	1.4	0.3	7.1	1.9	4.0	0.6	0.6
Percentage of current research space needed.....	23	25	21	22	19	21	27	22	18	10
Condition of existing research space [percentage of research space]										
Suitable for use in the most competitive scientific research.....	48	40	49	67	56	43	32	44	65	44
Effective for most uses but not the most sophisticated.....	31	36	35	15	25	34	43	31	28	37
Requires major renovation to be used effectively....	17	20	14	14	17	18	21	20	6	14
Requires replacement.....	4	5	2	4	2	5	4	6	1	5

[1] The number of institutions across institution types does not sum to grand totals because many institutions contain both a college/university and a medical school. In grand totals, medical schools are counted as separate institutions only if they are not affiliated with a college or university.

[2] The number of medical schools is based on the sum of the weights of institutions with medical school research space. Medical schools were not an explicit strata in the sampling scheme. Thus, this number may not reflect the actual number of medical schools in the universe.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- Research hospitals rated 56 percent (0.8 million NASF) of research space in the biological sciences and 44 percent (2.7 million NASF) of research space in the medical sciences as being in this condition. By contrast, 21 percent (8.2 million NASF) of research space in the biological sciences was rated as needing major renovation or replacement, while 23 percent (7.9 million NASF) of research space in the medical sciences was rated as being in this condition (see table E9-1 for total NASF by field by institution);
- Colleges and universities rated 25 percent (4.8 million NASF) of research space in the biological sciences and 25 percent (1.8 million NASF) of research space in the medical sciences as needing major renovation or replacement;

- Medical schools rated 16 percent (1.9 million NASF) of research space in the biological sciences and 26 percent (4.7 million NASF) of research space in the medical sciences as being in this condition;
- Nonprofit research organizations rated 18 percent (1.2 million NASF) of research space in the biological sciences and 7 percent (0.2 million NASF) of research space in the medical sciences as being in this condition; and
- Research hospitals rated 19 percent (0.3 million NASF) of research space in the biological sciences and 19 percent (1.2 million NASF) of research space in the medical sciences as being in this condition.

Construction of Biomedical Research Space

In fiscal years 1996 and 1997, 172 biomedical research-performing institutions started construction on 7.4 million NASF of research space. During this time period, 116 institutions started construction on 3.5 million NASF of research space in the biological sciences, while 81 institutions started construction on 3.9 million NASF of research space in the medical sciences (table 9-3). Construction projects were started at the different types of biomedical research-performing institutions as follows:

- Among colleges and universities, 89 institutions started construction on 1.9 million NASF of biomedical research space;
- Among medical schools, 47 institutions started construction on 3.4 million NASF of biomedical research space;
- Among nonprofit research organizations, 40 institutions started construction on 1.7 million NASF of biomedical research space; and
- Among research hospitals, 4 institutions started construction on 0.4 million NASF of biomedical research space.

Between 1994–95 and 1996–97, the amount of biomedical research space under construction increased by 74 percent or 3.1 million NASF (from 4.3 million to 7.4 million NASF). During this time period, the medical sciences experienced an appreciable increase of 76 percent (1.7 million NASF) of research space under construction (from 2.2 million to 3.9 million NASF). Among the different institution types, colleges and universities and medical schools experienced a substantial increase in biomedical research space under construction:

- At colleges and universities, the amount of biomedical research space under construction increased by 38 percent or 0.5 million NASF (from 1.4 million to 1.9 million NASF); and
- At medical schools, the amount of biomedical research space under construction increased by 48 percent or 1.1 million NASF (from 2.3 million to 3.4 million NASF).

In fiscal years 1998 and 1999, 203 biomedical research-performing institutions were scheduled to start construction on 10.7 million NASF of biomedical research space. During this time period, 155 institutions were scheduled to start construction on 7.4 million NASF of research space in the biological sciences, while 80 institutions were scheduled to start construction on 3.3 million NASF of research space in the medical sciences.

Construction projects were scheduled to start at the different types of biomedical research-performing institutions as follows:

- Among colleges and universities, 87 institutions were scheduled to begin construction on 3.3 million NASF of biomedical research space;
- Among medical schools, 45 institutions were scheduled to begin construction on 4.3 million NASF of biomedical research space;
- Among nonprofit research organizations, 64 institutions were scheduled to begin construction on 2.4 million NASF of biomedical research space; and
- Among hospitals, 23 institutions were scheduled to being construction on 0.7 million NASF of biomedical research space.

In fiscal years 1996 and 1997, biomedical research-performing institutions committed $2.2 billion to new construction projects costing over $100,000, an increase of 40 percent or $634 million over 1994–95 levels. Slightly more than half of these funds (53 percent or $1.2 billion) were committed to construction projects in the medical sciences, the remaining 47 percent or $1.0 billion were committed to construction projects in the biological sciences.

Table 9-3. Trends in the number of institutions starting biomedical research space construction projects costing more than $100,000, the amount of space constructed, and the cost of construction, by institution type, field, and fiscal year of project start: 1988–98

Fiscal Years	Institution type				All institutions		
	Academic institutions					Field	
	Colleges/ universities	Medical schools[2]	Research organizations	Hospitals	Total	Biological sciences	Medical sciences
Number of institutions starting construction[1]							
1988–89	94	46	18	10	158	--	--
1990–91	82	78	11	9	150	--	--
1992–93	63	54	13	16	151	--	--
1994–95	50	34	11	22	109	--	--
1996–97	89	47	40	4	172	116	81
1998–99 (scheduled)	87	45	64	23	203	155	80
Amount of new research space under construction [NASF in thousands]							
1988–89	1,855	2,660	245	1,057	5,817	2,853	2,982
1990–91	2,431	3,714	547	490	7,183	3,114	4,069
1992–93	1,838	4,175	483	513	7,010	2,686	4,324
1994–95	1,416	2,272	239	333	4,261	2,048	2,213
1996–97	1,949	3,353	1,742	354	7,398	3,496	3,903
1998–99 (scheduled)	3,312	4,340	2,386	678	10,715	7,382	3,333
Cost of new construction projects costing over $100,000 [in millions of constant 1997 dollars]							
1988–89	559	945	94	250	1,849	849	1,000
1990–91	715	1,231	140	193	2,280	1,090	1,189
1992–93	516	1,347	206	301	2,367	909	1,459
1994–95	537	792	71	205	1,605	879	726
1996–97	663	963	450	163	2,239	1,042	1,197
1998–99 (scheduled)	1,018	1,210	707	289	3,224	2,094	1,130

[1] The number of institutions across institution types does not sum to grand totals because many institutions contain both a college/university (exclusive of a medical school) and a medical school. In grand totals, medical schools are counted as separate institutions only if they are not part of larger universities.

[2] The number of medical schools is based on the sum of the weights of institutions with medical school research space. Medical schools were not an explicit strata in the sampling scheme. Thus, this number may not reflect the actual number of medical schools in the universe.

KEY: -- = data unavailable.
NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Among the different institution types, only medical schools committed substantially more funds to new construction projects in 1996 and 1997 ($963 million) than they did in fiscal years 1994 and 1995 ($792 million). However, the amount of funds they committed to new construction projects in fiscal years 1996 and 1997 is not substantially different than the amount of funds they committed to these types of projects a decade ago ($945 million).

In fiscal years 1998 and 1999, biomedical research-performing institutions were scheduled to commit $3.2 billion to new construction projects costing over $100,000. This is an increase of 44 percent or $985 million over 1996–97 levels.

Among the different institution types, only colleges and universities are scheduled to commit substantially more funds to new construction projects in fiscal years

1998 and 1999 ($1.0 billion) than they did in fiscal years 1996 and 1997 ($663 million). This is an increase of 54 percent or $355 million.

Repair/Renovation of Biomedical Research Space

In fiscal years 1996 and 1997, 379 biomedical research-performing institutions started repair/renovation projects on 9.0 million NASF of biomedical research space (table 9-4). This represents 21 percent more space under repair/renovation than under construction (see table 9-3). During this time period, 282 institutions began repair/renovation projects on 5.5 million NASF of research space in the biological sciences, while 172 institutions began repair/renovation projects on 3.5 million NASF of research space in the medical sciences.

Between 1994–95 and 1996–97, the amount of biomedical research space repaired or renovated increased by 26 percent or 1.8 million NASF (from 7.1 million to 9.0 million NASF). During this time period, the biological sciences experienced an appreciable increase of 94 percent (2.7 million NASF) of research space under repair/renovation. Among the different institution types, only colleges and universities experienced a substantial increase in the amount of new repair/renovation projects between 1994–95 and 1996–97. The amount of biomedical research space repaired or renovated at colleges and universities increased by 36 percent or 0.8 million NASF (from 2.4 million to 3.2 million NASF).

In fiscal years 1998 and 1999, 251 biomedical research-performing institutions were scheduled to begin repair/renovation projects on 7.7 million NASF of biomedical research space. During this time period, 174 institutions were scheduled to start repair/renovation projects on 4.5 million NASF of research space in the biological sciences, while 130 institutions were scheduled to start repair/renovation projects on 3.2 million NASF of research space in the medical sciences.

In fiscal years 1996 and 1997, biomedical research-performing institutions committed $770 million to new repair/renovation projects costing over $100,000. This was 66 percent or $1.5 billion less than they committed to new construction projects in 1996 and 1997 (see table 9-3). Slightly more than half of these funds (54 percent or $415 million) were committed to repair/renovation projects in the biological sciences, while the remaining 46 percent or $355 million were committed to repair/renovation projects in the medical sciences.

Overall, the amount of funds scheduled to be committed to new repair/renovation projects in 1998 and 1999 was not substantially different from the amount of funds they committed to these types of projects in 1996 and 1997.

In fiscal years 1998 and 1999, biomedical research-performing institutions were scheduled to commit $831 million to new repair/renovation projects. This was 74 percent less than they were scheduled to commit to new construction projects (see table 9-3). Slightly more than half of these funds (51 percent or $424 million) were scheduled to be committed to repair/renovation projects in the biological sciences, the remaining 49 percent ($407 million) were scheduled to be committed to repair/renovation projects in the medical sciences.

Sources of Funds for the Construction of Research Facilities at Biomedical Research-Performing Institutions

In fiscal years 1996 and 1997, State and local governments and debt financing each provided 27 percent of funds for all new science and engineering construction projects costing over $100,000 at biomedical research-performing institutions.[37] Institutional funds and private donations were the source for 19 and 18 percent, respectively, of funds for new construction projects, while the Federal Government contributed 8 percent of all construction funds (see table 9-5).

The largest source(s) of funds for new science and engineering construction projects at the different types of institutions was as follows:

- Colleges and universities derived the majority of their science and engineering construction funds from two sources—37 percent from State and local governments and 21 percent of from debt financing;
- Medical schools derived the majority of their construction funds from three sources—28 percent from institutional funds, 26 percent from State and local governments, and 22 percent from private donations;

[37] Sources of funds were not reported by field. Consequently, the distribution of construction funds across the various sources is for the biomedical fields and all other science and engineering fields (see Chapter 5).

Table 9-4. Trends in the number of institutions starting biomedical research facilities repair/renovation projects costing more than $100,000, the amount of space affected, and the cost of repair/renovation, by institution type, field, and fiscal year of project start: 1988–98

Fiscal Years	Institution type				All institutions		
	Academic institutions					Field	
	Colleges/ universities	Medical schools[2]	Research organizations	Hospitals	Total	Biological sciences	Medical sciences
Number of institutions starting repair/renovation projects[1]							
1988–89	132	76	34	39	241	--	--
1990–91	118	109	45	34	255	--	--
1992–93	121	89	30	34	228	--	--
1994–95	126	86	36	28	231	--	--
1996–97	199	92	76	49	379	282	172
1998–99 (scheduled)	162	62	28	22	251	174	130
Repair/renovation of research space [NASF in thousands]							
1988–89	2,910	2,856	355	333	6,454	3,854	2,600
1990–91	1,682	2,745	516	543	5,486	2,874	2,612
1992–93	1,588	2,542	268	770	5,168	2,848	2,320
1994–95	2,366	3,880	345	540	7,131	2,836	4,295
1996–97	3,207	3,703	1,683	376	8,969	5,498	3,471
1998–99 (scheduled)	4,332	2,759	215	397	7,702	4,523	3,180
Cost of repair/renovation projects costing over $100,000 [in millions of constant 1997 dollars]							
1988–89	228	292	37	92	649	337	419
1990–91	224	344	36	60	664	349	313
1992–93	156	399	43	151	749	409	340
1994–95	196	345	33	137	711	324	387
1996–97	277	360	81	52	770	415	355
1998–99 (scheduled)	357	376	48	50	831	424	407

[1] The number of institutions across institution types does not sum to grand totals because many institutions contain both a college/university (exclusive of a medical school) and a medical school. In grand totals, medical schools are counted as separate institutions only if they are not part of larger universities.

[2] The number of medical schools is based on the sum of the weights of institutions with medical school research space. Medical schools were not an explicit strata in the sampling scheme. Thus, this number may not reflect the actual number of medical schools in the universe.

KEY: -- = data unavailable.
NASF = net assignable square feet

NOTE: Components may not add to totals due to rounding. Current dollars have been adjusted to constant 1997 dollars using the Bureau of Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- Nonprofit research organizations derived the majority of their construction funds from two sources—49 percent from debt financing and 23 percent from State and local governments; and
- Research hospitals derived the majority of their construction funds from one source—91 percent from debt financing.

Sources of Funds for the Repair/Renovation of Research Facilities at Biomedical Research-Performing Institutions

In fiscal years 1996 and 1997, institutional funds were the largest source of funds (50 percent) for new science and engineering repair/renovation projects costing over

Table 9-5. Source of funds for the construction of research facilities at institutions with biomedical research space by year of project start and institution type: 1990–97

Source of funds and year of project start	All biomedical institutions	Institution type: Colleges and universities	Medical schools	Research organizations	Hospitals
Dollar contribution [in millions of constant 1997 dollars]					
1990–91	2,280	715	1,231	140	193
1992–93	2,367	516	1,347	206	301
1994–95	1,605	537	792	71	205
1996–97	2,239	663	963	450	163
Relative contribution [percentage of total cost]					
Federal Government:					
1990–91	13	19	11	15	0
1992–93	13	14	19	7	1
1994–95	5	4	6	0	0
1996–97	8	11	7	2	0
State and local governments:					
1990–91	21	29	22	2	0
1992–93	24	26	38	0	6
1994–95	35	49	22	0	0
1996–97	27	37	26	23	0
Private donations:					
1990–91	18	10	18	12	46
1992–93	13	12	7	22	16
1994–95	11	9	13	4	17
1996–97	18	16	22	19	4
Debt financing:*					
1990–91	28	30	28	46	0
1992–93	31	23	29	56	43
1994–95	30	26	36	49	61
1996–97	27	21	16	49	91
Institutional funds:					
1990–91	19	8	20	25	54
1992–93	16	21	7	15	7
1994–95	18	11	22	47	22
1996–97	19	14	28	7	5
Other:					
1990–91	1	4	1	0	0
1992–93	3	4	0	0	27
1994–95	0	1	0	0	0
1996–97	1	0	1	0	0

* Category includes tax-exempt bonds and other debt financing as reported in the questionnaire.

NOTES: Components may not add to totals due to rounding. Sources of funds information is not collected by field. Thus, the percentage of funds from each source is based on all S&E expenditures not just expenditures in biomedical fields. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Current dollars have been adjusted to constant 1997 dollars using the Bureau of Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

$100,000 at biomedical research-performing institutions.[38] State and local governments were the second largest source of funds (22 percent). Private donations and debt financing each accounted for 9 percent of funds for new repair/renovation projects, while the Federal Government contributed 8 percent of all repair/renovation funds (table 9-6).

The largest source(s) of funds for new science and engineering repair/renovation projects at the different types of institutions was as follows:

- Colleges and universities derived the majority of their science and engineering repair/renovation funds from two sources—45 percent from institutional funds and 26 percent from State and local governments;
- Medical schools derived the majority of their repair/renovation funds from two sources—56 percent from institutional funds and 19 percent from State and local governments;
- Nonprofit research organizations derived the majority of their repair/renovation funds from two sources—53 percent from institutional funds and 21 percent from private donations; and
- Research hospitals derived the majority of their repair/renovation funds from one source—89 percent from institutional funds.

Biomedical Research-Performing Institutions' Need for Research Facilities

In 1998, biomedical research-performing institutions reported $5.6 billion in combined capital projects (construction and repair renovation) that had to be deferred because of insufficient funds. Construction projects accounted for 64 percent ($3.6 billion) of the total deferred capital project costs (both included and not included in an institutional plan) (table 9-7).

Academic institutions accounted for 82 percent ($4.6 billion) of the total deferred costs, whereas nonprofit research organizations accounted for 10 percent ($587 million) and research hospitals account for 7 percent ($419 million).

More than half (61 percent or $2.8 billion) of the deferred costs in academic institutions was at colleges and universities, while the remaining 39 percent or $1.8 billion was at medical schools. Among colleges and universities, the deferred need was distributed as follows:

- The top 50 academic institutions accounted for $1.4 billion or 49 percent of the deferred need at colleges and universities;
- Other doctorate-granting institutions accounted for $1.2 billion or 43 percent of the deferred need; and
- Nondoctorate-granting institutions accounted for $0.2 billion or 9 percent of the deferred need.

More than half of the total deferred capital project costs (56 percent or $3.1 billion) were for projects in the biological sciences, while the remaining 44 percent or $2.5 billion in deferred costs were for projects in the medical sciences. Construction projects (both included and not included in an institutional plan) accounted for 62 percent of the deferred costs in the biological sciences ($1.9 billion) and 67 percent of the deferred costs in the medical sciences ($1.7 billion).

Biomedical Research Facilities at Historically Black Colleges and Universities

The Historically Black Colleges and Universities had 1.6 percent (2.34 million NASF) of all the science and engineering research space in the Nation's research-performing institutions in 1998 (143.3 million NASF) and 1.2 percent (670 thousand NASF) of all the biomedical sciences research space (56.2 million NASF). Overall, 73 percent (490 thousand NASF) of the HBCUs' biomedical sciences research space was in the biological sciences, the other 28 percent (190 thousand NASF) was in the medical sciences. The HBCUs' biomedical sciences research space was distributed unequally across institution types. More than half of the HBCUs' biomedical research space (60 percent or 400 thousand NASF) was located in colleges and universities, while the other 40 percent or 270 thousand NASF was located in medical schools (table 9-8).

Overall, 71 percent of the HBCUs with existing or needed research space in the biomedical sciences reported that the amount of research space they had was inadequate

[38] Ibid.

Table 9-6. Source of funds for the repair/renovation of research facilities at institutions with biomedical research space by year of project start and institution type: 1990–97

Source of funds and year of project start	All biomedical institutions	Institution type: Colleges and universities	Medical schools	Research organizations	Hospitals
Dollar contribution [in millions of constant 1997 dollars]					
1990–91	664	224	344	36	60
1992–93	749	156	399	43	151
1994–95	711	196	345	33	137
1996–97	770	277	360	81	52
Relative contribution [percentage of total cost]					
Federal Government:					
1990–91	5	4	5	19	3
1992–93	5	6	7	4	2
1994–95	8	8	7	2	1
1996–97	8	8	6	16	1
State and local governments:					
1990–91	20	33	18	0	2
1992–93	20	25	26	0	2
1994–95	14	15	14	7	0
1996–97	22	26	19	2	0
Private donations:					
1990–91	14	16	15	8	6
1992–93	8	10	9	15	2
1994–95	15	14	11	10	32
1996–97	9	9	8	21	10
Debt financing:*					
1990–91	10	2	14	16	8
1992–93	15	23	7	0	32
1994–95	13	14	16	28	8
1996–97	9	9	10	8	0
Institutional funds:					
1990–91	51	45	48	57	81
1992–93	50	35	48	81	62
1994–95	46	45	51	47	39
1996–97	50	45	56	53	89
Other:					
1990–91	0	0	0	0	0
1992–93	2	1	3	0	0
1994–95	3	4	0	6	21
1996–97	2	2	2	0	0

* Category includes tax-exempt bonds and other debt financing as reported in the questionnaire.

NOTES: Components may not add to totals due to rounding. Sources of funds information is not collected by field. Thus, the percentage of funds from each source is based on all S&E expenditures not just expenditures in biomedical fields. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Current dollars have been adjusted to constant 1997 dollars using the Bureau of Census' Composite Fixed-Weighted Price Index for Construction.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 9-7. Estimated costs for deferred capital projects to construct or repair/renovate biomedical research facilities by institution type, type of project, and whether project was included in an institutional plan: 1998

Institution type	Included in institutional plans			Not included in institutional plans			Total
	To construct new research facilities	To repair/ renovate existing research facilities	Subtotal	To construct new research facilities	To repair/ renovate existing research facilities	Subtotal	
	In millions of dollars						
Total	2,680	1,177	3,857	917	836	1,753	5,610
Academic institutions	2,265	1,067	3,332	493	780	1,272	4,604
Colleges/universities	1,309	634	1,943	344	521	865	2,808
Top 50	605	296	901	200	261	461	1,362
Other doctorate-granting	564	246	810	140	253	393	1,204
Nondoctorate-granting	140	92	232	4	7	11	243
Medical schools	955	434	1,389	149	258	407	1,796
Research organizations	178	78	256	314	17	331	587
Hospitals	238	32	270	110	40	150	419
Field							
Biological sciences	1,398	747	2,144	529	448	977	3,121
Medical sciences	1,283	431	1,714	388	388	776	2,490

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

to meet their current biomedical research commitments. Sixty-seven percent of all academic institutions reported inadequate amounts of biomedical research space.

With respect to the condition of their biomedical research space, the HBCUs rated 47 percent (315 thousand NASF) of their biomedical research space as "suitable for the most scientifically sophisticated research," whereas 45 percent of the biomedical research space at all academic institutions was rated this way. By contrast, the HBCUs rated 8 percent (54 thousand NASF) of their biomedical research space as needing major repair/renovation or replacement, whereas 21 percent of the biomedical research space at all academic institutions was reported as being in this condition.

In fiscal years 1996 and 1997, 6 HBCUs began construction on 111 thousand NASF of biomedical research space at an expected completion cost of $31 million. In 1998 and 1999, 8 HBCUs were scheduled to begin construction on 139 thousand NASF of biomedical research space at an expected completion cost of $40 million.

Similarly, in fiscal years 1996 and 1997, 8 HBCUs began new repair/renovation projects on 93 thousand NASF of biomedical research space at an expected completion cost of $6.0 million. In 1998 and 1999, 6 HBCUs were scheduled to begin new repair/renovation projects on 223 thousand NASF of biomedical research space at an expected completion cost of $8.9 million.

Animal Research Facilities at Biomedical Research-Performing Institutions

In 1998, 700 of the 908 biomedical research-performing institutions (77 percent) had animal laboratory facilities. While 85 percent of the academic

Table 9-8. Amount, condition, adequacy, construction, and repair/renovation of biomedical research facilities at Historically Black Colleges and Universities (HBCUs) compared to all academic institutions: 1998

Indicator	HBCUs	All academic institutions*
Number of institutions	57	660
Amount of S&E research space [NASF in millions]		
All S&E fields	2.34	143.3
Biomedical sciences, total	0.67	56.2
Colleges and universities	0.40	26.4
Biological sciences	0.31	19.4
Medical sciences	0.10	7.0
Medical schools	0.27	29.8
Biological sciences	0.18	11.6
Medical sciences	0.09	18.1
Adequacy of current amount of biomedical research space [percentage of institutions]		
Sufficient to support needs of current biomedical research program commitments	29	33
Not sufficient to support needs of current biomedical research program commitments	71	67
Condition of existing biomedical research space [percentage of space]		
Suitable for use in the most sophisticated scientific research	47	45
Effective for most uses but may need limited repair	45	33
Requires major repair/renovation to be used effectively	7	17
Requires replacement	1	4
Construction projects: fiscal years 1996–97		
Number of institutions with projects >$100,000	6	128
Biomedical research space to be constructed [NASF in thousands]	111	5,303
Expected cost [in thousands of dollars]	31,258	1,625,638
Sources of funds for all construction projects [percentage of total cost]		
Federal Government	7	9
State and local governments	76	31
Private donations	5	19
Institutional funds	2	19
Debt financing	7	21
Other	3	1
Scheduled construction projects: fiscal years 1998–99		
Number of institutions planning projects >$100,000	8	117
Biomedical research space to be constructed [NASF in thousands]	139	7,652
Expected cost [in thousands of dollars]	40,195	2,227,605
Repair/renovation projects: fiscal years 1996–97		
Number of institutions with projects >$100,000	8	244
Biomedical research space to be repaired or renovated [NASF in thousands]	93	6,897
Expected cost [in thousands of dollars]	6,042	637,046
Scheduled repair/renovation projects: fiscal years 1998–99		
Number of institutions planning projects >$100,000	6	189
Biomedical research space to be repaired or renovated [NASF in thousands]	223	7,927
Expected cost [in thousands of dollars]	8,850	732,933

* Includes all academic institutions, with and without biomedical research space.

KEY: NASF = net assignable square feet.
S&E = science and engineering

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

institutions and 80 percent of the research hospitals had animal laboratory facilities, less than half (46 percent) of the nonprofit research organizations had such facilities (table 9-9).

The biomedical research-performing institutions reported a total of 14 million NASF of animal research space at biomedical research-performing institutions. Most of that space (83 percent or 12 million NASF) was located in the academic institutions. The nonprofit research organizations accounted for 12 percent of all the animal research space (1.7 million NASF), while the research-performing hospitals account for 5 percent (0.7 million NASF). The majority of animal research space (71 percent or 10 million NASF) was animal housing space, the remaining 29 percent (4 million NASF) was animal research space.

Institutions with animal research space reported that 69 percent (9.8 million NASF) of that space was at Federal biosafety Level 1 (i.e., acceptable for work with microorganisms not known to cause disease in healthy humans). Another 28 percent (4.0 million NASF) of that space was at Level 2 (i.e., acceptable for work with moderate-risk agents present in the community and associated with human disease of varying severity), and 4 percent (0.6 million NASF) was at Level 3 (i.e., acceptable for work with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection). No biomedical research-performing institution had animal research space at Level 4 (i.e., acceptable for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure).

Overall, 88 biomedical research-performing institutions were scheduled to start construction on 1.2 million NASF of animal research facilities at an estimated cost of $462 million in 1998 and 1999. The scheduled construction projects across institution types were as follows:

- Among academic institutions, 35 institutions were scheduled to start construction on 492 thousand NASF of animal research space at an estimated cost of $162 million in 1998 and 1999;
- Among nonprofit research organizations, 45 institutions were scheduled to start construction on 422 thousand NASF of animal research space at an estimated cost of $143 million 1998 and 1999; and
- Among research hospitals, 8 institutions were scheduled to start construction on 242 thousand NASF of animal research space at an estimated cost of $157 million in 1998 and 1999.

Similarly, 69 biomedical research-performing institutions were scheduled to start repair/renovation projects on 350 thousand NASF of animal research space at an estimated cost of $69 million in 1998 and 1999. The scheduled repair/renovation projects across institutions types were as follows:

- Among academic institutions, 56 institutions were scheduled to start repair/renovation projects on 303 thousand NASF of animal research space at an estimated cost of $45 million in 1998 and 1999;
- Among nonprofit research organizations, 6 institutions were scheduled to start repair/renovation projects on 28 thousand NASF of animal research space at an estimated cost of $7 million 1998 and 1999; and
- Among research hospitals, 7 institutions were scheduled to start repair/renovation projects on 20 thousand NASF of animal research space at an estimated cost of $18 million in 1998 and 1999.

Appendix A

Technical Notes

Technical Notes

This appendix discusses the study methodology as well as various other technical aspects that the reader should consider when interpreting the data presented in this report. In addition to the current 1998 survey, the discussion includes the original 1988 survey, and the 1990, 1992, 1994, and 1996 surveys. The following topics are covered:

- Sampling procedures and response rates
- Survey questionnaire
- Data collection
- Item nonresponse
- Weighting
- Reliability of survey estimates
- Data considerations, definitions, and limitations

Sampling Procedures and Response Rates

A. Academic Institutions

1988 Survey

The 1988 survey was designed to provide estimates for all research-performing academic institutions as defined in the National Science Foundation's (NSF) fiscal year (FY) 1983 Survey of Scientific and Engineering Expenditures at Universities and Colleges. The universe datafile for the 1983 expenditures survey included *all* universities and colleges that offered a master's or doctorate degree in science and engineering, all others that reported separately budgeted S&E research and development expenditures of $50,000 or more, and all Historically Black Colleges and Universities that reported any R&D expenditures. This datafile represented the most recent available universe survey of R&D expenditures at academic institutions. The datafile contained a total of 566 institutions.

All HBCUs in the frame were included in the sample with certainty (N=30), and a stratified probability sample of 223 institutions was selected from among the remaining institutions in the frame. These institutions were first stratified by control (public versus private) and highest degree awarded in S&E (doctorate-granting versus nondoctorate-granting). A minimum sample size of 25 was set for each of the four resulting strata, and the remaining sample was allocated to strata in proportion to the "size" of each stratum. Stratum size was defined as the square root of the aggregate R&D expenditures in S&E of the institutions in the stratum. Academically administered Federally Funded Research and Development Centers were excluded from this survey. Within strata, institutions were sampled with probability proportionate to size. Again, size was defined as the square root of the institution's FY 1983 R&D expenditures.

Following the selection of an initial sample of 253 institutions, NSF determined that several of the sampled institutions were out of scope of the survey. Out of scope institutions included those in outlying territories, military academies, and three highly specialized institutions considered inappropriate given the nature of their programs. Elimination of these out-of-scope cases reduced the final sample to 247 institutions, of which 29 were HBCUs and 99 had (or were) medical schools.

Institutions in the sample accounted for more than 75 percent of all academic R&D expenditures in FY 1983 and encompassed at least 70 percent of the spending in each major S&E discipline. The sample represented a weighted national total of 525 institutions. The composition of this survey universe by type of institution is shown in table A-1.

Table A-1. Number of institutions in the survey universe of research-performing colleges and universities: weighted estimates, 1988

Institution type	Total	Non-HBCUs		HBCUs
		Public	Private	
Total	525	296	200	29
Doctorate-granting	293	190	100	3
Top 100 in research expenditures	100	69	31	0
Other	193	121	69	3
Nondoctorate-granting	232	106	100	26

KEY: HBCU = Historically Black Colleges and Universities.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1988 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

1990 Survey

The institution sample for the 1990 survey was the same as for the 1988 survey, except for two changes:

- The sample was updated to reflect recent R&D patterns as shown in NSF's fiscal year 1988 R&D expenditures survey, which collected expenditures data for all institutions in the survey frame for the first time since 1983. School-by-school comparisons of these two databases resulted in the identification of 12 institutions whose 1988 R&D expenditures would have given them substantially higher probabilities of selection than they had using 1983 expenditures. These 12 institutions were made certainty selections for the 1990 survey. Five were already in the sample, having been noncertainty selections in the 1988 study; the other seven were added to the sample for the 1990 survey.

- One institution from the 1988 sample became out of scope when it distributed its assets among other institutions in the same state system. Therefore, this institution was eliminated from the sample.

The same changes noted above produced a net increase of six institutions, increasing the sample size to 253 in 1990. The universe represented by the sample, however, did not change.

1992 Survey

The institution universe and sample for the 1992 survey were the same as for the 1990 survey, except for three changes:

- Shortly after the sample for the 1990 facilities survey was selected, NSF conducted a universe survey of all HBCUs and identified an expanded group of 70 that reported separately budgeted R&D expenditures in S&E disciplines. A sample of 46 of these 70 institutions was selected for the 1992 facilities survey, with probability proportionate to size. Size was measured as the square root of the institution's reported 1989 R&D expenditures (a minimum size measure of $10,000 was used to afford the smallest institutions some possibility of selection).

- The sample was expanded to include all institutions in the top 100 in 1988 R&D expenditures. Only two institutions from this analytically-important category were not already in the sample, and they were made certainty selections in 1992.

- To improve the precision of estimates for nondoctorate-granting institutions, an expanded sample of 91 institutions in this category was selected (excluding HBCUs, which were sampled separately). The sample included all (10) public institutions with 1988 R&D expenditures of $2 million or more, and all (11) private institutions with 1988 expenditures of $1 million or more. Institutions with R&D expenditures below these cutoffs were sampled with equal selection probabilities.

Of the 91 sampled nondoctorate-granting institutions, nine were later determined to be out of scope, since they reported in the 1992 facilities survey that they had no S&E research space and also reported in the 1988 R&D expenditures survey (which provided the basis for the sampling frame) that they had less than $50,000 in separately budgeted R&D expenditures. The exclusion of these out-of-scope institutions reduced the sample of nondoctorate-granting institutions to 82.

1994 Survey

The institution universe and sample for the 1994 survey closely matched the 1992 survey, with the following exceptions:

- The 1991 R&D expenditures survey information was used to generate the top 100 stratum. Three institutions were added to the top 100 list, and three institutions were moved out. The expenditures data also were used to calculate the measure of size for the doctorate-granting institutions. The 1988 expenditures survey data were used to calculate size measures for the nondoctorate-granting institutions, because subsequent surveys did not yield complete information for the nondoctorate-granting institutions.

- Institutions expending less than $50,000 in R&D in S&E fields were removed from the frame prior to sampling. In 1992, they were selected with probability proportionate to size and then excluded after contact.

- FICE codes were updated for 50 institutions.[1]

[1] This is the Federal Interagency Commission on Education number assigned by the Department of Education. Numbers beginning with 66 are for accredited institutions, which have not yet received a FICE number. These are identification numbers for the record file only.

- Six institutions were misclassified with the 1992 sampling list as nondoctorate-granting, when in fact they did award S&E doctorates. These misclassifications were corrected.

- Random (rather than systematic) draws from the strata were employed.

- The HBCUs selected with certainty were redefined to include 28 from the 1990 list,[2] plus all of the new institutions selected with certainty in 1992. This meant that a total of 33 HBCUs was selected with certainty and 12 others were selected with probability proportionate to size.

Of the 314 sampled institutions, five nondoctorate-granting institutions were later determined to be out-of-scope, because they reported no S&E research space. The exclusion of these out-of-scope institutions reduced the sample to 309.

1996 Survey

The institution universe and sample for the 1996 survey were the same as the universe and sample for the 1994 survey. No institutions were added, and none were deleted.

Seven of the nondoctorate-granting institutions in the sample reported no S&E research space in their survey response and were determined to be out of scope. The exclusion of these seven institutions reduced the sample to 307.

1998 Survey

The sampling frame for the 1998 survey was increased to 675 institutions to accommodate additional coverage for Hispanic-serving institutions and non-HBCU-Black institutions. The 1998 sampling frame included 675 institutions drawn from the most recent census of institutions reported in the 1993 Academic R&D Expenditures Survey. Fifteen institutions in the sampling frame reported no science and engineering research space and were determined to be out of scope for the current survey. The exclusion of these institutions reduced the universe to 660 institutions. The universe was divided into the following nine strata to ensure representativeness:

1. The top 100 colleges and universities in terms of the size of R&D expenditures, where size was defined as the square root of the 1993 R&D expenditures in thousands;
2. The original panel of 29 HBCUs that has been selected to the sample with certainty since the 1988 NSF Facilities survey;
3. The remaining 35 HBCUs in the sampling frame;
4. Non-HBCU-Black institutions—institutions that enrolled at least 25 percent black students according to the Integrated Postsecondary Education Data System (IPEDS);
5. Hispanic-serving Institutions—institutions that enrolled at least 25 percent Hispanic students according to IPEDS;
6. Other public doctorate-granting institutions;
7. Other private doctorate-granting institutions;
8. Public nondoctorate-granting institutions; and
9. Private nondoctorate-granting institutions.

Because these strata are not mutually exclusive categories, they were defined in a hierarchical manner. Stratum 1 was formed first so that all institutions in the top 100 were included irrespective of whether they could be included in any other stratum. Stratum 2, the 29 HBCUs in the sample since the 1988 NSF Facilities survey, was the second stratum formed. Stratum 3, the remaining 35 HBCUs, was the third stratum formed. Stratum 4, 13 institutions that enrolled at least 25 percent black students yet were not HBCUs, was the fourth stratum formed. The first four strata are mutually exclusive groups (i.e., no HBCU or non-HBCU-Black institution is found in the top 100). In the universe of all research-performing institutions with S&E research space, there were 13 institutions that enrolled at least 25 percent Hispanic students. Four institutions, however, had already been selected into other strata. Thus, Stratum Five only includes nine institutions. Institutions in the first five strata were all selected into the sample with certainty (i.e., all institutions were part of the sample).

The remaining 481 institutions in the universe formed the final four strata based on their institution type (e.g. doctorate-granting vs. nondoctorate-granting) and institutional control (e.g. public vs. private). Within each of these four strata, institutions were sampled using a probability proportional to size sampling scheme so that the larger institutions were selected with higher probability than the smaller ones. The size of the institution was defined as the square root of the 1993 R&D expenditures in thousands. Within each of these four strata, the minimum size of the institution was defined as 40 for doctorate-granting institutions and for public nondoctorate-granting institutions. The minimum size of the institution for private nondoctorate-granting institutions was defined as 11.

[2] One of the 29 HBCUs selected with certainty in 1990 was excluded because it had no currently funded R&D at the time the sample was taken.

Table A-2, below, presents the number of institutions in the sampling frame, eligible population, sample, and respondents, by stratum, as previously described.

The overall response rate for the 1998 survey was 86.9 percent. The response rate varied from 100 percent of the top 100 institutions to 73.2 percent of institutions sampled from stratum nine.

Table A-3 presents the number of non-HBCU institutions by institution type in the universe in all survey periods between 1990 and 1998.

Table A-4 presents the number of institutions within each stratum by institution type and control. Seventy of the top 100, 143 of other doctorate-granting, and 151 of nondoctorate-granting institutions are public institutions. Thirty of the top 100, 134 of the other doctorate-granting, and 131 of the nondoctorate-granting institutions are private institutions.

Table A-5 presents the number of HBCU, non-HBCU-Black, and Hispanic-serving institutions within each stratum. Only Strata 2 and 3 contained HBCUs. All non-HBCU-Black institutions fell within Stratum 4. The 13 Hispanic-serving institutions were drawn from Strata 1, 4, and 5. Three minority-serving institutions had enrollments of at least 25 percent black and at least 25 percent Hispanic students. These institutions were considered non-HBCU-Black institutions in all analyses in this report.

Table A-6 presents the number of HBCUs with S&E research space in the universe by institution type in each of the surveys between 1990 and 1998.

Table A-2. The number of academic institutions in the sampling frame, eligible population, sample, and the number of respondents, by stratum: 1998

Strata	Description	Sampling frame	Out of scope[3]	Eligible Population	Sample	Respondents	Response rate [percent]
Total	All research-performing institutions	675	15	660	350	304	86.9
1	Top 100 institutions	100	0	100	100	100	100.0
2	29 selected HBCUs	29	0	29	29	28	96.6
3	Remaining (35) HBCUs	35	7	28	28	24	85.7
4	Non-HBCU-Black institutions[1]	15	2	13	13	10	76.9
5	Hispanic-serving institutions[2]	9	0	9	9	7	77.8
6	Public doctorate-granting institutions	129	0	129	47	39	83.0
7	Private doctorate-granting institutions	127	4	123	42	33	78.6
8	Public nondoctorate-granting institutions	114	1	113	41	33	80.5
9	Private nondoctorate-granting institutions	117	1	116	41	30	73.2

[1] Non-HBCU-Black institutions enrolled at least 25 percent black students according to the Integrated Postsecondary Education Data System.

[2] Hispanic-serving institutions enrolled at least 25 percent Hispanic students according to the Integrated Postsecondary Education Data System.

[3] Institutions were determined to be out of scope if they had no S&E research space.

KEY: HBCU = Historically Black Colleges and Universities
S&E = science and engineering

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table A-3. Number of respondent non-HBCU institutions in the 1990, 1992, 1994, 1996, and 1998 samples of research-performing colleges and universities by institution type and institutional control

Institution type	Total					Public					Private				
	1990	1992	1994	1996	1998	1990	1992	1994	1996	1998	1990	1992	1994	1996	1998
Total	224	257	265	254	252	138	157	161	156	155	86	100	104	98	97
Doctorate-granting	173	175	177	173	178	115	117	117	116	112	58	58	60	57	66
Top 100 in research expenditures	98	100	100	100	100	67	69	70	70	70	31	31	30	30	30
Other	75	75	77	73	78	48	48	47	46	42	27	27	30	27	36
Nondoctorate-granting	51	82*	88	81	74	23	40	44	40	43	28	42	44	41	31

*Sample initially included nine other institutions that were later classified as out of scope of the study.

KEY: HBCU = Historically Black Colleges and Universities.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table A-4. Number of academic institutions by sampling stratum, institution type, and institutional control: 1998

Stratum	Doctorate-granting				Nondoctorate-granting		Grand Total
	Top 100		Other				
	Public	Private	Public	Private	Public	Private	
Total	70	30	143	134	151	131	660
1	70	30	0	0	0	0	100
2	0	0	10	5	11	2	29
3	0	0	0	2	14	12	28
4	0	0	1	3	8	1	13
5	0	0	3	1	5	0	9
6	0	0	129	0	0	0	129
7	0	0	0	123	0	0	123
8	0	0	0	0	113	0	113
9	0	0	0	0	0	116	116

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilites at Colleges and Universities.

B. Research Organizations and Hospitals

In preparation for the 1988 survey, NIH provided listings of all hospitals and nonprofit research organizations that received extramural research funding from NIH during FY 1986. A small number of agencies and institutions that primarily conduct public information dissemination or other nonresearch activities were eliminated from the listings.

Samples of 50 hospitals and 50 research organizations were selected from the listings, with probability proportional to size, as measured by total dollar awards from NIH in FY 1986. It was determined during data collection, however, that there was some duplication in the listings. Some nonprofit research institutions were located within hospitals and shared the same facilities, and some of the research organizations were units within other sampled research organizations. In addition, some of these institutions have been classified as out of scope of the survey based on their reports that they do not contain

Table A-5. Number of minority institutions by sampling stratum: 1998

Stratum	HBCUs	Non-HBCU-Black	HSIs	All minority-serving institutions
Total	57	13	13	80
1	0	0	1	1
2	29	0	0	29
3	28	0	0	28
4	0	13	3*	13
5	0	0	9	9
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0

* Three institutions were both non-HBCU-Black and Hispanic-serving institutions. These institutions were considered non-HBCU-Black institutions in all analyses.

KEY: HBCU = Historically Black Colleges and Universities.
HSI = Hispanic-serving Institutions.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table A-6. Number of Historically Black Colleges and Universities (HBCUs) in the 1990, 1992, 1994, 1996, and 1998 samples of research-performing colleges and universities

Institution type	1990	1992	1994	1996	1998
Total	29	46	44	44	57
Doctorate-granting	3	5	8	10	18
Top 100 in research expenditures	0	0	0	0	0
Other	3	5	8	10	18
Nondoctorate-granting	26	41	36	34	39

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

any research space (e.g., because their research grants have expired or because their current research is conducted entirely off premises). Elimination of duplicate and out-of-scope institutions has reduced the number of research organizations to 47 sampled in 1988 and the number of sampled hospitals to 42.

In 1994, an updated list of hospitals and research organizations that received extramural research funding from NIH during FY 1992 provided the sampling frame. Fifty hospitals and 50 research organizations were initially selected. One institution was eliminated from each of these samples either because it was a duplicate or out of scope for this study. This resulted in a sample of 49 hospitals and 49 research organizations. Like the sample of academic institutions, the 1996 sample of hospitals and research organizations was the same as that used in 1994.

The sampling frame for the 1998 survey included 126 hospitals and 175 research organizations. One hospital and four research organizations were eliminated from this sampling frame because they were out of scope for this study. This resulted in an eligible population of 125 hospitals and 171 research organizations. The research organizations and hospitals in the 1998 sample were drawn from an updated list of institutions receiving funding from NIH in FY 1997. Forty-six research organizations and 49 hospitals were sampled using a probability proportional to size (PPS) sampling scheme so that the larger institutions were selected with higher probability than the smaller ones. The measure of size of the institution was defined as the total dollar amount of NIH research funding each institution received in 1997. The PPS selection was accomplished using a systematic sampling scheme. With systematic PPS sampling, each selection represents a certain portion of the total population—in this case, a portion of the total dollars in grant awards. Institutions that received more grants than this amount are included in the sample with certainty. Sixteen research organizations and 29 hospitals were selected with certainty. The remaining 30 research organizations and 20 hospitals were sampled with uncertainty.

Table A-7 presents the number of institutions in the sampling frame, eligible population, sample, and respondents, by stratum, as previously described.

Eighty-three of the 95 sampled research organizations and hospitals (87.4 percent), completed the survey.

Biomedical institutions are the focus of chapter 9 of this report. There are five mutually exclusive categories of biomedical institutions:

1. Colleges and universities with no affiliated medical school;

2. Colleges and universities with an affiliated medical school;

3. Independent medical schools;[3]

4. Research hospitals; and

5. Nonprofit research organizations.

Colleges and universities with an affiliated medical school are counted as both a college or university and as a medical school in all tables reporting the number of institutions. Their biological and medical science research space—existing, needed, constructed, deferred, and repaired/renovated—and the associated expenditures are divided between the college or university and the medical school categories depending on whether the research space or capital project was designated as inside or outside a medical school. That is, while the institution is counted twice, its research space and associated costs are not.

Two notes of caution are necessary regarding the medical school information. A few institutions reported no existing medical school research space yet reported actual or planned construction or repair/renovation of medical school research space. Thus, the 'medical school' category does not refer to a constant group of institutions across all tables in Chapter 9. Second, the number of medical schools is based on the sum of the weights of the institutions with research space inside medical schools. Medical schools were not an explicit stratum in the sampling scheme. Thus, the number of medical schools reported may not reflect the actual number of medical schools in the universe.

Table A-8 presents the number of institutions within each stratum by institution type that reported existing research space in the biological or medical sciences, inside and outside of medical schools.

Out of the 956 institutions in the eligible population, 908 reported existing biomedical research space. The majority of the 48 academic institutions with no biomedical research space were nondoctorate granting.

THE SURVEY QUESTIONNAIRE

The 1998 survey questionnaire, reproduced in Appendix C, updated information collected during earlier (1988, 1990, 1992, 1994, and 1996) surveys regarding several topics:

- The total net assignable square feet of space in science and engineering disciplines, and the NASF used for instruction and research;
- The total amount of space in all nonscience disciplines, and an overall space total across all academic disciplines;
- The amount of research space that is leased by the institution;

[3] An independent medical school is a medical school with its own FICE code. An independent medical school may or may not be affiliated with a college or university.

Table A-7. The number of research organizations and hospitals in the sampling frame, eligible population, sample, and the number of respondents, by stratum: 1998

Strata	Description	Sampling frame	Out of Scope[2]	Eligible population	Sample	Respondents	Response rate
Total	All 1997 NIH grant recipients[1]	301	5	296	95	83	87.4
10	Research hospitals	126	1	125	49	42	85.7
11	Nonprofit research organizations	175	4	171	46	41	89.1

[1] These figures include only those institutions that received NIH grants and were either research hospitals or nonprofit research organizations. Other types of institutions that received NIH grants are not included.

[2] Institutions were determined to be out of scope if they had no S&E research space.

KEY: S&E = science and engineering
NIH = National Institutes of Health

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table A-8. Number of institutions with biomedical research space by sampling stratum: 1998

Stratum	Academic institutions: Colleges & universities with no affiliated medical school	Academic institutions: Colleges & universities with affiliated medical schools	Academic institutions: Independent medical schools	Research hospitals	Nonprofit research organizations	All institutions with biomedical research space
Total	467	103	42	125	171	908
1	37	57	6	0	0	100
2	26	1	2	0	0	29
3	28	0	0	0	0	28
4	9	1	1	0	0	12
5	9	0	0	0	0	9
6	99	18	8	0	0	126
7	66	25	24	0	0	115
8	88	0	0	0	0	88
9	105	0	0	0	0	105
10	0	0	0	125	0	125
11	0	0	0	0	171	171

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

- The condition of research facilities in each S&E discipline;
- The adequacy of the current amount of research space, by S&E discipline;
- The project costs, NASF, and sources of funds for major construction and repair/renovation activities (costing over $100,000) initiated in FYs 1996 and 1997 and scheduled for FY 1998 or 1999;
- Expenditures for research facility repair/renovation projects costing $5,000 to $100,000;
- The existence of an approved institutional plan that included deferred space requiring new construction or repair/renovation;
- The estimated costs for needed new construction and repair/renovation by S&E discipline that the institution had not scheduled to begin during FY 1998 or 1999; and
- Scheduled expenditures for FY 1998 or 1999 for construction and repair/renovation of research laboratory animal facilities.

In addition to collecting updated information on the above topics, the 1998 questionnaire added two new questions:

- A listing of any nonfixed equipment costing at least $1 million that was included in the cost of new construction or repair/renovation during FYs 1996 and 1997; and
- The amount of indirect costs recovered from Federal grants and/or contracts that is included in "institutional funds" if institutional funds was a source of funding for any new construction or repair/renovation activity in FYs 1996 and 1997.

The response categories for one question were modified slightly in 1998 from previous years' surveys. When classifying the current condition of research space, a distinction is made between research space that requires major renovation to be used effectively and research space that requires replacement. In 1996, these two categories were combined.

In addition, a modification was made to the categorization of laboratory animal facilities in relation to government regulations. In 1998, the categories reflect

the four levels of Animal Biological Safety, as described in *Biosafety in Microbiological and Biomedical Laboratories.*[4]

Finally, the 1998 questionnaire eliminated the question used in 1996 regarding the status of the institutions relative to the cap on tax-exempt bonds (applicable only to private universities and colleges).

World-Wide Web Survey

For the first time since the facilities survey began in 1988, institutions had the option in 1998 of responding to the survey either on the printed questionnaire or using an Internet-based version of the survey on the World-Wide Web. Institutions were encouraged to utilize the Internet version, which contained their 1996 responses. The Internet version was programmed to detect logic errors across the 1998 survey items, as well as inconsistencies from the institution's 1996 responses. Each institution was assigned an individual login and password to access the Internet survey.

Data Collection

A. Academic Institutions

In January 1998, a letter from Neal Lane, Director of the National Science Foundation, was sent to the president or chancellor of each sampled institution asking that the institution participate in the study and that a coordinator be named for the survey. A letter of endorsement of the project signed by the heads of two higher education associations also was enclosed. A few days after the two-week deadline for returning the coordinator identification card, telephone follow-up was conducted with all sampled institutions that had not yet identified a survey coordinator. Survey materials, including printed surveys, instructions for the Internet version of the survey, and facsimiles of the 1996 responses for each institution were sent to the coordinator in mid-February by overnight mail. The questionnaire and cover letter requested return of the completed survey by March 31, 1998. At the end of March, few surveys had been returned and the deadline was extended to late April 1998. All institutions were notified of the extension. Nonresponse follow-up began in mid-March and continued through July 1998.

B. Research Organizations and Hospitals

In May 1998, a letter from Judith Vaitukaitus, Director of the National Center for Research Resources, was mailed to the president, CEO, or director of each sampled organization asking that the institutions participate in the study and that a survey coordination be named for the survey. Survey packets, including printed surveys, instructions for completing the Internet survey, and facsimiles of the 1996 responses for each institution were sent to each coordination on a rolling basis, beginning on June 6, 1998. Although the return deadline for the survey was June 30, 1998, by the end of July, few responses had been received. The survey deadline was extended until September 25, 1998. Reminder phone calls were made and faxes were sent to determine participation status for the nonrespondents beginning in mid-June and continuing through September.

As printed versions of the survey were returned, responses were entered into the Internet version to run the series of logic and arithmetic checks. Responses returned on the Internet version were available immediately for analysis. Telephone followup was conducted with the institutions to resolve data inconsistencies discovered during analysis.

Item Nonresponse

After machine editing of questionnaire responses for completeness, internal consistency, and consistency with data from previous surveys, extensive telephone data retrieval was conducted to minimize the amount of missing data or otherwise problematic responses to individual questionnaire items. As a result of these persistent follow-up activities, most of the individual items had very low item nonresponse rates.

One exception was item 1a, which requested the total amount of academic space in all disciplines outside S&E fields. As in previous surveys, this item was difficult for some institutions to answer and, though data retrieval was attempted, it had a higher nonresponse rate (20 missing responses or 6.6 percent) than other items. Items on the amount (Item 1), adequacy or inadequacy assessment (Item 2), current condition (Item 3), completed construction and repair/renovation (Item 4), planned construction

[4] U.S. Government Printing Office (1993). *Biosafety in Microbiological and Biomedical Laboratories* (3rd Edition). Washington, D.C.: U.S. Government Printing Office.

and repair/renovation (Item 6), and additional need (Item 7) of research space had fewer than 2 percent missing values in each field.

Missing values were imputed for questionnaire items that were included in the data analysis. Missing data on total academic space outside S&E fields were imputed based on the ratio of total academic space to total space in S&E fields. In Items 2 and 3, reported percentages were converted to NASF based on the amount of research space in Item 1. In Items 4, 6, and 8 (on completed capital projects, planned capital projects, and scheduled animal facility improvement) most missing values involved either missing costs or missing NASF, but not both. In these cases, the missing data element was imputed from the reported element using 1996 data on average cost per NASF to estimate the one from the other.

Missing values that could not be imputed using the above methods were imputed using a "hot deck" approach. This involved imputing the missing value from a "donor" institution that did provide the needed information and that was as closely matched as possible to the institution with the missing information in terms of control, type (doctorate-granting or nondoctorate-granting) and size of research expenditures.

Weighting

After data collection, sampling weights were created for use in preparing national estimates from the data. First, within each weight class, a base weight was created for each institution in the sample. The base weight is the inverse of the probability of selecting the institution for the sample. Second, because some institutions in the sample did not respond to the survey, the base weights were adjusted in each weight class to account for this unit nonresponse. Finally, the weights were adjusted again to make the number of estimated institutions equal to the known number of institutions in various categories. For this final "poststratification" adjustment, the institutions were classified by type (top 100 in research expenditures, other doctorate-granting, nondoctorate-granting, control, and HBCU status. The poststratified weights were used to produce the estimates shown in this report. The weighting procedures were essentially the same as those employed in the 1988, 1990, 1992, 1994 and 1996 studies.

Reliability of Survey Estimates

The findings presented in this report are based on a sample and are therefore subject to sampling variability. Sampling variability arises because not all institutions are included in the study. If a different sample of institutions had been selected, the results might have been somewhat different. The standard error of an estimate can be used to measure the extent of sampling variability for that particular estimate.

One of the ways that the standard error can be used is in the construction of confidence intervals. If all possible samples were selected and surveyed under similar conditions, then the intervals of two standard errors below the estimates to two standard errors above the estimates would include the average result of these samples in about 95 percent of the cases. Because only one sample is actually selected and surveyed, the standard error must be estimated from the sample itself. The interval constructed using the estimated standard error from the sample is called a 95-percent confidence interval. In this report, discussion is limited to group differences or changes over time that fell outside the 95-percent confidence intervals of the 1998 estimates.

Another way standard errors are used is to calculate coefficients of variation. The coefficient of variation is calculated by dividing the estimates' standard error by the estimate. For example, if an estimate had a mean of 1000 and a standard error of 130, the estimate's coefficient of variation would be 13 percent. In this report, discussion is limited to estimates whose coefficient of variation was less than 25 percent.

In past reports, the standard errors were estimated using the jackknife repeated replication method. The jackknife replication method involves dividing the full sample into a number of replicates and estimating the standard errors based on the variability among these replicates. For the 1998 survey, the standard errors were generated using the Taylor series linearization method to approximate functions of linear statistics estimated from the sample. The statistical software package STATA was used for this variance estimation. Estimated standard errors for selected statistics are shown in table A-9.

Data Considerations, Definitions, and Limitations

In addition to sampling errors, survey estimates can be adversely affected by nonsampling errors. Errors of this type include those resulting from reporting and processing of data. In this survey, extensive follow-up with respondents was conducted to ensure that the data were as accurate as possible. This follow-up included a cross-year review that verified inconsistencies between the current and previous questionnaires.

Table A-9. Standard errors (S.E.) for selected estimates

Item	Total		Doctorate-granting						Nondoctorate-granting		Public		Private	
			Total		Top 100 research		Other							
	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
Total research	In thousands													
NASF														
1988	112,062	1,864	107,443	2,004	80,627	1,419	26,815	2,109	4,619	437	82,384	1,627	29,678	868
1990	116,327	4,054	111,166	4,062	81,659	1,327	29,508	3,574	5,161	485	86,880	3,538	29,447	1,591
1992	122,015	4,079	117,373	4,185	87,508	0	29,865	4,185	4,642	316	90,815	3,612	31,200	969
1994	127,369	2,885	121,930	2,766	90,974	0	30,865	2,766	5,439	372	91,723	2,163	35,645	1,569
1996	136,480	1,467	130,684	1,384	98,273	0	32,411	1,384	5,797	381	98,958	1,665	37,522	1,493
1998	143,288	1,937	135,879	1,763	101,272	0	34,607	1,763	7,410	806	106,093	1,602	37,195	1,091
Difference in	In thousands													
NASF														
1990 & 1988	4,265	3,586	3,723	3,659	1,032	3	2,693	3,659	542	205	4,496	3,026	-231	1,385
1992 & 1990	5,687	6,239	6,207	6,404	5,849	1,327	358	6,412	-519	481	3,934	6,246	1,753	1,200
1994 & 1992	5,354	4,996	4,557	5,016	3,466	0	1,091	5,016	797	488	908	4,210	4,445	1,844
1996 & 1994	9,111	3,237	8,754	3,093	7,299	0	1,455	3,093	358	532	7,235	2,730	1,877	2,166
1998 & 1996	6,808	2,430	5,195	2,241	2,999	0	2,196	2,241	1613	892	7,135	2,311	-327	1,849
Repair/renovation	In millions of current 1997 dollars													
cost														
1988	838	60	793	58	596	10	197	59	45	8	436	38	402	27
1990	1,010	265	979	264	483	12	496	259	30	15	699	266	311	18
1992	825	40	794	38	632	0	161	38	32	9	449	41	376	15
1994	837	45	803	44	623	0	180	44	34	5	522	41	315	21
1996	1,058	48	981	47	755	0	226	47	77	21	496	35	562	40
1998	1,325	69	1,142	47	857	0	285	47	182	43	655	51	670	39
Difference in cost	In millions of constant 1997 dollars													
1990 & 1988	172	269	186	267	-113	18	299	261	-15	22	263	265	-91	35
1992 & 1990	-185	269	-185	267	150	12	-355	262	2	39	-250	270	65	38
1994 & 1992	12	60	9	58	-9	0	19	58	2	10	73	58	-61	26
1996 & 1994	221	66	178	64	132	0	46	64	43	22	-26	54	247	45
1998 & 1996	267	84	161	67	102	0	59	67	105	48	159	61	108	56
Repair/renovation	In thousands													
NASF														
1988	13,431	1,305	12,841	1,345	9,124	304	3,717	1,299	590	90	8,745	1,196	4,685	528
1990	11,449	576	10,993	488	7,781	179	3,212	464	456	229	8,223	473	3,226	237
1992	8,606	657	8,344	624	5,622	0	2,722	624	262	81	5,420	613	3,187	180
1994	9,134	632	8,811	611	6,028	0	2,783	611	323	79	6,011	496	3,123	320
1996	13,122	758	12,364	746	8,758	0	3,606	746	758	113	6,839	498	6,282	681
1998	15,059	627	13,414	519	9,776	0	3,638	519	1,645	352	9,379	446	5,679	441
Difference in	In thousands													
NASF														
1990 & 1988	-1,982	1343	-1,848	1252	-1,343	351	-505	1,276	-134	251	-522	1,233	-1,459	384
1992 & 1990	-2,841	928	-2,649	914	-2,159	179	-490	841	-194	228	-2,804	788	-38	328
1994 & 1992	528	912	467	873	406	0	61	873	61	113	591	789	-64	367
1996 & 1994	3,988	987	3,553	964	2,730	0	823	964	435	138	828	703	3,159	752
1998 & 1996	1,937	984	1,050	909	1,018	0	32	909	887	370	2,540	668	-603	811

See explanatory information and SOURCE at end of table.

Table A-9. Standard errors (S.E.) for selected estimates

Item	Suitable for sophisticated research		Effective for most purposes		Needs limited repair/renovation		Needs major repair/renovation or replacement	
	Estimate	S.E.	Estimate[1]	S.E.	Estimate	S.E.	Estimate	S.E.
Amount of research space	NASF in thousands							
space								
1988	26,793	836	41,114	1,175	26,264	646	17,702	397
1990	30,135	1,239	41,072	1,794	27,047	914	18,073	983
1992	32,723	1,356	42,306	1,846	27,620	1,106	19,370	607
1994	33,743	1,078	41,904	1,017	29,700	1,004	22,021	770
1996	50,816	1,181			59,970	1,311	25,195	456
1998	56,154	1,274			54,120	1,022	32,961	953

[1] This category was not included in the 1996 and 1998 surveys.

KEY: NASF = net assignable square feet.

NOTE: Prior to 1998, standard errors were calculated using a jackknife replication method. In 1998, the Taylor series method was used.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Research Square Footage

In 1996 for the first time, and again in 1998, the survey included a definition of "net assignable square feet." NASF was defined as the sum of all areas (in square feet) on all floors assignable to, or available to be assigned to, an occupant for specific use, such as instruction or research. It is unlikely that the inclusion of a definition had any effect on trends in this item.

Respondents were instructed to prorate the NASF and the cost of construction and repair/renovation projects to reflect the proportion of space that was used for science and engineering research. For example, if half the space of a new 20 thousand square foot biological sciences building costing $8 million was to be used for biological research and the other half was to be used for instruction, only the prorated net assignable square footage for research (which would be less than 10 thousand gross square feet) and the prorated cost of construction for research ($4 million) were reported in the survey. Therefore, these figures do not reflect the total amount of space under construction or the total cost of the building or a "project."

Further, if multiple S&E fields shared research space, respondents were instructed to prorate the research construction and repair/renovation NASF and costs to reflect the proportion of use by each individual S&E field. If the prorated research construction or repair/renovation cost for an individual field was not over $100,000, the NASF and the costs were not to be reported in the survey.[5] However, some institutions' responses for some fields may reflect the NASF and the cost of several projects summed together. Further, some projects at some institutions may extend across several fields and, therefore, their NASF and costs were reported for several S&E fields, if they were reported at all.

For example, if an institution committed $1 million to renovate a 100 thousand square foot Biological Sciences building, of which 45 thousand NASF and $450,000 are allocated equally for research facilities in the medical sciences, the biological sciences, and bioengineering, then 15 thousand NASF and $150,000 were prorated to each of these three fields, and the remaining gross square footage and the remaining $550,000 were not reported. If, however, the prorated costs were $350,000 for the medical sciences, $75,000 for the biological sciences, and $75,000 for bioengineering, the NASF and costs for the latter two fields (which sum to $150,000) would not be reported.

[5] Note that the survey collected data on total repair/renovation projects costing between $5,000 and $100,000 for institutions' S&E research facilities. These costs were collected for the institution as a whole and were not broken out by field.

Finally, institutions' facility recordkeeping systems vary considerably. In general, most of the larger institutions have central computerized facility inventory systems, often based on space surveys conducted specifically for OMB Circular A-21. Many institutions with smaller research programs are not required to calculate square footage for OMB Circular A-21, and do not maintain databases that can provide such information. These institutions had to calculate or estimate square footage information specifically for this study.

Condition and Adequacy of Research Facilities

Questions eliciting assessments of the condition of S&E research space or its adequacy are by their very nature subjective. Two persons may make different assessments of the same facility or have different opinions of what is required in order for a facility to be suitable for a particular type of research. Despite the subjectivity involved, these items do provide an overall picture of the current status of facilities.

In 1996, the wording and response choices for the questions assessing both the condition of the institution's S&E research space and its adequacy were altered slightly from that used in previous years. Respondents were given only three possible choices for evaluating the adequacy of the amount of S&E research space: adequate, inadequate, or not applicable. In 1998, respondents were given four categories for assessing the condition of research space. In 1996, two of the categories "C—requires major renovation to be used effectively" and "D—requires replacement" were combined, but in 1998, they are separate categories again. Thus, the percent of change over time for these two items must be interpreted with some caution.

Capital Projects

Few institutions maintain information on construction and repair/renovation projects specific to research facilities. Many capital projects involve both research and nonresearch space. When a project was not dedicated exclusively to research, institutions had to estimate the proportion of the project that was related to research.

For projects taking more than one year to complete, institutions were asked to allocate the project costs to the fiscal year in which actual construction activity began or was scheduled to begin.

Because institutions use different dollar values to identify "major projects," this survey established a guideline to ensure consistency of reporting. As in previous cycles of the survey, projects with costs over $100,000 associated with research facilities were included. In 1992, 1994, and 1996, the surveys also had a separate question about repair/renovation projects costing between $5,000 and $100,000.

In 1998, a new question was added. It asked the institutions to list any nonfixed equipment costing $1 million or more that was included in their Item 4 costs for new construction or repair/renovation during the FYs 1996 and 1997.

Dollar Amounts: Current Versus Constant Dollars

Since 1994, the facilities report has used both constant and current dollars. Tables in the body of this report are presented in 1997 constant dollars; tables in Appendix E, "Detailed Statistical Tables," are in current dollars. Dollar amounts were adjusted using the Bureau of the Census' Composite Fixed-Weighted Price Index for Construction. Unlike a more general index, this construction index closely tracks inflation within the construction industry. This index reflects only changes in prices and is unaffected by changes in the mix of construction projects during any given year. The Bureau of the Census' Composite Fixed-Weighted Price Index for Construction for 1986–97 are presented below in table A-10.

Table A-10. Composite Fixed-Weighted Price Index for Construction inflation adjustments

Fiscal years	Average Composite Fixed-Weighted Price Index for Construction*
1986–87	1.329
1988–89	1.240
1990–91	1.197
1992–93	1.144
1994–95	1.055
1996–97	1.000

*The index for the second year was used in all calculations that spanned two fiscal years

SOURCES: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; Bureau of the Census' Composite Fixed-Weighted Price Index for Construction for 1986 to 1997.

Cost per Square Foot Data

The study did not collect unit cost data for individual construction or repair/renovation projects. It collected only the aggregate research-related costs and the aggregate research space involved in all projects begun during specified periods. These aggregates can be combined into indices of average cost per square foot, which are useful in tracking broad cost trends over time. However, they are of little practical value as guidelines for project planning. By all accounts, unit costs for both construction and repair/renovation projects are highly variable, depending on the specific requirements of the particular project and on many other factors as well (e.g., geographic region of the country). Such differences, which are of crucial importance in project planning, are obscured in the kinds of multiproject averages that can be constructed from this study's data.

Deferred Capital Needs

Both in 1998 and 1996, institutions reported separately the construction and repair/renovation costs for projects included in institutional plans, as well as for projects not included in such plans. In addition, institutions were asked to report their estimated central campus infrastructure needs separately for construction and repair/renovation and for both those both in plans and not in plans. This provided a more complete estimate of deferred capital projects.

In addition to this estimate of research facility needs based on institutions' reports of the S&E research construction and repair/renovation projects that had been deferred, the 1996 and 1998 surveys made additional efforts to measure this need. If institutions indicated that they had an inadequate amount of S&E research space in any given field (Item 2), they were asked to indicate the additional space needed. Institutions also were asked to report either the amount or percent of that space that was funded and scheduled to undergo major renovation or replacement (Item 3). It was thus possible to derive estimates of the amount of additional space needed and the amount of repair/renovation needed and not scheduled.

Both of these approaches, which are based on different assumptions, are believed to provide conservative estimates of the research facility needs of research-performing institutions.

A new item was added in 1998 asking the respondent to identify the amount of indirect costs recovered from Federal grants and/or contracts that is included in "institutional funds" if institutional funds was a source of funding in Item 5a for any repair/renovation or new construction in fiscal years 1996 and 1997.

Finally, one last item, the categorization of laboratory animal facilities in relation to government regulations, was modified in 1998. The categories used are the four levels of Animal Biological Safety as described in *Biosafety in Microbiological and Biomedical Laboratories*.[6]

[6] U.S. Government Printing Office (1993). *Biosafety in Microbiological and Biomedical Laboratories* (3rd Edition). Washington, DC: U.S. Government Printing Office.

Appendix B

List of Sampled Institutions

APPENDIX B: 1998 SAMPLED INSTITUTIONS

A. ACADEMIC INSTITUTIONS

Institution Name	State	Public Institutions	Doctorate-granting Institutions	Top 100	HBCUs	HSIs
Alabama A&M University	AL	*	*		*	
Alabama State University	AL	*			*	
Albany State College	GA	*			*	
Alcorn State University	MS	*			*	
Alfred University	NY		*			
Allegheny College	PA					
Allegheny University of the Health Sciences	PA		*			
Amherst College	MA					
Appalachian State University	NC	*				
Arizona State University	AZ	*	*	*		
Auburn University	AL	*	*	*		
Barnard College	NY					
Baylor College of Medicine	TX		*	*		
Beloit College	WI					
Bemidji State University	MN	*				
Benedict College	SC				*	
Bennett College	NC				*	
Bethune Cookman College	FL				*	
Biola University	CA		*			
Bloomsburg University of Pennsylvania	PA	*				
Boise State University	ID	*				
Boston University	MA		*	*		
Bowdoin College	ME					
Bowie State University	MD	*			*	
Brandeis University	MA		*			
Brigham Young University	UT		*			
Brown University	RI		*			
California Institute of Technology	CA		*	*		
California Poly State Univ-San Luis Obispo	CA	*				
California School of Prof Psychology-Alameda	CA		*			
California School Prof Psychology-Fresno	CA		*			
California State Poly University-Pomona	CA	*				
California State University- Dominguez Hills	CA	*				
California State University-Los Angeles	CA	*				*
California State University-Northridge	CA	*				
Calvin College	MI					
Carnegie Mellon University	PA		*	*		
Case Western Reserve University	OH		*	*		
Catholic University of America	DC		*			
Central Connecticut State University	CT	*				

Institution Name	State	Public Institutions	Doctorate-granting Institutions	Top 100	HBCUs	HSIs
Central State University	OH	*			*	
Charles R Drew University	CA					
Chicago State University	IL	*				
Claflin College	SC				*	
Clark Atlanta University	GA		*		*	
Clarkson University	NY		*			
Clemson University	SC	*	*	*		
Colby College	ME					
College of the Holy Cross	MA					
College of William & Mary	VA	*	*			
College of Wooster	OH					
Colorado School of Mines	CO	*	*			
Colorado State University	CO	*	*	*		
Columbia Union College	MD					
Columbia University	NY		*	*		
Connecticut College	CT					
Cooper Union	NY					
Coppin State College	MD	*			*	
Cornell University	NY		*	*		
CUNY-Brooklyn College	NY	*				
CUNY-City College	NY	*				
CUNY-John Jay College of Criminal Justice	NY	*				*
CUNY-Lehman College	NY	*				*
CUNY-Technology College	NY	*				
CUNY-York College	NY	*				
Dartmouth College	NH		*			
Delaware State University	DE	*			*	
Delta State University	MS	*	*			
Desert Research Institute	NV					
Dillard University	LA				*	
Drexel University	PA		*			
Duke University	NC		*	*		
Duquesne University	PA		*			
East Carolina University	NC	*	*			
East Stroudsburg University of Pennsylvania	PA	*				
Eastern New Mexico University	NM	*				
Eastern Virginia Medical School	VA		*			
Elizabeth City State University	NC	*			*	
Elizabethtown College	PA					
Embry-Riddle Aeronautical University	FL					
Emmanuel College	MA					
Emory University	GA		*	*		
Evergreen State College	WA	*				
Fayetteville State University	NC	*			*	
Finch University Health Sciences-Chicago	IL		*			
Fisk University	TN				*	
Florida A&M University	FL	*	*		*	
Florida Institute of Technology	FL		*			
Florida International University	FL	*	*			
Florida State University	FL	*	*			

Institution Name	State	Public Institutions	Doctorate-granting Institutions	Top 100	HBCUs	HSIs
Forest Institute of Prof Psychology	MO		*			
Fort Lewis College	CO	*				
Fort Valley State University	GA	*			*	
George Washington University	DC		*			
Georgetown University	DC		*	*		
Georgia Institute of Technology	GA	*	*	*		
Georgia Southern University	GA	*	*			
Georgia State University	GA	*	*			
Grambling State University	LA	*	*		*	
Grand Valley State University	MI	*				
Grinnell College	IA					
Hampshire College	MA					
Hampton University	VA		*		*	
Hartwick College	NY					
Harvard University	MA		*	*		
Harvey Mudd College	CA					
Haverford College	PA					
Henderson State University	AR	*				
Hendrix College	AR					
Hope College	MI					
Howard University	DC		*		*	
Humboldt State University	CA	*				
Illinois State University	IL	*	*			
Indiana University at Bloomington	IN	*	*	*		
Institute of Paper and Science Technology	GA		*			
Institute of Textile Technology	VA					
Iowa State University	IA	*	*	*		
Jackson State University	MS	*	*		*	
Jarvis Christian College	TX				*	
Johns Hopkins University	MD		*	*		
Johnson C Smith University	NC				*	
Kansas State University	KS	*	*			
Kentucky State University	KY	*			*	
Kenyon College	OH					
Kirksville College of Osteopathic Medicine	MO		*			
Knoxville College	TN				*	
Langston University	OK	*			*	
Lehigh University	PA		*			
Lincoln University	MO	*			*	
Lincoln University (PA)	PA	*			*	
Linfield College	OR					
Loma Linda University	CA		*			
Louisiana State University	LA	*	*	*		
Louisiana Tech University	LA	*	*			
Loyola University of Chicago	IL		*			
Manhattan College	NY					
Massachusetts Institute of Technology	MA		*	*		
MD Anderson Cancer Center	TX	*	*	*		
Medical College of Georgia	GA	*	*			
Medical College of Pennsylvania, The	PA		*			

Institution Name	State	Public Institutions	Doctorate-granting Institutions	Top 100	HBCUs	HSIs
Medical College of Wisconsin	WI		*			
Medical University of South Carolina	SC	*	*			
Meharry Medical College	TN		*		*	
Mercer University	GA		*			
Michigan State University	MI	*	*	*		
Michigan Tech University	MI	*	*			
Middlebury College	VT		*			
Millersville University of Pennsylvania	PA	*				
Mississippi State University	MS	*	*	*		
Mississippi Valley State University	MS	*			*	
Morehouse College	GA				*	
Morehouse School of Medicine	GA		*		*	
Morgan State University	MD	*	*		*	
Morris Brown College	GA				*	
Mount Sinai School of Medicine	NY		*	*		
Murray State University	KY	*				
National Hispanic University	CA					
New Mexico Highlands University	NM	*				*
New Mexico Institute Mining & Technology	NM	*	*			
New Mexico State University	NM	*	*	*		*
New York Institute Technology	NY		*			
New York Medical College	NY		*			
New York University	NY		*	*		
Norfolk State University	VA	*			*	
North Carolina A&T State University	NC	*	*		*	
North Carolina Central University	NC	*			*	
North Carolina State University-Raleigh	NC	*	*	*		
North Dakota State University	ND	*	*			
Northern Illinois University	IL	*	*			
Northern Marianas College	NP	*				
Northwestern University	IL		*	*		
Notre Dame College	OH					
Oakwood College	AL				*	
Occidental College	CA		*			
The Ohio State University	OH	*	*	*		
Oklahoma State University	OK	*	*	*		
Oral Roberts University	OK		*			
Oregon Grad Institute of Science & Technology	OR		*			
Oregon Health Sciences University	OR	*	*			
Oregon State University	OR	*	*	*		
Pace University	NY		*			
Pennsylvania State University	PA	*	*	*		
Pepperdine University	CA		*			
Philander Smith College	AR				*	
Pittsburg State University	KS	*				
Point Loma Nazarene College	CA					
Portland State University	OR	*	*			
Prairie View A&M University	TX	*			*	
Princeton University	NJ		*	*		
Providence College	RI		*			

Institution Name	State	Public Institutions	Doctorate-granting Institutions	Top 100	HBCUs	HSIs
Purdue University	IN	*	*	*		
Radcliffe College	MA					
Reed College	OR					
Rensselaer Polytech Institute	NY		*			
Rhodes College	TN					
Rice University	TX		*			
Rockefeller University	NY		*	*		
Rollins College	FL					
Rose Hulman Institute of Technology	IN					
Rust College	MS				*	
Rutgers, The State University of New Jersey	NJ	*	*	*		
Saint Olaf College	MN					
San Diego State University	CA	*	*			
San Francisco State University	CA	*				
Savannah State College	GA	*			*	
Selma University	AL				*	
Shaw University	NC				*	
Simmons College	MA		*			
South Carolina State College	SC	*	*		*	
Southeastern Louisiana University	LA	*				
Southern College of Optometry	TN					
Southern University	LA	*	*		*	
Southwest Missouri State University	MO	*				
Southwest State University	MN	*				
Spelman College	GA				*	
St Louis University	MO		*			
St Mary's University-San Antonio	TX		*			*
Stanford University	CA		*	*		
Sul Ross State University	TX	*				*
SUNY- Stony Brook	NY	*	*	*		
SUNY-Buffalo	NY	*	*	*		
SUNY-Health Sciences Center-Brooklyn	NY	*	*			
SUNY College at Buffalo	NY	*				
SUNY College at Geneseo	NY	*				
SUNY College at Old Westbury	NY	*				
SUNY College at Oswego	NY	*				
SUNY College at Purchase	NY	*				
Swarthmore College	PA					
Syracuse University	NY		*			
Talladega College	AL				*	
Temple University	PA	*	*			
Tennessee State University	TN	*	*		*	
Texas A&M University	TX	*	*	*		
Texas A&M University-Kingsville	TX	*	*			*
Texas Southern University	TX	*	*		*	
Texas Tech University	TX	*	*			
Texas Woman's University	TX	*	*			
Thomas Jefferson University	PA		*			
Tougaloo College	MS				*	

Institution Name	State	Public Institutions	Doctorate-granting Institutions	Top 100	HBCUs	HSIs
Trenholm State Technical College	AL	*			*	
Truman State University	MO	*				
Tufts University	MA		*			
Tulane University	LA		*	*		
Tuskegee University	AL		*		*	
University Maryland-Baltimore Prof Sch	MD	*	*	*		
University Maryland-College Park	MD	*	*	*		
University Maryland-Eastern Shore	MD	*	*		*	
University of Alabama	AL	*	*			
University of Alabama-Birmingham	AL	*	*	*		
University of Alaska-Fairbanks	AK	*	*	*		
University of Arizona	AZ	*	*	*		
University of Arkansas-Fayetteville	AR	*	*			
University of Arkansas-Pine Bluff	AR	*			*	
University of Arkansas Med Sciences	AR	*	*			
University of California-Berkeley	CA	*	*	*		
University of California-Davis	CA	*	*	*		
University of California-Irvine	CA	*	*	*		
University of California-Los Angeles	CA	*	*	*		
University of California-Riverside	CA	*	*			
University of California-San Diego	CA	*	*	*		
University of California-San Francisco	CA	*	*	*		
University of California-Santa Barbara	CA	*	*	*		
University of California-Santa Cruz	CA	*	*			
University of Central Florida	FL	*	*			
University of Central Oklahoma	OK	*				
University of Chicago	IL		*	*		
University of Cincinnati	OH	*	*	*		
University of Colorado	CO	*	*	*		
University of Connecticut	CT	*	*	*		
University of Dayton	OH		*			
University of Detroit Mercy	MI		*			
University of Florida	FL	*	*	*		
University of Georgia	GA	*	*	*		
University of Guam	GU	*				
University of Hartford	CT		*			
University of Hawaii-Manoa	HI	*	*	*		
University of Houston-Clear Lake	TX	*				
University of Illinois-Chicago	IL	*	*	*		
University of Illinois-Urbana	IL	*	*	*		
University of Iowa	IA	*	*	*		
University of Kansas	KS	*	*	*		
University of Kentucky	KY	*	*	*		
University of Louisville	KY	*	*			
University of Massachusetts-Amherst	MA	*	*	*		
University of Massachusetts-Boston	MA	*	*			
University of Massachusetts-Lowell	MA	*	*			
University of Massachusetts-Worcester	MA	*	*			
University of Medicine and Dentistry of New Jersey	NJ	*	*	*		
University of Memphis	TN	*	*			

Institution Name	State	Public Institutions	Doctorate-granting Institutions	Top 100	HBCUs	HSIs
University of Miami	FL		*	*		
University of Michigan	MI	*	*	*		
University of Minnesota	MN	*	*	*		
University of Mississippi	MS	*	*			
University of Missouri Columbia	MO	*	*	*		
University of Montana	MT	*	*			
University of Nebraska Kearney	NE	*				
University of Nebraska Lincoln	NE	*	*	*		
University of New Hampshire	NH	*	*			
University of New Mexico	NM	*	*	*		
University of North Carolina-Chapel Hill	NC	*	*	*		
University of North Carolina-Charlotte	NC	*				
University of North Carolina-Greensboro	NC	*	*			
University of North Dakota	ND	*	*			
University of Oklahoma	OK	*	*	*		
University of Oregon	OR	*	*			
University of Osteopathic Med & Hlth Sciences	IA		*			
University of Pennsylvania	PA		*	*		
University of Pittsburgh	PA	*	*	*		
University of Puerto Rico Med Science Campus	PR	*	*			
University of Rhode Island	RI	*	*			
University of Rochester	NY		*	*		
University of San Diego	CA		*			
University of Scranton	PA					
University of South Alabama	AL	*	*			
University of South Carolina	SC	*	*			
University of South Florida	FL	*	*	*		
University of Southern California	CA		*	*		
University of Tennessee	TN	*	*	*		
University of Texas-Austin	TX	*	*	*		
University of Texas-El Paso	TX	*	*			
University of Texas-Pan American	TX	*				*
University of Texas-San Antonio	TX	*	*			*
University of Texas Health Sci Center-San Antonio	TX	*	*	*		
University of Texas Medical Branch-Galveston	TX	*	*	*		
University of Texas SW Medical Center-Dallas	TX	*	*	*		
University of the District of Columbia	DC	*			*	
University of the Virgin Islands	VI	*			*	
University of Utah	UT	*	*	*		
University of Vermont	VT	*	*			
University of Virginia	VA	*	*	*		
University of Washington	WA	*	*	*		
University of West Florida	FL	*				
University of Wisconsin-Green Bay	WI	*				
University of Wisconsin-La Crosse	WI	*				
University of Wisconsin-Madison	WI	*	*	*		
University of Wisconsin-River Falls	WI	*				
University of Wyoming	WY	*	*			
Utah State University	UT	*	*	*		
Valdosta State University	GA	*				

Institution Name	State	Public Institutions	Doctorate-granting Institutions	Top 100	HBCUs	HSIs
Vanderbilt University	TN		*	*		
Vassar College	NY					
Virginia Commonwealth University	VA	*	*	*		
Virginia Military Institute	VA	*				
Virginia Polytech Institute & State University	VA	*	*	*		
Virginia State University	VA	*			*	
Voorhees College	SC				*	
Wake Forest University	NC		*			
Washington and Lee University	VA					
Washington State University	WA	*	*	*		
Washington University	MO		*	*		
Wayne State University	MI	*	*	*		
Wellesley College	MA					
West Virginia State College	WV	*			*	
West Virginia University	WV	*	*			
Western Illinois University	IL	*				
Western Michigan University	MI	*	*			
Wheeling Jesuit College	WV					
Whitman College	WA					
Wilberforce University	OH					
Winston Salem State University	NC	*			*	
Winthrop University	SC	*				
Woods Hole Oceanographic Institute	MA		*	*		
Worcester Polytech Institute	MA		*			
Xavier University of Louisiana	LA		*		*	
Yale University	CT		*	*		
Yeshiva University	NY		*	*		

B. Hospitals

Barnes-Jewish Hospital
Beth Israel Deaconess Medical Center
Beth Israel Medical Center (New York)
Brigham And Women's Hospital
Bronx-Lebanon Hosp Center (Bronx, NY)
California Pacific Medical Center-Pacific Campus
Cedars-Sinai Medical Center
Children's Hospital (Boston)
Children's Hospital (Columbus)
Children's Hospital And Health Center
Children's Hospital And Regional Medical Center
Children's Hospital Medical Center (Cincinnati)
Children's Hospital Of Los Angeles
Children's Hospital Of Philadelphia
Children's Hospital Of Pittsburgh
Children's Memorial Hospital (Chicago)
Children's Mercy Hospital (Kansas City, MO)
Children's National Medical Center
City Of Hope National Medical Center
Cooper Hospital/University Medical Center
Dana-Farber Cancer Institute
Good Samaritan Hospital and Medical Center
Hartford Hospital
Hebrew Rehabilitation Center For Aged
Hospital For Joint Diseases, Ortho Institute
Hospital For Sick Children (Wash, DC)
Hospital For Special Surgery
Kessler Institute For Rehabilitation
Legacy Health Systems
Long Island Jewish Medical Center
Magee-Women's Hospital
Massachusetts Eye And Ear Infirmary
Massachusetts General Hospital
McLean Hospital (Belmont, MA)
Memorial Hospital Of Rhode Island
Mercy Hospital Of Pittsburgh
Miriam Hospital
Montefiore Medical Center (Bronx, NY)
Moss Rehabilitation Hospital
Mount Sinai Medical Center (Miami Beach)
National Jewish Medicine & Research Center
New England Medical Center
North Shore University Hospital
Northwest Hospital
Rhode Island Hospital (Providence, RI)
Rush-Presbyterian-St Luke's Medical Center
St. Elizabeth's Medical Center Of Boston
St. Jude's Children's Research Hospital
Summit Medical Center
Women And Infants Hospital-Rhode Island

C. Biomedical Research Organizations

American Type Culture Collection
Allegheny-Singer Research Institute
AMC Cancer Research Center
American Health Foundation
Associated University-Brookhaven National Lab
Battelle Memorial Institute
Burnham Institute
Center For Blood Research
Cleveland Clinic Foundation
Cold Spring Harbor Laboratory
Doheny Eye Institute
Eleanor Roosevelt Inst For Cancer Research
Ernest Gallo Clinic And Research Center
Family Health International
Fox Chase Cancer Center
Fred Hutchinson Cancer Research Center
Friends Research Institute, Inc.
Frontier Science & Technical Res. Foundation, Inc
Harbor-UCLA Research & Education Institute
Henry M. Jackson Foundation For The Adv Mil/Med
Institute For Cancer Research
Institute For Genomic Research
J. David Gladstone Institutes
Jackson Laboratory
John Wayne Cancer Institute
Joslin Diabetes Center
Kaiser Foundation Research Institute
Kennedy Krieger Research Institute, Inc.
Massachusetts Health Research Institute
Mellon Pitts Corporation (MPC)
Mitretek Systems, Inc.
National Bureau of Economic Research
National Childhood Cancer Foundation
National Development & Research Institutes
Oklahoma Medical Research Foundation
Oregon Regional Primate Research Center
Oregon Social Learning Center, Inc.
Public Health Research Institute Of The City Of NY

Research Triangle Institute
Salk Institute For Biological Studies
Scripps Research Institute
Sloan-Kettering Institute For Cancer Research
Southern Research Institute
Southwest Foundation for Biomedical Research
SRI International
Texas Heart Institute
Trudeau Institute, Inc.
Virginia Mason Research Center
Western Consortium For Public Health
Whitehead Institute For Biomedical Research

APPENDIX C

SURVEY QUESTIONNAIRE

January 5, 1998

<<address>>

Dear <<sal>>:

I am writing to request your assistance in a matter of considerable importance to research efforts at higher education institutions. At the direction of Congress, the National Science Foundation is once again collecting information on the status and condition of academic science and engineering research facilities in the United States. *The 1998 Survey of Scientific and Engineering Research Facilities at Universities and Colleges*, co-sponsored by the Foundation and the National Institutes of Health, is about to begin, and we would very much appreciate your assistance in making it as comprehensive as possible.

The 1998 survey is the seventh in this biennial series and will form the basis for a Fall 1998 report to Congress. By providing information on the current status of research facilities and continuing the systematic assessment of changes in the status of facilities, the 1998 study will continue to provide policymakers with important updated data on the condition of research facilities in the United States.

Your participation in the survey is voluntary; however, we are certain that you appreciate the importance of this effort and ask that you appoint a senior official to coordinate the survey at your institution. Please fax the enclosed coordinator identification form to our contractor, within the next week. The complete packet of survey materials will be sent directly to the coordinator about January 30, 1998.

If you have any questions about the study, please contact Dr. Ann Lanier of the Division of Science Resources Studies at the National Science Foundation at (703) 306-1772, extension 6910.

Thank you for your assistance in this important effort.

Sincerely Yours,

Neal Lane

Neal Lane
Director

Enclosure: Coordinator Identification Form
cc: 1996 Coordinator:

DEPARTMENT OF HEALTH & HUMAN SERVICES Public Health Service

National Institutes of Health
National Center for
Research Resources
Bethesda, Maryland 20892

May 4, 1998

President
Title
Institution
Address
City, State Zip

Dear *Title Last Name:*

I am writing to request your assistance in a matter of considerable importance. Based on concerns raised by the academic community, Congress instructed the National Science Foundation to collect information on the status and condition of science and engineering research facilities at the Nation's colleges and universities. At the request of the National Institutes of Health (NIH), which is co-sponsoring this effort, the 1998 *Survey of Scientific and Engineering Research Facilities* again includes independent biomedical research organizations and independent hospitals. Your participation in the survey is voluntary.

The 1998 survey is the seventh biennial series and will form the basis for a September 1, 1998 report to Congress; an additional report on biomedical research facilities will be issued by NIH. By providing an assessment of the current status of research facilities, and continuing the systematic assessment of changes in the status of facilities, the survey will provide policy makers with information not previously available.

I am certain that you appreciate the importance of this effort, and ask that you appoint a senior official to coordinate your institution's response. Please fax the enclosed coordinator identification form to our contractor, The Gallup Organization, within the next two weeks. The complete package of survey materials will be sent directly to the Coordinator by the end of May.

If you have any questions about the study, please contact Dr. Mary Barton of the Gallup's Government and Education Division, at 1-800-713-2595 or Dr. Sidney A. McNairy, Jr. of NIH, at 301-435-0788.

Thank you for your assistance in this important effort.

Sincerely yours,

Judith L. Vaitukaitis

Judith L. Vaitukaitis, M.D.
Director-National Center for Research Resources

Enclosure: 1998 Coordinator Identification Form
cc: 1996 Coordinator: Name, Title

1998 Survey Of Scientific And Engineering Research Facilities At Universities And Colleges

OMB # 3145-0101
Expires 12/2000

National Science Foundation (NSF)
National Institutes Of Health (NIH)

Acting out of concerns raised by the academic community, Congress directed the National Science Foundation (NSF) to collect and analyze data about research facilities at universities and colleges and to report to Congress every two years. This survey is in response to that requirement under authorization of the National Science Foundation Act of 1950, as amended.

The main topics in this year's survey are:

- amount of space in your institution;
- amount and condition of research space in your institution;
- costs of capital projects completed, begun, or planned;
- deferred capital projects; and
- miscellaneous topics.

We will use the information that you provide for a report that gives a broad, quantitative picture of

- the cost, availability, and condition of existing science and engineering (S&E) research facilities; and
- the current capital spending by universities and colleges, sources of funding, and plans for future repair/ renovation and new construction of S&E research facilities.

Your participation in this survey is voluntary. However, your response is very important to us. Aggregate data from this report are used by Congress, the Executive Branch, many higher education associations, and university and college administrators to help make policy decisions. **NSF and NIH do not use or allow others to use detailed responses in any manner that would identify an individual institution's responses.**

The president or chancellor of your institution named the individual on the label to the right to coordinate data collection for this survey. Please correct any wrong information on the label.

If someone other than the person listed above coordinates the data collection, please tell us whom we may call if we have questions about the information.

Name	**Title/Department**	**Telephone no. and ext.**

It is estimated that responding to the survey requires an average of 24 hours. If you wish to comment on this burden, contact Gail McHenry, Reports Clearance Officer, NSF, at 703-306-1125, extension 2010; and the Office of Management and Budget, Paperwork Reduction Project (OMB Number 3145-0101), Washington, DC 20503.

Return the completed survey by ***March 31, 1998,*** to: ***The Gallup Organization***
Attention: Bernadine Karunaratne
One Church Street, Suite 900
Rockville, MD 20850

If you have any questions or comments about the survey, contact Dr. Ann Lanier of NSF at 703-306-1774, extension 6910, or Bernadine Karunaratne of The Gallup Organization at 1-800-288-9439 (bernadine_karunaratne@gallup.com).

GUIDELINES

Refer to these guidelines as you fill out the survey.

1. About this survey—how to use the "Tips" box

With each item in this survey, along with instructions for completing the item, you will find a "Tips" box containing additional information to help you complete the item correctly. The box also contains definitions of terms that appear in the item. Terms appearing in **boldface type** in the instructions are defined in the "Tips" box on that page.

2. The definition of research

In this survey, research is defined as all research activities of your institution that are budgeted and accounted for. Research can be funded by the institution itself, the Federal government, state governments, foundations, corporations, or other sources.

3. What to include as research facilities

In this survey, the term "research facilities" *includes:*

- research laboratories;
- controlled-environment space, such as clean or white rooms;
- technical-support space, such as carpentry and machine shops;
- facilities for laboratory animals, such as animal production colonies, holding rooms, isolation and germ-free rooms;
- faculty or staff offices, to the extent that they are used for research;
- department libraries, to the extent that they are used for research;
- fixed (built-in) equipment, such as fume hoods and benches; and
- non-fixed equipment costing $1 million or more.

It does *not* include:

- facilities that have been designated as federally funded research and development centers (FFRDC);
- facilities that are used by faculty, but are not administered by the institution, such as research space at Veterans Administration or other non-university hospitals;
- facilities that are administered by your institution but are leased to others for their use

4. What fields to include as science and engineering (S&E) fields

Because every institution has its own way of classifying fields of study, for consistency, please use the *Cross Reference* chart (see page 25) to classify areas of study at your institution. The *Cross Reference* chart identifies the departments that are included within each of the S&E fields used in this survey. The *Cross Reference* chart is based on the classification of academic departments used by the National Center for Educational Statistics. If you are unable to separate data for academic departments, report the combined data under "Other Sciences, not elsewhere classified" and list the fields that those data represent.

For this survey, S&E fields *include*:

- Engineering
- Physical Sciences
- Earth, Atmospheric, and Ocean Sciences
- Mathematics
- Computer Sciences
- Agricultural Sciences
- Biological Sciences
- Medical Sciences
- Psychology
- Social Sciences
- Other Sciences, not elsewhere classified

They do *not* include:

- law, business administration/management (except economics), humanities, history, the arts, or education (except educational psychology).

5. The definition of net assignable square feet (NASF)

In this survey, instruction or research NASF is defined as the sum of all areas (in square feet) on all floors of a building assigned to, or available to be assigned to, an occupant for specific use. NASF should be measured from the inside faces of walls. Refer to pages 95–96 in Appendix 2 of *Postsecondary Education Facilities Inventory and Classification Manual*, U.S. Department of Education, Office of Educational Research and Improvement, NCES 92-165 (or to the 1988 NACUBO *Taxonomy of Functions*, or to the 1972 WICHE *Program Classification Structure).*

6. How to calculate space and cost

Space in NASF

For space used for both S&E research and other purposes: *Prorate* the NASF to reflect the proportion of use for S&E research activity. For example, if a room or building is used for S&E research only during the summer months (one-fourth of the year), then count 25% of the NASF as S&E research space.

For space that is shared by S&E fields: Prorate the NASF to reflect the proportion of use by each field. For example, if a room or building is used equally for research activity in Computer Sciences and Mathematics, count 50% of the NASF as research space for Computer Sciences and 50% for Mathematics.

Cost of repair/renovation and new construction

What to include under "completion costs": Several survey items ask you to report completion costs for repair/renovation and new construction projects. When you report completion costs for projects on S&E research space, include costs for

- planning;
- site preparation; and
- repair/renovation or new construction of
  - the research space itself;
  - fixed equipment;
  - non-fixed equipment costing $1 million or more; and
  - building infrastructure, such as plumbing, lighting, air exchange, and safety systems in the building and within five feet of the building foundation.

For projects involving both S&E research space and space used for other purposes: Prorate the cost of repair/renovation and new construction projects to reflect the proportion of the space that is used for S&E research. For example, you might construct a new Biological Sciences building at a cost of $8 million. Half of the space in the new building will be used for biological research and the other half will be used for class instruction. In this case, the prorated cost of construction for S&E research facilities that you should report would be $4 million, or half of the total cost.

For multi-year projects: Allocate the entire project completion cost to the fiscal year in which the project began or is expected to begin. Consider the start-date for a project to be the date on which repair/renovation or new construction actually began or is expected to begin.

7. Changes to the survey

What's different in 1998

- **Item 3,** page 10. There are now four categories for assessing the condition of research space. In 1996, two of the categories *"C - requires major renovation to be used effectively"* and *"D - requires replacement"* were combined, but in 1998 they are separate categories again.
- **Item 4b,** page 14. This is a new item. It asks you to list any non-fixed equipment costing $1 million or more that was included in your Item 4 costs of repair/renovation or new construction during your fiscal years 1996 and 1997.
- **Item 5b,** page 17. This is a new item. It asks you to identify the amount of indirect costs recovered from federal grants and/or contracts that is included in "Institutional funds" if institutional funds was a source of funding in Item 5a for any repair/renovation or new construction in your fiscal years 1996 and 1997.
- **Item 8,** page 22. The categorization of laboratory animal facilities in relation to government regulations has been modified. The categories are now the four levels of Animal Biological Safety, as described in *Biosafety in Microbiological and Biomedical Laboratories* (see complete reference, page 20.)

Detailed instructions and tips containing additional information on how to answer the questions are provided with each item in the survey.

Item 1a. Instructional and research space

To complete Item 1a, do the following:

1. In Column 1 of the table on the facing page, fill in the current amount of net assignable square feet (**NASF**) devoted to instruction and **research** for each field listed.

2. Near the bottom of Column 1, fill in the current total NASF devoted to instruction and research for
   - science and engineering (S&E) fields (TOTAL #1),
   - non-science fields (TOTAL #2), and
   - all academic fields (TOTAL #3).

3. In Column 2, fill in the current amount of **research space** (NASF devoted to research only) for each S&E field listed.

4. Near the bottom of Column 2, fill in the total NASF devoted to research in all S&E fields.

Note for institutions using a facilities inventory system based on NCES, NACUBO, or WICHE classifications:

- For Column 1 ("Instructional and research NASF"), add the space that is assigned to functional category 1 (Instruction) and category 2 (Research).

- For Column 2 ("Research NASF"), use only the space that is assigned to functional category 2 (Research). Please refer to pages 95–96 in Appendix 2 of *Postsecondary Education Facilities Inventory and Classification Manual*, U.S. Department of Education, Office of Educational Research and Improvement, NCES 92-165 (or to the 1988 NACUBO *Taxonomy of Functions*, or to the 1972 WICHE *Program Classification Structure*).

Tips for completing Item 1a

- Include leased space used by your institution for your research.
- Estimate if exact figures are not available.
- If space is used for more than one purpose, prorate the NASF to reflect the proportion of use for the activity the item is asking about. (For an example, see page 3.)
- If space is shared by S&E fields, prorate the NASF to reflect the proportion of use by each field. (For an example, see page 3.)
- For help in classifying your programs, refer to the *Cross Reference* chart on page 25.
- Use these definitions for bolded items:

  NASF: Is the sum of all areas (in square feet) on all floors of a building assigned to, or available to be assigned to, an occupant for specific use, such as instruction or research. NASF should be measured from the inside faces of walls.

  research: Refers to all research activities of your institution that are budgeted and accounted for. Research can be funded by the institution itself, the Federal government, state governments, foundations, corporations, or other sources.

  research space: Refers to the NASF of space in facilities within which research activities take place. These facilities may include the following (to the extent that they are used for research): research laboratories, controlled-environment space, technical-support space, facilities for laboratory animals, faculty or staff offices, department libraries, fixed equipment (such as fume hoods and benches), and non-fixed equipment costing $1 million or more.

Table for Item 1a. Instructional and research space

FIELD	Column 1 Instructional and research NASF	Column 2 Research NASF
SCIENCE AND ENGINEERING (S&E) FIELDS		
Engineering		
Physical Sciences		
Earth, Atmospheric, and Ocean Sciences		
Mathematics		
Computer Sciences		
Agricultural Sciences		
Biological Sciences Other than medical school		
Biological Sciences Medical school		
Medical Sciences Other than medical school		
Medical Sciences Medical school		
Psychology		
Social Sciences		
Other Sciences, not elsewhere classified List them:		
TOTAL #1: ALL S&E FIELDS		
TOTAL #2: ALL NON-SCIENCE FIELDS [for example, law, business administration/management (except economics), humanities, history, the arts, or education (except educational psychology)]		
TOTAL #3: GRAND TOTAL		

Item 1b. Leased research space

Look at the total research space for all S&E fields (TOTAL #1) in the table above. How much of that space is leased?

_____ **NASF of leased research space**

Item 2. Current amount of research space, by field

Item 2 asks you to rate the amount of science and engineering (S&E) **research space** available at your institution. For each field, you will choose one of the following three categories:

A *Adequate amount of space:* sufficient to support all the needs of your current S&E **research program commitments** in the field

B *Inadequate amount of space:* not sufficient to support the needs of your current S&E research program commitments in the field; or non-existent but needed

NA Not applicable or no space needed in the field

To complete Item 2, do the following:

1. For each field listed on the table on the facing page, circle the letter of the category in Column 1 that best describes the amount of space available for your current S&E research program commitments in that field.
2. For each field for which you circled **B** (inadequate amount), estimate and record in Column 2 the additional NASF or percent more space that is needed.

Example 1: The Engineering department's research space is overcrowded to the extent that efficiency of work on an existing grant has been affected. In your answer to Item 2, you should consider the additional space you need to support work on this already awarded grant.

Example 2: The Biology department has made offers to three new faculty needed to support an existing program in molecular biology. In your answer to Item 2, you should consider the space needed to accommodate these new colleagues (even though they are not currently on campus) because it is needed to fulfill already existing program commitments and because offers have been made.

Tips for completing Item 2

➲ Use these definitions for bolded items:

research program commitments: Refers to all research and development activities of an institution that are budgeted, approved, and funded.

Research program commitments *include*

- current faculty and staff or those to whom offers have been made;
- grants awarded, whether or not research has actually begun; and
- programs which have been approved.

They do *not* include

- potential staff without offers,
- grants applied for but not awarded, and
- programs designed but not yet approved.

research space: Refers to the NASF of space in facilities within which research activities take place. These facilities may include the following (to the extent that they are used for research): research laboratories, controlled-environment space, technical-support space, facilities for laboratory animals, faculty or staff offices, department libraries, fixed equipment (such as fume hoods and benches), and non-fixed equipment costing $1 million or more.

Table for Item 2. Current amount of research space, by field

Key:

A = ***Adequate*** *amount of space:* *sufficient to support all the needs of your current S&E research program commitments in the field*

B = ***Inadequate*** *amount of space:* *not sufficient to support the needs of your current S&E research program commitments in the field; or non-existent but needed*

NA = ***Not applicable*** *or no space needed in the field*

FIELD	Column 1 Adequacy or inadequacy of amount of S&E research space *For each field, circle the appropriate code in one of the columns below.*			Column 2 Additional space needed for current S&E research program commitments *For each field, you may choose to enter **either** NASF **or** percent more space needed. (Enter a figure in **one** of the columns below for each field.)*	
	Adequate	Inadequate	Not Applicable	Additional NASF needed	Percent more space needed
Engineering	A	B	NA		
Physical Sciences	A	B	NA		
Earth, Atmospheric, and Ocean Sciences	A	B	NA		
Mathematics	A	B	NA		
Computer Sciences	A	B	NA		
Agricultural Sciences	A	B	NA		
Biological Sciences Other than medical school	A	B	NA		
Biological Sciences Medical school	A	B	NA		
Medical Sciences Other than medical school	A	B	NA		
Medical Sciences Medical school	A	B	NA		
Psychology	A	B	NA		
Social Sciences	A	B	NA		
Other Sciences, not elsewhere classified List them:	A	B	NA		

Item 3. Current condition of research space, by field

To complete Item 3, do the following:

1. For each field listed on the table on the facing page, fill in the percent of **research space** that falls into each category below:

   A Suitable for the most scientifically competitive research in the field

   B Effective for most levels of research in the field, but may need limited repair/ renovation

   C Requires **major renovation** to be used effectively

   D Requires replacement

   NA Not applicable or no research space in that field

2. For each field for which you reported space in category D, record in Column 2 the number of NASF or percent of that space that is funded and scheduled for replacement in your FY 1998 or FY 1999.

Tips for completing Item 3

- Consider only space supporting your *current* S&E research program commitments.

- Use these definitions for bolded items:

  major renovation: Refers to an extensive repair project that results in facilities that are equivalent, or nearly equivalent, to new facilities in their ability to support S&E research.

  research space: Refers to the NASF of space in facilities within which research activities take place. These facilities may include the following (to the extent that they are used for research): research laboratories, controlled-environment space, technical-support space, facilities for laboratory animals, faculty or staff offices, department libraries, fixed equipment (such as fume hoods and benches), and non-fixed equipment costing $1 million or more.

Table for Item 3. Current condition of research space, by field

Key:

A = *Suitable for the most scientifically competitive research in the field*

B= *Effective for most levels of research in the field, but may need limited repair/renovation*

C = *Requires major renovation to be used effectively (categories C + D were combined in the 1996 survey)*

D = *Requires replacement (categories C + D were combined in the 1996 survey)*

NA = *Not applicable or no research space in this field*

	Column 1						**Column 2**	
	Percent of research space according to condition *For each field, fill in the percent of research space that falls into each category*						**Amount of space in category D that is funded and scheduled for replacement in your FY 1998 or FY 1999** *For each field, you may choose to enter **either** NASF **or** percent of space. (Enter a figure in **one** of the columns below for each field.)*	
FIELD	**A**	**B**	**C**	**D**	Total	**NA**	**NASF**	**Percent of space**
Engineering					100%			
Physical Sciences					100%			
Earth, Atmospheric, and Ocean Sciences					100%			
Mathematics					100%			
Computer Sciences					100%			
Agricultural Sciences					100%			
Biological Sciences Other than medical school					100%			
Biological Sciences Medical school					100%			
Medical Sciences Other than medical school					100%			
Medical Sciences Medical school					100%			
Psychology					100%			
Social Sciences					100%			
Other Sciences, not elsewhere classified List them:					100%			

Item 4a. Research facilities projects over $100,000: your FY 1996 and FY 1997

This item asks you to report the completion costs (planning, site preparation, construction, **fixed equipment**, **non-fixed equipment** costing $1 million or more, **building infrastructure**) and net assignable square feet (**NASF**) involved in **repair/renovation** and **new construction** of science and engineering (S&E) research facilities.

To complete Item 4a, do the following:

1. In Columns 1 and 3 of the table on the facing page:
   - for each field listed, fill in the completion costs for repair/renovation and new construction projects over $100,000; and
   - in the row marked TOTAL, fill in the total completion costs for repair/renovation and new construction.
2. In Columns 2 and 4 of the table on the facing page:
   - for each field listed, fill in the estimated NASF involved in repair/renovation and new construction projects over $100,000; and
   - in the row marked TOTAL, fill in the estimated total NASF for repair/renovation and new construction.

Note: Do not total the cost of several small projects and report their costs if the sum is $100,000 or more. Repair/renovation projects costing between $5,000 and $100,000 should be reported in Item 4c, page 15.

Tips for completing Item 4a

- Consider only projects that began during your FY 1996 or FY 1997. (Consider the start-date for a project to be the date on which repair/ renovation or new construction actually began.)
- If space is shared by S&E fields, prorate the NASF and cost to reflect the proportion of use by each field. (For an example, see page 3.)
- Consider only projects whose individual prorated cost in a given field is over $100,000. (All the dollar figures in Column 1 or Column 3 of the table on the facing page should be *over $100,000*.)
- Use these definitions for bolded items:

  building infrastructure: Includes systems that exist in the building and within five feet of the building foundation, such as plumbing, lighting, air exchange, and safety systems.

  fixed equipment: Refers to equipment that is built into facilities, such as fume hoods and lab benches.

  NASF: Is the sum of all areas (in square feet) on all floors of a building assigned to, or available to be assigned to, an occupant for specific use, such as instruction or research. NASF should be measured from the inside faces of walls.

  new construction: Refers to additions to an existing building or construction of a new building.

  non-fixed equipment: Refers to equipment that is not built into the facilities. The non-fixed equipment must cost $1 million or more (such as MRI equipment) to be included in completion costs.

  repair/renovation: Refers to the fixing up of facilities in deteriorated condition, capital improvements on facilities, conversion of facilities, etc.

Table for Item 4a. Research facilities projects over $100,000: your FY 1996 and FY 1997

FIELD	REPAIR/RENOVATION over $100,000 begun during your FY 1996 or FY 1997		NEW CONSTRUCTION over $100,000 begun during your FY 1996 or FY 1997	
	Column 1	Column 2	Column 3	Column 4
	Cost	NASF	Cost	NASF
Engineering				
Physical Sciences				
Earth, Atmospheric, and Ocean Sciences				
Mathematics				
Computer Sciences				
Agricultural Sciences				
Biological Sciences Other than medical school				
Biological Sciences Medical school				
Medical Sciences Other than medical school				
Medical Sciences Medical school				
Psychology				
Social Sciences				
Other Sciences, not elsewhere classified List them:				
TOTAL				

Did any of the repair/renovation or construction project costs listed above include **non-fixed equipment** costs of $1 million or more?

☐ Yes (Continue with Item 4b)

☐ No (Go to Item 4c)

Item 4b. Non-fixed equipment costing $1 million or more

To complete Item 4b, do the following:

- Review the completion costs in Columns 1 and 3 in each field of Item 4a to determine if those costs included any non-fixed equipment costing $1 million or more.

- If so, fill in the table by listing each field that included such non-fixed equipment costs and the cost of that equipment.

FIELD	Non-fixed equipment costs of $1 million or more included in REPAIR/RENOVATION	Non-fixed equipment costs of $1 million or more included in NEW CONSTRUCTION
List field:	$	$
List field:	$	$
List field:	$	$
List field:	$	$
List field:	$	$

Item 4c. Research facilities projects between $5,000 and $100,000: your FY 1996 and FY 1997

To complete Item 4c, do the following:

In the blank below, fill in the total dollar amount for completion costs of **repair/renovation** projects between $5,000 and $100,000 begun in your FY 1996 and FY 1997.

$ _____

Total for repair/renovation projects (costing between $5,000 and $100,000 each) of your science and engineering (S&E) research facilities

Tips for completing Item 4c

- Consider only projects that began during your FY 1996 or FY 1997. (Consider the start-date for a project to be the date on which repair/renovation actually began.)
- Exclude projects whose prorated cost is less than $5,000 or more than $100,000.
- Use these definitions for bolded items:

  building infrastructure: Includes systems that exist in the building and within five feet of the building foundation, such as plumbing, lighting, air exchange, and safety systems.

  fixed equipment: Refers to equipment that is built into facilities, such as fume hoods and lab benches.

  repair/renovation: Refers to the fixing up of facilities in deteriorated condition, capital improvements on facilities, conversion of facilities, etc.

Item 5a. Sources of funding for research facilities projects: your FY 1996 and FY 1997

To complete Item 5a, do the following:

1. In the row marked TOTAL on the table on the facing page, at the bottom of Columns 1 and 2, copy the cost totals for your science and engineering (S&E) research facilities projects from Item 4a, Columns 1 and 3:
   - **repair/renovation** projects costing over $100,000, and
   - **new construction** projects costing over $100,000.
2. Fill in the dollar amounts of funding from each source listed.

Tips for completing Item 5a and 5b

- Consider only projects that began during your FY 1996 or FY 1997. (Consider the start-date for a project to be the date on which repair/ renovation or new construction actually began.)
- Note that "Institutional funds" include operating funds, endowments, indirect costs recovered from federal grants and/or contracts, indirect costs recovered from other sources, etc.
- If your institution maintains a separate line in your institutional budget that identifies indirect costs recovered from federal grants and/or contracts, you should be able to answer Item 5b.
- Use these definitions for bolded items:

  new construction: Refers to additions to an existing building or construction of a new building.

  repair/renovation: Refers to the fixing up of facilities in deteriorated condition, capital improvements on facilities, conversion of facilities, etc.

Table for Item 5a. Sources of funding for research facilities projects: your FY 1996 and FY 1997

Source	Column 1 Dollar amount for REPAIR/RENOVATION projects costing over $100,000	Column 2 Dollar amount for NEW CONSTRUCTION projects costing over $100,000
Federal government		
State or local government		
Private donations		
Institutional funds (Operating funds, endowments, indirect costs recovered from federal grants and/or contracts, indirect costs recovered from other sources, etc.)		
Tax-exempt bonds		
Other debt financing		
Other sources List them:		
TOTAL		

Item 5b. Indirect costs from Federal grants/contracts included in institutional funds

1. Can you identify the amount of indirect costs recovered from federal grants and/or contracts that is included in the "Institutional funds" amount listed above?

   ☐ Yes (Continue)

   ☐ No (Go to Item 6)

   ☐ NA (Institutional funds not a source of funding in Item 5a)

2. What is the amount of indirect costs recovered from federal grants and/or contracts that is included in the "Institutional funds" amount listed above?

Source	REPAIR/RENOVATION	NEW CONSTRUCTION
Indirect costs recovered from federal grants/contracts	$	$

Item 6. Planned research facilities projects over $100,000 scheduled to begin in your FY 1998 and FY 1999

To complete Item 6, do the following:

1. In Columns 1 and 3 of the table on the facing page,
   - for each field listed, fill in the completion costs for projects over $100,000 (planning, site preparation, construction, **fixed equipment**, non-fixed equipment costing $1 million or more, **building infrastructure**) for **planned projects** (both **repair/renovation** and **new construction**), and
   - in the row marked TOTAL #1, fill in the total completion costs for all science and engineering (S&E) fields.
2. In Columns 2 and 4,
   - for each field listed, estimate the net assignable square feet (**NASF**) involved in those projects (***Note:*** *be sure to include here any space that you reported in Column 2 of the table for Item 3)*, and
   - in the row marked TOTAL #1, fill in the estimated NASF for all S&E fields.
3. Near the bottom of the table, in the row marked TOTAL #2, enter the estimated completion costs for planned capital projects to extend, repair, or renovate **central campus infrastructure**.
4. Add the figures in the row marked TOTAL #1 to those in the row marked TOTAL #2. Record the total figures in the row marked TOTAL #3.

Tips for completing Item 6

- Consider only projects scheduled to begin during your FY 1998 or FY 1999.
- If space is shared by S&E fields, prorate the NASF and cost to reflect the proportion of use by each field. (For an example, see page 3.)
- Include only projects whose prorated cost in a given field is over $100,000. (All the dollar figures in Column 1 or Column 3 of the table on the facing page should be *over $100,000*.)
- Estimate if exact figures are not available.
- Use these definitions for bolded items:

  building infrastructure: Includes systems that exist in the building and within five feet of the building foundation, such as plumbing, lighting, air exchange, and safety systems.

  central campus infrastructure: Refers primarily to systems that exist between the buildings of a campus (excluding the area within five feet of any individual building foundation) and to the nonarchitectural elements of campus design (central wiring for telecommunications systems, storage/disposal facilities, electrical wiring between buildings, central heating and air exchange systems, drains and sewers, roadways, walkways, parking systems, etc.)

  fixed equipment: Refers to equipment that is built into facilities, such as fume hoods and lab benches.

  NASF: Is the sum of all areas (in square feet) on all floors of a building assigned to, or available to be assigned to, an occupant for specific use, such as instruction or research. NASF should be measured from the inside faces of walls.

  new construction: Refers to additions to an existing building or construction of a new building.

  planned project: Refers to a project that is funded and scheduled but on which construction has not yet begun.

  repair/renovation: Refers to the fixing up of facilities in deteriorated condition, capital improvements on facilities, conversion of facilities, etc.

Table for Item 6. Planned research facilities projects over $100,000 scheduled to begin in your FY 1998 and FY 1999

FIELD	REPAIR/RENOVATION over $100,000 scheduled to begin in your FY 1998 or FY 1999		NEW CONSTRUCTION over $100,000 scheduled to begin in your FY 1998 or FY 1999	
	Column 1	Column 2	Column 3	Column 4
	Expected Cost	Estimated NASF	Expected Cost	Estimated NASF
Engineering				
Physical Sciences				
Earth, Atmospheric, and Ocean Sciences				
Mathematics				
Computer Sciences				
Agricultural Sciences				
Biological Sciences Other than medical school				
Biological Sciences Medical school				
Medical Sciences Other than medical school				
Medical Sciences Medical school				
Psychology				
Social Sciences				
Other Sciences, not elsewhere classified List them:				
TOTAL #1: ALL S&E FIELDS				
TOTAL #2: CENTRAL CAMPUS INFRA-STRUCTURE (Includes telecommunications, electrical systems, plumbing systems, steam and chilled water lines, hazardous materials systems, etc.)				
TOTAL #3: GRAND TOTAL				

Item 7. Costs for repair/renovation and new construction of research space needed but not funded

To complete Item 7, do the following:

1. Read the definition in the "Tips" box to the right for **deferred project**. According to this definition, answer the question above the table on the facing page.
2. Read the definition in the "Tips" box to the right for **institutional plan**. Then,
   - for deferred projects that are *part of an institutional plan*, enter the estimated completion costs (planning, site preparation, construction, **fixed equipment**, non-fixed equipment costing $1 million or more, **building infrastructure**) in Columns 1 and 2 of the table on the facing page; and
   - for deferred projects that are *not* part of an institutional plan, enter the estimated completion costs in Columns 3 and 4.
3. Record the totals for these estimates in the row marked TOTAL #1.
4. Near the bottom of the table, in the row marked TOTAL #2, enter the estimated completion costs for deferred capital projects to extend, repair, or renovate **central campus infrastructure**—both those that are, and those that are not, part of an institutional plan.
5. Add the figures in the row marked TOTAL #1 to those in the row marked TOTAL #2. Record the total figures in the row marked TOTAL #3.

Tips for completing Item 7

- If space is shared by S&E fields, prorate the cost to reflect the proportion of use by each field. (For an example, see page 3.)
- For help in classifying your programs, refer to the *Cross Reference* chart on page 25.
- Use these definitions for bolded items:

building infrastructure: Includes systems that exist in the building and within five feet of the building foundation, such as plumbing, lighting, air exchange, and safety systems.

central campus infrastructure: Refers primarily to systems that exist between the buildings of a campus (excluding the area within five feet of any individual building foundation) and to the nonarchitectural elements of campus design (central wiring for telecommunications systems, storage/disposal facilities, electrical wiring between buildings, central heating and air exchange systems, drains and sewers, roadways, walkways, parking systems, etc.)

deferred project: Refers to a repair/renovation or new construction project which meets all of the following criteria:

- is necessary to meet your current S&E research program commitments,
- is not scheduled for your FY 1998 or FY 1999,
- does not have funding, *and*
- is neither for the purpose of developing new programs nor for expanding faculty beyond what is required to fulfill current S&E research program commitments.

fixed equipment: Refers to equipment that is built into facilities, such as fume hoods and lab benches.

institutional plan: Refers to an institution's approved plan, including goals, strategies, steps, and budgets, for fulfilling the institution's mission during a specific time period.

new construction: Refers to additions to an existing building or construction of a new building.

repair/renovation: Refers to the fixing up of facilities in deteriorated condition, capital improvements on facilities, conversion of facilities, etc.

Table for Item 7. Costs for repair/renovation and new construction of research space needed but not funded

Does your institution have any deferred projects for repair/renovation or new construction of your science and engineering (S&E) research facilities?

☐ **Yes.** Continue. ☐ **No.** Go to Item 8.

***Note**: If you cannot provide cost estimates, **you may instead record estimated NASF** for deferred projects (prorate if necessary).*

If you choose to do this and are recording NASF rather than dollars in the table below, check (✓) here: ☐

FIELD	Estimated cost for deferred projects needed for current S&E research program commitments			
	Needs INCLUDED in an institutional plan		Needs NOT INCLUDED in an institutional plan	
	Column 1	Column 2	Column 3	Column 4
	Repair/renovation costs	New construction costs	Repair/renovation costs	New construction costs
Engineering				
Physical Sciences				
Earth, Atmospheric, and Ocean Sciences				
Mathematics				
Computer Sciences				
Agricultural Sciences				
Biological Sciences Other than medical school				
Biological Sciences Medical school				
Medical Sciences Other than medical school				
Medical Sciences Medical school				
Psychology				
Social Sciences				
Other Sciences, not elsewhere classified List them:				
TOTAL #1: ALL S&E FIELDS				
TOTAL #2: CENTRAL CAMPUS INFRA-STRUCTURE (See "Tips" box for definition.)				
TOTAL #3: GRAND TOTAL				

Item 8. Facilities for laboratory animals

To complete Item 8, answer the questions on the facing page.

The following is a brief description of the four recommended biosafety levels of Animal Biological Safety, reprinted from *Biosafety in Microbiological and Biomedical Laboratories* (see below).

Level 1 practices, safety equipment, and facilities are appropriate for undergraduate and secondary educational training and teaching laboratories, and for other facilities in which work is done with defined and characterized strains of viable microorganisms not known to cause disease in healthy adult humans.

Level 2 practices, equipment, and facilities are applicable to clinical, diagnostic, teaching and other facilities in which work is done with the broad spectrum of indigenous moderate-risk agents present in the community and associated with human disease of varying severity.

Level 3 practices, safety equipment, and facilities are applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection.

Level 4 practices, safety equipment, and facilities are applicable for work with dangerous and exotic agents which pose a high individual risk of life-threatening disease, which may be transmitted via the aerosol route, and for which there is no available vaccine or therapy.

Note: For a complete description of Animal Biological Safety, reference the report, U.S. Department of Health and Human Services. Public Health Service, Centers for Disease Control and Prevention; and National Institutes of Health. *Biosafety in Microbiological and Biomedical Laboratories*, 3rd Edition, 1993. Washington D.C.; U.S. Government Printing Office, 1993.

Tips for completing Item 8

- Include as laboratory animal facilities both departmental and central facilities that are subject to government and state policies and regulations concerning humane care and use of laboratory animals.
- Do *not* include in your lab animal facilities space:
  - agricultural field buildings sheltering animals that do not directly support research or that are not subject to government regulations concerning humane care and use of laboratory animals; or
  - areas for treatment of animals that are veterinary patients.
- Use these definitions for bolded items:

  animal housing NASF: Refers to all general animal housing (for example, cage rooms, stalls, wards, isolation rooms) and maintenance areas (for example, feed storage rooms, cage-washing rooms, shops, storage), if these areas directly support research. (Animal housing NASF are Codes 570 and 575 in the *Postsecondary Education Facilities Inventory and Classification Manual.)*

  animal laboratory NASF: Refers to all animal laboratory space used exclusively for research activities, such as bench space, animal production colonies, holding rooms, germ-free rooms, surgical facilities and recovery rooms.

  total animal research NASF: Refers to the combined amount of animal laboratory and animal housing NASF.

Item 8. Facilities for laboratory animals

1. Does your institution have facilities for laboratory animals?

   ☐ No. Go to Item 9 on the next page.

   ☐ Yes. Go to step 2.

2. Below, fill in the amounts of your **animal housing NASF** and **animal laboratory NASF.** Add the two figures to arrive at your **total animal research NASF.**

   _____ Animal housing NASF

   \+ _____ Animal laboratory NASF

   = _____ **Total** animal research NASF

3. Fill in the amounts of your total animal research NASF that match the following four recommended biosafety levels[1]:

   Level 1 _____ NASF

   Level 2 _____ NASF

   Level 3 _____ NASF

   Level 4 _____ NASF

   Total _____ NASF

   The total of the four levels above should equal your **Total** animal research NASF in 2. above.

4. Fill in the costs and amounts of NASF for animal facility improvements involving

   - repair/renovation over $100,000 scheduled to begin in your FY 1998 or FY 1999

     Cost _____ NASF_____

   - new construction over $100,000 scheduled to begin in your FY 1998 or FY 1999

     Cost _____ NASF_____

Note: *Be sure to also include in your answer to Item 6 on page 19 any projects you list here as repair/renovation and/or new construction projects on animal facilities.*

[1]Reference the report, U.S. Department of Health and Human Services. Public Health Service, Centers for Disease Control and Prevention; and National Institutes of Health. ***Biosafety in Microbiological and Biomedical Laboratories,*** 3rd Edition, 1993. Washington, D.C.: U.S. Government Printing Office, 1993.

Item 9. Additional comments

This is an optional, open-ended question designed with two purposes in mind. It allows you to

- give us information which numerical data cannot capture, and
- help us identify new areas of concern relating to science and engineering (S&E) research facilities. Such discoveries may, in future surveys, warrant further quantitative investigation.

To complete Item 9, write any additional comments you may have in the space below:

FICE Code

Institution Name

Item 10. Feedback

We appreciate the time you have taken to fill out the 1998 survey.

How many person-hours were required to complete this form? _____

Return the survey by ***March 31, 1998***, to: ***The Gallup Organization***
Attention: Bernadine Karunaratne
One Church Street, Suite 900
Rockville, MD 20850

Cross Reference Between NSF Field Categories And The NCES Classification Of Academic Departments

Use this chart to identify the departments that are included within each of the science and engineering (S&E) fields used in this survey.

ENGINEERING

101 Aerospace Engineering
- 14.02 Aerospace, aeronautical, and astronautical engineering

102 Agricultural Engineering
- 14.03 Agricultural engineering

103 Biomedical Engineering
- 14.05 Bioengineering and biomedical engineering

104 Chemical Engineering
- 03.0509 Wood sciences
- 14.07 Chemical engineering

105 Civil Engineering
- 04.02 Architecture
- 14.04 Architectural engineering
- 14.08 Civil engineering
- 14.14 Environmental health engineering

106 Electrical Engineering
- 14.09 Computer engineering
- 14.10 Electrical, electronics, and communications engineering
- 14.1002 Microelectronic engineering

107 Engineering Science
- 14.12 Engineering physics
- 14.13 Engineering science

108 Industrial Engineering/Management Science
- 14.17 Industrial engineering
- 14.27 Systems engineering
- 30.06 Systems science

109 Mechanical Engineering
- 14.11 Engineering mechanics
- 14.19 Mechanical engineering

110 Metallurgical and Materials Engineering
- 14.06 Ceramic engineering
- 14.18 Materials engineering
- 14.20 Metallurgical engineering
- 40.0701 Metallurgy

111 Mining Engineering
- 14.15 Geological engineering
- 14.16 Geophysical engineering
- 14.21 Mining and mineral engineering

112 Nuclear Engineering
- 14.23 Nuclear engineering

113 Petroleum Engineering
- 14.25 Petroleum engineering

114 Engineering, not elsewhere classified
- 14.01 Engineering, general
- 14.22 Naval architecture and marine engineering
- 14.24 Ocean engineering
- 14.28 Textile engineering
- 14.99 Engineering, other
- 19.09 Textiles and clothing (excluding 19.0902, Fashion Design)
- 30.03 Engineering and other fields

PHYSICAL SCIENCES

201 Astronomy
- 40.02 Astronomy
- 40.03 Astrophysics
- 40.09 Planetary science

202 Chemistry
- 40.05 Chemistry

203 Physics
- 40.08 Physics

204 Physical Sciences, not elsewhere classified
- 40.01 Physical sciences, general
- 40.0799 Miscellaneous physical sciences, other
- 40.099 Physical sciences, other

EARTH, ATMOSPHERIC, AND OCEAN SCIENCES

301 Atmospheric Sciences
- 40.4 Atmospheric sciences and meteorology

302 Geosciences
- 40.06 Geological and related sciences
- 40.0703 Earth and planetary sciences

303 Ocean Sciences
- 26.0607 Marine/aquatic biology
- 40.0702 Oceanography

304 Earth, Atmospheric, and Ocean Sciences, N.E.C.

MATHEMATICS

402 Mathematics and Applied Mathematics
- 06.1302 Operations research (quantitative methods)
- 27.01 Mathematics, general
- 27.03 Applied mathematics
- 27.04 Pure mathematics
- 27.99 Mathematics, other
- 30.08 Mathematics and computer science

403 Statistics
- 27.02 Actuarial sciences
- 27.05 Statistics

COMPUTER SCIENCES

401 Computer Sciences
- 06.12 Management information systems
- 11 Computer and information sciences, general
- 30.09 Imaging science

AGRICULTURAL SCIENCES (SEE ALSO 102 AND 901)

501 Agricultural Sciences
- 02.01 Agricultural sciences, general
- 02.02 Animal sciences
- 02.03 Food sciences
- 02.04 Plant sciences
- 02.05 Soil sciences
- 02.99 Agricultural sciences, other
- 03.01 Renewable natural resources, general
- 03.03 Fishing and fisheries
- 03.05 Forestry and related sciences
- 03.06 Wildlife management
- 03.99 Renewable natural resources, other
- 31.04 Water resources

BIOLOGICAL SCIENCES

601 Anatomy
- 18.0201 Clinical anatomy
- 26.0601 Anatomy

602 Biochemistry
- 18.0202 Clinical biochemistry
- 26.02 Biochemistry and biophysics

603 Biology
- 26.01 Biology, general
- 26.0604 Embryology

604 Biometry and epidemiology
- 18.2202 Epidemiology
- 26.0602 Biometrics and biostatistics

605 Biophysics

606 Botany
- 26.03 Botany (excluding 26.0302, Bacteriology; see 611)

607 Cell Biology
- 26.04 Cell and molecular biology
- 26.0606 Histology

608 Ecology
- 26.0603 Ecology

609 Entomology and Parasitology
- 26.0610 Parasitology
- 26.07102 Entomology

610 Genetics
- 26.0703 Genetics, human and animal

611 Microbiology, Immunology, and Virology
- 18.0203 Clinical microbiology
- 18.1002 Allergies and endomology
- 18.1009 Immunology
- 26.0302 Bacteriology
- 26.05 Microbiology

612 Nutrition
- 19.05 Food sciences and human nutrition
- 20.0108 Food and nutrition
- 26.0609 Nutritional sciences

613 Pathology
- 18.0204 Clinical pathology
- 18.1018 Pathology
- 26.0704 Pathology, human and animal

614 Pharmacology
- 18.0206 Clinical toxicology
- 26.0612 Toxicology
- 26.0705 Pharmacology, human and animal
- 42.14 Psychopharmacology

615 Physiology
- 18.0205 Physiology
- 26.0706 Physiology, human and animal

616 Zoology
- 26.0701 Zoology
- 26.0799 Zoology, other

617 Biosciences, not elsewhere classified
- 26.0699 Miscellaneous specialized areas, life sciences, other
- 26.99 Life sciences, other

MEDICAL SCIENCES (see also 103)

701 Anesthesiology
- 18.1003 Anesthesiology

702 Cardiology

703 Cancer Research/Oncology

704 Endocrinology
- 26.0605 Endocrinology

705 Gastroenterology

706 Hematology
- 18.08 Hematology

707 Neurology
- 18.1024 Neurology
- 26.0608 Neurosciences

708 Obstetrics and Gynecology
- 18.1013 Obstetrics and gynecology

709 Ophthalmology
- 18.1014 Ophthalmology
- 18.12 Optometry

710 Otorhinolaryngology
- 18.1017 Otorhinolaryngology/otolaryngology

711 Pediatrics
- 18.1019 Pediatrics
- 20.0102 Child development

712 Preventive Medicine and Community Health
- 18.1007 Family practice
- 18.1022 Preventive medicine

713 Psychiatry
- 18.1023 Psychiatry
- 18.1106 Psychiatry/mental health

714 Pulmonary Disease

715 Radiology
- 18.1012 Nuclear medicine
- 18.1025 Radiology
- 26.0611 Radiobiology

716 Surgery
- 18.1004 Colon and rectal surgery
- 18.1011 Neurological surgery
- 18.1016 Orthopedic
- 18.1021 Plastic surgery
- 18.1026 Surgery
- 18.1027 Thoracic surgery

717 Clinical Medicine, not elsewhere classified
- 18.0299 Basic clinical health sciences, other
- 18.1001 Medicine, general
- 18.1005 Dermatology
- 18.1008 Geriatrics
- 18.1010 Internal medicine
- 18.1020 Physical medicine and rehabilitation
- 18.1028 Urology
- 18.1099 Medicine, other
- 18.13 Osteopathic medicine
- 18.15 Podiatry
- 30.01 Biological and physical sciences

718 Dental Sciences
- 18.04 Dentistry
- 18.1015 Orthodontic surgery

719 Nursing
- 18.11 Nursing (excluding 18.1106, Psychiatry/mental health; see 713)

720 Pharmaceutical Sciences
- 18.14 Pharmacy

721 Veterinary Sciences
- 18.24 Veterinary medicine

722 Health Related, not elsewhere classified
- 17.0807 Occupational therapy
- 17.0813 Physical therapy
- 17.0899 Rehabilitation services, other
- 17.99 Allied health, other
- 18.07 Health sciences administration
- 18.09 Medical laboratory
- 18.22 Public health
- 18.99 Health sciences, other

723 Speech Pathology and Audiology
- 18.01 Audiology and speech pathology

PSYCHOLOGY

801 Psychology
- 13.08 School psychology (not including Educational Psychology)
- 17.0801 Art therapy
- 42 Psychology (including Educational Psychology)

SOCIAL SCIENCES

901 Agricultural Economics
- 01.0102 Agricultural business and management
- 01.0103 Agricultural economics

902 Anthropology (Cultural and Social)
- 45.02 Anthropology
- 45.03 Archeology

903 Economics (except Agricultural)
- 06.05 Business Economics
- 45.06 Economics

904 Geography
- 45.07 Geography

905 History and philosophy of science

906 Linguistics
- 23.06 Linguistics
- 42.12 Psycholinguistics

907 Political Science
- 44.01 Public affairs, general
- 44.03 International public service
- 44.04 Public administration
- 44.05 Public policy studies
- 44.99 Public affairs, other
- 45.09 International affairs
- 45.10 Political science and government

908 Sociology
- 45.05 Demography
- 45.11 Sociology

909 Sociology and Anthropology

910 Social Sciences, not elsewhere classified
- 04.03 City, community, and regional planning
- 05 Area and ethnic studies
- 06.06 Human resources development
- 06.15 Organizational behavior
- 31.03 Parks and recreational management
- 43.01 Criminal justice
- 44.02 Community services
- 44.07 Social work
- 45.01 Social sciences, general
- 45.04 Criminology
- 45.12 Urban studies
- 45.99 Social sciences, other

Appendix D

Reference List

Reference List

National Science Foundation (1996). *Academic Research and Development Expenditures: Fiscal Year 1996* (NSF 98-304). Arlington, VA: National Science Foundation.

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Schmidt, P. (1998). A building boom for public colleges. *Chronicle of Higher Education, June 12, A29-A30*.

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Appendix E

Detailed Statistical Tables

Table E1-1. Amount of instructional and research space by institution type: 1998

Institution type and control	Number of institutions	Instructional and research space in all academic fields	Instructional and research space in S&E fields	Research space in S&E fields
		NASF in millions		
Total	660	488	286	143
Doctorate-granting	378	416	261	136
Top 100 in research expenditures	100	252	177	101
Other	278	164	84	35
Nondoctorate-granting	282	72	25	7
Public	365	346	212	106
Doctorate-granting	213	303	196	102
Nondoctorate-granting	151	43	16	5
Private	295	141	74	37
Doctorate-granting	164	113	65	34
Nondoctorate-granting	131	29	9	3

KEY: NASF = net assignable square feet.
S&E = science and engineering.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E1-2. Amount of science and engineering (S&E) instructional and research space by institution type: 1988, 1990, 1992, 1994, 1996, and 1998

Institution type and control	Number of institutions						Total NASF in S&E fields						Research NASF in S&E fields					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
							NASF in millions											
Total	525	525	525	565	560	660	270.6	276.0	285.4	282.2	284.9	286.2	112.1	116.3	122.0	127.2	136.5	143.3
Doctorate-granting	293	293	294	319	318	378	240.7	243.9	256.3	252.7	255.9	260.8	107.4	111.2	117.4	121.8	130.7	135.9
Top 100 in research expenditures	100	100	100	100	100	100	165.7	163.9	171.9	170.6	173.4	177.3	80.6	81.7	87.5	90.9	98.3	101.3
Other	193	193	194	219	218	278	75.1	80.0	84.3	82.1	82.5	83.5	26.8	29.5	29.9	30.9	32.4	34.6
Nondoctorate-granting	232	232	231	246	242	282	29.9	32.1	29.1	29.4	29.0	25.4	4.6	5.2	4.6	5.4	5.8	7.4
Public	320	319	319	326	324	365	204.3	211.7	218.7	203.1	207.5	212.2	82.4	86.9	90.8	91.7	99.0	106.1
Doctorate-granting	191	190	192	188	188	213	183.5	188.9	198.6	182.7	187.3	195.8	79.3	83.6	88.0	88.2	95.5	101.5
Nondoctorate-granting	129	129	127	138	136	151	20.8	22.8	20.1	20.5	20.2	16.4	3.1	3.3	2.8	3.5	3.5	4.6
Private	205	206	206	239	236	295	66.3	64.4	66.7	79.0	77.4	74.0	29.7	29.4	31.2	35.6	37.5	37.2
Doctorate-granting	102	103	102	131	130	164	57.2	55.1	57.6	70.9	68.6	65.0	28.2	27.6	29.4	33.7	35.2	34.4
Nondoctorate-granting	103	103	104	108	106	131	9.1	9.3	9.1	8.9	8.8	9.0	1.5	1.8	1.8	1.9	2.3	2.8

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions; 1994 data represent 565 institutions; and all data prior to 1994 (1988, 1990, 1992), represent 525 institutions.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E1-3. Number of institutions with instructional and research space in science and engineering fields, by field and institution type: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Total						Institution type: Doctorate-granting: Top 100 in research expenditures						Institution type: Doctorate-granting: Other						Institution type: Nondoctorate-granting					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
Total	525	525	525	565	560	660	100	100	100	100	100	100	193	193	194	219	218	278	232	232	231	246	242	282
Biological sciences																								
inside medical schools	94	105	128	131	121	127	50	55	60	60	58	53	44	50	68	71	63	73	0	0	0	0	0	1
outside medical schools	475	479	485	509	517	575	96	95	94	93	94	94	151	156	161	184	186	217	229	228	231	232	237	264
Physical sciences	473	471	468	512	510	569	93	93	89	91	90	89	150	147	147	181	181	217	230	231	231	241	239	263
Psychology	472	470	435	469	479	529	91	91	86	88	88	86	155	155	155	176	176	190	227	225	194	205	215	252
Social sciences	461	447	421	450	457	507	94	95	91	93	91	90	153	155	152	165	164	198	214	198	177	191	201	218
Mathematics	455	457	458	486	493	530	93	93	88	90	88	87	148	145	153	171	178	198	215	219	217	225	227	245
Computer sciences	426	404	426	455	441	483	86	86	83	82	82	80	133	131	144	167	158	182	207	187	199	208	200	222
Earth, atmospheric, and ocean sciences	323	326	329	336	339	387	84	85	83	86	88	87	120	112	122	129	131	144	118	129	124	121	120	155
Engineering	295	299	304	314	322	339	86	86	86	88	87	87	128	129	130	129	133	153	81	84	88	98	102	98
Agricultural sciences	104	103	98	120	118	113	42	41	40	41	42	40	30	27	25	29	24	28	32	35	33	50	52	45
Medical sciences																								
outside medical schools	235	250	257	272	285	320	68	68	72	67	78	76	79	91	114	119	116	132	88	91	70	86	91	112
inside medical schools	138	144	150	125	118	140	64	64	67	66	64	63	74	80	83	59	54	73	0	0	0	0	0	4
Other sciences	111	75	82	86	95	165	47	40	38	41	38	37	40	23	30	25	34	61	24	12	14	19	23	68

NOTE: Components may not add to totals due to rounding. In the biological and medical sciences, the total number of institutions is less than the sum of the subcategories because medical schools that are part of larger universities are not counted twice in the total.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E1-4. Number of institutions with research space in science and engineering fields by field and institution type: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Total						Institution type: Doctorate-granting: Top 100 in research expenditures						Institution type: Doctorate-granting: Other						Institution type: Nondoctorate-granting					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
Total	513	517	501	551	560	660	100	100	100	100	100	100	188	187	188	219	218	278	225	229	213	232	242	282
Biological sciences																								
inside medical schools	94	105	125	131	116	127	50	55	60	60	58	53	44	50	66	71	58	73	0	0	0	0	0	1
outside medical schools	456	451	434	489	504	556	95	94	94	93	94	94	144	149	152	184	186	217	217	208	188	213	223	245
Physical sciences	446	450	432	485	490	545	92	92	89	91	90	89	142	141	141	181	181	217	212	217	202	214	219	239
Psychology	403	402	377	412	430	464	87	86	84	85	86	86	131	132	142	165	171	163	185	184	150	162	173	215
Social sciences	360	347	318	370	378	413	89	91	87	89	89	89	127	117	114	141	137	157	144	140	116	140	152	167
Mathematics	318	296	285	321	343	396	85	88	85	82	83	82	105	85	91	125	140	149	129	124	109	114	120	165
Computer sciences	332	281	284	333	340	367	78	79	80	74	77	76	95	89	90	130	132	142	159	113	114	128	131	149
Earth, atmospheric, and ocean sciences	299	294	298	291	306	348	80	82	81	81	85	85	120	112	121	118	125	141	98	89	96	92	96	122
Engineering	283	296	280	290	288	290	85	86	86	87	86	86	128	129	126	122	123	131	70	81	68	82	79	73
Agricultural sciences	96	94	95	114	112	108	42	41	40	41	42	40	30	27	25	29	24	28	24	26	30	44	45	40
Medical sciences																								
inside medical schools	134	141	146	122	118	127	63	64	66	66	64	62	71	77	80	56	54	65	0	0	0	0	0	0
outside medical schools	205	189	208	235	239	262	67	67	67	67	77	75	70	64	96	101	100	113	69	57	44	67	62	74
Other sciences	92	69	71	66	81	149	45	40	37	40	37	36	35	18	26	15	30	59	12	11	7	12	15	54

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions; 1994 data represent 565 institutions; and all data prior to 1994 (1988, 1990, 1992), represent 525 institutions. In the biological and medical sciences, the total number of institutions is less than the sum of the subcategories because medical schools that are part of larger universities are not counted twice.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E1-5. Number of institutions with science and engineering (S&E) instructional and research space by field and type of institutional control: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Institutions with S&E instructional and research space												Institutions with S&E research space											
	Public						Private						Public						Private					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
Total	320	319	319	326	324	365	205	206	206	239	236	295	316	319	311	323	324	365	197	198	190	228	236	295
Biological sciences																								
inside medical schools	68	70	79	66	61	59	26	35	49	64	60	68	68	70	77	66	56	59	26	35	49	64	60	68
outside medical schools	291	291	296	313	312	341	184	187	189	196	205	234	287	277	266	298	303	324	168	174	168	191	201	231
Physical sciences	286	285	283	310	308	334	188	186	185	202	202	235	280	280	269	301	294	312	165	170	164	184	195	233
Psychology	286	285	269	290	295	315	186	185	166	179	184	213	263	261	245	259	263	269	140	141	132	153	166	195
Social sciences	272	278	262	283	277	316	189	169	159	167	179	191	246	244	214	232	229	260	114	103	103	138	149	152
Mathematics	277	275	275	295	302	325	178	182	184	191	191	205	218	197	184	197	206	219	101	98	101	124	137	177
Computer sciences	253	247	264	278	261	300	173	158	162	177	180	183	213	164	192	199	205	215	120	116	92	134	135	152
Earth, atmospheric, and ocean sciences	224	221	210	229	233	243	99	105	119	106	106	144	213	195	193	201	211	218	87	88	105	91	95	131
Engineering	219	225	220	221	232	219	76	73	84	92	90	119	207	222	204	198	202	183	76	73	77	92	86	107
Agricultural sciences	99	96	88	116	112	104	6	7	10	4	6	8	90	87	84	110	106	99	6	7	10	4	6	8
Medical sciences																								
inside medical schools	86	89	96	65	63	73	51	55	54	60	54	67	82	86	92	63	63	70	51	55	54	60	54	57
outside medical schools	196	202	195	211	225	233	38	48	62	62	59	87	170	152	156	179	193	194	36	37	51	56	47	68
Other sciences	92	63	61	51	67	117	19	13	21	35	29	48	73	57	53	45	60	108	19	13	18	21	22	41

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions; 1994 data represent 565 institutions; and all data prior to 1994 (1988, 1990, 1992), represent 525 institutions. In the biological and medical sciences, the total number of institutions is less than the sum of the subcategories because medical schools that are part of larger universities are not counted twice.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E1-6. Amount of instructional and research space in science and engineering fields, by field and institution type: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Total						Institution type: Doctorate-granting: Top 100 in research expenditures					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
	NASF in thousands											
Total	270,621	276,041	285,383	282,176	284,905	286,239	165,655	163,911	171,895	170,627	173,370	177,311
Biological sciences												
inside medical schools	12,739	14,936	18,670	16,954	16,016	17,120	7,999	9,231	11,575	11,151	11,105	10,792
outside medical schools	32,445	34,385	33,108	34,717	35,889	35,293	18,769	19,046	18,703	18,866	19,385	19,582
Physical sciences	35,634	37,542	36,722	37,648	37,822	37,787	18,807	19,264	19,075	18,530	19,139	18,793
Psychology	9,011	9,122	8,329	8,728	8,923	8,389	4,182	4,025	3,894	3,866	4,054	3,898
Social sciences	16,433	15,158	14,926	17,089	17,270	18,300	9,766	8,798	8,659	9,647	9,974	9,957
Mathematics	4,786	5,190	5,198	5,956	5,746	5,780	2,179	2,279	2,207	2,398	2,410	2,290
Computer sciences	4,938	4,625	5,707	6,206	6,290	6,072	2,245	2,430	2,818	2,795	2,839	2,839
Earth, atmospheric, and ocean sciences	12,268	12,019	12,411	12,174	12,463	12,182	7,816	7,598	6,799	7,751	7,859	7,880
Engineering	40,063	42,291	43,150	44,752	46,140	45,294	24,422	24,810	26,089	26,361	27,543	29,028
Agricultural sciences	29,994	34,003	33,161	33,971	35,056	36,485	22,276	24,706	25,699	26,402	27,282	29,458
Medical sciences												
inside medical schools	44,843	41,213	45,532	37,578	35,899	35,947	28,502	23,934	27,668	25,881	24,413	25,322
outside medical schools	21,387	21,955	24,572	22,445	23,449	22,465	14,699	15,090	15,576	13,731	14,735	15,109
Other sciences	6,078	3,602	3,846	3,958	3,941	5,124	3,993	2,701	3,132	3,247	2,633	2,362

See explanatory information and SOURCE at end of table.

Table E1-6. Amount of instructional and research space in science and engineering fields by field and institution type: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Institution type											
	Doctorate-granting						Nondoctorate-granting					
	Other											
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
	NASF in thousands											
Total	75,070	80,024	84,340	82,110	82,500	83,537	29,895	32,107	29,148	29,440	29,035	25,391
Biological sciences												
inside medical schools	4,741	5,705	7,095	5,803	4,911	6,289	0	0	0	0	0	38
outside medical schools	7,850	9,318	8,842	10,349	11,202	10,453	5,827	6,022	5,562	5,501	5,302	5,259
Physical sciences	9,677	9,854	10,613	12,059	11,938	12,614	7,150	8,425	7,085	7,057	6,746	6,380
Psychology	2,528	2,759	2,726	3,009	3,016	2,845	2,302	2,339	1,708	1,852	1,853	1,645
Social sciences	3,264	3,424	3,655	4,790	4,721	5,864	3,403	2,936	2,612	2,651	2,576	2,479
Mathematics	1,490	1,662	1,753	1,921	1,864	2,134	1,116	1,249	1,238	1,637	1,473	1,356
Computer sciences	1,594	1,318	1,673	1,826	1,880	2,162	1,099	877	1,216	1,584	1,571	1,070
Earth, atmospheric, and ocean sciences	3,239	3,222	4,371	3,181	3,333	2,996	1,214	1,199	1,241	1,242	1,272	1,306
Engineering	11,353	12,177	12,505	14,481	14,731	14,507	4,288	5,303	4,556	3,909	3,866	1,759
Agricultural sciences	5,948	7,194	5,500	5,796	5,759	5,140	1,771	2,103	1,962	1,773	2,015	1,886
Medical sciences												
inside medical schools	16,341	17,279	17,864	11,697	11,486	10,602	0	0	0	0	0	23
outside medical schools	5,441	5,651	7,380	6,890	6,740	6,056	1,247	1,214	1,615	1,823	1,974	1,300
Other sciences	1,604	461	362	303	919	1,874	480	440	352	407	389	888

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988,1990, 1992) represent 525 institutions.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E1-7. Amount of research space in science and engineering fields: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Total						Institution type: Doctorate-granting: Top 100 in research expenditures					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
	NASF in thousands											
Total	112,062	116,327	122,015	127,369	136,481	143,288	80,627	81,659	87,508	90,974	98,273	101,272
Biological sciences												
inside medical schools	7,838	8,584	10,649	10,876	10,797	11,642	5,401	5,831	7,489	7,587	8,093	7,930
outside medical schools	16,072	17,569	17,072	16,982	18,662	19,425	11,403	11,715	11,316	11,487	12,409	12,867
Physical sciences	16,024	16,121	16,353	17,001	17,872	18,191	10,443	10,429	10,487	10,380	11,154	11,205
Psychology	3,085	2,978	2,984	3,178	3,404	3,360	1,771	1,581	1,665	1,717	1,829	1,841
Social sciences	3,337	3,338	3,253	3,403	3,977	4,620	2,380	2,359	2,339	2,204	2,766	2,912
Mathematics	722	790	829	937	1,005	889	397	415	437	491	555	460
Computer sciences	1,437	1,445	1,606	1,779	2,075	2,018	835	1,017	1,114	1,179	1,396	1,381
Earth, atmospheric, and ocean sciences	6,313	6,056	6,728	7,053	7,246	7,524	4,645	4,534	4,145	5,324	5,411	5,416
Engineering	15,900	17,057	18,095	20,730	21,832	22,833	11,444	12,130	13,577	14,538	15,649	16,192
Agricultural sciences	17,622	20,821	19,910	20,120	22,118	24,607	14,433	16,032	16,714	16,952	18,496	20,141
Medical sciences												
inside medical schools	14,042	14,762	16,139	16,799	17,727	18,128	10,365	9,957	11,569	12,564	13,485	13,669
outside medical schools	5,320	4,959	6,234	6,070	7,402	7,001	4,208	4,133	4,806	4,397	5,435	5,670
Other sciences	4,350	1,846	2,162	2,442	2,363	3,050	2,903	1,526	1,851	2,152	1,596	1,588

See explanatory information and SOURCE at end of table.

Table E1-7. Amount of research space in science and engineering fields: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Institution type											
	Doctorate-granting						Nondoctorate-granting					
	Other											
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
	NASF in thousands											
Total	26,815	29,508	29,865	30,956	32,411	34,607	4,620	5,161	4,642	5,438	5,797	7,410
Biological sciences												
inside medical schools	2,437	2,754	3,160	3,288	2,704	3,675	0	0	0	0	0	37
outside medical schools	3,668	4,727	4,589	4,106	4,803	4,800	1,001	1,128	1,167	1,389	1,450	1,758
Physical sciences	4,236	4,232	4,767	5,347	5,358	5,200	1,344	1,459	1,099	1,275	1,361	1,786
Psychology	896	984	981	1,047	1,133	1,056	418	413	337	413	442	463
Social sciences	635	671	654	872	877	1,185	322	309	260	326	334	524
Mathematics	260	300	300	312	306	286	65	75	92	132	145	144
Computer sciences	431	315	332	361	430	442	170	113	160	238	249	195
Earth, atmospheric, and ocean sciences	1,458	1,314	2,251	1,436	1,530	1,676	210	208	332	292	305	431
Engineering	3,928	4,214	3,996	5,557	5,599	6,312	529	713	523	636	584	329
Agricultural sciences	2,821	4,247	2,737	2,692	3,031	3,155	368	542	459	475	590	1,310
Medical sciences												
inside medical schools	3,677	4,805	4,571	4,234	4,242	4,458	0	0	0	0	0	0
outside medical schools	1,004	713	1,328	1,497	1,712	1,151	109	113	100	175	255	180
Other sciences	1,364	232	198	203	685	1,210	83	87	113	86	82	252

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E1-8. Amount of instructional and research space in science and engineering (S&E) fields, by field and institution control: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Instructional and research space in S&E fields											
	Public						Private					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
Total	204,302	211,651	218,687	203,107	207,483	212,241	66,318	64,390	66,696	79,069	77,422	73,998
Biological sciences												
inside medical schools	8,433	9,388	10,306	8,352	7,756	9,144	4,307	5,547	8,364	8,601	8,259	7,976
outside medical schools	24,164	26,449	25,754	26,186	27,145	26,716	8,281	7,937	7,354	8,530	8,744	8,577
Physical sciences	24,505	26,595	25,912	25,048	25,533	26,311	11,129	10,947	10,860	12,599	12,289	11,476
Psychology	6,254	6,415	5,960	6,224	6,486	6,145	2,758	2,706	2,369	2,503	2,437	2,244
Social sciences	12,284	11,071	11,305	12,006	12,708	13,577	4,149	4,087	3,621	5,082	4,562	4,723
Mathematics	3,520	3,874	3,811	4,309	4,097	4,097	1,266	1,316	1,387	1,646	1,649	1,683
Computer sciences	3,530	3,041	3,947	3,977	4,181	4,158	1,408	1,584	1,759	2,229	2,110	1,914
Earth, atmospheric, and ocean sciences	9,624	9,393	9,981	9,307	9,555	9,317	2,644	2,626	2,430	2,866	2,908	2,865
Engineering	29,780	32,224	33,252	33,492	35,375	34,453	10,284	10,066	9,898	11,260	10,765	10,841
Agricultural sciences	29,238	32,510	31,409	30,707	31,852	33,298	756	1,493	1,753	3,264	3,204	3,186
Medical sciences												
inside medical schools	31,891	28,935	34,335	23,306	21,239	23,578	12,953	12,278	11,197	14,272	14,660	12,370
outside medical schools	16,920	18,755	19,675	17,563	18,683	17,509	4,468	3,200	4,897	4,882	4,766	4,957
Other sciences	4,162	3,000	3,038	2,627	2,873	3,938	1,917	602	808	1,332	1,068	1,185

See explanatory information and SOURCE at end of table.

Table E1-8. Amount of instructional and research space in science and engineering (S&E) fields, by field and institution control: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Research space in S&E fields											
	Public						Private					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
Total	82,384	86,881	90,815	91,723	98,958	106,093	26,678	29,447	31,200	35,645	37,522	37,195
Biological sciences												
inside medical schools	4,854	5,067	5,768	5,189	5,069	6,232	2,984	3,517	4,881	5,687	5,729	5,410
outside medical schools	11,473	13,240	13,327	12,646	13,852	14,737	4,599	4,329	3,745	4,337	4,811	4,688
Physical sciences	10,719	10,944	11,299	11,342	12,175	12,745	5,305	5,177	5,054	5,659	5,697	5,446
Psychology	2,216	2,102	2,148	2,266	2,434	2,401	869	876	836	911	970	959
Social sciences	2,794	2,684	2,601	2,806	3,284	3,816	543	655	652	597	693	804
Mathematics	505	527	554	635	629	529	217	264	276	301	376	361
Computer sciences	875	735	973	975	1,135	1,098	562	710	633	804	940	921
Earth, atmospheric, and ocean sciences	5,045	4,833	5,718	5,692	5,774	6,071	1,267	1,223	1,009	1,361	1,472	1,452
Engineering	11,593	12,562	13,383	15,418	16,373	17,072	4,306	4,495	4,712	5,311	5,459	5,761
Agricultural sciences	17,233	19,434	18,304	18,788	20,937	23,443	389	1,387	1,607	1,331	1,181	1,163
Medical sciences												
inside medical schools	8,368	9,022	10,434	9,738	9,766	10,255	5,675	5,739	5,705	7,061	7,960	7,873
outside medical schools	3,948	4,137	4,674	4,608	5,802	5,393	1,373	822	1,560	1,461	1,600	1,608
Other sciences	2,761	1,593	1,632	1,620	1,727	2,302	1,589	253	530	824	636	748

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E1-9. Amount of leased space in science and engineering fields, by institution type and control: 1988, 1990, 1992, 1994, 1996, and 1998

Institution type and control	Amount of leased space (NASF in thousands)						Leased space as a percentage of total research space					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
Total	3,771	3,551	4,755	4,366	5,461	6,124	3.4	3.1	3.9	9.0	4.0	4.3
Doctorate-granting	3,760	3,536	4,717	4,317	5,444	6,004	3.5	3.2	4.0	3.5	4.2	4.4
Top 100 in research expenditures	2,847	2,601	3,532	3,696	4,544	4,777	3.5	3.2	4.0	4.0	4.6	4.7
Other	913	935	1,185	621	900	1,228	3.4	3.2	4.0	2.0	2.8	3.6
Nondoctorate-granting	11	15	38	48	17	120	0.2	0.3	0.8	0.9	0.3	1.6
Public	2,315	2,145	2,869	3,169	1,625	4,198	2.8	2.5	3.2	3.0	4.3	4.0
Private	1,456	1,406	1,886	1,196	3,836	1,926	4.9	4.8	6.0	3.0	3.9	5.2

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions.

SOURCE: National Science Foundation/Divison of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E2-1. Adequacy of the amount of science and engineering research space by field: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Number of institutions[1]						Adequate					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996[3]	1998[3]
							Percentage of institutions assessments					
Biological sciences												
inside medical school	91	105	125	132	116	127	3.7	10.4	3.6	10.6	55.9	29.5
outside medical school	444	451	434	490	504	569	8.3	8.7	10.8	6.0	45.9	35.6
Physical sciences	445	450	433	489	490	556	4.7	8.7	10.6	6.4	44.9	36.4
Psychology	403	398	388	425	430	464	16.8	13.2	17.2	14.8	55.4	48.8
Social sciences	360	345	328	378	378	413	12.9	12.7	8.2	7.2	51.2	39.5
Mathematics	318	296	300	348	343	416	21.0	17.6	16.1	16.0	68.4	55.8
Computer sciences	331	280	297	347	340	395	15.1	13.5	12.9	15.5	54.6	44.4
Earth, atmospheric, and ocean sciences	297	284	314	310	306	365	11.0	11.1	10.5	7.2	53.7	38.5
Engineering	283	296	290	297	288	305	8.7	10.6	5.8	6.7	42.8	39.9
Agricultural sciences	96	94	96	123	112	108	11.0	17.0	17.5	10.5	48.1	44.9
Medical sciences												
inside medical school	134	141	146	126	118	127	0.8	7.0	4.2	10.8	34.1	32.8
outside medical school	191	189	210	243	239	280	14.3	13.0	14.2	11.7	42.6	46.6
Other, not elsewhere classified	90	69	71	63	81	149	10.4	16.9	14.0	15.0	51.8	56.5

See explanatory information and SOURCE at end of table.

Table E2-1. Adequacy of the amount of science and engineering research space by field: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Generally adequate						Inadequate[2]					
	1988	1990	1992	1994	1996[3]	1998[3]	1988	1990	1992	1994	1996[3]	1998[3]
	Percentage of institutions assessments											
Biological sciences												
inside medical school	47.3	35.5	60.5	53.5			49.0	54.1	35.9	35.5	45.5	70.5
outside medical school	45.8	48.0	51.8	53.7			45.9	43.1	37.4	40.1	53.3	64.4
Physical sciences	52.4	50.8	52.3	53.1			42.9	40.5	37.0	40.5	54.5	63.6
Psychology	51.4	54.3	50.0	53.9			31.8	32.4	32.9	31.2	43.8	51.2
Social sciences	50.2	51.0	64.4	63.4			36.9	36.2	27.4	29.3	47.6	60.5
Mathematics	53.6	47.2	58.6	55.5			25.4	35.2	25.3	28.3	30.3	44.2
Computer sciences	38.2	41.5	56.7	48.3			46.9	45.0	30.3	36.0	43.7	55.6
Earth, atmospheric, and ocean sciences	49.4	48.4	59.4	59.6			39.5	40.5	30.1	33.2	46.0	61.5
Engineering	40.1	40.8	49.1	53.3			51.1	48.6	45.1	40.5	57.2	60.1
Agricultural sciences	51.2	39.9	48.2	59.7			37.7	43.1	34.3	29.6	51.9	55.1
Medical sciences												
inside medical school	52.6	33.8	54.1	44.8			46.6	59.2	41.8	44.0	65.9	67.2
outside medical school	46.0	40.3	50.1	50.3			39.7	46.7	35.7	38.2	57.4	53.4
Other, not elsewhere classified	51.3	39.2	44.9	50.0			38.4	44.0	41.1	36.5	40.7	43.5

[1] Excludes institutions that have no research space in the field and report "not applicable or not needed."

[2] Includes the category "nonexistent but needed."

[3] 1996 and 1998 survey question included only two categories: adequate and inadequate. In previous years' surveys, there were three categories: adequate, generally adequate, and inadequate.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data are national estimates derived from samples representing the 560 largest research-performing U.S. colleges and universities; 1994 data represent 565 institutions; all previous years data (1988, 1990, 1992) represent 525 institutions.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E2-2. Adequacy of the amount of science and engineering research by field and institution type: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Institution type																	
	Doctorate-granting												Nondoctorate-granting					
	Top 100 in research expenditures						Other											
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
	Percent																	
Biological sciences																		
inside medical school	51	64	46	49	31	62	35	43	26	24	38	78	--	--	--	--	--	--
outside medical school	52	50	44	51	61	74	46	43	35	32	49	56	43	40	37	38	52	68
Physical sciences	63	57	48	51	56	71	43	45	38	46	55	55	35	31	31	32	51	69
Psychology	32	38	34	31	43	59	26	32	35	25	42	56	36	29	32	37	42	45
Social sciences	36	39	37	38	55	65	29	34	27	26	42	60	44	36	26	27	44	59
Mathematics	45	35	28	32	30	47	29	35	24	19	26	41	10	37	28	35	32	45
Computer sciences	54	55	35	43	39	63	46	39	26	30	36	47	43	42	28	39	47	61
Earth, atmospheric, and ocean sciences	47	50	38	41	46	61	44	33	23	34	39	61	33	42	40	27	47	63
Engineering	61	59	52	55	57	78	46	41	37	35	57	52	49	49	53	35	48	54
Agricultural sciences	42	45	42	37	30	65	39	51	29	29	50	53	28	32	31	24	35	47
Medical sciences																		
inside medical school	62	52	53	33	40	73	57	33	35	35	69	62	--	--	--	--	--	--
outside medical school	48	56	32	43	44	68	43	35	41	41	65	48	26	49	32	30	47	51

KEY: -- = no space in this field.

NOTES: All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data are national estimates derived from samples representing the 560 largest research-performing U.S. colleges and universities; 1994 data represent 565 institutions; all previous years data (1988, 1990, 1992) represent 525 institutions. In 1994, data from 1988, 1990, and 1992 were adjusted to match the analytic procedure used to calculate 1994 figures. In 1996, survey question categories were worded slightly differently (see Table E2-1 notes).

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E2-3. Adequacy of the amount of science and engineering research space by field and institution control: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Public						Private					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
	Percent											
Biological sciences												
inside medical school	56	61	37	39	50	73	31	40	34	32	41	68
outside medical school	48	54	43	46	63	70	42	25	28	30	39	57
Physical sciences	44	47	43	43	60	64	40	29	26	36	51	63
Psychology	32	31	36	33	47	53	31	34	28	29	40	49
Social sciences	37	37	32	32	48	60	38	34	23	25	47	61
Mathematics	27	43	31	32	40	48	21	21	17	22	16	40
Computer sciences	45	49	31	38	49	57	50	40	24	33	35	50
Earth, atmospheric, and ocean sciences	50	46	39	34	46	65	23	29	17	31	46	56
Engineering	51	51	52	47	62	67	50	10	28	25	46	49
Agricultural sciences	39	45	38	29	53	56	20	14	12	46	33	40
Medical sciences												
inside medical school	55	61	42	48	67	62	33	56	42	40	65	73
outside medical school	41	50	39	38	59	47	36	31	27	39	51	74

NOTES: 1996 data are national estimates derived from samples representing the 560 largest research-performing U.S. colleges and universities; 1994 data represent 565 institutions; all previous years data (1988, 1990, 1992) represent 525 institutions. In 1994, data from 1988, 1990, and 1992 were adjusted to match the analytic procedure used to calculate 1994 figures. In 1996, survey question categories were worded slightly differently (see Table E2-1 notes).

SOURCE: National Science Foundation/Divison of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E2-4. Condition of science and engineering (S&E) research space by institution type and control: 1988, 1990, 1992, 1994, 1996, and 1998

Institution type and control	Suitable for use in most scientifically sophisticated research						Effective for most uses, but not most scientifically sophisticated research						Requires limited repair/renovation to be used effectively					
	1988	1990	1992	1994	1996[3]	1998	1988	1990	1992	1994	1996[3]	1998[4]	1988	1990	1992	1994	1996[3]	1998[4]
	Percentage of institution s S&E research space																	
Total	23.9	25.9	26.8	26.4	37.2	39.2	36.8	35.3	34.7	32.8			23.5	23.3	22.6	23.1	43.9	37.8
Doctorate-granting	24.3	26.2	27.2	26.9	37.8	39.6	36.2	34.8	34.3	32.4			23.5	23.3	22.4	22.9	43.4	37.8
Top 100 in research expenditures	23.9	27.2	26.7	26.7	37.9	39.2	35.0	33.4	31.8	31.7			24.0	22.9	23.4	22.9	42.7	36.9
Other	25.6	23.5	28.8	27.1	37.5	40.7	39.8	38.6	41.8	34.8			21.8	24.2	19.3	23.1	45.4	40.6
Nondoctorate-granting	15.6	18.9	16.8	15.8	23.8	32.0	49.5	47.2	43.0	41.3			23.8	22.8	29.2	26.7	56.8	36.7
Public	23.1	24.5	25.5	25.2	35.2	37.7	36.2	35.7	34.8	33.2			24.4	23.9	23.1	24.1	45.8	38.7
Doctorate-granting	23.4	24.6	25.7	26.0	35.7	38.2	35.7	35.4	34.6	32.9			24.4	24.0	22.9	23.8	45.3	38.9
Nondoctorate-granting	17.5	21.1	19.1	16.0	21.7	26.4	48.0	44.3	41.8	38.3			24.0	22.7	26.8	27.2	58.9	35.8
Private	26.2	30.1	30.8	27.7	42.5	43.5	38.4	34.1	34.3	31.9			21.0	21.2	21.4	21.6	39.0	35.1
Doctorate-granting	27.0	31.1	31.8	29.4	43.5	43.7	37.6	32.9	33.6	32.0			20.9	21.1	20.7	20.5	38.0	34.8
Nondoctorate-granting	11.5	15.1	13.3	15.3	26.9	41.0	52.8	52.4	44.9	46.6			23.3	22.9	32.8	25.7	53.7	38.2

See explanatory information and SOURCE at end of table.

Table E2-4. Condition of science and engineering (S&E) research space by institution type and control: 1988, 1990, 1992, 1994, 1996, and 1998

Institution type and control	Requires major repair/renovation to be used effectively[1]						Requires replacement[2]			
	1988	1990	1992	1994	1996[3]	1998[4]	1992	1994	1996[3]	1998[4]
	Percentage of institution s S&E research space									
Total	15.8	15.5	12.8	12.9	18.5	18.1	3.1	4.1		4.9
Doctorate-granting	16.2	15.7	12.9	12.9	18.5	17.7	3.2	4.2		4.9
Top 100 in research expenditures	17.1	16.5	14.2	13.1	18.9	18.7	3.9	4.8		5.2
Other	12.8	13.6	9.2	12.2	17.1	14.6	1.0	2.5		4.0
Nondoctorate-granting	11.1	11.1	9.8	13.9	18.4	25.6	1.2	2.2		5.0
Public	16.4	15.9	13.1	13.0	18.5	18.7	3.5	4.7		4.9
Doctorate-granting	16.6	16.0	13.2	12.5	18.5	18.0	3.6	4.7		4.9
Nondoctorate-granting	10.4	11.8	11.2	16.0	19.4	32.8	1.1	2.3		3.9
Private	14.4	14.5	11.7	12.7	18.4	16.5	1.8	2.7		5.0
Doctorate-granting	14.5	14.8	12.0	11.7	18.5	16.7	1.9	2.6		4.8
Nondoctorate-granting	12.4	9.7	7.5	10.1	17.1	13.9	1.4	1.9		6.9

[1] The data for 1988 and 1990 in this category include space requiring replacement.

[2] This category was first used in the 1992 survey.

[3] 1996 survey response categories changed to: suitable for the most scientifically competitive research; effective for most levels of research, but may need limited repair/renovation; and requires major renovation or replacement to be used effectively.

[4] 1998 survey response categories changed to: suitable for the most scientifically competitive research; effective for most levels of research, but may need limited repair/renovation; requires major renovation to be used effectively; and requires replacement.

NOTES: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data are national estimates derived from samples representing the 560 largest research-performing U.S. colleges and universities; 1994 data represent 565 institutions; all previous years data (1988, 1990, 1992) represent 525 institutions. In 1994, data from 1988, 1990, and 1992 were adjusted to match the analytic procedure used to calculate 1994 figures.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E2-5. Condition of science and engineering research space by field: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Requires major repair/renovation to be used effectively						Requires replacement[2]			
	1988[1]	1990[1]	1992	1994	1996[3]	1998[4]	1992	1994	1996[3]	1998[4]
	Percent									
Biological sciences										
outside medical school	15.5	14.0	12.5	14.2	17.8	19.6	2.8	5.0		5.3
inside medical school	13.4	13.2	12.5	13.3	14.7	14.1	1.4	1.8		2.0
Physical sciences	17.5	16.5	12.5	15.3	18.8	16.5	2.1	2.3		4.9
Psychology	12.3	11.6	9.0	11.1	12.3	16.3	1.0	2.0		2.2
Social sciences	10.8	9.8	12.2	9.0	13.1	14.5	1.2	1.9		1.5
Mathematics	5.8	7.6	3.0	4.1	9.9	11.5	1.8	1.3		2.9
Computer sciences	16.2	8.1	6.0	4.7	7.5	10.8	1.0	1.2		5.0
Earth, atmospheric, and ocean sciences	14.7	14.8	9.5	13.0	19.1	17.5	2.4	6.0		8.0
Engineering	13.9	14.5	10.8	12.1	17.9	14.9	2.4	2.8		3.9
Agricultural sciences	20.0	22.0	18.5	13.6	23.5	23.8	7.7	8.8		6.5
Medical sciences										
outside medical school	14.6	17.0	13.8	11.8	20.6	20.9	3.4	4.7		4.4
inside medical school	16.6	13.4	12.6	13.5	19.7	19.9	2.0	3.3		2.0

[1] The data for 1988 and 1990 in this category include space requiring replacement.

[2] This category was first used in the 1992 survey.

[3] 1996 survey response categories changed to: suitable for the most scientifically competitive research; effective for most levels of research, but may need limited repair/renovation; and requires major renovation or replacement to be used effectively.

[4] 1998 survey response categories changed to: suitable for the most scientifically competitive research; effective for most levels of research, but may need limited repair/renovation; requires major renovation to be used effectively; and requires replacement.

NOTES: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data are national estimates derived from samples representing the 560 largest research-performing U.S. colleges and universities; 1994 data represent 565 institutions; all previous years data (1988, 1990, 1992) represent 525 institutions. In 1994, data from 1988, 1990, and 1992 were adjusted to match the analytic procedure used to calculate 1994 figures.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E3-1. Number of research-performing institutions starting projects to construct science and engineering research facilities by institution type and control: 1986 99

Institution type and control	1986 87	1988 89	1990 91	1992 93	1994 95	1996 97	(scheduled) 1998 99
Total	192	227	191	184	164	197	202
Doctorate-granting	135	154	165	144	132	143	143
Top 100 in research expenditures	72	71	81	81	75	68	64
Other	64	83	84	63	57	75	79
Nondoctorate-granting	57	73	27	39	32	54	59
Public	140	158	136	133	115	134	139
Doctorate-granting	103	106	116	103	97	101	107
Nondoctorate-granting	37	52	20	30	19	34	32
Private	52	68	55	51	49	63	63
Doctorate-granting	32	48	49	42	35	42	36
Nondoctorate-granting	19	21	7	10	14	21	27

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E3-2. Trends in the amounts of science and engineering research space to be constructed and the estimated cost of construction by institution type and control: 1986 99

Institution type and control	1986 87		1988 89		1990 91		1992 93		1994 95		1996 97		1998 99 (scheduled)	
	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost
	NASF in thousands; cost in millions of current dollars													
Total	9,922	2,051	10,647	2,464	11,433	2,976	10,992	2,811	9,521	2,768	11,101	3,110	14,556	3,949
Doctorate-granting	8,908	1,888	9,840	2,315	11,022	2,847	10,474	2,720	8,818	2,437	9,914	2,843	12,825	3,494
Top 100 in research expenditures	7,261	1,599	6,073	1,558	6,972	2,022	6,787	2,029	6,426	2,007	6,944	2,054	8,708	2,537
Other	1,647	288	3,767	757	4,050	826	3,687	691	2,391	430	2,970	789	4,116	957
Nondoctorate-granting	1,014	163	807	150	411	128	518	92	703	331	1,187	267	1,731	455
Public	7,344	1,355	8,115	1,727	8,268	2,020	8,189	2,016	6,838	1,872	7,607	1,989	11,507	2,844
Doctorate-granting	6,516	1,220	7,460	1,626	7,942	1,906	7,695	1,929	6,252	1,578	6,712	1,813	10,265	2,538
Nondoctorate-granting	828	134	656	101	325	114	494	86	586	294	895	176	1,242	306
Private	2,578	696	2,532	738	3,165	956	2,802	796	2,683	895	3,494	1,122	3,049	1,105
Doctorate-granting	2,392	667	2,381	689	3,079	941	2,778	789	2,566	859	3,202	1,031	2,560	955
Nondoctorate-granting	186	29	152	48	86	15	24	6	117	36	292	91	489	149

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1986, 1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 3 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E3-3. Number of institutions starting projects to construct science and engineering research facilities by field: 1986 99

Field	1986 87	1988 89	1990 91	1992 93	1994 95	1996 97	(scheduled) 1998 99
Total	192	227	191	184	164	197	202
Biological sciences							
inside medical schools	20	26	41	26	12	18	29
outside medical schools	43	87	57	49	42	73	67
Physical sciences	41	67	50	44	49	59	75
Psychology	21	11	29	8	8	19	25
Social sciences	19	13	--*	10	15	19	17
Mathematics	3	5	13	5	4	2	19
Computer sciences	28	21	20	13	7	15	12
Earth, atmospheric, and ocean sciences	28	17	42	26	15	40	31
Engineering	79	252	48	49	44	33	42
Agricultural sciences	36	32	28	32	25	30	21
Medical sciences							
inside medical schools	42	35	62	41	31	42	26
outside medical schools	18	14	33	25	14	25	30
Other sciences	14	13	22	13	17	15	15

* Psychology and the social sciences were not differentiated in the questionnaire item for the 1990 91 period.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E3-4. Trends in the amount of science and engineering research space to be constructed in projects costing over $100,000 and the estimated cost of construction by field: 1986 99

Field	1986 87		1988 89		1990 91		1992 93		1994 95		1996 97		1998 99 (scheduled)	
	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost
	NASF in thousands; cost in millions of current dollars													
Total	9,922	2,051	10,647	2,464	11,433	2,976	10,992	2,812	9,521	2,768	11,101	3,110	14,556	3,949
Biological sciences														
inside medical schools	433	139	712	181	1,426	381	1,020	341	579	226	701	178	2,442	597
outside medical schools	1,275	324	1,549	396	1,374	451	1,169	292	1,028	388	1,216	404	2,694	812
Physical sciences	799	182	2,000	401	1,609	430	1,257	337	1,551	426	1,229	381	1,516	525
Psychology	132	23	115	25	164	36	78	16	145	42	208	77	378	91
Social sciences	202	38	329	48	--*	--*	221	44	380	112	233	75	261	81
Mathematics	9	2	25	8	46	12	44	10	8	2	16	9	128	19
Computer sciences	237	61	286	65	293	40	172	47	143	46	92	21	94	27
Earth, atmospheric, and ocean sciences	380	57	324	82	529	170	502	123	282	33	534	172	796	235
Engineering	2,390	430	1,490	388	1,697	395	1,065	286	2,174	575	1,484	332	1,825	528
Agricultural sciences	1,513	150	1,146	152	955	175	1,218	210	808	150	1,539	273	1,727	169
Medical sciences														
inside medical schools	1,335	302	1,948	587	2,288	655	3,154	839	1,694	525	2,652	784	1,898	613
outside medical schools	613	203	306	61	673	151	669	160	388	122	733	259	618	206
Other sciences	603	139	418	70	380	79	420	106	340	122	463	145	179	46

* Psychology and social sciences were not differentiated in the questionnaire item for the 1990 91 period.

KEY: NASF = net assignable square feet

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 3 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E4-1. Number of institutions starting projects to repair/renovate science and engineering research facilities by institution type and control: 1986 99

Institution type and control	1986 87	1988 89	1990 91	1992 93	1994 95	1996 97	(scheduled) 1998 99
Total	288	248	244	252	252	343	304
Doctorate-granting	224	204	212	196	194	252	236
Top 100 in research expenditures	96	85	91	90	88	92	85
Other	128	119	121	106	106	160	151
Nondoctorate-granting	64	44	32	56	59	91	68
Public	210	164	155	137	149	203	200
Doctorate-granting	163	133	137	112	116	158	160
Nondoctorate-granting	47	31	17	25	33	45	40
Private	78	84	89	115	103	140	105
Doctorate-granting	61	71	75	84	77	94	77
Nondoctorate-granting	17	14	15	31	25	46	28

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E4-2. Trends in the amount of science and engineering research space and the estimated cost of repair/renovation by institution type and control: 1986 99

Institution type and control	1986 87		1988 89		1990 91		1992 93		1994 95		1996 97		1998 99 (scheduled)	
	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost
	NASF in thousands; cost in millions of current dollars													
Total	13,431	838	11,449	1,010	8,655	826	9,133	837	13,122	1,058	15,059	1,325	14,707	1,580
Doctorate-granting	12,841	793	10,993	979	8,352	794	8,811	803	12,364	981	13,414	1,142	13,404	1,399
Top 100 in research expenditures	9,124	596	7,781	483	5,622	633	6,028	623	8,758	755	9,776	857	8,471	1,023
Other	3,717	197	3,212	496	2,730	161	2,783	180	3,607	226	3,638	285	4,934	376
Nondoctorate-granting	590	45	456	30	303	32	323	34	758	77	1,645	182	1,303	181
Public	8,745	436	8,223	699	5,460	449	6,011	522	6,839	496	9,379	670	10,353	929
Doctorate-granting	8,307	399	7,890	674	5,295	431	5,877	508	6,242	450	8,381	581	9,522	828
Nondoctorate-granting	438	37	333	25	165	18	134	14	597	46	999	89	831	102
Private	4,685	402	3,226	311	3,195	376	3,123	315	6,283	562	5,679	655	4,354	650
Doctorate-granting	4,534	393	3,102	305	3,057	363	2,934	295	6,122	531	5,033	562	3,882	571
Nondoctorate-granting	152	9	123	6	137	14	189	20	161	31	646	93	471	79

KEY: NASF = net assignable square feet

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 3 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E4-3. Number of institutions starting projects to repair/renovate science and engineering research facilities, by field: 1986 99

Field	1986 87	1988 89	1990 91	1992 93	1994 95	1996 97	(scheduled) 1998 99
Total	288	248	244	252	252	343	304
Biological sciences							
outside medical schools	112	121	96	104	113	163	118
inside medical schools	44	44	59	53	57	69	43
Physical sciences	98	104	98	104	118	168	119
Psychology	35	20	44	18	22	36	50
Social sciences	29	17	--*	20	33	51	60
Mathematics	25	26	12	6	14	14	14
Computer sciences	49	16	29	20	25	24	46
Earth, atmospheric, and ocean sciences	40	26	37	38	33	43	44
Engineering	118	106	71	85	86	100	81
Agricultural sciences	32	24	25	21	31	27	21
Medical sciences							
outside medical schools	28	32	41	36	39	73	66
inside medical schools	75	70	92	74	66	53	44
Other sciences	17	17	23	8	8	28	18

* Psychology and the social sciences were not differentiated in the questionnaire for the 1990 91 period.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E4-4. Trends in the amount of science and engineering research space to be repaired or renovated in projects costing over $100,000 and the estimated cost of repair/renovation by field: 1986 99

Field	1986 87		1988 89		1990 91		1992 93		1994 95		1996 97		(scheduled) 1998 99	
	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost	NASF	Cost
	NASF in thousands; cost in millions of current dollars													
Total	13,431	838	11,449	1,010	8,606	826	9,134	837	13,122	1,058	15,059	1,325	14,707	1,580
Biological sciences														
inside medical schools	1,056	78	1,259	76	1,301	123	864	116	752	101	1,527	164	817	93
outside medical schools	2,555	146	2,203	126	1,055	135	1,304	108	1,610	127	2,481	200	3,374	280
Physical sciences	1,746	105	1,928	165	1,680	151	1,725	134	2,474	192	2,432	244	2,064	241
Psychology	256	14	88	11	254	31	141	10	182	28	468	65	475	33
Social sciences	181	36	119	8	--*	--*	236	10	296	40	652	40	728	124
Mathematics	37	4	136	11	39	6	11	2	67	6	81	5	246	51
Computer sciences	193	17	144	9	164	21	54	4	124	8	160	12	629	95
Earth, atmospheric, and ocean sciences	362	21	930	18	450	16	418	31	521	35	430	52	581	54
Engineering	2,716	141	1,630	361	1,159	82	1,932	139	1,803	150	2,691	208	2,163	198
Agricultural sciences	628	20	530	23	391	35	335	14	1,245	72	836	50	625	26
Medical sciences														
inside medical schools	2,499	174	1,598	161	1,443	166	1,678	234	3,129	226	2,176	196	1,943	282
outside medical schools	737	52	705	24	627	53	284	28	757	59	726	76	958	77
Other sciences	465	30	180	17	42	6	152	7	162	12	400	11	106	24

* Psychology and social sciences were not differentiated in the questionnaire item for the 1990 91 period.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1986, 1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 3 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E4-5. Number of research institutions and estimated total project completion cost of all repair/renovation projects between $5,000 and $100,000 for science and engineering research facilities by institution type and control: 1996 and 1997

Institution type and control	Number of institutions	Estimated total completion cost
		In millions of current dollars
Total	384	207.9
Doctorate-granting	272	194.8
Top 100 in research expenditures	86	124.8
Other	186	70.0
Nondoctorate-granting	112	13.1
Public	224	132.4
Doctorate-granting	164	123.4
Nondoctorate-granting	60	9.0
Private	160	75.6
Doctorate-granting	108	71.4
Nondoctorate-granting	52	4.1

NOTE: Components may not add to totals due to rounding. Project costs reflect research component only.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E5-1. Amount of funds for science and engineering research facility construction projects, by institution type, and source of funds: 1986 97

Year of project start and type of institution	All sources	Governments		Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
		Federal	State/ local					
	In millions of current dollars							
1986 or 1987:								
Total	2,050.6	145.4	779.1	487.5	289.8	313.1	3.1	31.9
Doctorate-granting	1,887.7	129.9	690.4	462.5	289.2	280.1	3.1	31.9
Nondoctorate-granting	162.9	15.5	88.7	25.1	0.6	33.1	0.0	0.0
1988 or 1989:								
Total	2,464.5	352.0	890.7	459.2	343.8	320.2	95.9	0.8
Doctorate-granting	2,315.0	339.0	807.3	411.7	338.3	320.2	95.9	0.8
Nondoctorate-granting	149.5	13.0	83.4	47.5	5.6	0.0	0.0	0.0
1990 or 1991:								
Total	2,975.6	476.3	956.6	352.6	394.1	727.5	35.4	33.1
Doctorate-granting	2,847.3	465.5	947.9	348.0	390.3	627.0	35.4	33.1
Nondoctorate-granting	128.4	10.8	8.7	4.6	3.8	100.5	0.0	0.0
1992 or 1993:								
Total	2,810.8	459.3	968.0	301.0	374.3	620.3	39.0	50.0
Doctorate-granting	2,720.0	452.0	893.0	297.0	374.0	616.0	39.0	48.0
Nondoctorate-granting	91.8	7.3	75.0	4.0	0.3	4.3	0.0	2.0
1994 or 1995:								
Total	2,767.6	206.5	1,180.8	360.0	442.0	426.1	145.7	6.5
Doctorate-granting	2,436.9	201.2	890.4	344.0	437.5	411.6	145.7	6.5
Nondoctorate-granting	330.6	5.2	290.5	16.0	4.4	14.5	0.0	0.0
1996 or 1997								
Total	3,110.3	270.9	966.6	596.6	593.1	553.0	106.6	23.5
Doctorate-granting	2,843.2	268.3	880.6	517.8	592.9	488.1	73.2	22.3
Nondoctorate-granting	267.1	2.5	86.0	78.8	0.2	65.0	33.4	1.2

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of more than $100,000 for research-related space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 5 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E5-2. Trends in the sources of funding for the construction of research facilities at public institutions: 1986 97

Year of project start and type of institution	All sources	Governments: Federal	Governments: State/ local	Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
	In millions of current dollars							
1986 or 1987:								
Total	1,354.8	40.3	754.5	259.1	109.2	189.5	2.4	0.2
Doctorate-granting	1,220.4	31.4	665.9	238.6	109.2	173.1	2.4	0.2
Nondoctorate-granting	134.4	8.9	88.5	20.6	0.0	16.4	0.0	0.0
1988 or 1989:								
Total	1,727.0	274.3	838.4	192.9	256.3	154.5	8.1	0.6
Doctorate-granting	1,625.6	268.3	755.0	184.8	252.4	154.6	8.1	0.6
Nondoctorate-granting	101.4	6.0	83.4	8.1	3.9	0.0	0.0	0.0
1990 or 1991:								
Total	2,020.0	388.1	809.4	139.1	270.2	398.6	7.8	6.9
Doctorate-granting	1,906.4	382.3	800.7	139.1	270.2	299.4	7.8	6.9
Nondoctorate-granting	113.7	5.8	8.7	0.0	0.0	99.2	0.0	0.0
1992 or 1993:								
Total	2,016.4	325.8	929.8	152.5	198.3	390.5	16.2	3.3
Doctorate-granting	1,929.9	320.1	854.4	152.5	198.1	386.9	16.2	1.7
Nondoctorate-granting	86.4	5.7	75.4	0.0	0.2	3.6	0.0	1.6
1994 or 1995:								
Total	1,872.3	115.4	1,164.6	123.9	142.4	306.1	13.5	6.5
Doctorate-granting	1,578.1	112.5	874.0	123.9	141.6	306.1	13.5	6.5
Nondoctorate-granting	294.2	3.0	290.5	0.0	0.8	0.0	0.0	0.0
1996 or 1997								
Total	1,988.7	201.0	940.2	267.3	249.3	259.7	54.4	16.9
Doctorate-granting	1,812.7	198.4	863.2	262.0	249.3	203.1	21.0	15.7
Nondoctorate-granting	176.0	2.5	77.0	5.3	0.0	56.6	33.4	1.2

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of more than $100,000 for research-related space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 5 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E5-3. Trends in the sources of funding for the construction of research facilities at private institutions: 1986 97

Year of project start and type of institution	All sources	Governments		Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
		Federal	State/ local					
	In millions of current dollars							
1986 or 1987:								
Total	695.8	105.1	24.6	228.4	180.6	123.6	0.7	31.7
Doctorate-granting	667.3	98.5	24.5	223.9	180.0	107.0	0.7	31.7
Nondoctorate-granting	28.5	6.6	0.2	4.5	0.6	16.7	0.0	0.0
1988 or 1989:								
Total	737.5	77.7	52.3	266.3	87.5	165.7	87.8	0.2
Doctorate-granting	689.4	70.7	52.3	226.9	85.9	165.6	87.8	0.2
Nondoctorate-granting	48.1	7.0	0.0	39.4	1.7	0.0	0.0	0.0
1990 or 1991:								
Total	955.6	88.2	147.2	213.5	123.9	328.9	27.6	26.2
Doctorate-granting	940.9	83.2	147.2	208.9	120.1	327.6	27.6	26.2
Nondoctorate-granting	14.7	5.0	0.0	4.6	3.8	1.3	0.0	0.0
1992 or 1993:								
Total	795.5	133.5	38.8	148.5	176.1	229.6	22.7	46.4
Doctorate-granting	789.7	132.2	38.8	144.6	175.8	229.3	22.7	46.4
Nondoctorate-granting	5.8	1.3	0.0	3.9	0.3	0.3	0.0	0.0
1994 or 1995:								
Total	895.2	91.0	16.3	236.1	299.5	120.0	132.2	0.0
Doctorate-granting	858.8	88.8	16.3	220.1	295.9	105.5	132.2	0.0
Nondoctorate-granting	36.3	2.2	0.0	16.0	3.6	14.5	0.0	0.0
1996 or 1997								
Total	1,121.6	69.9	26.4	329.4	343.8	293.4	52.2	6.6
Doctorate-granting	1,030.5	69.9	17.4	255.9	343.6	285.0	52.2	6.6
Nondoctorate-granting	91.1	0.0	9.0	73.5	0.2	8.4	0.0	0.0

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of more than $100,000 for research-related space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 5 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E5-4. Trends in the sources of funding for the repair/renovation of science and engineering research facilities: 1986 97

Year of project start and type of institution	All sources	Governments		Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
		Federal	State/ local					
	In millions of current dollars							
1986 or 1987:								
Total	837.9	27.3	233.1	101.0	328.0	137.6	3.8	7.4
Doctorate-granting	792.7	23.5	201.7	99.3	325.2	132.2	3.8	7.4
Nondoctorate-granting	45.2	3.7	31.4	1.6	3.0	5.4	0.0	0.0
1988 or 1989:								
Total	1,009.5	61.1	233.8	52.1	570.8	69.9	15.9	5.2
Doctorate-granting	979.2	55.9	226.6	42.1	563.6	69.8	15.9	5.2
Nondoctorate-granting	30.3	5.1	7.1	10.0	7.2	0.0	0.0	0.0
1990 or 1991:								
Total	825.7	49.0	243.0	100.6	355.4	66.4	8.0	3.2
Doctorate-granting	794.1	48.3	227.3	97.5	346.7	63.2	8.0	3.2
Nondoctorate-granting	31.6	0.7	15.8	3.2	8.7	3.3	0.0	0.0
1992 or 1993:								
Total	835.4	56.2	252.4	73.0	332.0	81.0	27.0	16.2
Doctorate-granting	803.0	47.0	244.0	66.0	325.0	79.0	27.0	16.2
Nondoctorate-granting	32.4	9.2	8.4	7.0	7.0	2.0	0.0	0.0
1994 or 1995:								
Total	1,058.1	110.7	265.5	110.7	432.7	50.4	78.6	9.3
Doctorate-granting	981.3	101.9	233.0	93.7	423.2	43.8	76.3	9.3
Nondoctorate-granting	76.8	8.8	32.6	17.0	9.5	6.6	2.4	0.0
1996 or 1997								
Total	1,324.5	120.8	338.1	140.6	578.6	84.6	35.7	26.1
Doctorate-granting	1,142.2	96.1	273.2	86.8	568.0	56.3	35.7	26.1
Nondoctorate-granting	182.3	24.7	64.9	53.8	10.6	28.3	0.0	0.0

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of more than $100,000 for research-related space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 5 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E5-5. Trends in the sources of funding for the repair/renovation of research facilities at public institutions: 1986 97

Year of project start and type of institution	All sources	Governments		Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
		Federal	State/ local					
	In millions of current dollars							
1986 or 1987:								
Total	435.9	13.2	226.6	15.0	155.1	25.5	0.3	0.2
Doctorate-granting	399.3	10.9	195.1	14.3	153.4	25.0	0.3	0.2
Nondoctorate-granting	36.6	2.2	31.4	0.6	1.8	0.5	0.0	0.0
1988 or 1989:								
Total	698.5	31.4	229.3	22.0	403.5	6.6	4.9	0.0
Doctorate-granting	673.9	26.5	222.1	13.9	399.8	6.5	4.9	0.0
Nondoctorate-granting	24.6	4.9	7.1	8.1	3.6	0.0	0.0	0.0
1990 or 1991:								
Total	449.3	24.6	233.5	43.8	134.6	12.1	0.0	0.6
Doctorate-granting	431.3	23.9	217.8	43.8	133.1	12.1	0.0	0.6
Nondoctorate-granting	18.0	0.7	15.8	0.0	1.5	0.0	0.0	0.0
1992 or 1993:								
Total	520.4	34.3	237.1	24.9	154.4	55.9	1.6	11.9
Doctorate-granting	507.9	31.1	228.5	24.9	153.8	55.9	1.6	11.9
Nondoctorate-granting	12.4	3.2	8.6	0.0	0.6	0.0	0.0	0.0
1994 or 1995:								
Total	495.8	38.9	254.4	16.0	160.8	18.3	0.9	6.5
Doctorate-granting	449.9	31.8	222.3	15.7	154.4	18.3	0.9	6.5
Nondoctorate-granting	45.9	7.1	32.1	0.2	6.5	0.0	0.0	0.0
1996 or 1997								
Total	669.6	72.4	328.3	38.3	179.6	25.1	0.3	25.7
Doctorate-granting	580.5	58.2	263.4	36.8	175.6	20.6	0.3	25.7
Nondoctorate-granting	89.1	14.2	64.9	1.5	4.0	4.6	0.0	0.0

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of more than $100,000 for research-related space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 5 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E5-6. Trends in the sources of funding for the repair/renovation of science and engineering research facilities at private institutions: 1986 97

Year of project start and type of institution	All sources	Governments		Private donations	Institutional funds	Tax-exempt bonds	Other debt	Other sources
		Federal	State/ local					
	In millions of current dollars							
1986 or 1987:								
Total	402.0	14.1	6.5	86.0	172.9	112.1	3.5	7.2
Doctorate-granting	393.4	12.6	6.6	85.0	171.8	107.2	3.5	7.2
Nondoctorate-granting	8.6	1.5	0.0	1.0	1.2	4.9	0.0	0.0
1988 or 1989:								
Total	311.0	29.7	4.5	30.1	167.3	63.3	11.0	5.2
Doctorate-granting	305.3	29.4	4.5	28.2	163.8	63.3	11.0	5.2
Nondoctorate-granting	5.7	0.2	0.0	1.9	3.6	0.0	0.0	0.0
1990 or 1991:								
Total	376.4	24.4	9.5	56.8	220.8	54.3	8.0	2.6
Doctorate-granting	362.8	24.4	9.5	53.7	213.6	51.1	8.0	2.6
Nondoctorate-granting	13.6	0.0	0.0	3.2	7.2	3.3	0.0	0.0
1992 or 1993:								
Total	314.6	21.8	15.0	47.5	176.3	24.5	25.2	4.3
Doctorate-granting	294.7	16.0	15.0	40.7	170.5	22.9	25.2	4.2
Nondoctorate-granting	19.9	5.8	0.0	6.8	5.8	1.6	0.0	0.1
1994 or 1995:								
Total	562.3	71.8	11.2	94.8	271.9	32.2	77.7	2.8
Doctorate-granting	531.4	70.1	10.7	78.0	268.8	25.6	75.4	2.8
Nondoctorate-granting	30.8	1.6	0.5	16.8	3.0	6.6	2.4	0.0
1996 or 1997								
Total	654.9	48.4	9.8	102.4	399.0	59.5	35.4	0.4
Doctorate-granting	561.7	37.9	9.8	50.1	392.4	35.7	35.4	0.4
Nondoctorate-granting	93.2	10.5	0.0	52.3	6.6	23.7	0.0	0.0

NOTE: Components may not add to totals due to rounding. All 1998 data are national estimates derived from samples representing the 660 largest research-performing U.S. colleges and universities; 1996 data represent 560 institutions, 1994 data represent 565 institutions, and all data prior to 1994 (1988, 1990, 1992) represent 525 institutions. Findings are limited to projects with estimated total costs at completion of more than $100,000 for research-related space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 5 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E6-1. Percentage of institutions with deferred capital projects to construct or repair/ renovate science and engineering (S&E) research facilities by institution type, project type, and whether the project was included in institutional plans: 1998

Institution type	Included in institutional plans			Not included in institutional plans		
	To construct or repair/ renovate	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	To construct or repair/ renovate	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities
Total	48	31	34	24	10	21
Doctorate-granting	57	37	41	30	11	28
Top 100 in research expenditures	68	51	61	28	17	26
Other	53	33	34	31	8	28
Nondoctorate-granting	35	22	24	16	9	12
Public	56	39	41	24	13	19
Doctorate-granting	67	48	50	29	14	26
Nondoctorate-granting	41	26	29	17	12	9
Private	37	21	25	25	6	23
Doctorate-granting	44	24	30	32	6	30
Nondoctorate-granting	29	18	19	15	6	15

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E6-2. Estimated cost of deferred capital projects to construct or repair/renovate science and engineering (S&E) research facilities by institution type, project type and whether the project was included in institutional plans: 1998

Institution type	Included in institutional plans		Not included in institutional plans		Total
	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	
	In millions of current dollars				
Total	5,856.7	2,834.2	1,142.2	1,547.8	11,380.9
Doctorate-granting	5,404.6	2,545.9	1,118.1	1,486.6	10,555.2
Top 100 in research expenditures	3,685.2	1,713.6	730.6	1,024.8	7,154.2
Other	1,719.3	832.3	387.5	461.8	3,400.9
Nondoctorate-granting	452.1	288.3	24.0	61.1	825.5
Public	5,049.4	2,238.0	940.0	1,107.0	9,334.4
Doctorate-granting	4,729.5	2,082.0	921.3	1,089.2	8,822.0
Nondoctorate-granting	319.9	156.0	18.7	17.8	512.4
Private	807.3	596.1	202.2	440.8	2,046.4
Doctorate-granting	675.1	463.8	196.8	397.5	1,733.2
Nondoctorate-granting	132.2	132.3	5.3	43.3	313.1

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E6-3. Number of institutions with deferred capital projects to construct or repair/ renovate science and engineering (S&E) research facilities by field, project type and whether the project was included in institutional plans: 1998

Field	Included in institutional plans		Not included in institutional plans	
	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities
Biological sciences				
inside medical schools	10	23	5	17
outside medical schools	81	128	25	60
Physical sciences	103	122	26	58
Psychology	29	62	8	33
Social sciences	25	65	11	45
Mathematics	22	53	10	38
Computer sciences	29	48	12	44
Earth, atmospheric, and ocean sciences	30	60	15	24
Engineering	58	90	11	43
Agricultural sciences	28	39	15	24
Medical sciences				
inside medical schools	18	32	8	13
outside medical schools	25	57	14	25
Other sciences	13	19	5	17

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E6-4. The cost of deferred capital projects to construct or repair/renovate science and engineering (S&E) research facilities by field and whether the project was included in institutional plans: 1998

Field	Included in institutional plans		Not included in institutional plans		Total
	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	To construct new S&E research facilities	To repair/ renovate existing S&E research facilities	
Total	5,856.7	2,834.2	1,142.2	1,547.8	11,380.8
Biological sciences					
inside medical schools	266.6	159.8	40.2	73.9	540.4
outside medical schools	967.3	504.7	272.6	348.0	2,092.5
Physical sciences	1,339.4	596.5	212.2	304.7	2,452.7
Psychology	107.4	71.4	30.3	33.4	242.5
Social sciences	136.0	110.0	44.1	66.9	357.0
Mathematics	82.7	75.0	5.0	19.4	182.2
Computer sciences	198.2	25.5	38.2	34.7	296.6
Earth, atmospheric, and ocean sciences	326.8	105.6	70.6	41.8	544.9
Engineering	877.7	556.2	166.3	144.2	1,744.4
Agricultural sciences	422.0	164.6	64.3	117.0	767.8
Medical sciences					
inside medical schools	688.9	273.9	108.6	184.2	1,255.6
outside medical schools	332.8	129.0	71.3	173.5	706.7
Other sciences	101.8	62.0	18.4	6.2	188.4

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-1. Total number of Historically Black Colleges and Universities (HBCUs) by type and control: 1998

Institution type and control	Original group[1]	Expanded group[2]
Number of research-performing HBCUs	29	57
Public	22	36
Doctorate-granting	10	10
Nondoctorate-granting	11	25
Private	7	21
Doctorate-granting	5	8
Nondoctorate-granting	2	14

[1] The original group consists of the 29 HBCUs also surveyed in 1986, 1988, 1990, 1992, 1994, and 1996.

[2] The expanded group consists of the 57 research-performing HBCUs surveyed in 1998.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-2. Amount of instructional and research space in Historically Black Colleges and Universities (HBCUs): 1998

Type of space	Original group[1]	Expanded group[2]
	NASF in millions	
Total instructional and research space all fields	14	18
Instructional and research space S&E fields	7	9
Research space S&E fields	2	2

[1] The original group consists of the 29 HBCUs also surveyed in 1986, 1988, 1990, 1992, 1994, and 1996.

[2] The expanded group consists of the 57 research-performing HBCUs surveyed in 1998.

KEY: NASF = net assignable square feet.
S&E = science and engineering.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-3. Total amount of science and engineering (S&E) research space in the 29 original* Historically Black Colleges and Universities (HBCUs) by field: 1988, 1990, 1992, 1994, 1996, and 1998

Field	Total NASF in S&E fields						Total research NASF in S&E fields					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
Number of research-performing HBCUs	29	29	29	28	29	29	29	29	29	28	29	29
	NASF in thousands											
Total	6,077	6,175	6,576	6,084	6,755	6,818	1,112	1,440	1,782	1,759	1,797	1,885
Biological sciences												
inside medical schools	621	388	388	456	470	513	91	121	121	159	150	181
outside medical schools	509	546	621	581	634	663	141	170	254	250	208	216
Physical sciences	804	810	1,005	876	939	841	179	190	235	212	229	234
Psychology	119	105	86	106	134	114	14	19	16	18	16	16
Social sciences	304	322	278	233	268	257	28	47	57	43	56	46
Mathematics	173	164	191	158	194	204	12	26	29	19	24	20
Computer sciences	150	114	160	128	140	159	43	30	42	31	36	40
Earth, atmospheric and ocean sciences	44	56	85	73	115	121	10	26	35	27	42	43
Engineering	777	979	1,207	1,136	1,354	1,385	152	167	285	315	349	363
Agricultural sciences	604	834	783	704	718	786	259	433	414	470	451	471
Medical sciences												
inside medical schools	1,253	810	810	649	872	903	141	158	160	69	84	87
outside medical schools	593	956	963	913	719	726	37	50	133	134	63	82
Other sciences	126	91	0	70	198	146	4	4	0	12	88	86

* The original group consists of 29 HBCUs also surveyed in 1986, 1988, 1990, 1992, 1994, and 1996.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-4. Total amount of science and engineering (S&E) instructional and research space in Historically Black Colleges and Universities (HBCUs): 1992, 1994, 1996, and 1998

Field	Total NASF in S&E fields				Total research NASF in S&E fields			
	1992	1994	1996	1998	1992	1994	1996	1998
Number of research-performing HBCUs*	70	70	68	57	70	70	68	57
Total	9,095	7,923	8,984	8,734	2,920	2,197	2,374	2,339
Biological sciences								
inside medical schools	388	456	470	513	121	159	150	181
outside medical school	1,757	1,063	1,182	1,005	1,137	480	393	305
Physical sciences	1,380	1,344	1,482	1,212	275	280	352	321
Psychology	173	222	219	214	25	33	31	31
Social sciences	438	367	413	415	78	61	77	56
Mathematics	325	365	345	338	34	38	44	31
Computer sciences	283	278	356	383	53	52	64	65
Earth, atmospheric, and ocean sciences	131	97	219	214	64	36	54	57
Engineering	1,353	1,278	1,445	1,499	302	355	364	388
Agricultural sciences	930	705	979	1,081	497	483	595	635
Medical sciences								
inside medical schools	862	649	872	903	187	69	84	87
outside medical school	1,070	989	799	805	147	141	77	95
Other sciences	5	109	202	151	0	14	88	86

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-5. Institutional assessment of the condition of research facilities at Historically Black Colleges and Universities (HBCUs): 1988, 1990, 1992, 1994, 1996, and 1998

Condition of research facilities	Original 29 HBCUs[1]						Expanded HBCUs[2]			
	1988	1990	1992	1994	1996[3]	1998[4]	1992	1994	1996[3]	1998[4]
	Percentage of research space									
Total	100	100	100	100	100	100	100	100	100	100
Suitable for most highly developed and scientifically sophisticated research	36	31	34	31	32	36	22	24	31	35
Effective for most uses, but not most scientifically sophisticated research	39	45	41	39			56	35		
Effective for most levels of research in the field, but may need limited repair/renovation	18	18	17	21	56	47	14	25	55	48
Requires major repair/renovation to be used effectively[5]	7	7	8	9	13	17	8	16	14	16

[1] The original group consists of the 29 HBCUs also surveyed in 1986, 1988, 1990, 1992, 1994, and 1996.

[2] The expanded group consists of all research-performing HBCUs, including the 29 original HBCUs.

[3] 1996 survey response categories changed to: suitable for the most scientifically competitive research; effective for most levels of research in the field, but may need limited repair/renovation; and requires major renovation or replacement to be used effectively.

[4] 1998 survey response categories changed to: suitable for the most scientifically competitive research; effective for most levels of research in the field, but may need limited repair/renovation; requires major renovation to be used effectively; and requires replacement.

[5] Includes category "requires replacement" for the survey years 1992, 1994, and 1998.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-6. Science and engineering research facility construction and repair/renovation projects at Historically Black Colleges and Universities (HBCUs), by project characteristics: 1986 99

Capital project activity	Original[1]							Expanded[2]				
	1986 87	1988 89	1990 91	1992 93	1994 95	1996 97	(scheduled) 1998 99	1990 91	1992 93	1994 95	1996 97	(scheduled) 1998 99
Construction projects:[3]												
Number of HBCUs with projects	11	10	6	4	4	10	6	10	9	13	14	10
Total estimated completion cost (in millions of dollars)	72	55	23	9	3	64	35	38	29	21	66	64
Amount of space (NASF in thousands)	481	319	328	88	68	335	165	449	226	166	347	252
Repair/renovation projects costing $100,000:[3]												
Number of HBCUs with projects	13	10	5	11	7	5	9	8	12	9	15	13
Total estimated completion cost (in millions of dollars)	14	17	12	9	22	8	16	21	9	22	13	18
Amount of space (NASF in thousands)	137	308	129	106	343	114	262	177	110	347	150	280
Repair/renovation projects costing $5,000-$100,000:												
Number of HBCUs with projects	--	--	10	13	11	13	--	21	38	24	22	--
Total estimated completion cost (in millions of dollars)	--	--	1	3	1	1	--	1	26	2	2	--

[1] The original group consists of the 29 HBCUs also surveyed in 1986, 1988, 1990, 1992, 1994, and 1996.

[2] The expanded group consists of all research-performing HBCUs, including the 29 original HBCUs.

[3] Findings are limited to projects with estimated total cost at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only.

KEY: NASF = net assignable square feet.
-- = data were not collected.

NOTE: Components may not add to totals due to rounding. In 1996, two HBCUs did not have R&D expenditures. In 1998, seven HBCUs did not have R&D expenditures. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 7 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-7. Source of funds for science and engineering research facility construction projects at Historically Black Colleges and Universities (HBCUs): 1986 97

Source of funds	1986 87[1]	1998 89[1]	1990 91 [Original][2]	1990 91 [Expanded][3]	1992 93 [Original][2]	1992 93 [Expanded][3]	1994 95 [Original][2]	1994 95 [Expanded][3]	1996 97 [Original][2]	1996 97 [Expanded][3, 5]
Number of research-performing HBCUs	29	29	29	70	28	68 [4]	29	68 [4]	29	57
	In millions of dollars									
Total	71.8	55.1	22.5	37.6	8.6	28.8	3.3	21.3	64.3	66.2
Federal Government	32.7	35.0	12.1	13.0	6.5	4.6	1.3	3.3	4.6	4.8
State/local government	25.8	11.5	6.3	18.0	2.0	22.4	2.0	16.8	50.5	50.5
Private donations	11.1	7.7	0.0	0.0	0.0	0.0	0.0	0.3	3.0	3.4
Institutional funds	2.3	0.9	4.2	4.6	0.0	0.2	0.0	0.9	1.5	1.5
Debt financing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.7
Tax-exempt bonds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.6
Other debt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Other sources	0.0	0.0	0.0	1.9	0.0	1.6	0.0	0.0	1.0	2.2

[1] Data for the first two time periods were heavily inflated by construction activity at a single institution, which accounted for a substantial fraction of the total dollar amount shown.

[2] The original group consists of the 29 HBCUs also surveyed in 1988, 1990, 1992, 1994, and 1996.

[3] The expanded group consists of all research-performing HBCUs, including the 29 original HBCUs.

[4] Two of the HBCUs were determined to be out of scope since they had no S&E research space; data are weighted to 28 in the original panel and 68 in the expanded group.

[5] Seven of the HBCUs were determined to be out of scope since they had no S&E research space; data are weighted to 29 in the original panel and 57 in the expanded group.

NOTE: Components may not add to totals due to rounding. Findings are limited to projects with estimated total cost at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 7 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-8. Sources of funds for science and engineering research facilities repair/renovation projects at Historically Black Colleges and Universities (HBCUs): 1986 97

Source of funds	1986 87	1988 89	1990 91 [Original][1]	1990 91 [Expanded][2]	1992 93 [Original][1]	1992 93 [Expanded][2]	1994 95 [Original][1]	1994 95 [Expanded][2]	1996 97 [Original][1]	1996 97 [Expanded][2,4]
Number of research-performing HBCUs	29	29	29	70	28	68[3]	29	68[3]	29	57
	In millions of dollars									
Total	14.1	21.1[5]	11.6	21.4	8.7	9.1	21.5	22.0	7.6	13.2
Federal Government	8.7	12.9	3.5	3.6	5.0	4.8	10.2	10.4	2.2	4.5
State/local government	4.9	8.0	8.0	17.7	2.1	2.1	6.4	6.6	1.8	2.5
Private donations	0.5	0.1	0.1	0.2	1.7	1.7	0.0	0.0	0.0	0.2
Institutional funds	0.0	0.1	0.1	0.1	0.1	0.4	2.6	2.6	3.6	6.0
Debt financing	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	0.0	0.0
Tax-exempt bonds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other debt	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	0.0	0.0
Other sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[1] The original group consists of the 29 HBCUs also surveyed in 1986, 1988, 1990, 1992, 1994, and 1996.

[2] The expanded group consists of all research-performing HBCUs, including the 29 original HBCUs.

[3] Two of the HBCUs were determined to be out of scope since they had no S&E research space; data are weighted to 28 in the original panel and 68 in the expanded group.

[4] Seven of the HBCUs were determined to be out of scope since they had no S&E research space; data are weighted to 28 in the original panel and 57 in the expanded group.

[5] The 1988 89 total has been revised since the 1996 report.

NOTE: Components may not add to totals due to rounding. Findings are limited to projects with estimated total cost at completion of $100,000 or more for research space. Estimates are prorated to reflect research components only. Dollar amounts are reported in current dollars, unadjusted for inflation. See table A-5 in the Technical Notes for the inflation adjustment used in chapter 7 of this report.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E7-9. Laboratory animal facilities at Historically Black Colleges and Universities (HBCUs): 1998

Indicator	Original group[1]	Expanded group[2]
Total animal research space (NASF in thousands)	229,622	245,268
Animal laboratory space (NASF in thousands)	90,773	96,961
Animal housing space (NASF in thousands)	138,849	148,307
Regulation status (percentage of animal research space):[3]		
Level 1	0.9	0.9
Level 2	6.8	8.8
Level 3	1.7	2.2
Level 4	0.0	0.0
Cost of scheduled construction and repair/renovation of laboratory animal facilities, FYs 1996 or 1997 (in thousands of dollars)	517,858	517,858
Amount of space scheduled for construction and repair/renovation of laboratory animal facilities, FYs 1996 or 1997 (NASF in thousands)	10,358	10,358

[1] The original group consists of the HBCUs also surveyed in 1986, 1988, 1990, 1992, 1994, and 1996.

[2] The expanded group consists of all research-performing HBCUs, including the 29 original HBCUs.

[3] Definitions of levels are as follows:

Level 1 practices, safety equipment, and facilities are appropriate for undergraduate and secondary educational training and teaching laboratories, and for other facilities in which work is done with defined and characterized strains of viable microorganisms not known to cause disease in healthy adult humans.

Level 2 practices, equipment, and facilities are applicable to clinical, diagnostic, teaching and other facilities in which work is done with the broad spectrum of indigenous moderate-risk agents present in the community and associated with human disease of varying severity.

Level 3 practices, safety equipment, and facilities are applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection.

Level 4 practices, safety equipment, and facilities are applicable for work with dangerous and exotic agents which pose a high individual risk of life-threatening disease, which may be transmitted via the aerosol route, and for which there is no available vaccine or therapy.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E8-1. Amount of space in laboratory animal facilities by institution type and control: 1998

Institution type and control	Number of institutions	Total animal research space	Animal housing space	Animal laboratory space
		NASF in thousands		
Total	542	11,852	8,551	3,301
Doctorate-granting	323	11,235	8,115	3,120
Top 100 in research expenditures	97	8,491	6,094	2,397
Other	226	2,744	2,021	723
Nondoctorate-granting	219	617	436	181
Public	302	9,139	6,630	2,509
Doctorate-granting	193	8,721	6,300	2,421
Nondoctorate-granting	109	418	330	88
Private	240	2,713	1,921	792
Doctorate-granting	130	2,514	1,815	699
Nondoctorate-granting	110	199	106	93

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Limited to institutions reporting any animal research space that is subject to government regulations concerning the humane care and use of laboratory animals.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E8-2. Percentage of animal research space at each animal biological safety level by institution type and control: 1998

Institution type and control	Total	Animal biological safety level			
		Level 1[1]	Level 2[2]	Level 3[3]	Level 4[4]
Total	100	75	23	3	0
Doctorate-granting	100	74	24	3	0
Top 100 in research expenditures	100	72	25	3	0
Other	100	80	18	2	0
Nondoctorate-granting	100	93	7	0	0
Public	100	76	22	2	0
Doctorate-granting	100	76	22	2	0
Nondoctorate-granting	100	94	6	1	0
Private	100	69	27	4	0
Doctorate-granting	100	67	28	5	0
Nondoctorate-granting	100	91	9	0	0

[1] Acceptable for work with microorganisms not known to cause disease in healthy humans.

[2] Acceptable for work with moderate-risk agents present in the community and associated with human disease of varying severity.

[3] Acceptable for work with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection.

[4] Acceptable for work with biological agents that may cause the transmission of a potentially lethal disease for which there is no readily available cure.

NOTE: Components may not add to totals due to rounding. Limited to institutions reporting any animal research space that is subject to government regulations concerning the humane care and use of laboratory animals.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E8-3. Amount of animal research space and funds scheduled for the construction and repair/renovation of laboratory animal facility improvement by institution type and control: 1998

Institution type and control	Construction			Repair/Renovation		
	Number of institutions	NASF [in thousands]	Cost [in millions of dollars]	Number of institutions	NASF [in thousands]	Cost [in millions of dollars]
Total	56	303	45.1	35	492	162.1
Doctorate-granting	50	292	43.2	30	440	143.5
Top 100 in research expenditures	34	193	34.9	21	329	119.1
Other	16	99	8.3	9	112	24.3
Nondoctorate-granting	6	12	1.9	5	52	18.6
Public*	27	154	20.1	25	340	99.8
Private	29	149	25.0	10	151	62.3
Doctorate-granting	24	143	23.7	7	117	45.3
Nondoctorate-granting	5	6	1.3	3	34	17.0

*The data for the public doctorate and nondoctorate-granting institutions have been combined due to confidentiality pledge.

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Limited to institutions reporting any animal research space that is subject to government regulations concerning the humane care and use of laboratory animals.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E9-1. Total assigned instructional and research space at biomedical institutions by field and institution type: 1988 98

Field	Total assigned instructional and research space						Total assigned research space					
	1988	1990	1992	1994	1996	1998	1988	1990	1992	1994	1996	1998
	NASF in millions											
Biological sciences	45	49	52	52	52	60	24	26	28	28	29	39
CI						(57.04 63.25)						(36.20 41.61)
CV						3						4
Universities and colleges	32[T]	34	33[T]	35	36	35	16[T]	18	17[T]	17[T]	19	19
CI						(33.44-36.69)						(18.49 20.36)
CV						2						3
Medical schools	13[T]	15	19	17	16	17	8[T]	9[T]	11	11	11	12
CI						(15.12 19.12)						(10.34 12.9)
CV						6						6
Research organizations	--	--	--	--	--	7	--	--	--	--	--	6
CI						(4.28 8.64)						(4.21 8.53)
CV						17						17
Hospitals	--	--	--	--	--	2	--	--	--	--	--	2
CI						(0.50 2.50)						(0.47 2.46)
CV						34						33
Medical sciences	66	63	70	60	59	69	19	20	22	23	25	34
CI						(62.78 75.90)						(29.88 38.99)
CV						5						7
Universities and colleges	21	22	25	22	23	22	5[T]	5[T]	6[T]	6[T]	7	7
CI						(19.96 24.67)						(6.53 7.47)
CV						5						3
Medical schools	45[T]	41[T]	46[T]	38	36	36	14[T]	15[T]	16	17	18	18
CI						(31.84 40.06)						(16.19 20.06)
CV						6						5
Research organizations	--	--	--	--	--	3	--	--	--	--	--	3
CI						(1.66 4.74)						(1.64 4.72)
CV						25						25
Hospitals	--	--	--	--	--	8	--	--	--	--	--	6
CI						(3.53 11.98)						(2.23 9.82)
CV						27						32

KEY: T = Significant differences between this time period and 1996 (outside 1996 CI).
-- = data not available.
NASF = net assignable square feet.
S&E = science and engineering.
CI = Confidence interval.
CV = Coefficient of variation.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E9-2. Condition of biomedical research space by institution type: 1998

Institution type	Suitable for the most scientifically competitive research in the field	Effective for most levels of research	Requires major renovation	Requires replacement
	Percentage of research NASF			
All biomedical research institutions	0	0	0	0
CI	(42.3 48.4)	(30.7 35.0)	(16.2 18.5)	(3.8 5.0)
CV	0	0	0	0
Colleges and universities, total	38	38	20	5
CI	(35.8 39.3)	(35.9 39.0)	(19.0 20.9)	(4.5 5.6)
CV	2	2	3	6
Top 50 in research expenditures	40	34	22	5
CI	(38.7 40.4)	(32.9 34.2)	(21.6 22.6)	(4.5 5.1)
CV	5	1	1	4
Other doctorate-granting	34	43	18	5
CI	(30.9 37.8)	(39.6 46.1)	(15.9 19.7)	(4.0 6.0)
CV	1	4	6	10
Nondoctorate-granting	43	32	18	7
CI	(31.2 54.7)	(23.2 39.8)	(12.7 24.0)	(2.7 11.7)
CV	14	13	16	32
Medical schools	46	33	18	4
CI	(41.9 49.2)	(29.2 36.1)	(16.0 19.2)	(3.5 4.9)
CV	4	6	5	7
Research organizations	67	19	11	3
CI	(57.0 76.2)	(12.6 25.8)	(6.6 16.0)	(0 6.2)
CV	7	17	21	59
Hospitals	46	35	15	5
CI	(27.8 64.2)	(24.3 45.3)	(8.4 20.6)	(1.8 7.7)
CV	20	15	21	31

KEY: NASF = net assignable square feet.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E9-3. Number of institutions and funds committed to nonfixed equipment costing over $1 million in repair/renovation projects by biomedical field: 1996 97

Field	Number of institutions with expenditures on nonfixed equipment	Expenditures on nonfixed equipment [in millions of dollars]	Total construction expenditures [in millions of dollars]	Nonfixed equipment expenditures as a percentage of total construction expenditures
All Biomedical Institutions.....	7	24.4	73.3	33.3
Biological sciences.....	4	16.1	38.9	41.3
Medical sciences.....	5	8.3	34.4	24.2

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table E9-4. Number of institutions with scheduled construction or repair/renovation projects for laboratory animal facilities by institution type and control: 1998

Institution type	Institutions with projects scheduled for 1998		Total cost	
	Number	Percentage of institutions with facilities*	Dollars [in millions]	Percentage of total cost
Total	137	20	573	100
CI		(14.0–25.1)	(304–758)	
CV		14	22	
Colleges, universities, and medical schools	74	14	207.2	36
CI		(11.1–17.2)	(166–249)	
CV		11	10	
Public	42	15	119.8	21
CI		(10.9–18.2)	(90.6–149)	
CV		13	13	
Private	32	14	87.4	15
CI		(8.5–18.8)	(57.9–117)	
CV		19	17	
Research organizations	48	48	149.9	26
CI		(18.1–77.5)	(25.2–275)	
CV		32	42	
Hospitals	15	19	174.1	30
CI		(5.2–33.1)	(0–360)	
CV		37	54.0	

* The number of institutions with animal research facilities is drawn from table 9-9.

NOTES: Components may not add to totals due to rounding. The data refer to institutions reporting any space in laboratory animal facilities that are subject to government regulations concerning the humane care and use of laboratory animals. Figures include all animal facilities in institutions with biomedical research space, regardless of field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Appendix F

Glossary

GLOSSARY

Animal Biological Safety level. The categorization of laboratory animal facilities in relation to government regulations described in *Biosafety in Microbiological and Biomedical Laboratories* (1993).

Animal housing space. All general animal housing (e.g., cage rooms, stalls, wards, isolation rooms) and maintenance areas (e.g., feed storage rooms, cage-washing rooms, shops, storage), if these areas directly support research.

Animal laboratory facilities. All animal laboratory space used exclusively for research activities, such as bench space, animal production colonies, holding rooms, germ-free rooms, surgical facilities, and recovery rooms.

Animal research space. The combined amount of animal housing and animal laboratory space.

Biomedical institution. Any academic institution, hospital, or nonprofit research organization that has research space in the biological or medical sciences inside or outside of a medical school.

Capital projects. Science and engineering research space construction and repair/renovation projects.

Central campus infrastructure. Refers primarily to systems that exist between the buildings of a campus (excluding the area within five feet of any individual building foundation) and to the nonarchitectural elements of campus design (central wiring for telecommunications systems, storage/disposal facilities, electrical wiring between buildings, central heating and air exchange systems, drains and sewers, roadways, walkways, parking systems, etc.).

Construction. Additions to an existing building or construction of a new building.

Deferred cost. The cost of S&E construction or repair/renovation projects that are necessary to meet current S&E research commitments but which are not scheduled and do not have funding.

Deferred need. S&E construction or repair/renovations projects that are needed but have been postponed because, in general, funds are not available.

Deferred project. S&E construction or repair/renovation projects that are necessary to meet current S&E research commitments but which are not scheduled or funded. This category excludes projects that would house new projects or expand faculty beyond what is required to fulfill current S&E research program commitments.

Doctorate-granting institutions. Research-performing institutions where the highest degree offered is the doctorate.

Existing field. Fields in which institutions reported research space.

Facilities. To the extent they are used for research, facilities refers to research laboratories, controlled environment space, technical support space, facilities for laboratory animals, faculty or staff offices, department libraries, fixed equipment (such as fume hoods and benches), and nonfixed equipment costing $1 million or more.

Fixed equipment. Equipment that is built into facilities, such as fume hoods and laboratory benches.

Gross square footage. The sum of all areas (in square feet) on all floors of a building.

Hispanic-serving institutions (HSI). Colleges and universities whose enrollments are at least 25 percent Hispanic according to the Integrated Postsecondary Education Data System (IPEDS).

Historically Black Colleges and Universities (HBCUs). HBCUs are a recognized group of institutions that were established prior to 1964 and whose principal mission has been, and still is, the education of black students. These institutions qualify for Federal funding under 20 USC 1060.

Hospital. Research hospitals that were NIH grant recipients in 1997.

Institutional control. An institution's sector, that is, whether it is publicly or privately controlled.

Institutional funds. An institution's operating funds, endowments, indirect costs recovered from Federal grants and/or contracts, indirect costs recovered from other sources, and so on.

Institutional plan. An institution's approved plan, including goals, strategies, steps, and budgets, for fulfilling the institution's mission during a specific time period.

Instructional and research NASF. All space used for academic purposes, that is, space used for instruction and space used for research.

Internal sources. The sum of funds from institutional sources such as private donations, institutional funds, tax-exempt bonds, debt financing, and other sources.

Major renovation. An extensive repair project that results in facilities that are equivalent, or nearly equivalent, to new facilities in their ability to support science and engineering research.

Minority-serving institutions. Colleges and universities that have large minority enrollments, specifically HBCUs, HSIs, and non-HBCU-Black institutions.

NASF. See net assignable square feet.

Net assignable square feet. The sum of all areas (in square feet) on all floors of a building assigned to, or available to be assigned to, an occupant for specific use, such as instruction or research. NASF is measured from the inside faces of walls.

Nondoctorate-granting institutions. Research-performing institutions where the highest degree offered is a bachelor's or a master's.

Non-HBCU-Black institutions. Colleges and universities whose enrollments are at least 25 percent black according to the Integrated Postsecondary Education Data System (IPEDS), but are not designated as Historically Black Colleges and Universities.

Nonfixed equipment. Equipment that is not built into facilities.

Other doctorate-granting institutions. Research-performing, doctorate-granting institutions that were not top 100 or top 50, depending on the chapter, institutions in research and development expenditures in the National Science Foundation's 1993 Academic R&D Expenditures Survey.

Repair/renovation. The fixing up of facilities in deteriorated condition, capital improvements on facilities, conversion of facilities, and so on.

Research. All S&E research activities at an institution that are budgeted and accounted for. Research can be funded by the institution itself, the Federal Government, State or local governments, foundations, corporations, or other sources.

Research-performing institutions. All colleges and universities that offer a master's or a doctorate degree in science and engineering, and all other institutions that reported separately budgeted S&E research and development expenditures of $50,000 or more in the National Science Foundation's 1993 Academic R&D Expenditures Survey. It also refers to all HBCUs, HSIs, and non-HBCU-Black institutions with any research expenditures.

Research organizations. Nonprofit research institutions other than colleges, universities, medical schools, and hospitals that were NIH grant recipients in 1997.

Research NASF. Space that is used only for research; it does not include space that is used for instruction. To the extent it is used for research, it may include: research laboratories, controlled environment space, technical support space, facilities for laboratory animals, faculty or staff offices, department libraries, fixed equipment (such as fume hoods and benches), and nonfixed equipment costing $1 million or more.

Scheduled. A planned project that is funded and scheduled but on which construction or repair/renovation has not yet begun.

Top 50 institutions. The top 50 institutions in research and development expenditures in the National Science Foundation's 1993 Academic R&D Expenditures Survey.

Top 100 institutions. The top 100 institutions in research and development expenditures in the National Science Foundation's 1993 Academic R&D Expenditures Survey.