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AUTHOR Canalan, Margaret; And Others
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ABSTRACT

In January 1989, a survey was conducted of a national sample of public and private two-year and community colleges regarding aspects of their science, mathematics, engineering, and technology programs. The survey requested information on the prevalence of course and program offerings, the number and educational level of faculty, use of part-time faculty, faculty teaching loads, and the opinions of division heads regarding hiring and programs. Of the 323 institutions surveyed, 295 provided usable responses for a 91% response rate. Study findings included the following: (1) the majority of colleges without basic science courses were private two-year schools; (2) 78% of the responding colleges offered calculus or courses having calculus as a prerequisite, 69% offered two-year science transfer programs, and 46% had pre-engineering transfer programs; (3) science, mathematics, and technology faculty constituted about 37% of the total full-time faculty and 23% of the total part-time faculty; (4) the average total contact hours (lecture and lab) per week for full-time faculty was 18.6 in science, 16.2 mathematics, and 19.0 in engineering and technology; (5) in 7 of the 11 science and technology subjects studied, a majority of division heads reported the their institutions did not have any full-time faculty openings in the last three years; (6) the most serious problem cited by division heads was inadequate preparation of students in high school; and (7) the aspect of science and mathematics programs rated most highly by division heads was transfer to four-year institutions. Detailed data tables and the survey instrument are included. (JMC)

SCIENCE, MATHEMATICS, ENGINEERING, AND TECHNOLOGY IN TWO-YEAR AND COMMUNITY COLLEGES

HES

Higher Education Surveys

Higher Education Survey Report
Survey Number 9
December 1990

A Survey System Sponsored by the National Science Foundation, the National Endowment for the Humanities, and the U.S. Department of Education

Prepared by:

Margaret Cahalan, Survey Manager, Westat, Inc.
Elizabeth Farris, Project Director, Westat, Inc.
Patricia White, Senior Science Resources Analyst, NSF

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Sponsored by and written for:

The National Science Foundation
Directorate for Education and Human Resources
Office of Studies and Program Assessment

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A survey system sponsored by the National Science Foundation, the National Endowment for the Humanities, and the U.S. Department of Education

Highlights

- The percentage of all two-year and community colleges offering science, mathematics or technology courses ranged from 32 percent offering interdisciplinary science courses to 96 percent offering mathematics.

- Most of the colleges without basic science courses are private two-year schools. Percentages of private two-year colleges offering science, mathematics and technology courses ranged from 11 percent for engineering and 11 percent for agriculture and natural resources to 85 percent offering mathematics.

- Virtually all public two-year colleges have courses in biology (97 percent), chemistry (97 percent), physics (98 percent), mathematics (100 percent), and computer science (100 percent).

- Overall, 78 percent of the total two-year colleges offered calculus or courses having calculus as a prerequisite. Among public two-year colleges, 93 percent offered such courses, as did 40 percent of private two-year colleges.

- Of the total two-year and community colleges, 69 percent have two-year science transfer programs and 46 percent have pre-engineering transfer programs. Among public two-year colleges, 81 percent have a science transfer program and 58 percent have a pre-engineering transfer program.

- Science, mathematics, and technology faculty constituted about 37 percent of the total full-time faculty and 23 percent of the total part-time faculty in two-year colleges.

- Of the subject areas included in the survey, the largest number of total faculty (full and part time) were in allied health, mathematics, engineering technologies, and computer science.

- The percentage of full-time faculty having a doctorate ranged from 4 percent for allied health to 38 percent for chemistry. The percentage of part-time faculty having a doctorate ranged from 2 percent for computer science to 21 percent for chemistry.

- Of the total two-year and community college faculty, about 61 percent are part time. This compares with about 36 percent part-time faculty for the total institutions of higher education and an estimated 25 percent at four-year institutions.

- The percentage of science and technology faculty who are part time ranged from 35 percent for science professors hired to teach several different courses (multi-science) and 37 percent for chemistry to 60 percent for mathematics and 64 percent for computer science.

- While almost half of the total science and technology faculty were part time, the mean percentage of total contact hours (lecture and lab) taught by part-time faculty was considerably lower. Division heads estimate the mean percentage of total contact hours for part-time faculty to be 22 percent for science, 27 percent for mathematics, and 22 percent for engineering and technology.*

- The mean number of different course preparations required of full-time teaching staff was 3.0 for science, 3.2 for mathematics, and 3.5 for technology.

- The average total contact hours (lecture and lab) per week for full-time faculty was 18.6 for science, 16.2 for mathematics, and 19.0 for engineering and technology.

- For 7 of the 11 science and technology subjects studied, a majority of division heads reported their institutions did not have any full-time faculty openings in the last three years. Of those reporting their institutions had openings, the percentage who reported experiencing difficulty hiring fully qualified faculty ranged from 6 percent for agriculture and natural resources to 44 percent for computer science.

- Among those division heads reporting openings in the last three years for part-time faculty, the percentage experiencing difficulty hiring fully qualified faculty ranged from 19 percent for agriculture and natural resources to 51 percent for engineering.

- Reasons most frequently cited by division heads for difficulty in hiring qualified full- and part-time faculty at their institutions were inadequate salaries and lack of qualified personnel in the geographic area.

- On the average, a majority (61 percent) of full-time faculty were recruited from the local area of the institution, and another 25 percent were recruited from the same region as the institution.

- The program aspect most frequently rated by division heads as a serious problem in science, mathematics, and engineering and technology programs was inadequate preparation of students in high school.

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*Mean percentages were calculated by averaging the percentages of contact hours reported by division heads.

- The program aspect most frequently rated by division heads as excellent for science and mathematics was successful transfer to four-year institutions. The program aspects they rated most frequently as excellent for engineering and technology were consistency with the technical/occupational requirements of industry and job placement after completion.

- The program aspect rated most frequently by division heads as inadequate for science, mathematics, and engineering and technology was recruitment of minority students.

Acknowledgments

This survey was conducted by Westat, Inc., at the request of the Office of Studies and Program Assessment of the National Science Foundation. The survey is part of an on-going effort of the National Science Foundation to provide Congress and the educational community with updated information on the characteristics and problems of science and technology education in two-year colleges. The following persons assisted in the development of the study and provided review of the study and report.

- David H. Florio, Program Director, Office of Studies and Program Assessment, National Science Foundation
- Patricia White, HES Program Officer, Education and Human Resources Program, Division of Science Resources Studies, National Science Foundation
- Mary Golladay, Director, Education and Human Resources Program, Division of Science Resources Studies, National Science Foundation
- William T. Mooney, Chairperson, American Chemical Society (ACS) Committee on Education Task Force on ACS Involvement in the Two-Year Colleges

At Westat the successful completion of the project depended on the coordination of several people. The Westat project team included Margaret Cahalan (Survey Manager/Analyst), Adam Chu (Statistician), Elizabeth Farris (HES Project Director), Susan Robbins Hein (Graphics), Sheila Heaviside (Data Collection Manager), Pat Cruz (Data File Preparation, Coding, and Editing), Warren Mason and Ted Trela (Programming), and Sylvie Warren (Word Processing).

We especially acknowledge the indispensable contribution of the many officials and staff members at the sampled institutions who completed the survey questionnaires.

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Survey Background

The National Science Foundation has been asked by Congress to prepare periodic reports on the status of science and engineering and technology in two-year and community colleges. This report presents the findings of a Higher Education Survey (HES) on selected characteristics of science, mathematics, engineering, and engineering technologies programs in those institutions. The survey is part of the ongoing effort of the National Science Foundation to provide Congress and the educational community with updated information.

There are over 1,250 two-year and community colleges in the United States, serving 4.5 million full- and part-time students. Current data indicate that these institutions enroll about 37 percent of all higher education students.[1] More than half the students who begin college in the United States begin in a two-year college. Five out of eight of these students are part-time students. Although community colleges enroll a large number of adults, the median age is still below 22 years--that is, half the students are in the traditional college age population.[2] Two-year and community colleges also enroll the highest percentage of minority students in any level of higher education. In 1986, 47 percent of all minorities in higher education were in two-year colleges.[3]

In contrast, Federal support to higher education has been concentrated in four-year institutions, particularly those with doctoral programs. The 356 doctoral-granting institutions receive about 76 percent of all Federal educational funding and 97 percent of all science education money.[4]

Data on degrees earned show that a sizable portion of those earning doctorates have attended community colleges. Of the total science and engineering doctoral degrees granted in 1987, 8.5 percent were earned by students who had attended

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[1]United States Department of Education, [National] Center for Education Statistics, "Fall Enrollment in Colleges and Universities." As cited in Digest of Education Statistics, 1988, Table 122.

[2]Arthur M. Cohen, "The Sciences in American Community Colleges," AAS Convention, January 7, 1982, p.2. ERIC Document ED 213448, JC 820 018.

[3]United States Department of Education, [National] Center for Education Statistics, "Fall Enrollment in Colleges and Universities," As cited in Digest of Education Statistics, 1988, Table 146.

[4]These figures are taken from 1985 NSF Congressional Committee testimony of Bernard Luskin, Executive Vice President of the American Association of Community and Junior Colleges, on the "Role of the National Science Foundation in Undergraduate Science and Engineering Education." The author does not specify whether research funding is included in these figures.

community colleges at an earlier point in their education. The figures for minorities are much higher. One-quarter of the Native Americans and 10 percent of blacks earning doctorates in science and engineering in 1987 had attended community colleges.[5]

The community college has been characterized as serving five functions:[6]

- Collegiate, the traditional transfer program;
- Career or occupational;
- Continuing or adult education, which includes personal interest courses and occupational upgrading;
- Compensatory, remedial, or developmental; and
- Community service, short courses and recreational and cultural activities for the benefit of the public.

Despite high noncompletion rates among two-year college students, associate degrees and postsecondary certificates or diplomas in less than four-year programs increased more rapidly than all other awards granted by institutions of higher education from 1975-85 (although their growth has slowed since 1983). About 16 percent of less than four-year awards are in engineering technologies, 17 percent in health sciences, 18 percent in liberal/general studies, 28 percent in business and management, and 22 percent in other fields.[7]

In light of these statistics, there has been increased awareness of the crucial role two-year and community colleges are playing in higher education in the United States. The aim of this survey was to provide a general overview of the major characteristics and problems of science, mathematics, and engineering technology programs within a two-year college setting.

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[5]National Science Foundation and National Research Council, Special analysis runs from the 1987 Survey of Earned Doctorates

[6]Arthur M. Cohen, "The Sciences in American Community Colleges," AAS Convention, January 7, 1982. ERIC Document ED 213448, JC 820 018, 1.

[7]Elaine Kroe, Less than Four-Year Awards in Institutions of Higher Education, 1983-85, (Washington, D.C.: [National] Center for Education Statistics, 1987) ERIC Document ED 286 540, JC 870 383.

Information Collected

The HES survey collected information on the following aspects of science, mathematics, engineering, and technology programs in two-year and community colleges:

- Prevalence of course and program offerings
- Number and education of faculty
- Use of part-time faculty
- Teaching loads of faculty
- Division heads' opinions on difficulties in hiring faculty
- Division heads' identification of problems and evaluation of programs

In the first part of the survey, respondents were asked a series of questions about specific subject areas. These included the following:

- Agriculture and natural resources (animal/plant science, forestry, fisheries, wildlife management, food science)
- Biology
- Chemistry
- Physics
- Earth and space sciences (geography, geology, astronomy, meteorology, oceanography)
- Interdisciplinary natural sciences
- Mathematics
- Computer science (programming, data processing)
- Engineering
- Engineering technologies (mechanics, electronics, repairs, design and other trade training)
- Allied health
- Science laboratory technologies (chemical, biological, other)

For the remaining questions respondents were asked to provide information for the more general categories of science, mathematics, and engineering and technology. For the purposes of this survey, "science" covers the subjects of biology, chemistry, earth and space sciences, physics, and interdisciplinary natural sciences. "Engineering and technology" covers courses in engineering, engineering technologies, and computer science. Agriculture and allied health are not considered in this series of questions.

Questionnaires were mailed in January of 1989 to the HES coordinators in the 336 sampled two-year institutions. A few (13) had no science, mathematics, or technology courses at all and were considered out of scope for the study. These institutions were secretarial, art, and drama schools. The term two-year and community college as used in this report excludes these schools. Sections of the survey dealing with identification of problems and evaluation of science, mathematics, and engineering and technology programs included a request that a person within each division be responsible for completion of that section. In most cases these parts of the survey were completed by the head of the applicable division.

Ninety-one percent (295) of the 323 eligible institutions responded to the survey. A nonresponse adjustment was made and data included in this report have been weighted to produce national estimates. Appendix Table A-1 presents the total number of unweighted and weighted institutional respondents.[8]

The report presents data for all two-year and community colleges and by institutional control (public and private), institutional enrollment (small, less than 1,500; medium, 1,500-5,999; and large, 6,000 or more), and geographic region (Northeast, Central, Southeast, and West). Because the estimates in the report are based on sample data, they are subject to sampling variability. Standard errors for selected statistics are presented in Appendix Table B-2. Specific statements of comparison in the text are significant at the 95 percent confidence level or better.[9]

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[8]The initial sampling weight assigned to schools for estimation purposes was equal to the reciprocal of the overall probability of selecting the school for the sample. Within a stratum, the initial weight was computed as the ratio of the number of schools in the population (frame) in the stratum to the number of schools sampled from that stratum. To obtain the final weight, the initial weight was multipled by a school nonresponse-adjustment factor equal to the total number of sampled (and eligible) schools in the stratum divided by the number of responding (and eligible) schools in the stratum.

[9]For categorical data, relationships between variables with two or more levels have been tested using chi-square tests at the .05 level of significance. If the overall chi-square was significant, it was followed with pairwise t tests.

It should be noted that only 27 percent of two-year and community colleges are private, and 95 percent of the private two-year institutions have enrollments of less than 1,500 (Appendix Table B-3). Many of the private two-year schools are specialized and have either a limited range of science and technology programs or none at all. Hence, the data on science and technology programs for private institutions present a very different profile than those for public institutions.

The report is organized by survey topic from the questionnaire. Appendix A presents detailed tables; Appendix B discusses the sample and survey methodology; and Appendix C shows the survey questionnaire.

Prevalence of Course Offerings

The percentage of two-year and community colleges offering science and technology courses ranged from 32 percent offering interdisciplinary natural science courses to 96 percent offering mathematics courses (Table 1).[10] Ninety-one percent offered computer science, 85 percent physics, 84 percent biology, 83 percent chemistry, 73 percent allied health, 71 percent engineering technologies, 45 percent science laboratory technologies, and 39 percent agriculture and natural resources (Table 1). Within the area of mathematics, 78 percent offered calculus or courses requiring calculus as a prerequisite.

Offerings by Institutional Control

Most of the colleges that do not have basic science courses (biology, chemistry, physics) are private two-year schools. Virtually all public two-year colleges have courses in biology (97 percent), chemistry (97 percent), physics (98 percent), mathematics (100 percent), and computer science (100 percent; Table 1). In other areas of study, 88 percent have courses in allied health, 83 percent in engineering technologies, 53 percent in engineering and science laboratory technology, and 49 percent in agriculture and natural resources. Ninety-three percent of public colleges have courses in calculus or courses requiring calculus as a prerequisite. The figures for private two-year colleges are much lower, ranging from 11 percent offering engineering, and agriculture and natural resources courses, to 85 percent offering mathematics.

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[10] To be included in the survey an institution had to have at least one science, mathematics or technology course. A small percentage (3.8 percent) of the initial sample did not have at least one course. These were primarily art or business schools.

Table 1. Percentage of two-year and community colleges offering selected specific science and technology courses by institutional control and enrollment: United States

Subject area	All institutions	Control		Enrollment		
		Private	Public	Less than 1,500	1,500 to 5,999	6,000 or or more
Agriculture and natural resources (animal/plant science, forestry, fisheries, wildlife management, food science)	39	11	49	25	52	46
Biology	84	49	97	69	93	100
Chemistry	83	44	97	65	94	100
Physics	85	51	98	69	96	99
Earth and space sciences (geography, geology, astronomy, meteorology, oceanography)	64	29	77	44	74	88
Interdisciplinary natural sciences	32	20	36	22	35	47
Mathematics	96	85	100	91	100	99
Calculus or math courses requiring calculus as a prerequisite	78	40	93	55	95	98
Computer science (programming, data processing)	91	69	100	82	98	100
Engineering	42	11	53	13	57	73
Engineering technologies (mechanics, electronics, repairs, design and other trade training)	71	38	83	48	86	92
Allied health	73	33	88	48	90	96
Science laboratory technologies (chemical, biological, other)	45	24	53	31	51	63

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges. HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Offerings by Enrollment Size

As might be expected, the category of small institutions (enrollments of less than 1,500), which includes a number of specialized colleges, had the lowest percentage of institutions offering science and technology courses (Table 1). For example, all large schools (enrollments of 6,000 or more) offered chemistry courses compared with 65 percent of small schools, and 73 percent of large schools offered engineering courses compared with only 13 percent of small schools.

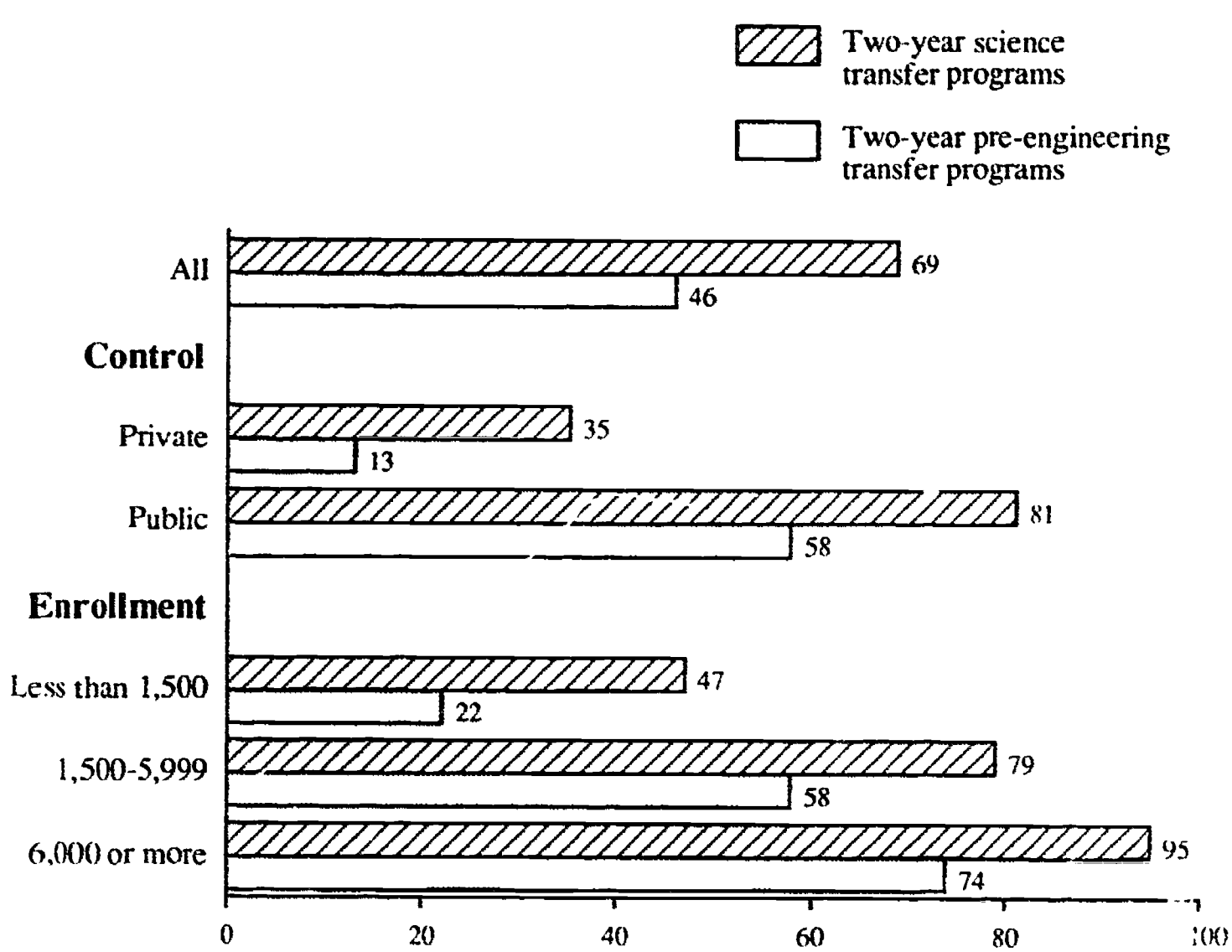
Offerings by Region

Data presenting regional differences in course offerings reflect the types of two-year schools in each of the regions (Table A-2). For example, over 50 percent of the two-year colleges in the Southeast and Northeast are small, compared with 23 percent in the West (Appendix Table B-2). Only 8 percent of schools in the Southeast, 16 percent in the Northeast, and 17 percent in the Central region have enrollments of 6,000 or more compared with 39 percent in the West. The Northeast region has the largest percentage of private two-year schools (38 percent) compared with 13 percent in the West. Consistent with these differences, in several science areas Western two-year and community colleges are more likely to offer courses than schools in the Northeast. For example, 93 percent of Western schools offer chemistry courses and 53 percent offer agriculture courses, compared with 69 and 20 percent, respectively, of schools in the Northeast (Appendix Table A-2).

Transfer Programs

There are science transfer programs at 69 percent and pre-engineering transfer programs at 46 percent of all two-year institutions. Transfer programs were found at public two-year institutions more often than at private two-year institutions (Appendix Table A-3 and Figure 1); 81 percent of the public institutions have a science transfer program and 58 percent have a pre-engineering transfer program compared with 35 and 13 percent of private institutions, respectively. Almost all large two-year colleges have science transfer programs (95 percent) and about three-fourths (74 percent) have pre-engineering transfer programs.

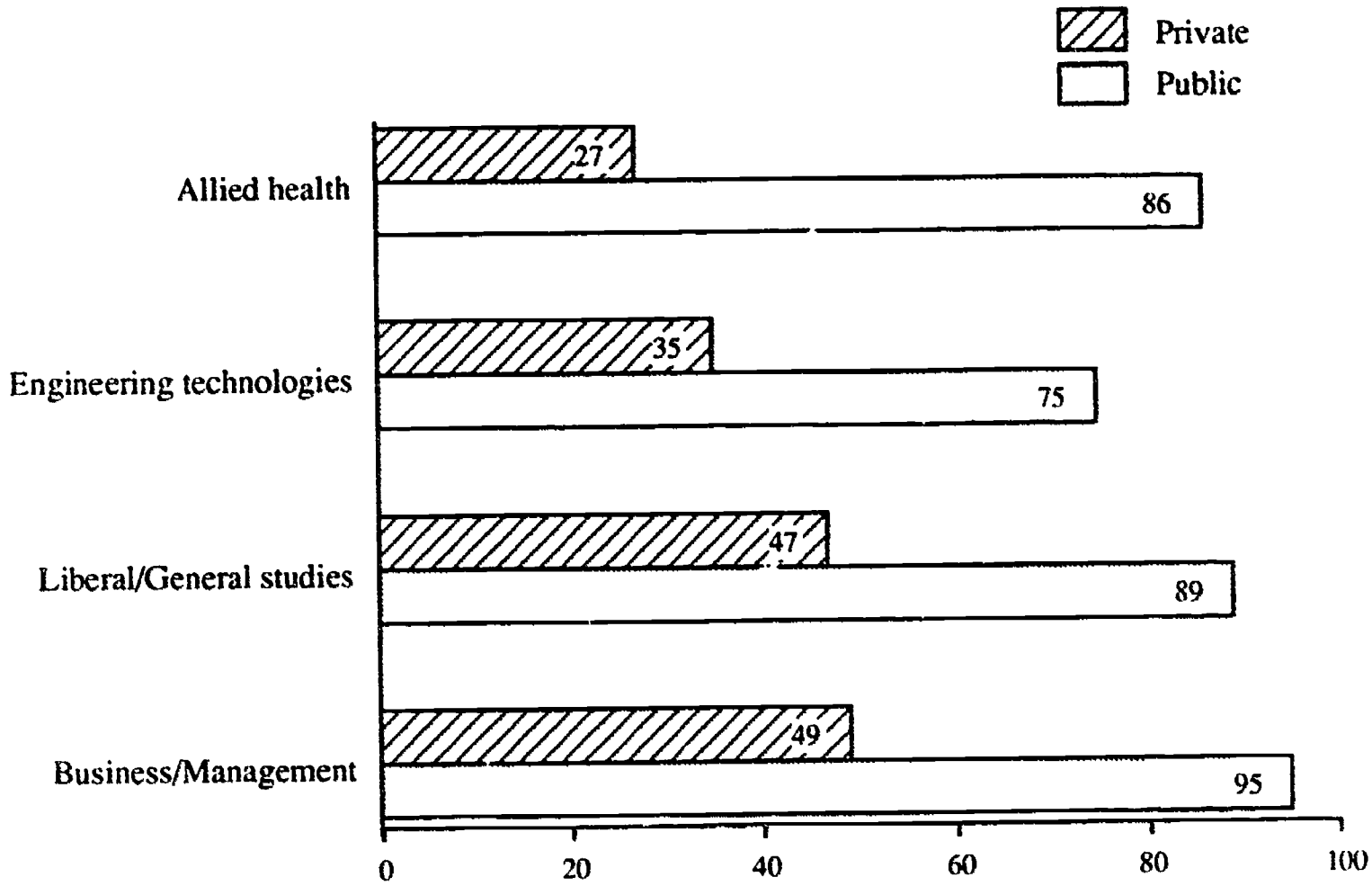
Figure 1. Percentage of two-year and community colleges having two-year science transfer and pre-engineering transfer programs: 1989 survey



Degrees and Certificates Offered

Of all two-year institutions, 83 percent offered degrees or certificates in business/management, 78 percent in liberal/general studies, 70 percent in allied health, and 64 percent in engineering technologies (Appendix Table A-4). Public and large institutions are more likely to offer each type of degree and certificate than private and small institutions (Appendix Table A-4 and Figure 2).

Figure 2. Percentage of two-year and community colleges offering degrees or certificates in selected areas by institutional control: 1989 survey



Number of Faculty

Two-year and community colleges reported a total of about 239,000 full- and part-time faculty[11] (Appendix Table A-5). Of these, about 61 percent (143,000) were employed part time by the school. Most of the part-time faculty are in public (95 percent) and large (55 percent) two-year institutions.

The total faculty reported for the science, mathematics, and technology subjects included in the survey was about 61,000. Survey results showed that about 33,000 taught full time and 28,000 taught part time (data not shown). Science, mathematics, and technology faculty thus were about 37 percent of the total full-time faculty and 23 percent of the total part-time faculty (Appendix Table A-6).

Of the subject areas included in the survey, the largest number of total full- and part-time science and technology faculty were in allied health, mathematics, engineering technologies, and computer science (Appendix Table A-7 and Figure 3). The mean number of full-time faculty in all institutions, including those having no faculty in the subject area, ranged from only .5 for multi-science courses[12] to 6.7 for allied health. Mathematics had the second highest number of full-time faculty, averaging 5 full-time faculty per school. The mean number of part-time faculty ranged from .2 for multi-science courses to 7.1 for mathematics. Biology averaged 2.9 full-time and 2.1 part-time faculty; chemistry averaged 1.7 full-time and 1.0 part-time faculty; and physics averaged 1.2 full-time and .7 part-time faculty.

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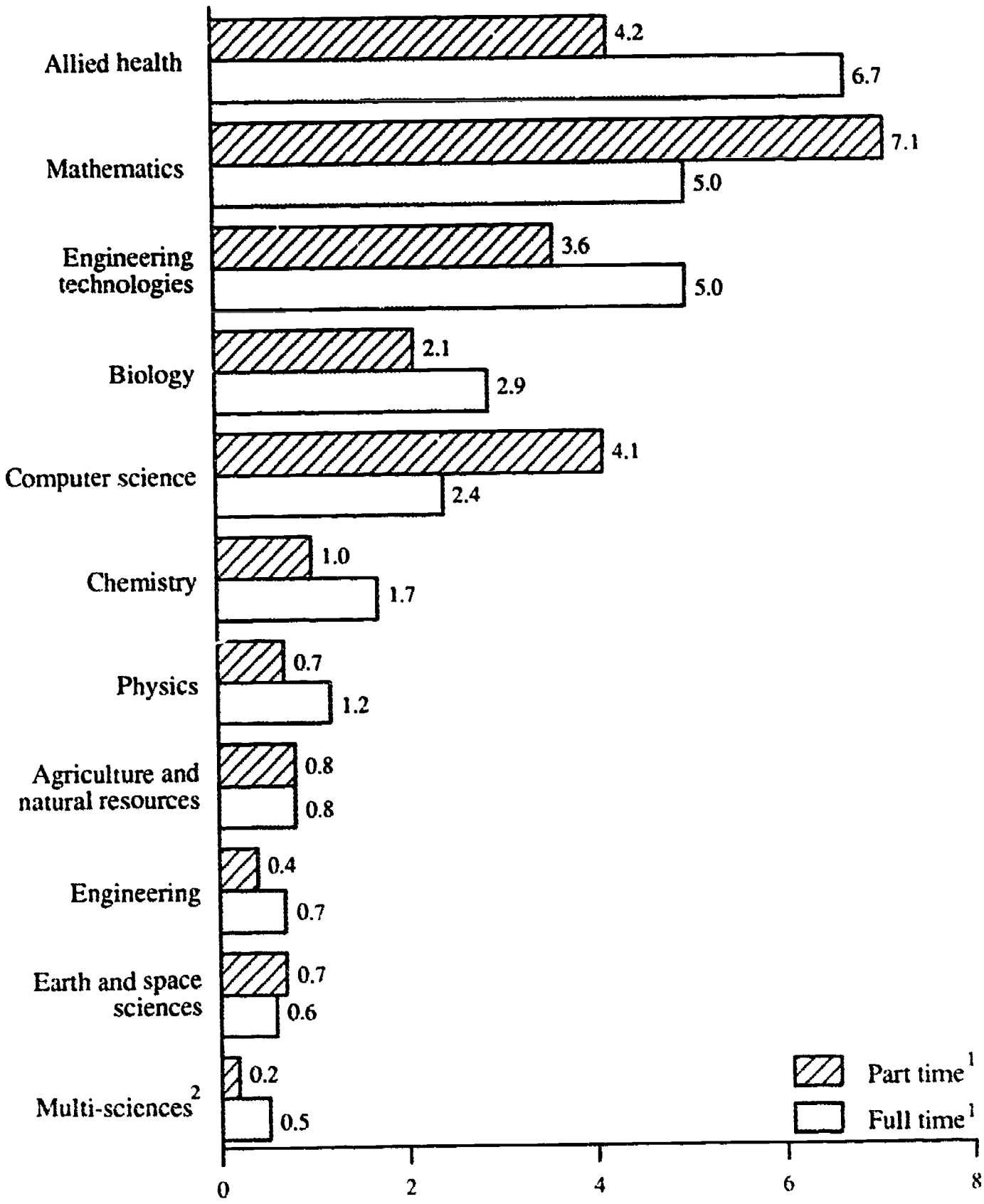
[11]The National Center for Education Statistics estimates (based on enrollment for 1988) reported a total of 221,000 full- and part-time senior faculty for 1988 in two-year and community colleges (excludes graduate instructors) and faculty employed by system offices. The number from this study is somewhat higher, perhaps because certain categories of faculty were not excluded. The Digest of Education Statistics, 1989, U.S. Department of Education, NCES, Table 190, p. 212.

[12]For the purposes of this survey, the term "multi-sciences" was used if a science professor taught several different courses (e.g., physics, chemistry, and biology), and the institution was unable to determine which course he or she taught most frequently.

Figure 3. Mean number of full- and part-time two-year and community college science and technology faculty by subject area: 1989 survey



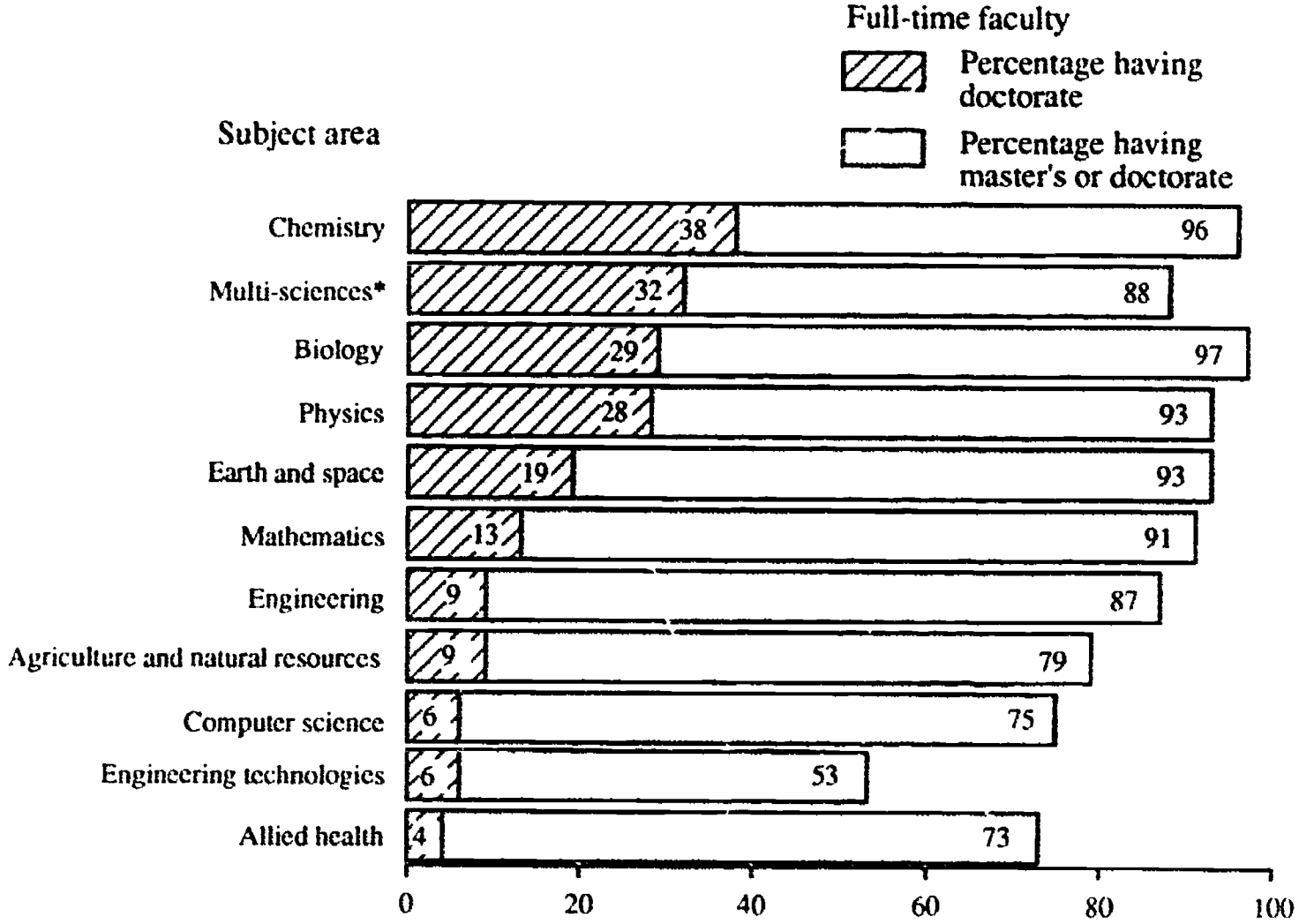
[1] Includes institutions having zero faculty in subject area.

[2] This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

Highest Degree Earned by Faculty

The percentage of full-time science and technology faculty in two-year and community colleges having a doctorate ranged from 4 percent for allied health to 38 percent for chemistry (Appendix Table A-8 and Figure 4). In general, fewer faculty in the more applied subjects have doctorates. For example, 28 percent of physics faculty have doctorates compared with only 9 percent of engineering faculty; similarly, 29 percent of biology faculty have doctorates compared with only 4 percent of allied health faculty. Thirteen percent of mathematics full-time faculty have doctorates. The percentage having either a master's degree or a doctorate ranged from 53 percent for engineering technologies to 96 percent for chemistry (Figure 4). Highest degree earned did not vary greatly with the size of the institution (Appendix Table A-9).

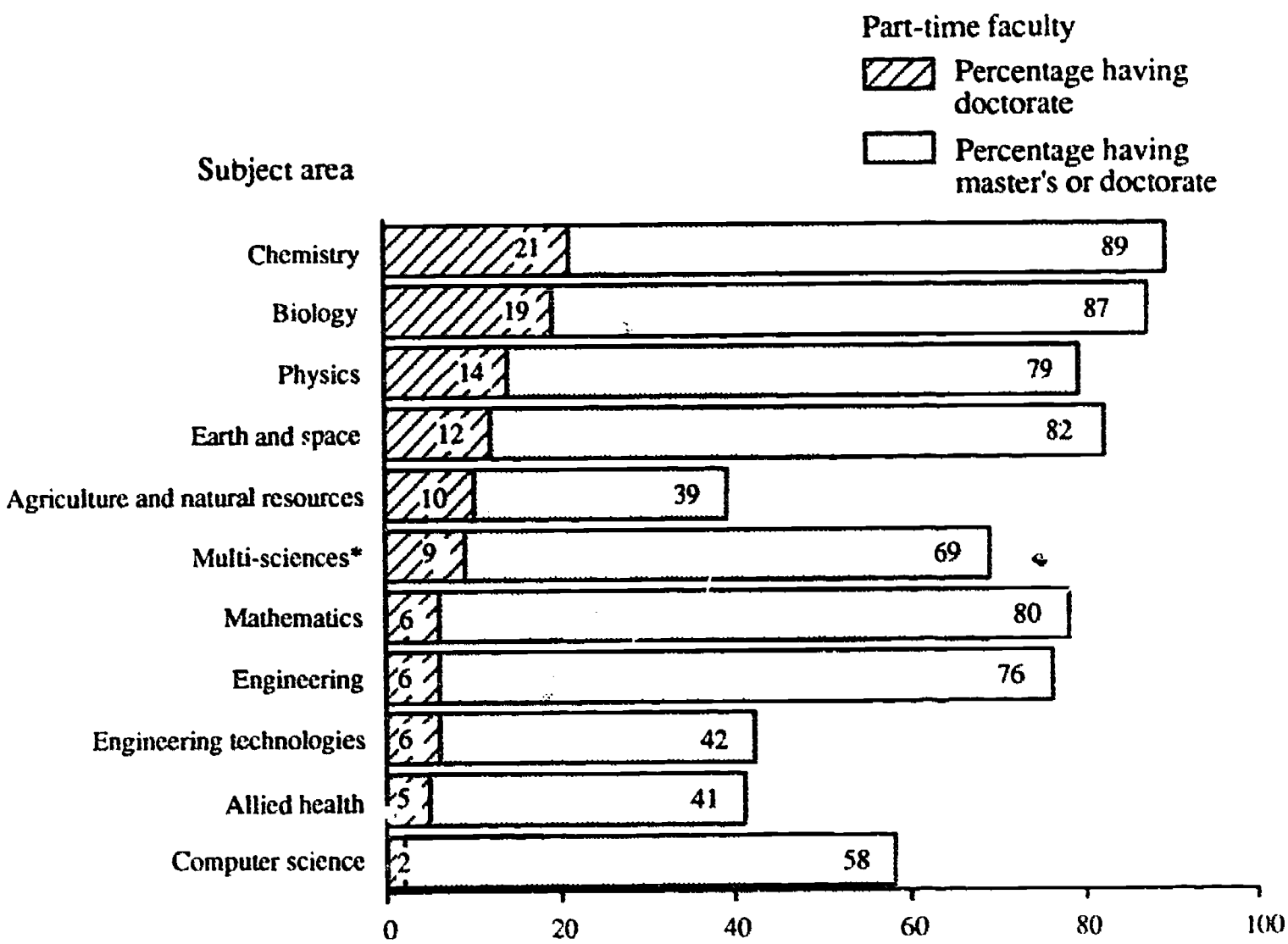
Figure 4. Percentage of full-time two-year and community college science and technology faculty having a doctorate and percentage having a master's or doctorate by subject area: 1989 survey



* This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

The percentages having a doctorate were lower for part-time faculty (although not always to a statistically significant degree) than for full-time faculty for biology, chemistry, physics, mathematics, and computer science. They were similar to those for full-time faculty for agriculture and natural resources, allied health, and engineering technologies. The percentage of part-time faculty having doctorates ranged from 2 percent for computer science to 21 percent for chemistry (Appendix Table A-8 and Figure 5). The percentage of part-time faculty having either a master's or doctorate as the highest degree earned ranged from 39 percent for agriculture and natural resources to 89 percent for chemistry.

Figure 5. Percentage of part-time two-year and community college science and technology faculty having a doctorate and percentage having a master's or doctorate by subject area: 1989 survey



* This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

Comparative figures for four-year institutions show that the mean percentage of faculty with doctorates is about 80 to 82 percent for national universities and national liberal arts colleges; for regional colleges and universities, the range is from 50 to 70 percent; and for specialized schools such as engineering, business, military, and art and music colleges, the range is 30 to 40 percent.[13]

Use of Part-Time Faculty

About 61 percent of the total two-year and community college faculty are part time (Appendix Table A-10). This compares with about 36 percent who are part time for all two- and four-year institutions of higher education and an estimated 25 percent at four-year institutions alone.[14]

In the total science and technology subject areas which this study covers, about 48 percent of faculty were part time. The percentage of part-time faculty ranged from 35 percent for multi-sciences and 37 percent for chemistry to 60 percent for mathematics and 64 percent for computer science (Appendix Table A-10 and Figure 6). For certain subject areas (especially engineering and engineering technology), the use of part-time faculty was more prevalent in large institutions. Other subject areas such as physics, chemistry, and biology showed less or inconsistent variation by size of institution.

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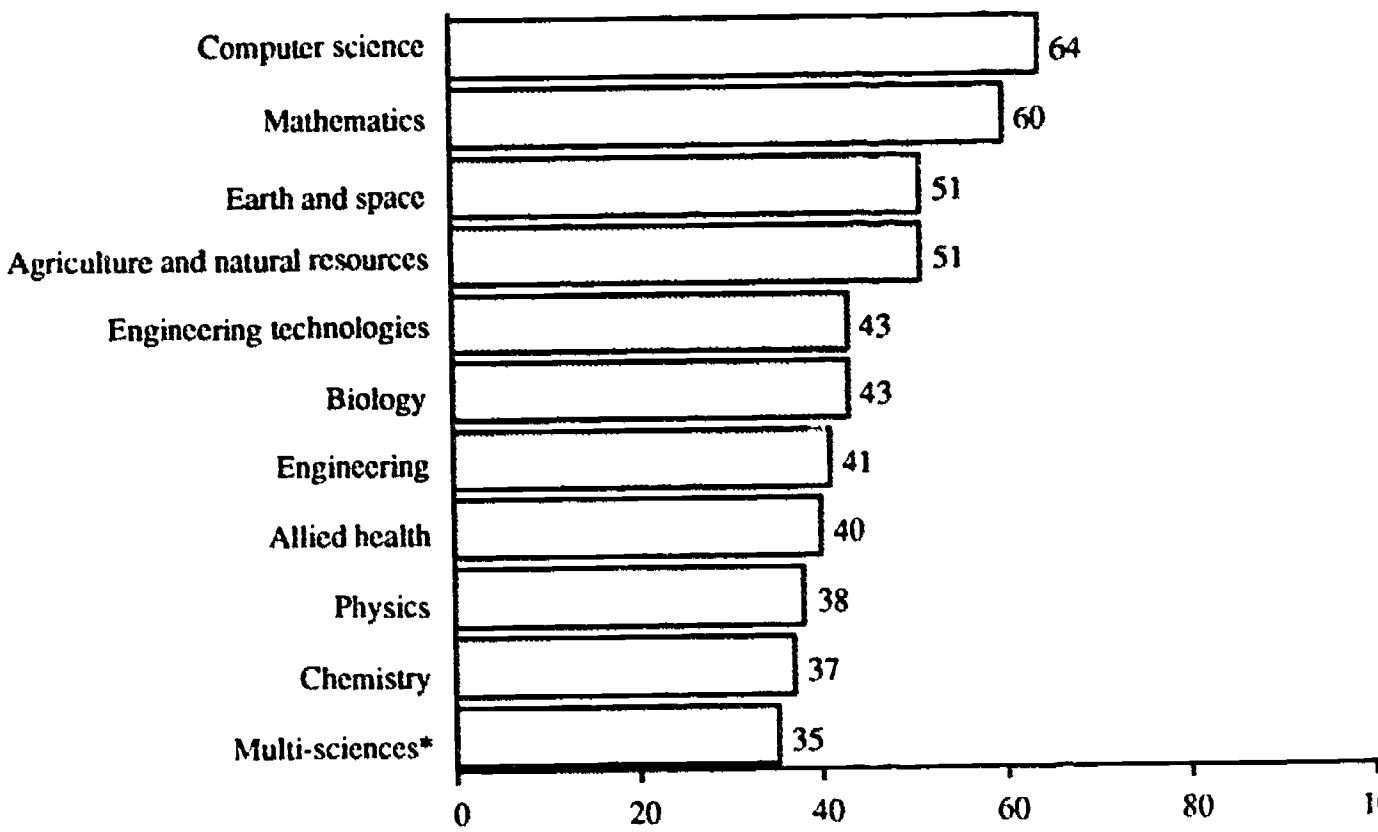
[13]The categories "national," "regional," and "specialized," and the data used to tabulate these comparisons are derived from information published in America's Best Colleges and 1990 Directory of Colleges and Universities, U.S. News and World Report, Roger Rosenblatt, ed., Washington, D.C. 1989.

[14]Data calculated based on U.S. Department of Education, National Center for Education Statistics, "Employees in Institutions of Higher Education," as included the Digest of Education Statistics, 1988, Table 153.

Figure 6. Percentage of total faculty in two-year and community colleges that are part time by subject area: 1989 survey



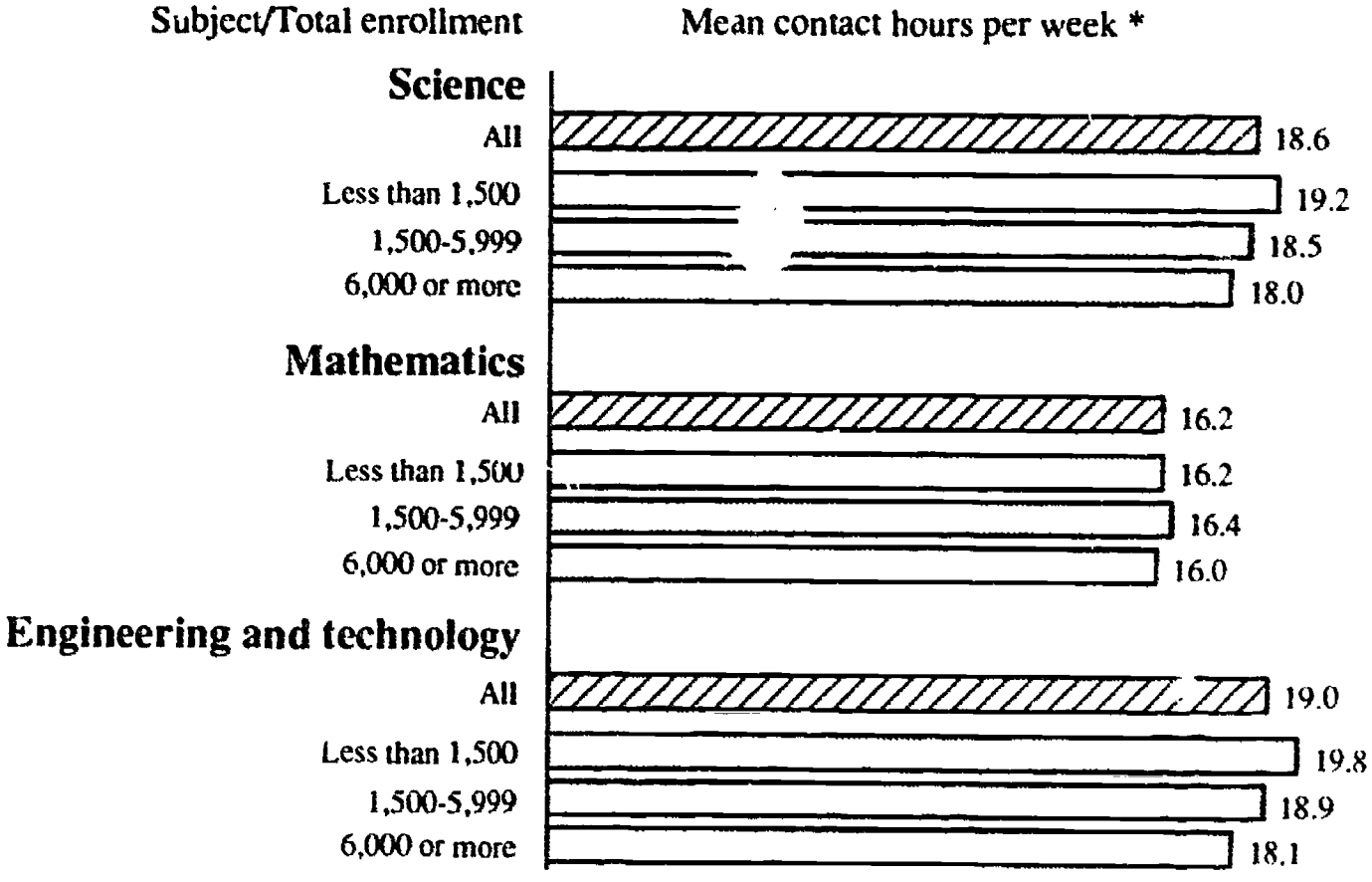
* This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

While almost half of the total science and technology faculty were part time, the percentage of total contact hours (lecture and lab) taught by part-time faculty was considerably lower (Appendix Table A-11). Division heads estimated that the mean percentage of total contact hours taught by part-time faculty for science was 22 percent; for mathematics, 27 percent; and for engineering and technology, 22 percent. There was little consistent difference in these percentages between public and private institutions.

Normal Teaching Load of Full-Time Faculty

The mean number of different course preparations was 3.0 for science, 3.2 for mathematics, and 3.5 for engineering and technology (Appendix Table A-12). The average teaching load of full-time faculty in large institutions was somewhat lower than in small institutions for science, and engineering and technology, but these differences were statistically significant. The average total contact hours per week including lecture and lab was 18.6 for science, 16.2 for mathematics, and 19.0 for engineering and technology (Appendix Table A-12 and Figure 7).

Figure 7. Normal teaching load of two-year and community college science, mathematics, and engineering and technology full-time faculty by total enrollment of institution: 1989 survey



* Includes lecture and lab.

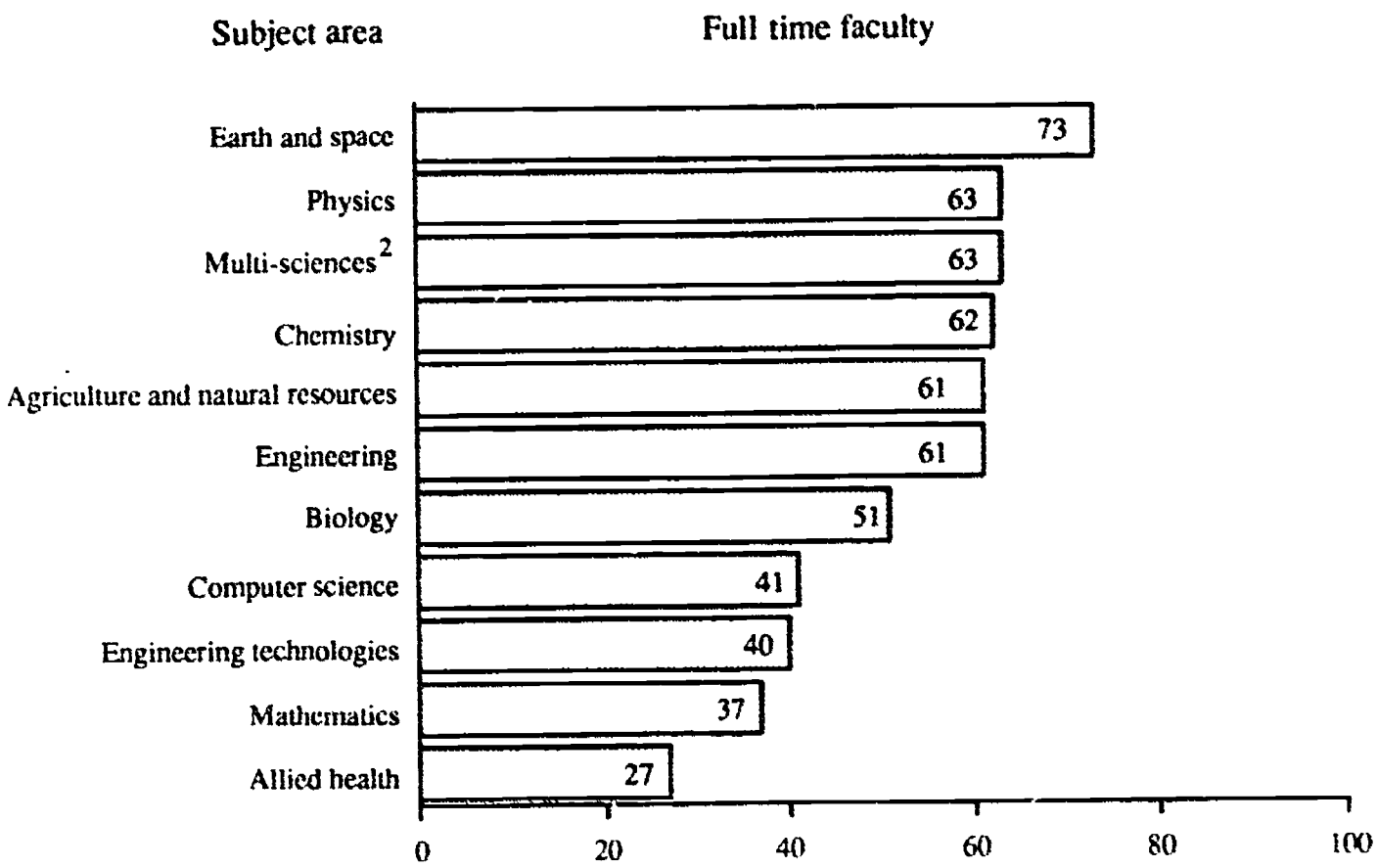
Faculty Hiring

In order to learn the extent to which hiring fully qualified faculty was a problem for two-year institutions, heads of divisions with at least one faculty member in a given subject area were asked whether they had any difficulty hiring fully qualified full- and part-time faculty to fill openings occurring within the last three years. They were first asked whether there had been any positions in the subject area over the last three years for which they had attempted to hire new teachers (openings occurred). Only those who reported they had such openings were asked to indicate whether they had difficulty in hiring.

Openings

For 7 of 11 of the science and technology subjects, a majority of division heads reported having no openings for full-time faculty over the last three years (Appendix Table A-13 and Figure 8). For example, about 73 percent reported no openings in the last three years for full-time faculty for earth and space sciences;

Figure 8. Percentage of division heads at two-year and community colleges reporting no openings[1] for full-time faculty in subject area in last three years: 1989 survey



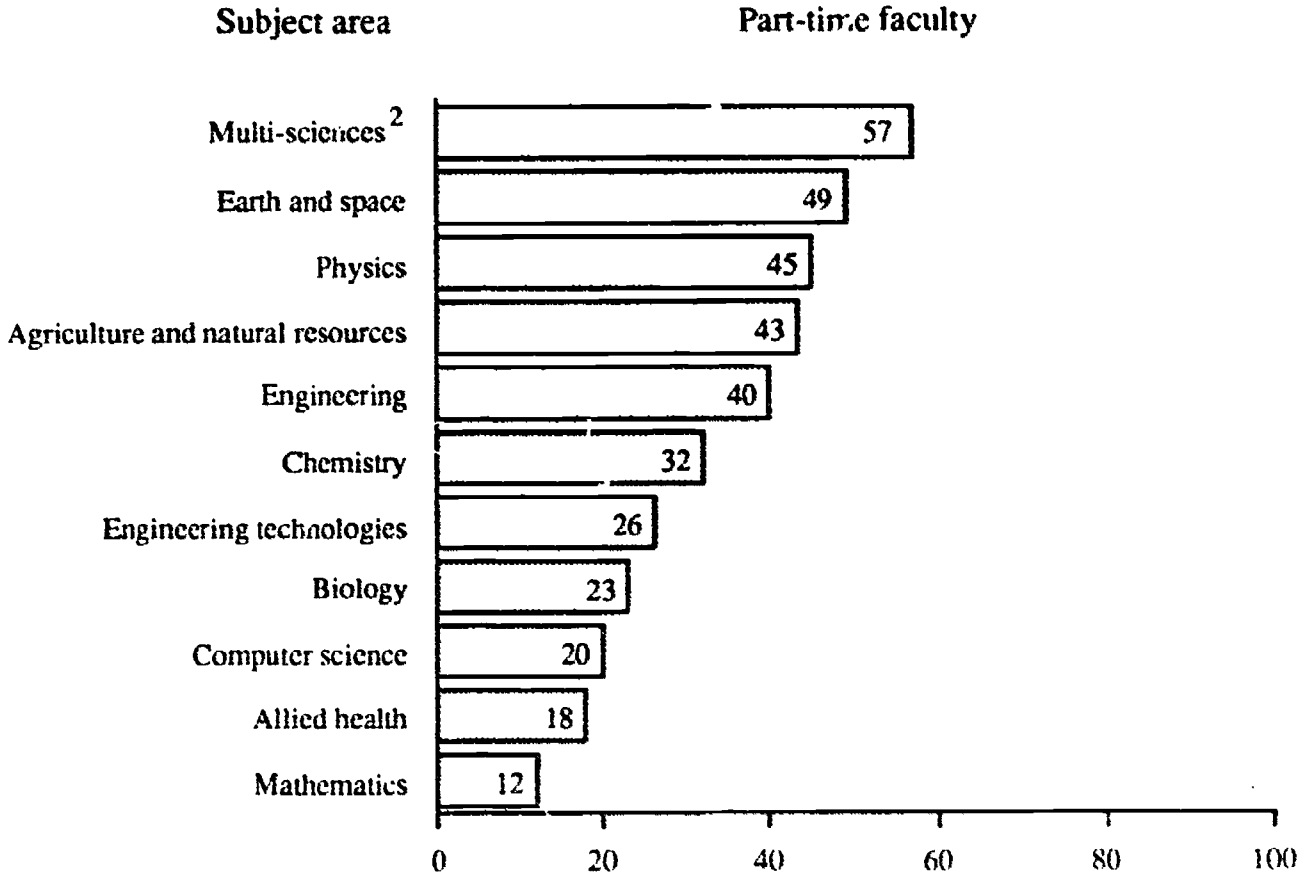
1 Indicates there were no positions for which hiring was attempted over the last three years.

2 This category was used if a science professor was hired to teach several different courses and the institution was unable to determine which course he or she taught most frequently.

slightly over 60 percent reported having no full-time openings for chemistry, physics, engineering, agriculture and natural resources, and multi-science courses; and 51 percent reported no openings for biology. A smaller percentage reported no openings in the last three years for allied health (27 percent), mathematics (37 percent), engineering technologies (40 percent), and computer science (41 percent); these fields also have the largest number of faculty.

The percentage of division heads reporting no openings in the last three years was considerably less for part-time faculty than for full-time faculty for most of the subject areas (Appendix Table A-13 and Figure 9). Among the subject areas, the percentage reporting no openings in the last three years for part-time faculty ranged from 12 percent for mathematics to 57 percent for multi-sciences.

Figure 9. Percentage of division heads at two-year and community colleges reporting no openings[1] for part-time faculty in subject area in the last three years: 1989 survey



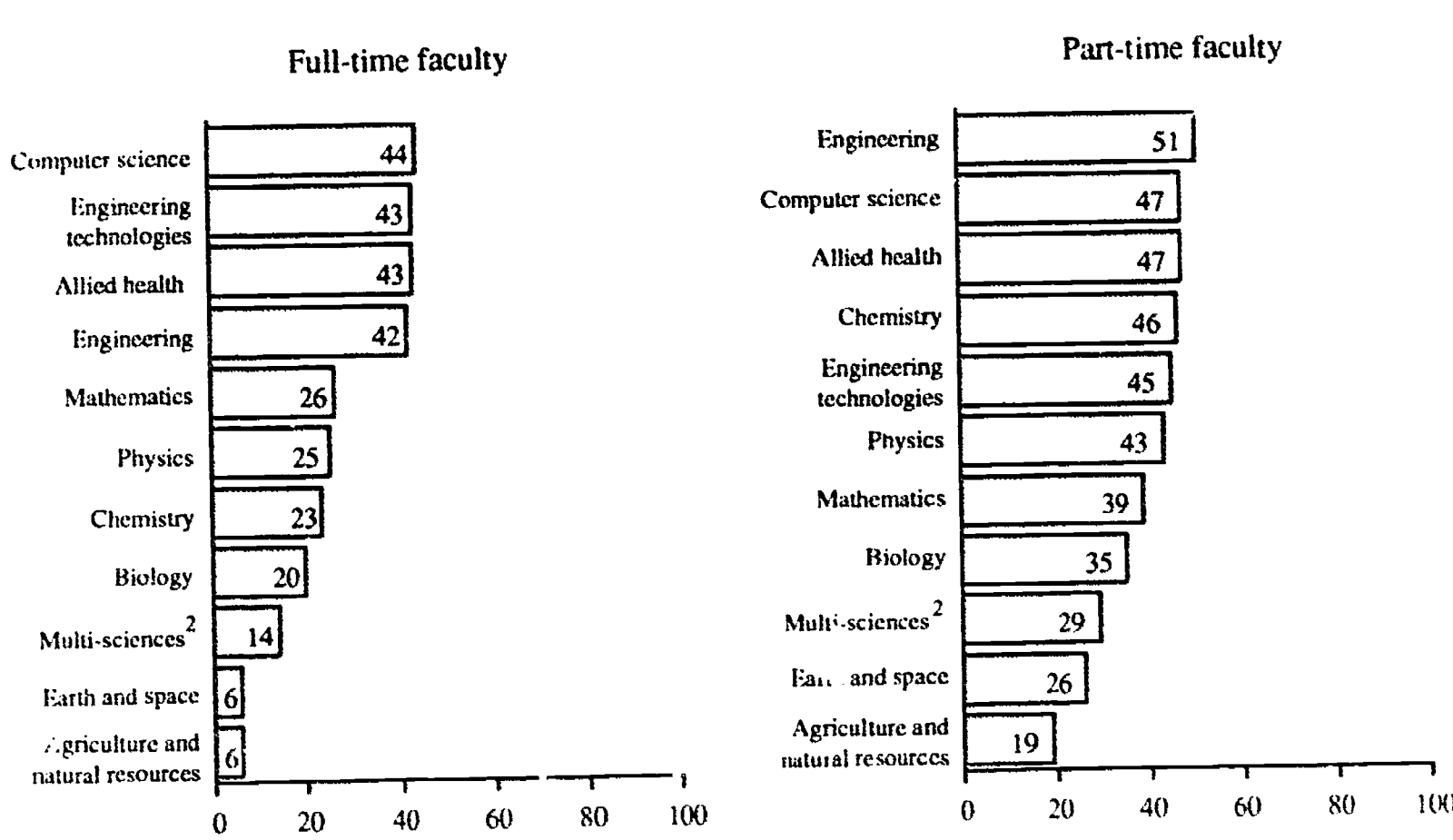
[1] Indicates there were no positions for which hiring was attempted over the last three years.

[2] This category was used if a science professor was hired to teach several different courses and the institution was unable to determine which course he or she taught most frequently.

Difficulty in Hiring

If division heads reported an opening in the selected subject areas, they were next asked if they had difficulty filling the vacancy. Among those reporting openings, difficulty in hiring qualified full-time faculty was reported by just over 40 percent of institutions for computer science (44 percent), allied health (43 percent), engineering technologies (43 percent), and engineering (42 percent; Appendix Tables A-14 and A-15 and Figure 10). About one-fourth of division heads reported difficulty in hiring full-time faculty in biology (20 percent), chemistry (23 percent), physics (25 percent), and mathematics (26 percent). Difficulty in hiring full-time faculty was less often reported for agriculture and natural resources (6 percent), earth and space sciences (6 percent), and multi-sciences (14 percent).

Figure 10. Percentage of division heads at two-year and community colleges reporting openings[1] in last three years that reported difficulty in hiring fully qualified faculty by subject area: 1989 survey



1 Only respondents having faculty openings in subject area in the last three years reported whether or not they had difficulty hiring fully qualified faculty. See Figures 9 and 10.

2 This category was used if a science professor was hired to teach several different courses and the institution was unable to determine which course he or she taught most frequently.

Division heads more frequently reported difficulty hiring qualified part-time faculty than full-time faculty for several subject areas (Appendix Tables A-14 and A-15 and Figure 10). Among those having openings at their institutions in the last three years, the percentage reporting difficulty in hiring part-time faculty ranged from 19 percent for agriculture and natural resources to 51 percent for engineering. In addition to engineering, subject areas in which difficulty was frequently reported were allied health (47 percent), computer science (47 percent), chemistry (46 percent), engineering technologies (45 percent), physics (43 percent), mathematics (39 percent), and biology (35 percent).

Reasons for Difficulty

Division heads reporting difficulty in hiring within a given subject area were asked to choose up to three reasons for the difficulty. The most frequently chosen reasons for both full- and part-time faculty were *inadequate salary, lack of qualified personnel in the geographic area*, and *availability of other higher paying jobs in the area* (Appendix Table A-16).[15] The percentage of those having difficulty in hiring full-time faculty who cited *inadequate salary* as the reason ranged from 41 percent for agriculture and natural resources to 82 percent for engineering. The percentage of those having difficulty in hiring full-time faculty who cited *lack of qualified personnel in geographic area* ranged from 55 percent for engineering to 70 percent for agriculture and natural resources. These factors were more frequently cited than factors directly related to working conditions such as lack of student preparation, faculty support services, and excessive teaching loads.

Reasons for difficulty in hiring part-time faculty were similar to those cited for full-time faculty, with *lack of qualified personnel in the geographic area* and *inadequate salaries* most frequently chosen. The percentage of those reporting difficulty in hiring who cited *lack of qualified personnel in the geographic area* ranged from 60 percent for biology to 70 percent for engineering technologies. The range for *inadequate salaries* was from 43 percent for chemistry to 70 percent for engineering. The *availability of other high paying jobs* and the *need for daytime teaching* were also cited by a number of those responding for part-time faculty.

Where Full-Time Faculty Resided When Initially Hired to Teach

The results of this study indicate that most two-year and community college faculty are recruited locally or within the region in which the institution is located (Appendix Table A-17 and Figure 11). On average, a majority (61 percent) of full-time faculty were reported to be residing in the local area of the two-year or community college when initially hired to teach, and 25 percent were residing outside the local area but within the region. Only an average of 14 percent were residing outside the local area and region.

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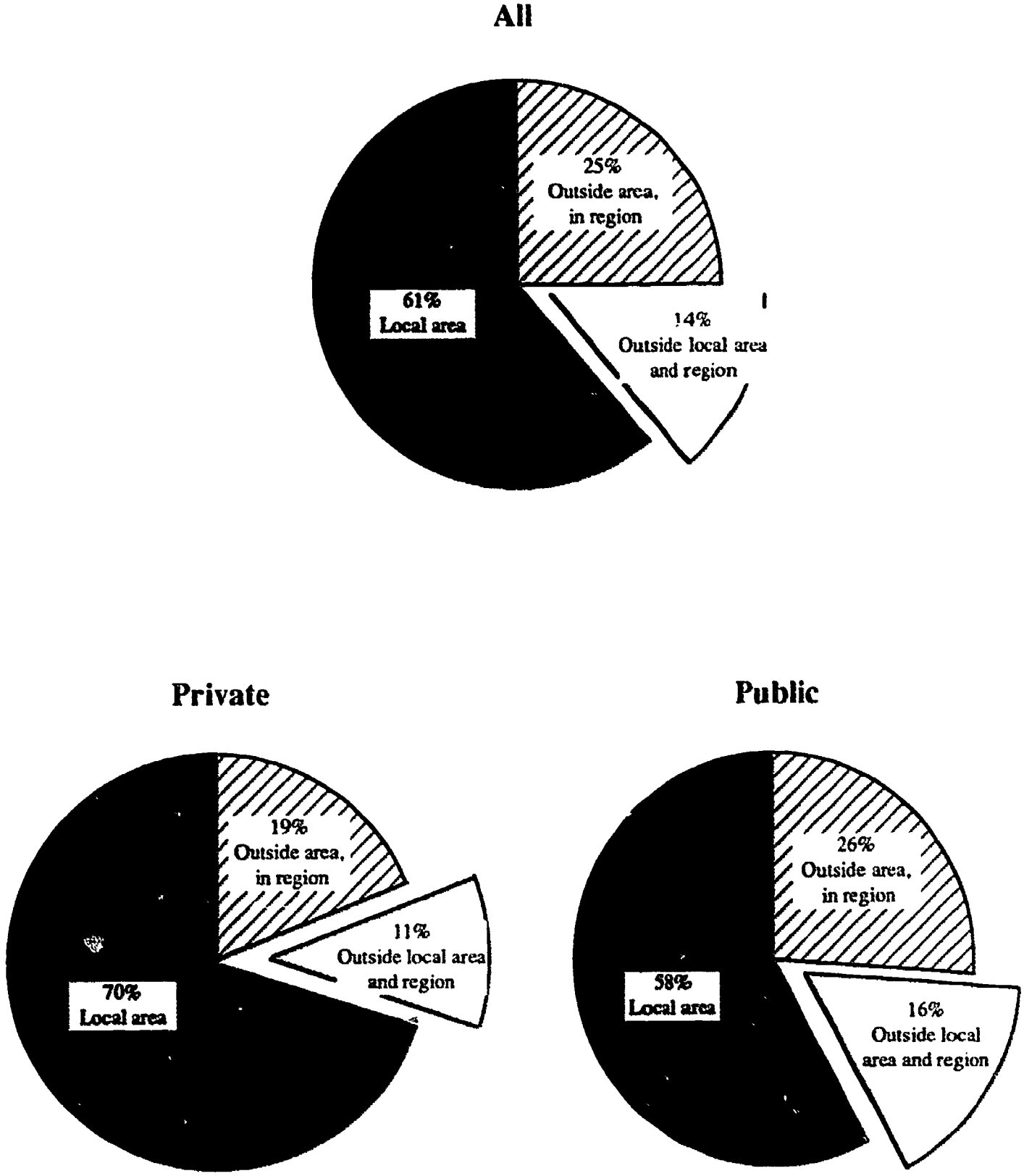
[15] These data should be used with caution. Since they are based on institutions having an opening and experiencing difficulty in hiring, they are often based on a relatively small number of schools and may not be very reliable.

Figure 11. Location in which two-year and community college science and technology faculty were residing when initially hired to teach by institutional control: 1989 survey



Identification of Problems

Respondents were asked to rate a series of potential problems for two-year and community colleges on a scale of 1 to 5 with "1" being *not a problem* and "5" being a *serious problem*. Ratings were completed separately for science, mathematics, and engineering and technology. Allied health and agriculture were not covered by these questions. The persons completing this part of the survey were most frequently heads of the specific divisions or departments, so that these items may have had different respondents for each area. Results from these questions are presented in Table 2 and in Appendix Tables A-18 to A-20.

Table 2. Division/department heads' evaluation of selected aspects of science, mathematics, and engineering and technology programs: United States

Program aspect	Science	Mathematics	Engineering and technology
	Percent rating as serious problem* "4" or "5"		
Adequate preparation of students in high school/scientific literacy	64	70	62
Funds for purchase and maintenance of modern equipment	46	23	46
Adequate computer facilities	33	29	27
Small course enrollments	31	20	50
Adequate opportunity for faculty professional development (e.g., research time, conference attendance)	27	25	28
Student motivation/interest	26	35	17
Adequate laboratory facilities	21	13	28
Funds for purchase of expendable laboratory supplies	20	11	21
Sufficient library resources	20	10	13
Disposal of toxic waste	20	NA	8
Assessment and placement of students in sequential courses/adherence to prerequisites	12	18	13
Large class sizes	11	16	3
Laboratory safety	6	NA	3
Adequate academic preparation of teachers in the subject	4	7	13

*Respondents rated items on a scale from 1 to 5, with "1" = not a problem and "5" = serious problem.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

The program aspect most frequently rated as a serious problem ("4" or "5") for all three subject areas (science, mathematics, and engineering and technology) was *adequate preparation of students in high school*. Sixty-four percent of respondents rated this as a serious problem for science, 70 percent for mathematics, and 62 percent for engineering and technology education. For mathematics, *student motivation and interest* was second most frequently rated as a serious problem with 35 percent giving this aspect a "4" or "5" rating.

For engineering and technology, *small course enrollments* was the aspect second most frequently rated as a serious problem (by 50 percent of respondents). For those colleges having a minimum requirement for class size, insufficient enrollment may result in class cancellation or offering the class at less frequent intervals.

For science, the program aspect second most frequently rated as a serious problem was *funds for the purchase and maintenance of modern equipment*. This aspect was rated as a serious problem by 46 percent of respondents for both science and engineering and technology. *Adequate computer facilities* was also frequently rated as a serious problem (33 percent for science, 29 percent for mathematics, and 27 percent for engineering and technology).

Adequate opportunity for faculty professional development (e.g., research time, conference attendance) was rated as a serious problem by about one-fourth of the respondents (27 percent for science, 25 percent for mathematics, and 28 percent for engineering and technology). About 20 percent of respondents for science rated *disposal of toxic waste* as a serious problem, but only 8 percent rated this as a problem for engineering and technology. *Large class sizes* was rated as a serious problem by 11 percent for science, 16 percent for mathematics, and only 3 percent for engineering and technology, which more frequently rated *small class size* as a problem.

Adequate preparation of teachers in the subject was infrequently rated as a serious problem, with only 4 percent rating this aspect as a serious problem for science, 7 percent for mathematics, and 13 percent for engineering and technology.

Evaluation of Selected Program Aspects

Respondents were also asked to evaluate selected aspects of their science, mathematics, and engineering and technology programs on a scale of 1 to 5, with "1" being *inadequate* and "5" being *excellent*. Allied health and agriculture were not included in these questions. Results from these questions are presented in Tables 3 to 5.

Respondents answering for science and mathematics most frequently gave excellent ("4" or "5") ratings to *successful transfer to four-year institutions* (65 percent for science and 64 for mathematics) and to *maintenance of an up-to-date curriculum* (62 percent for mathematics, 59 percent for science). Respondents answering for engineering and technology also gave high ratings for *maintaining an up-to-date curriculum* (58 percent) and to *successful transfer to four-year institutions* (56 percent), although *consistency with technical/occupational requirements of industry* and *job placement after completion* were most frequently rated as excellent (66 percent and 61 percent, respectively). These aspects were also rated high relatively frequently by science and mathematics respondents. Forty-six percent of respondents for science and 51 percent for mathematics rated *consistency with occupational/technical requirements of industry* highly; 43 percent of science respondents and 39 percent of mathematics respondents rated *job placement after program completion* as excellent.

Table 3. Percentage distribution of division/department heads' evaluation* of selected aspects of science programs in two-year and community colleges: United States

Program aspect	Inadequate "1" & "2"	Adequate "3"	Excellent "4" & "5"
Recruitment of minority students	48	32	20
Retention of minority students	41	43	15
Student course completion rate	21	53	26
Recruitment of female students	24	40	36
Degree/certificate/program completion rate	21	52	27
Use of innovative instructional methods	19	36	45
Articulation with baccalaureate programs	18	26	56
Retention of female students	17	45	38
Job placement after program completion	16	41	43
Breadth of offering	14	46	40
Successful transfer to four-year institutions	12	23	65
Consistency with technical/occupational requirements of industry	10	44	46
Maintenance of up-to-date curriculum	7	34	59

*Respondents rated items on a scale of 1 to 5, with "1" = inadequate, "3" = adequate, and "5" = excellent.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Articulation with baccalaureate programs was third in frequency of being rated as excellent by science and mathematics respondents (56 and 60 percent, respectively) and was rated as excellent by 47 percent of engineering, and engineering and technology respondents.

For each of the subject areas, the program aspect least frequently rated as excellent and most frequently rated as inadequate was *recruitment of minority students*. This aspect was rated as inadequate ("1" or " 2") by 48 percent for science, 38 percent for mathematics, and 48 percent for engineering and technology. *Retention of minority students* was also frequently rated as inadequate by 41 percent for science, 37 percent for mathematics, and 39 percent for engineering and technology.

Table 4. Percentage distribution of division/department heads' evaluation* of selected aspects of mathematics programs in two-year and community colleges: United States

Program aspect	Inadequate "1" & "2"	Adequate "3"	Excellent "4" & "5"
Recruitment of minority students	38	43	19
Retention of minority students	37	47	16
Student course completion rate	32	47	21
Recruitment of female students	23	43	34
Use of innovative instructional methods	21	42	37
Degree/certificate/program completion rate	19	51	30
Articulation with baccalaureate programs	18	22	60
Retention of female students	16	52	32
Job placement after program completion	14	47	39
Successful transfer to four-year institutions	13	23	64
Breadth of offering	7	41	52
Maintenance of up-to-date curriculum	6	32	62
Consistency with technical/occupational requirements of industry	5	44	51

*Respondents rated items on a scale of 1 to 5, with "1" = inadequate, "3" = adequate, and "5" = excellent.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Recruitment of female students, especially for engineering and technology, was also frequently rated as inadequate. This evaluation was given by 43 percent of respondents for engineering and technology, 23 percent for mathematics, and 24 percent for science. *Retention of female students* was rated as inadequate by 17 percent of science respondents, 16 percent of mathematics respondents, and 28 percent of engineering and technology respondents.

There was consistency across subject areas in the percentage of respondents rating *degree/certificate completion rate* as inadequate; 21 percent of science respondents, 19 percent of mathematics respondents, and 20 percent of engineering and technology respondents rated this aspect as inadequate. Almost one-third (32 percent) of mathematics respondents rated course completion as inadequate.

Table 5. Percentage distribution of division/department heads' evaluation* of selected aspects of engineering and technology programs in two-year and community colleges: United States

Program aspect	Inadequate "1" & "2"	Adequate "3"	Excellent "4" & "5"
Recruitment of minority students	48	32	20
Recruitment of female students	43	36	21
Retention of minority students	39	42	19
Retention of female students	28	44	28
Student course completion rate	21	50	29
Articulation with baccalaureate programs	21	32	47
Degree/certificate/program completion rate	20	47	33
Breadth of offering	18	38	44
Successful transfer to four-year institutions	18	26	56
Use of innovative instructional methods	14	41	45
Maintenance of up-to-date curriculum	11	31	58
Job placement after program completion	8	31	61
Consistency with technical/occupational requirements of industry	5	29	66

*Respondents rated items on a scale of 1 to 5, with "1" = inadequate, "3" = adequate, and "5" = excellent.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

APPENDIX A

DETAILED TABLES

LIST OF APPENDIX TABLES

LIST OF APPENDIX TABLES (Continued)

Table A-1. Number of two-year and community colleges included in the study sample by institutional characteristics: United States

Institutional characteristic	Unweighted		Weighted*	
	Number	Percent	Number	Percent
All	295	100	1,253	100
Control				
Private	55	19	336	27
Public	240	81	917	73
Enrollment				
Less than 1,500	90	31	537	43
1,500 - 5,999	101	34	460	37
6,000 or more	104	35	255	20
Region				
Northeast	63	21	271	22
Central	74	25	326	26
Southeast	67	23	319	26
West	91	31	336	27

*Data presented in all subsequent tables are weighted to produce national estimates. The sample was selected with probabilities proportionate to the square root of enrollment. Institutions with larger enrollments have higher probabilities of inclusion and lower weights. Because of rounding, components may not add to total.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges. HES 9. National Science Foundation, 1990 (survey conducted in 1989).

Table A-2. Percentage of two-year and community colleges offering selected science and technology courses by institutional region and two-year science transfer status: United States

Subject area	All institutions	Region				Science transfer program	
		North-east	Central	South-east	West	Yes	No
Agriculture and natural resources (animal/plant science, forestry, wildlife management, food science)	39	20	42	38	53	49	17
Biology	84	72	81	87	95	99	52
Chemistry	83	69	80	87	93	99	48
Physics	85	79	83	83	94	96	63
Earth and space sciences (geography, geology, astronomy, meteorology, oceanography)	64	53	59	49	92	81	28
Interdisciplinary natural sciences	32	38	28	21	42	39	15
Mathematics	96	91	98	98	96	100	87
Calculus or math courses requiring calculus as a prerequisite	78	66	76	76	93	97	39
Computer sciences (programming, data processing)	91	87	88	96	95	100	73
Engineering	42	40	44	26	56	56	10
Engineering technologies (mechanics, electronics, repairs, design and other trade training)	71	58	76	70	77	75	63
Allied health	73	64	76	71	79	84	48
Science laboratory technologies (chemical, biological, other)	45	49	45	38	48	49	36

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-3. Percentage of two-year and community colleges having science transfer programs and pre-engineering transfer programs by institutional characteristics: United States

Institutional characteristic	Two-year science transfer programs		Two-year pre-engineering transfer programs	
	Number	Percentage of total	Number	Percentage of total
All institutions	859	69	574	46
Control				
Private	116	35	43	13
Public	743	81	531	58
Enrollment				
Less than 1,500	254	47	116	22
1,500 - 5,999	363	79	268	58
6,000 or more	242	95	190	74
Region				
Northeast	155	57	111	41
Central	226	69	162	50
Southeast	192	60	110	34
West	286	85	190	57

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-4. Percentage of two-year and community colleges offering degrees or certificates in selected areas by institutional characteristics and two-year science transfer program: United States

Institutional characteristic	Area of degree or certificate			
	Allied health	Engineering technologies	Liberal/ General studies	Business/ Management
All institutions	70	64	78	83
Control				
Private	27	35	47	49
Public	86	75	89	95
Enrollment				
Less than 1,500	42	43	63	66
1,500 - 5,999	90	76	86	94
6,000 or more	93	88	94	99
Region				
Northeast	62	53	68	78
Central	71	70	71	80
Southeast	71	67	77	89
West	75	66	92	85
Two-year science transfer program				
Yes	81	66	97	93
No	47	60	36	62

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-5. Total, full-time, and part-time faculty in two-year and community colleges by institutional characteristics: United States

Institutional characteristic	Total faculty[1]	Full time	Part time	Percent part time[2]
	(Numbers are in thousands)[3]			
All institutions	239	96	143	61
Control				
Private	12	6	6	49
Public	226	89	137	61
Enrollment				
Less than 1,500	26	13	13	50
1,500 - 5,999	81	35	46	58
6,000 or more	131	48	83	64
Region				
Northeast	42	18	24	58
Central	64	26	38	61
Southeast	43	19	24	57
West	89	33	56	63

[1]The total number of two-year senior faculty is estimated to be 215,000 by the National Center for Education Statistics (NCES). Our total is slightly higher due to possible inclusion of other faculty excluded from NCES totals.

[2]Calculation based on only those institutions reporting complete data for both full- and part-time faculty and not on totals reported in this table under full time and part time. About .3 percent did not report total full-time faculty and 2 percent could not report total part-time faculty.

[3]Because of rounding, components may not add to totals.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-6. Science and technology faculty as a percentage of the total, full-time, and part-time two-year and community college faculty by institutional characteristics: United States

Institutional characteristic	Percentage science and technology faculty are of:		
	Total faculty	Total full-time faculty	Total part-time faculty
All institutions	29	37	23
Control			
Private	39	44	33
Public	28	37	22
Enrollment			
Less than 1,500	37	46	29
1,500 - 5,999	28	37	22
6,000 or more	27	35	22
Region			
Northeast	31	41	25
Central	32	39	27
Southeast	31	40	24
West	24	33	20

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-7. Mean number of full- and part-time two-year and community college faculty in selected science and techology subject areas by institutional enrollment: United States

Subject area	Full-time faculty[1]				Part-time faculty[1]			
	Enrollment				Enrollment			
	All	Less than 1,500	1,500-5,999	6,000 or more	All	Less than 1,500	1,500-5,999	6,000 or more
Agriculture and natural resources	0.8	0.4	1.2	1.0	0.8	0.4	1.0	1.6
Biology	2.9	1.0	2.9	7.1	2.1	.7	1.7	6.2
Chemistry	1.7	.6	1.6	4.3	1.0	.3	.7	2.9
Physics	1.2	.5	1.2	2.7	.7	.3	.4	2.1
Earth and space sciences	.6	.2	.6	1.8	.7	.2	.6	1.9
Multi-sciences[2]	.5	.3	.4	1.0	.2	.2	.1	.5
Mathematics	5.0	1.8	4.5	12.9	7.1	1.6	6.0	21.7
Computer science	2.4	1.2	2.5	4.7	4.1	1.3	4.4	10.2
Engineering	.7	.2	.6	1.6	.4	.1	.3	1.4
Engineering technologies	4.9	2.8	5.2	9.2	3.6	.8	4.0	9.7
Allied health	6.7	2.1	7.3	16.0	4.2	1.2	4.2	11.6

[1]Includes institutions having zero faculty in subject area.

[2]This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges. HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-8. Total number of full- and part-time two-year and community college faculty in selected science and technology areas and percentage of faculty having a master's or a doctorate as highest degree: United States

Subject area	Full-time faculty			Part-time faculty		
	Total[1]	Percentage having highest degree of		Total[1]	Percentage having highest degree of	
		Master's[2]	Doctorate[2]		Master's[2]	Doctorate[2]
Agriculture and natural resources	1,022	70	9	1,033	30	9
Biology	3,529	69	29	2,526	68	19
Chemistry	2,076	58	38	1,173	68	21
Physics	1,435	65	28	836	65	14
Earth and space sciences	796	74	19	810	70	12
Multi-sciences[3]	586	56	32	281	59	9
Mathematics	6,151	78	13	8,476	74	6
Computer science	2,919	69	6	4,905	56	2
Engineering	801	77	9	502	70	6
Engineering technologies	6,047	47	6	4,323	37	6
Allied health	8,238	68	4	4,996	37	5

[1]About 2 percent of colleges could not report total full-time faculty and about 5 to 7 percent could not report total part-time faculty for individual subjects. Total number of faculty in subject areas are therefore underreported.

[2]Percentages were calculated based upon institutions reporting complete data for subject.

[3]This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-9. Percentage of full- and part-time faculty in selected science and technology subjects having a doctorate by institutional enrollment: United States

Subject area	Full-time faculty[1]				Part-time faculty[1]			
	Enrollment				Enrollment			
	All	Less than 1,500	1,500-5,000	6,000 or more	All	Less than 1,500	1,500-5,999	6,000 or more
Agriculture and natural resources	9	11	8	13	10	29	3	10
Biology	29	28	27	30	19	19	17	20
Chemistry	38	37	35	40	21	24	13	24
Physics	28	25	26	30	14	4	6	18
Earth and space sciences	19	19	22	17	12	5	8	16
Multi-sciences[2]	32	34	30	32	9	5	*	22
Mathematics	13	13	10	15	6	4	3	8
Computer science	6	5	4	8	2	2	1	3
Engineering	9	5	11	10	6	16	2	6
Engineering technologies	6	3	6	8	6	8	10	1
Allied health	4	1	4	6	5	4	3	6

*Less than .5 percent.

[1]Calculated based on cases reporting both total faculty and highest degree earned.

[2]This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-10. Percentage of two-year and community college faculty in selected science and technology subjects who are part time by institutional control and enrollment: United States

Subject area	All two-year colleges	Control		Enrollment		
		Private[1]	Public	Less than 1,500	1,500-5,999	6,000 or more
Agriculture and natural resources	51	52	50	48	45	61
Biology	43	53	42	41	37	48
Chemistry	37	43	37	37	32	41
Physics	38	43	38	41	27	44
Earth and space sciences	51	69	50	54	50	51
Multi-sciences[2]	35	40	34	45	22	36
Mathematics	60	51	60	48	57	64
Computer science	64	45	66	53	64	6[illegible]
Engineering	41	[3]27	41	22	32	50
Engineering technologies	43	31	46	23	44	52
Allied health	40	43	40	35	37	44
Total science and technology faculty	48	42	49	39	46	53
Total faculty	61	49	61	50	58	64

[1]Due to the large percentage of private two-year colleges not having faculty in certain subject areas, percentages are based on small cell sizes in some cases.

[2]This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

[3]Cell size too small for reliable data.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-11. Percentage of total contact hours (lecture and lab) in two-year and community colleges taught by part-time faculty in science, mathematics, and engineering and technology by institutional characteristics: United States

Institutional characteristic	Mean percentage taught by part-time faculty		
	Science	Mathematics	Engineering and technology
All institutions	22	27	22
Control			
Private	29	24	16
Public	20	29	24
Enrollment			
Less than 1,500	23	23	20
1,500 - 5,999	19	26	19
6,000 or more	26	37	30
Region			
Northeast	27	31	16
Central	19	26	22
Southeast	23	24	22
West	19	30	26

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges. HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-12. Normal teaching load of two-year and community college full-time faculty for science, mathematics, and engineering and technology by institutional characteristics: United States

Institutional characteristic	Science		Mathematics		Engineering and technology	
	Mean contact hours per week*	Mean number of different course preparations	Mean contact hours per week*	Mean number of different course preparations	Mean contact hours per week*	Mean number of different course preparations
All institutions	18.6	3.0	16.2	3.2	19.0	3.5
Control						
Private	19.4	3.0	16.5	2.8	20.4	3.8
Public	18.5	3.0	16.2	3.3	18.7	3.4
Enrollment						
Less than 1,500	19.2	3.2	16.2	3.1	19.8	3.7
1,500 - 5,999	18.5	3.0	16.4	3.4	18.9	3.5
6,000 or more	18.0	2.8	16.0	3.1	18.1	3.1
Region						
Northeast	16.7	2.9	15.4	3.0	18.4	3.7
Central	19.5	3.2	17.4	3.6	19.1	3.4
Southeast	19.6	3.1	16.3	3.1	20.3	3.5
West	18.4	2.9	15.8	3.2	18.1	3.4

*Includes lecture and laboratory contact hours.

SOURCE: Higher Education Surveys. Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-13. Percentage of department/division heads who reported they had difficulty, no difficulty, and no openings for fully qualified full- and part-time faculty in selected science and technology subject areas in the last three years: United States

Subject area	Full time			Part time		
	Difficulty	No difficulty	No openings occurred[1]	Difficulty	No difficulty	No openings occurred[1]
Agriculture and natural resources	2	37	61	11	47	43
Biology	10	39	51	27	50	23
Chemistry	9	30	62	31	37	32
Physics	9	28	63	24	31	45
Earth and space sciences	2	25	73	13	38	49
Multi-sciences[2]	5	32	63	13	30	57
Mathematics	17	47	37	35	53	12
Computer science	26	33	41	38	42	20
Engineering	16	22	61	31	30	40
Engineering technologies	26	34	40	33	41	26
Allied health	31	41	27	38	43	18

[1]This category was used if the college had no positions over the last three years for which hiring was necessary to fill a vacancy.

[2]This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-14. Percentage of department/division heads reporting openings who stated they had difficulty in hiring fully qualified full- and part-time faculty in selected science and technology subject ar as in the last three years[1] by institutional control: United States

Subject area	Full-time faculty			Part-time faculty		
	All	Control		All	Control	
		Private	Public		Private	Public
Agriculture and natural resources	6	*	7	19	*	22
Biology	20	33	17	35	44	34
Chemistry	23	20	23	46	45	46
Physics	25	25	26	43	30	45
Earth and space sciences	6	*	7	26	25	26
Multi-sciences[2]	14	*	17	29	33	29
Mathematics	26	23	27	39	23	42
Computer science	44	44	44	47	28	50
Engineering	42	*	45	51	50	51
Engineering technologies	43	36	44	45	40	46
Allied health	43	30	45	47	23	50

*Less than .5 percent.

[1]Only respondents having faculty vacancies in subject area in last three years reported whether or not they had difficulty hiring fully qualified faculty.

[2]This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-15. Percentage of department/division heads reporting openings who stated they had difficulty in hiring fully qualified full- and part-time faculty in selected science and technology subject areas in the past three years[1] by institutional region: United States

Subject area	Full-time faculty					Part-time faculty				
	All	Region				All	Region			
		North-east	Central	South-east	West		North-east	Central	South-east	West
Agriculture and natural resources	6	19	6	7	*	19	30	27	7	16
Biology	20	25	20	15	24	35	38	34	36	34
Chemistry	23	12	10	33	31	46	55	43	43	42
Physics	25	27	22	39	18	43	48	45	41	40
Earth and space sciences	6	*	*	14	6	26	22	40	21	20
Multi-sciences[2]	14	*	22	6	24	29	35	30	28	28
Mathematics	26	19	18	40	24	39	36	31	44	46
Computer science	44	34	43	54	40	47	51	45	48	45
Engineering	42	40	52	58	33	51	57	58	44	47
Engineering technologies	43	25	52	56	31	45	47	51	49	35
Allied health	43	47	36	41	50	47	44	41	52	50

*Less than .5 percent.

[1]Only respondents having faculty vacancies in subject area in last three years reported whether or not they had difficulty in hiring fully qualified faculty.

[2]This category was used if a science professor taught several different courses and the institution was unable to determine which course he or she taught most frequently.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-16. Department/division heads' reasons for why they had difficulty in hiring fully qualified two-year and community college full- and part-time science and technology faculty: United States

Reasons	Percentage of institutions choosing item as reason for difficulty in hiring in subject area**								
	Agriculture/ natural resources	Biology	Chemistry	Physics	Math-ematics	Computer science	Engi-neering	Engineer-ing tech-nologies	Allied health
Full-time faculty									
Lack of qualified personnel in geographic area	70	56	60	64	58	61	55	68	67
Inadequate salaries	41	66	76	63	63	69	82	62	63
Excessive teaching loads	*	3	11	13	2	8	*	7	5
Lack of support services for faculty (e.g., secretarial, teaching or lab assistants)	*	1	1	1	*	1	*	4	6
Lack of student preparation/ interest	*	3	4	3	*	*	*	*	*
Need for evening and weekend teaching	*	16	5	8	5	4	8	11	9
Availability of other higher paying jobs in the area	41	35	36	42	31	51	50	40	50
High cost of living in the area	*	4	3	8	5	2	15	6	6
Inability of college to pay for cost of travel for prospective faculty to interview and/or to relocate	30	10	12	20	14	5	19	11	2
Other	*	13	19	10	7	1	*	2	7
Part-time faculty									
Lack of qualified personnel in geographic area	66	60	68	64	69	65	63	70	65
Inadequate salaries	48	56	43	59	47	57	70	61	50
Excessive teaching loads	*	*	*	1	2	2	*	3	4
Lack of support services for faculty (e.g., secretarial, teaching or lab assistants)	16	5	7	6	1	2	*	2	4
Lack of student preparation/ interest	*	2	4	*	*	*	2	1	*
Need for evening and weekend teaching	*	14	15	13	16	13	14	18	7
Availability of other higher paying jobs in the area	5	27	25	29	26	37	28	31	44
Need for daytime teaching	16	31	32	22	29	30	19	18	16
Uncertainty as to schedules	*	9	7	8	6	8	6	5	9
Other	*	5	3	4	2	4	3	4	3

*Less than .5 percent.

**Data in this table should be used with caution. Respondents were first asked whether they had difficulty hiring qualified faculty. Only those responding "yes" were then asked to choose up to three reasons from the lists above. For several fields there were only a small percentage of schools reporting difficulty in hiring (see Table A-13), therefore, the data are based on very few cases. Percentages are of those choosing response as one of up to three reasons and, therefore, total more than 100 percent.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-17. Mean percentage of full-time science and technology faculty in two-year and community colleges by locations in which they were residing when initially hired to teach and institutional characteristics: United States

Institutional characteristic	Local area	Outside area but in region	Outside local area and region
	(Mean percentage)		
All institutions	61	25	14
Control			
Private	70	19	11
Public	58	26	16
Enrollment			
Less than 1,500	62	23	14
1,500 - 5,999	53	29	17
6,000 or more	73	18	9
Region			
Northeast	66	22	11
Central	62	24	14
Southeast	60	22	18
West	58	29	14

NOTE: Mean percentage was calculated by averaging the percentages given as responses to Question 9. See Appendix C for wording.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-18. Division/department heads' identification of problems of science programs in two-year and community colleges: United States

Program aspect	Percentage distribution		
	Not a problem "1" & "2"*	"3"*	Serious problem "4" & "5"*
Adequate laboratory facilities	52	27	21
Funds for purchase and maintenance of modern equipment	28	26	46
Funds for purchase of expendable laboratory supplies	58	23	20
Adequate computer facilities	48	19	33
Sufficient library resources	59	22	20
Adequate opportunity for faculty professional development (e.g., research time, conference attendance)	41	31	27
Large class sizes	72	17	11
Small course enrollments	43	26	31
Adequate preparation of students in high school/scientific literacy	9	27	64
Adequate academic preparation of teachers in the subject	83	13	4
Assessment and placement of students in sequential courses/adherence to prerequisites	63	25	12
Student motivation/interest	30	43	26
Disposal of toxic waste	59	20	20
Laboratory safety	74	20	6

*Respondents rated items on a scale from 1 to 5, with "1" = not a problem and "5" = serious problem.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-19. Division/department heads' identification of problems of mathematics programs in two-year and community colleges: United States

Program aspect	Percentage distribution		
	Not a problem "1" & "2"*	"3"	Serious problem "4" & "5"*
Adequate laboratory facilities	73	15	13
Funds for purchase and maintenance of modern equipment	56	20	23
Funds for purchase of expendable laboratory supplies	74	15	11
Adequate computer facilities	47	24	29
Sufficient library resources	68	22	10
Adequate opportunity for faculty professional development (e.g., research time, conference attendance)	46	29	25
Large class sizes	64	20	16
Small course enrollments	61	19	20
Adequate preparation of students in high school	11	19	70
Adequate academic preparation of teachers in the subject	85	8	7
Assessment and placement of students in sequential courses/adherence to prerequisites	62	20	18
Student motivation/interest	24	40	35

*Respondents rated items on a scale from 1 to 5, with "1" = not a problem and "5" = serious problem.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

Table A-20. Division/department heads' identification of problems of engineering and technology programs in two-year and community colleges: United States

Program aspect	Percentage distribution		
	Not a problem "1" & "2"*	"3"*	Serious problem "4" & "5"*
Adequate laboratory facilities	51	21	28
Funds for purchase and maintenance of modern equipment	32	22	46
Funds for purchase of expendable laboratory supplies	55	24	21
Adequate computer facilities	47	26	27
Sufficient library resources	62	25	13
Adequate opportunity for faculty professional development (e.g., research time, conference attendance)	46	27	28
Large class sizes	84	13	3
Small course enrollments	29	21	50
Adequate preparation of students in high school/scientific literacy	13	24	62
Adequate academic preparation of teachers in the subject	70	17	13
Assessment and placement of students in sequential courses/adherence to prerequisites	63	24	13
Student motivation/interest	43	40	17
Disposal of toxic waste	82	11	8
Laboratory safety	82	15	3

* Respondents rated items on a scale from 1 to 5, with "1" = not a problem and "5" = serious problem.

SOURCE: Higher Education Surveys, Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges, HES 9, National Science Foundation, 1990 (survey conducted in 1989).

APPENDIX B

TECHNICAL NOTES

Higher Education Surveys (HES)

The Higher Education Surveys (HES) system was established to conduct brief surveys of higher education institutions on topics of interest to Federal policy makers and the educational community. The system is sponsored by the National Science Foundation, the U.S. Department of Education, and the National Endowment for the Humanities.

The HES system maintains a panel of about 1,093 institutions divided into two subsamples, each of which is nationally representative of 3,212 colleges and universities in the United States. HES questionnaires typically request a limited amount of readily accessible data from one of the two HES panels. Each institution in the panel has identified a HES campus representative who serves as the survey coordinator. The campus representative facilitates data collection by identifying the appropriate respondent for each survey and distributing the questionnaire to that person.

Survey Methodology

The survey of Science, Mathematics, Engineering, and Technology in Two-Year and Community Colleges was requested by the National Science Foundation, Office of Studies and Program Assessment. The study was commissioned as part of an ongoing effort by the National Science Foundation to provide Congress and the educational community with updated information on the characteristics and problems of science and technology education in two-year colleges.

For this study, all two-year institutions in both HES panels were included for a total sample of 336 two-year year and community colleges. A few (13) two-year institutions had no science, mathematics, or technology courses and were considered out of scope for the study. Questionnaires were mailed in January of 1989 to the HES coordinators with instructions that parts of the survey be answered by persons from the specific science, mathematics, and engineering and technology divisions. Telephone followup data collection was continued until April, when a 91 percent response rate (295 institutions) was obtained for eligible institutions. The response rate was 92 percent for private institutions and 91 percent for public institutions

The initial sampling weight assigned to schools for estimation purposes was equal to the reciprocal of the overall probability of selecting the school for the sample. Within a stratum, the initial weight was computed as the ratio of the number of schools in the population (frame) in the stratum to the number of schools sampled from that stratum. To obtain the final weight, the initial weight was multipled by a school nonresponse-adjustment factor equal to the total number of sampled (and eligible) schools in the stratum divided by the number of responding (and eligible) schools in the stratum. The effect of this adjustment was to increase the initial weights by about 9 percent.

The item response rate was 97 percent or higher for all variables except the part of Question 4 asking for the highest degree earned of full- and part-time faculty in each of the specific subject areas (see Appendix Table B-1). Responses for Question 4 ranged from 93 to 99 percent.

Reliability of Survey Estimates

The findings presented in this report are estimates based on the sample from the HES panels, and consequently, are subject to sampling variability. If the questionnaires had been sent to a different sample, the responses would not have been identical; some figures might have been higher, while others might have been lower. The standard error of a statistic (an estimate of sampling variation) is used to estimate the precision of that statistic obtained in a particular sample. If all possible samples were surveyed under similar conditions, intervals of 1.96 standard errors below to 1.96 standard errors above a particular statistic would include the average result of these samples in 95 percent of the cases. An interval computed this way is called a 95 percent confidence interval.

Appendix Table B-2 presents standard errors for selected questionnaire items and the 95 percent confidence intervals. For example, an estimated 83 percent offered courses in chemistry. The standard error is 1.63 and the 95 percent confidence interval is 83 $\pm$ 3.19 (1.96 times 1.63). Therefore, in at least 95 percent of all possible samples, between 80 and 86 percent of all two-year and community colleges would offer a course in chemistry.

For categorical data, relationships between variables with two or more levels have been tested using chi-square tests at the .05 level of significance, adjusted for the design effect. The adjustment for design effect was done using a modified chi-square test which compares the actual survey responses to a simple random sample and makes adjustments based on this. The adjusted chi-square statistic, RS3, is based upon Satterthwaite's approximation. The statistic, RS3, is part of Westat's WESVAR procedure, a user-written SAS procedure, and is the most stringent available for doing approximations.[1] If the overall chi-square was significant, it was followed with pairwise t tests. Continuous data, such as means or totals, were tested by pairwise t tests. Every comparison cited in the text is significant at the .05 level unless otherwise noted.

Survey estimates are also subject to errors of reporting and errors made in the collection of the data. These errors, called

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[1] The formula for RS3: $X^2 = \frac{v X^2}{\left(\sum_{i=1}^{rc} \frac{B_{ij}}{P_j}\right)}$. See the WesVAR Procedure B version, Westat, Inc., Rockville, MD, May 1989, pp. 14-18 for further discussion.

nonsampling errors, can sometimes bias the data. While general sampling theory can be used to determine how to estimate the sampling variability of a statistic, nonsampling errors are not easy to measure and usually require that an experiment be conducted as part of the data collection procedures or the use of data external to the study.

Nonsampling errors may include such things as differences in the respondents' interpretation of the meaning of the questions, differences related to the particular time the survey was conducted, or errors in data preparation. During the design of the survey, and survey pretest, an effort was made to check for consistency of interpretation of questions and to eliminate ambiguous items. The questionnaire was pretested with respondents like those who completed the survey, and the questionnaire and instructions were extensively reviewed by the National Science Foundation. Manual and machine editing of the questionnaires was conducted to check the data for accuracy and consistency. Cases with missing or inconsistent items were recontacted by telephone; data were keyed with 100 percent verification.

Opinion data may be biased if the respondents wish to promote a particular viewpoint concerning their science and technology programs, or if they are simply mistaken in a systematic manner in their impressions. Also, to limit respondent burden, some questions asked for general impressions instead of requesting specific numerical estimates. However, in many cases the survey responses will represent the only existing data regarding certain issues and, hence, are valuable even given these limitations.

Institutional Type Relationships

The data in this report are presented as "total" figures that represent all two-year institutions and are also broken down by institutional control, enrollment, and geographic region. These classifications are:

- Institutional control
  - Public
  - Private
- Institutional enrollment (based on 1989 HEP Higher Education Directory institutional enrollments)
  - Small: less than 1,500 students
  - Medium: 1,500-5,999 students
  - Large: 6,000 or more students

- Geographic region (based on the U.S. Bureau of Economic Analysis of the U.S. Department of Commerce Regions)

Northeast	Southeast
Connecticut	Alabama
Delaware	Arkansas
District of Columbia	Florida
Maine	Georgia
Maryland	Kentucky
Massachusetts	Louisiana
New Hampshire	Mississippi
New Jersey	North Carolina
New York	South Carolina
Pennsylvania	Tennessee
Rhode Island	Virginia
Vermont	West Virginia

Central (Middle)	West
Illinois	Alaska
Indiana	Arizona
Iowa	California
Kansas	Colorado
Michigan	Hawaii
Minnesota	Idaho
Missouri	Montana
Nebraska	Nevada
North Dakota	New Mexico
Ohio	Oklahoma
South Dakota	Oregon
Wisconsin	Texas
	Utah
	Washington
	Wyoming

As can be seen from Appendix Table B-3, these institutional characteristics are related to each other.

- Among private two-year institutions, 95 percent are small (less than 1,500 enrollment); 31 percent are in the Northeast.

- Among large two-year institutions (those with 6,000 or more enrollment), 100 percent are public; 51 percent are in the West; and only 10 percent are in the Southeast.

- Among institutions in the Northeast, 53 percent are small (less than 1,500 enrollment) and 16 percent are large; among institutions in the Southeast, 54 percent are small and 8 percent are large; among institutions in the West, 23 percent are small and 39 percent are large.

Table B-1. Response rate for items on the questionnaire

Question number	Description	Response rate
1 (A-L)	Specific courses offered	100
2 (A-E)	Types of degrees awarded	100
3A	Total number of full-time faculty	99
3B	Total number of part-time faculty	98
4 (A1-K1)	Total number of specific course full-time faculty	98
4 (A2-K2)	Total number of specific course full-time faculty having master's as highest degree	96-99
4 (A3-K3)	Total number of specific course full-time faculty having doctorate as highest degree	96-99
4 (A4-K4)	Total number of specific course part-time faculty..	95-98
4 (A5-K5)	Total number of specific course part-time faculty having master's as highest degree	93-97
4 (A6-K6)	Total number of specific course part-time faculty having doctorate as highest degree	93-97
5A (A-K)	Difficulty in hiring full-time specific course faculty	99
5B (A-K)	Difficulty in hiring part-time specific course faculty	99
Q6	Reasons for difficulty if had difficulty	100
Q7A	Percent of science taught by part-time faculty	99
Q7B	Percent of mathematics taught by part-time faculty	99
Q7C	Percent of engineering and technology taught by part-time faculty	99
Q8A1	Average science contact hours per week	99
Q8B1	Average mathematics contact hours per week	99
Q8C1	Average engineering and technology contact hours per week	100
Q8A2	Average science course preparations per week	98
Q8B2	Average mathematics course preparations per week	99
Q8C2	Average engineering and technology course preparations per week	100
Q9A	Percent full-time faculty recruited locally	97
Q9B	Percent full-time faculty recruited regionally	97
Q8C	Percent full-time faculty recruited nationally	97

Table B-1. Response rate for items on the questionnaire--Continued

Question number	Description	Response rate
Q10A (A-N)	Rating of extent to which specific science program aspects are problematic	98-99
Q10B (A-L)	Rating of extent to which specific mathematics program aspects are problematic	98-99
Q10C (A-N)	Rating of extent to which specific engineering and technology program aspects are problematic	98-99
Q11A (A-N)	Evaluation of selected specific science program aspects	97-99
Q11B (A-M)	Evaluation of selected specific mathematics program aspects	97-99
Q11C (A-M)	Evaluation of selected specific engineering and technology program aspects	97-99

Table B-2.--Standard errors for selected statistics

Item	Estimate	Standard error	95 percent confidence interval	
			Lower	Upper
Percentage offering chemistry course				
All institutions	83	1.63	80	86
Less than 1,500 enrollment	65	3.76	57	72
1,500-5,999 enrollment	94	2.47	89	99
Private institutions	44	5.88	32	55
Northeast region	69	5.26	58	79
Percentage having two-year science transfer programs				
All institutions	69	2.23	64	73
1,500-5,999 enrollment	79	3.90	71	87
6,000 or more enrollment	95	1.74	91	98
Public	81	2.48	76	86
Percentage having two-year engineering transfer programs				
All institutions	46	2.55	41	51
Less than 1,500 enrollment	22	4.18	13	30
West	57	4.56	48	66
Percentage having allied health degree or certificate				
All institutions	70	2.72	65	75
Public	86	2.81	80	91
Total number of full-time faculty	95,804	3,016	89,894	101,715
Total number of part-time faculty	142,942	9,163	124,982	160,901
Mean number of engineering/technologies full-time faculty	4.95	.29	4.38	5.51
Mean number of chemistry full-time faculty	1.69	.06	1.57	1.81
Mean number of mathematics part-time faculty	7.07	.44	6.21	7.94
Mean number of allied health part-time faculty	4.20	.40	3.41	4.98

Table B-2.--Standard errors for selected statistics -- Continued

Item	Estimate	Standard error	95 percent confidence interval	
			Lower	Upper
Percentage part-time faculty computer science - All institutions	64	1.84	61	68
Percentage part-time faculty mathematics - All institutions	60	1.65	57	63
Percentage part-time faculty mathematics - Public institutions	60	1.06	57	63
Percentage part-time faculty mathematics - Private institutions	51	7.74	36	66
Mean percentage of total contact hours taught by part-time faculty				
Science - All institutions	22	1.42	19	25
Engineering technologies - All institutions	22	1.51	19	25
Mathematics - All institutions	27	1.23	25	30
Mathematics - 6,000 or more enrollment	37	2.04	33	41
Mean contact hours per week				
Full-time faculty				
Science - All institutions	18.6	.24	18.2	19.1
Science - Less than 1,500 enrollment	19.2	.66	17.9	20.5
Science - 6,000 or more enrollment	18.0	.32	17.3	18.6
Mean number of course preparations				
Engineering and technology - All institutions	3.5	.13	3.2	3.8
Engineering and technology - 6,000 or more enrollment	3.1	.08	3.0	3.3
Percentage having no openings for faculty in last 3 years				
Agriculture and natural resources - full-time faculty	61	3.80	54	69
Engineering technologies - full-time faculty	40	2.51	35	45
Agriculture and natural resources - part-time faculty	43	3.67	35	50

Table B-2.--Standard errors for selected statistics -- Continued

Item	Estimate	Standard error	95 percent confidence interval	
			Lower	Upper
Mean percentage of full-time faculty residing in local area when hired to teach				
All institutions	61	1.80	58	65
6,000 or more enrollment	73	2.70	68	78
Less than 1,500 enrollment	62	3.50	55	69
Percentage rating *Funds for purchase and maintenance of modern equipment* as a serious problem ("4" or "5" rating)				
Science - All institutions	46	2.89	41	52
Percentage rating *Recruitment of minority students* as inadequate ("1" or "2" rating)				
Mathematics - All institutions	38	2.87	32	43
Percentage rating *Breadth of offering* as excellent ("4" or "5" rating)				
Engineering and technology - All institutions	44	2.41	40	49

Table B-3.--Relationship among institutional characteristics

A. Percentage of public and private two-year institutions that are in each enrollment and region category

	Private	Public
Enrollment		
Less than 1,500	95	24
1,500 - 5,999	5	48
6,000 or more	0	28
Total	100	100
Region		
Northeast	31	18
Central	29	25
Southeast	27	25
West	13	32
Total	100	100

B. Percentage of small, medium and large two-year institutions that are in each control and region category

	Less than 1,599	1,500-5,999	6,000 or more
Control			
Private	59	4	0
Public	41	96	100
Total	100	100	100
Region			
Northeast	27	18	17
Central	27	28	22
Southeast	32	27	10
West	14	28	51
Total	100	100	100

C. Percentage of Northeast, Central, Southeast and Western two-year institutions that are in each control and enrollment category

	Northeast	Central	Southeast	West
Central				
Private	38	30	29	13
Public	62	70	71	87
Total	100	100	100	100
Enrollment				
Less than 1,500	53	44	54	23
1,500-5,999	31	39	38	38
6,000 or more	16	17	8	39
Total	100	100	100	100

Note: Percents may not add to 100 because of rounding.

APPENDIX C

SURVEY QUESTIONNAIRE

Higher Education Surveys

OMB 3145-0009
Exp. 1/31/90

SURVEY OF SCIENCE, MATHEMATICS, ENGINEERING, AND TECHNOLOGY IN TWO-YEAR AND COMMUNITY COLLEGES

January 1989

Dear Colleague:

On behalf of the National Science Foundation, I request your participation in our Higher Education Survey on *Science, Mathematics, Engineering and Technology in Two-Year and Community Colleges.* Recently there has been increased awareness on the part of Federal policymakers of the crucial role played by two-year and community colleges in science and technology education. This survey is part of an ongoing effort by the National Science Foundation to provide Congress and the educational community with updated information on the characteristics and problems of science and technology education in two-year colleges.

Participation in this survey is voluntary, but your response is very important to the development of accurate national estimates. Data collected in the survey will be published in aggregate form only, and will not identify individual institutions. All members of the Higher Education Surveys national panel will receive a copy of the survey findings.

If you have any questions about this survey please do not hesitate to call Margaret Cahalan, the Westat Survey Manager, at 800-937-8281. Thank you for your assistance.

Sincerely,

Wayne Welch

Wayne Welch
Office Head
Office of Studies and Program Assessment
National Science Foundation

Sponsored by the National Science Foundation, the National Endowment for the Humanities, and the Department of Education

SECTION A: TYPE OF PROGRAM AND COURSE OFFERINGS

1. Please check whether courses are offered at your institution in the following subjects.

Subject area	Courses offered in subject	
	Yes	No
a. Agriculture and natural resources (animal/plant science, forestry, fisheries, wildlife management, food science)	☐	☐
b. Biology	☐	☐
c. Chemistry	☐	☐
d. Physics	☐	☐
e. Earth and space sciences (geography, geology, astronomy, meteorology, oceanography)	☐	☐
f. Interdisciplinary natural sciences	☐	☐
g. Mathematics	☐	☐
g-1. Calculus or math courses requiring calculus as a prerequisite	☐	☐
h. Computer science (programming, data processing)	☐	☐
i. Engineering	☐	☐
j. Engineering technologies	☐	☐
k. Allied health	☐	☐
l. Science laboratory technologies (chemical, biological, other)	☐	☐

2. For which of the following programs does your institution offer degrees/certificates?

		Yes	No
a.	Allied health	☐	☐
b.	Engineering technologies	☐	☐
c.	Liberal/general studies	☐	☐
d.	Business and management	☐	☐
e.	Other (specify)_____	☐	

Does your institution have:

		Yes	No
f.	A two-year science transfer program	☐	☐
g.	A two-year pre-engineering transfer program	☐	☐

SECTION B: FACULTY

3. What was the total number of full- and part-time faculty employed to teach credit courses at your institution in the fall of 1988? Include teachers in all subjects (e.g., English, math, science, music, technology, health, etc.).

Full-time faculty _____

Part-time faculty _____

4. Please enter the number of full- and part-time science and technology faculty employed by your institution in the fall of 1988 by highest degree earned in any field. Count each faculty member only once. If a faculty member teaches in more than one area, count this faculty member in the area in which he/she has the largest portion of his/her teaching load. If a faculty member does not have a master's or doctorate degree, count this faculty member in the total column only. If your institution does not have any faculty teaching in the subject area, enter "0" in the total column.

Subject area	Full-time faculty			Part-time faculty		
	Total	Highest degree		Total	Highest degree	
		Master's	Doctorate		Master's	Doctorate
a. Agriculture and natural resources						
b. Biology						
c. Chemistry						
d. Physics						
e. Earth and space sciences						
f. Multi-science courses*						
g. Mathematics						
h. Computer science						
i. Engineering						
j. Engineering technologies						
k. Allied health						

*Use this category if a science professor teaches several different courses (e.g., physics, chemistry, biology) and you are unable to determine which course he or she teaches most frequently.

5. In Column A, indicate whether it has been difficult during the last 3 years for your institution to hire qualified **full-time** teachers (who meet the minimum qualifications in the job announcement) in the following subject areas. Enter NA if you have no faculty in the area.

If Yes, in Column B indicate up to 3 major reasons for the difficulty in hiring qualified full-time faculty, using the codes below.

a = Lack of qualified personnel in geographic area
b = Inadequate salaries
c = Excessive teaching loads
d = Lack of support services for faculty (e.g., secretarial, teaching or lab assistants)
e = Lack of student preparation/interest
f = Need for evening and weekend teaching
g = Availability of other higher paying jobs in the area
h = High cost of living in the area
i = Inability of college to pay for cost of travel for prospective faculty to interview and/or to relocate
j = Other (specify)_____

_____

Answer for full-time faculty					
Subject area	A. Difficulty in hiring qualified full-time faculty (check one for each area)				B. Enter codes for major reasons
	Yes	No	No vacancies occurred	NA	
a. Agriculture and natural resources	☐	☐	☐	☐	_____
b. Biology	☐	☐	☐	☐	_____
c. Chemistry	☐	☐	☐	☐	_____
d. Physics	☐	☐	☐	☐	_____
e. Earth and space sciences	☐	☐	☐	☐	_____
f. Multi-science courses*	☐	☐	☐	☐	_____
g. Mathematics	☐	☐	☐	☐	_____
h. Computer science	☐	☐	☐	☐	_____
i. Engineering	☐	☐	☐	☐	_____
j. Engineering technologies	☐	☐	☐	☐	_____
k. Allied health	☐	☐	☐	☐	_____

*Use this category if a science professor is hired to teach several different science courses and you are unable to determine which course he or she teaches most frequently.

6. In Column A, indicate whether it has been difficult during the last 3 years for your institution to hire qualified **part-time** teachers (who meet the minimum qualifications in the job announcement) in the following subject areas. Enter NA if you have no faculty in the area.

If Yes, in Column B indicate up to 3 major reasons for the difficulty in hiring qualified part-time faculty, using the codes below.

a = Lack of qualified personnel in geographic area
b = Inadequate salaries
c = Excessive teaching loads
d = Lack of support services for faculty (e.g., secretarial, teaching or lab assistants)
e = Lack of student preparation/interest
f = Need for evening and weekend teaching
g = Availability of other higher paying jobs in the area
h = Need for daytime teaching
i = Uncertainty as to schedules
j = Other (specify)_____

_____

Answer for part-time faculty					
Subject area	A. Difficulty in hiring qualified part-time faculty (check one for each area)				B. Enter codes for major reasons
	Yes	No	No vacancies occurred	NA	
a. Agriculture and natural resources	☐	☐	☐	☐	_____
b. Biology	☐	☐	☐	☐	_____
c. Chemistry	☐	☐	☐	☐	_____
d. Physics	☐	☐	☐	☐	_____
e. Earth and space sciences	☐	☐	☐	☐	_____
f. Multi-science courses*	☐	☐	☐	☐	_____
g. Mathematics	☐	☐	☐	☐	_____
h. Computer science	☐	☐	☐	☐	_____
i. Engineering	☐	☐	☐	☐	_____
j. Engineering technologies	☐	☐	☐	☐	_____
k. Allied health	☐	☐	☐	☐	_____

*Use this category if a science professor is hired to teach several different science courses and you are unable to determine which course he or she teaches most frequently.

The remaining questions ask for information on the general categories of science, mathematics, and engineering and technology. It is appropriate for these questions to be answered by persons from these divisions. For purposes of this survey:

SCIENCE COVERS:

Biology
Chemistry
Earth and Space Sciences
Physics
Interdisciplinary Natural Sciences

ENGINEERING AND TECHNOLOGY COVERS:

Engineering
Engineering Technologies
Computer Science

AGRICULTURE AND ALLIED HEALTH ARE NOT COVERED IN THESE QUESTIONS.

7. What percent of the total contact hours (lecture and lab) at your institution in the 3 areas below are taught by part-time faculty?

   a. Science _____%

   b. Mathematics _____%

   c. Engineering and technology _____%

8. What is the normal teaching load each term for full-time faculty in the 3 areas below?

   a. **Science**

      Contact hours (lecture and lab) per week _____

      Number of different course preparations (not total sections) per term _____

   b. **Mathematics**

      Contact hours (lecture and lab) per week _____

      Number of different course preparations (not total sections) per term _____

   c. **Engineering and technology**

      Contact hours (lecture and lab) per week _____

      Number of different course preparations (not total sections) per term _____

9. At the time they were initially hired to teach at your institution, about what percent of the full-time science and technology faculty were residing:

   In your local area _____%

   Outside your area but in your region _____%

   Outside your local area and region _____%

   100%

SECTION C: PROBLEMS AND EVALUATION

10-A. Please evaluate on a scale of 1 to 5 (with 1 = not a problem to 5 = serious problem) the extent to which each item below is a problem for your institution. Answer Part A for science education by circling the appropriate numbers.

Check box if you have no science courses/programs and the questions are not applicable. ☐

Part A: Answer for science					
Program aspect	Not a problem 1	2	3	4	Serious problem 5
a. Adequate laboratory facilities	1	2	3	4	5
b. Funds for purchase and maintenance of modern equipment	1	2	3	4	5
c. Funds for purchase of expendable laboratory supplies	1	2	3	4	5
d. Adequate computer facilities	1	2	3	4	5
e. Sufficient library resources	1	2	3	4	5
f. Adequate opportunity for faculty professional development (e.g., research time, conference attendance)	1	2	3	4	5
g. Large class sizes	1	2	3	4	5
h. Small course enrollments	1	2	3	4	5
i. Adequate preparation of students in high school/scientific literacy	1	2	3	4	5
j. Adequate academic preparation of teachers in the subject	1	2	3	4	5
k. Assessment and placement of students in sequential courses/adherence to prerequisites	1	2	3	4	5
l. Student motivation/interest	1	2	3	4	5
m. Disposal of toxic waste	1	2	3	4	5
n. Laboratory safety	1	2	3	4	5

Question 10 continued (Part B)

10-B. Please evaluate on a scale of 1 to 5 (with 1 = not a problem to 5 = serious problem) the extent to which each item below is a problem for your institution. Answer Part B for mathematics education by circling the appropriate numbers.

Check box if you have no mathematics courses/programs and the questions are not applicable. ☐

Part B: Answer for mathematics					
Program aspect	Not a problem 1	2	3	4	Serious problem 5
a. Adequate laboratory facilities	1	2	3	4	5
b. Funds for purchase and maintenance of modern equipment	1	2	3	4	5
c. Funds for purchase of expendable laboratory supplies	1	2	3	4	5
d. Adequate computer facilities	1	2	3	4	5
e. Sufficient library resources	1	2	3	4	5
f. Adequate opportunity for faculty professional development (e.g., research time, conference attendance)	1	2	3	4	5
g. Large class sizes	1	2	3	4	5
h. Small course enrollments	1	2	3	4	5
i. Adequate preparation of students in high school/scientific literacy	1	2	3	4	5
j. Adequate academic preparation of teachers in the subject	1	2	3	4	5
k. Assessment and placement of students in sequential courses/adherence to prerequisites	1	2	3	4	5
l. Student motivation/interest	1	2	3	4	5

Question 10 continued (Part C)

10-C. Please evaluate on a scale of 1 to 5 (with 1 = not a problem to 5 = serious problem) the extent to which each item below is a problem for your institution. Answer Part C for engineering and technology education by circling the appropriate numbers.

Check box if you have no engineering and technology courses/programs and the questions are not applicable. ☐

Part C: Answer for engineering and technology					
Program aspect	Not a problem 1	2	3	4	Serious problem 5
a. Adequate laboratory facilities	1	2	3	4	5
b. Funds for purchase and maintenance of modern equipment	1	2	3	4	5
c. Funds for purchase of expendable laboratory supplies	1	2	3	4	5
d. Adequate computer facilities	1	2	3	4	5
e. Sufficient library resources	1	2	3	4	5
f. Adequate opportunity for faculty professional development (e.g., research time, conference attendance)	1	2	3	4	5
g. Large class sizes	1	2	3	4	5
h. Small course enrollments	1	2	3	4	5
i. Adequate preparation of students in high school/scientific literacy	1	2	3	4	5
j. Adequate academic preparation of teachers in the subject	1	2	3	4	5
k. Assessment and placement of students in sequential courses/adherence to prerequisites	1	2	3	4	5
l. Student motivation/interest	1	2	3	4	5
m. Disposal of toxic waste	1	2	3	4	5
n. Laboratory safety	1	2	3	4	5

11-A. On a scale of 1 to 5 (1 = inadequate, 3 = adequate, and 5 = excellent), please rate each of the following aspects of your science courses/programs.

Check box if you have no science courses/programs and the questions are not applicable. ☐

Part A: Answer for science					
Program aspect	Inadequate		Adequate		Excellent
	1	2	3	4	5
a. Breadth of offerings	1	2	3	4	5
b. Maintenance of an up-to-date curriculum	1	2	3	4	5
c. Use of innovative instructional methods	1	2	3	4	5
d. Recruitment of female students	1	2	3	4	5
e. Retention of female students	1	2	3	4	5
f. Recruitment of minority students	1	2	3	4	5
g. Retention of minority students	1	2	3	4	5
h. Student course completion rate	1	2	3	4	5
i. Articulation with baccalaureate programs	1	2	3	4	5
j. Consistency with technical/ occupational requirements of industry	1	2	3	4	5
k. Degree/certificate/program completion rate	1	2	3	4	5
l. Job placement after program completion	1	2	3	4	5
m. Successful transfer to four-year institutions	1	2	3	4	5

Title of person completing this form for science:

_____

Question 11 continued (Part B)

11-B. On a scale of 1 to 5 (1 = inadequate, 3 = adequate, and 5 = excellent), please rate the following aspects of your mathematics courses/programs.

Check box if you have no mathematics courses/programs and the questions are not applicable. ☐

Part B: Answer for mathematics					
Program aspect	Inadequate		Adequate		Excellent
	1	2	3	4	5
a. Breadth of offerings	1	2	3	4	5
b. Maintenance of an up-to-date curriculum	1	2	3	4	5
c. Use of innovative instructional methods	1	2	3	4	5
d. Recruitment of female students	1	2	3	4	5
e. Retention of female students	1	2	3	4	5
f. Recruitment of minority students	1	2	3	4	5
g. Retention of minority students	1	2	3	4	5
h. Student course completion rate	1	2	3	4	5
i. Articulation with baccalaureate programs	1	2	3	4	5
j. Consistency with technical/ occupational requirements of industry	1	2	3	4	5
k. Degree/certificate/program completion rate	1	2	3	4	5
l. Job placement after program completion	1	2	3	4	5
m. Successful transfer to four-year institutions	1	2	3	4	5

Title of person completing this form for mathematics:

_____

Question 11 continued (Part C)

11-C. On a scale of 1 to 5 (1 = inadequate, 3 = adequate, and 5 = excellent), please rate each of the following aspects of your engineering and technology courses/programs.

Check box if you have no engineering and technology courses/programs and the questions are not applicable. ☐

Part C: Answer for engineering and technology					
Program aspect	Inadequate		Adequate		Excellent
	1	2	3	4	5
a. Breadth of offerings	1	2	3	4	5
b. Maintenance of an up-to-date curriculum	1	2	3	4	5
c. Use of innovative instructional methods	1	2	3	4	5
d. Recruitment of female students	1	2	3	4	5
e. Retention of female students	1	2	3	4	5
f. Recruitment of minority students	1	2	3	4	5
g. Retention of minority students	1	2	3	4	5
h. Student course completion rate	1	2	3	4	5
i. Articulation with baccalaureate programs	1	2	3	4	5
j. Consistency with technical/ occupational requirements of industry	1	2	3	4	5
k. Degree/certificate/program completion rate	1	2	3	4	5
l. Job placement after program completion	1	2	3	4	5
m. Successful transfer to four-year institutions	1	2	3	4	5

Title of person completing form for engineering and technolgy:

_____

Do we have permission to release these data to the National Science Foundation with your institutional identification code? This would allow NSF to use data from other surveys to help analyze the results. All information published by NSF will be in aggregate form only.

☐ Yes
☐ No

Please sign _____

Thank you for your assistance. Please return this form by February 17 to:

Higher Education Surveys
WESTAT
1650 Research Boulevard
Rockville, MD 20850

Person completing this form:

Name: _____

Title: _____

Telephone: _____

Please keep a copy of this survey for your records.

If you have any questions or problems concerning this survey, please call Margaret Cahalan at (800) 937-8281 (toll-free).