

# CHAPTER 4

## BEYOND THE BACCALAUREATE IN SCIENCE AND ENGINEERING

### Graduate Enrollment Across the Board

Graduate education constitutes a critical step in the preparation of all scholars and professionals, including scientists and engineers. During this time of focused study, choices become firmer and the broad knowledge gained at earlier levels deepens and often narrows. Graduate education in the United States sets a world standard. Not only is it highly regarded by students in this country, but also the numbers of students from abroad coming to study here—particularly in science and engineering fields—testify to its esteem worldwide.

Graduate school enrollment<sup>1</sup> in this Nation increased in all disciplines by more than 22 percent during the 1980s (NSF 1994). Total full- and part-time graduate enrollment rose in all fields by an average of 2 percent per year between 1986 and 1993; the number of women increased faster than the number of men (see figure 4-1) (Syverson and Maguire 1995, p. 23).<sup>2</sup>

The overall growth during those 7 years in graduate enrollment occurred in all fields reported; however, the nonscience areas of engineering, business, and public administration lost students between 1992 and 1993 (Syverson and Maguire 1995, p. 27).

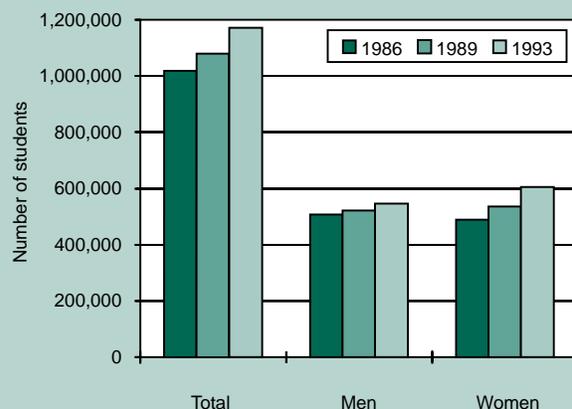
In addition, student composition in all disciplines became more diverse. Enough more women enrolled that, by the middle of the 1980s, they were a majority among graduate students (NSF 1994, p. 61). More women than men were studying in all fields in 1993 except engineering, business, and the biological and physical sciences (Syverson and Maguire 1995, p. 4). Business and education enroll the largest number of graduate students, accounting for 14 and 20 percent of 1993 enrollment, respectively. That year, 62 percent of the students in business were men, and 73 percent of

those in education were women (Syverson and Maguire 1995, p. 4–5).

Graduate enrollment grew consistently but not steadily across most fields and within most racial/ethnic groups between 1986 and 1993 (Syverson and Maguire 1995, p. 31). In 1993, minorities were about 16 percent of graduate enrollment in all fields (see figure 4-2). Almost one-half of Asian graduate students with U.S. citizenship or permanent visas were enrolled in science and engineering programs, compared with about one-fourth or less of black, Hispanic, or American Indian graduate students (Syverson and Maguire 1995, p. 30). Students of different racial/ethnic groups varied widely in their choice of fields of study. Education is the most popular field for all U.S. graduate students except for Asians (Syverson and Maguire 1995, p. 13).

Women registered gains over the last decade in both graduate enrollment and degrees, however, and underrepresented racial/ethnic minorities made limited progress. Among minorities with U.S. citizenship, blacks were best represented, accounting for 42 percent of minority graduate enrollment. Hispanic enrollment was slightly lower than Asian. More women than men from underrepresented minorities were enrolled in graduate school; nearly twice as many black women attended as black men (Syverson and Maguire 1995, p. 11).

Figure 4-1.  
Trends in graduate enrollment, 1986–1993

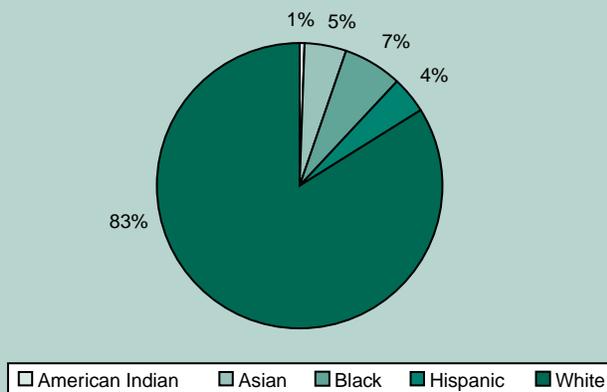


SOURCE: Syverson and Maguire 1995, p. 25.

<sup>1</sup> Unless otherwise noted, data come from National Science Foundation (NSF) universe surveys, including all higher education institutions offering graduate programs. NSF makes imputations for nonresponse.

<sup>2</sup> The Council of Graduate Schools (in 1995, Peter D. Syverson and Moira J. Maguire) annually summarizes data gathered on a survey it sends with the Graduate Record Examinations Board to the some 650 graduate schools that have membership in the council or its regional associations. About 600 reply. The responding institutions enroll about 75 percent of the Nation's master's candidates and more than 90 percent of the doctoral students (citizens and foreign students alike) (personal communication, Syverson, October 24, 1995).

Figure 4-2.  
Percentage of graduate students, by race/ethnicity:  
Fall 1993



NOTE: Data are for U.S. citizens and permanent residents only.

SOURCE: Syverson and Maguire 1995, p. 10.

Progress in baccalaureate enrollment has been slower in science and engineering fields for women, blacks, Hispanics, and American Indians than in graduate study overall. All these groups except American Indians earned more science and engineering doctoral degrees in 1993 than in 1986; Asians increased their degree earning by 97 percent compared to the 18 percent more doctorates awarded to all U.S. citizens and permanent residents. (See appendix table 4-26.) Graduate students with disabilities enrolled in science and engineering programs (though not in engineering itself) at a rate similar to their proportion in the post baccalaureate population as a whole. (See appendix table 4-4.)

## Graduate Students: Some Characteristics

### Financing Graduate School

Financial support during graduate school is often crucial. Study for graduate degrees can be expensive, and few students and/or their families can foot the bills on their own. Although this report breaks out some separate data for master's degrees, only in engineering are master's degrees sometimes terminal,<sup>3</sup> serving in the sciences mostly as way stations to the doctorate.

Students receiving U.S. doctorates support themselves and their studies through teaching and research assistantships, through "other" sources of support, and through funds of "unknown" origin. See appendix tables

4-1–4-3, which report only on *primary* sources of maintenance (not combinations). When listing such sources, few recipients cited institutional assistantships. Students of both sexes, from all races and ethnicities, U.S. citizens or not—77 percent of those with disabilities, 69 percent of those without, 75 percent of U.S. citizens, and 71 percent of graduates from all citizenship groups—support their doctoral studies through other sources. The exception is students in the physical sciences, slightly more than half of whom are primarily supported by their work for their institutions.

About the same percentage of men and women studying for their doctorates supported themselves primarily through teaching assistantships (12 percent and 11 percent, respectively). These percentages were slightly higher for doctoral recipients in science and engineering than for recipients in all fields: 12 percent of the 17,647 men and 13 percent of the 7,537 women. A greater percentage of men than women received most of their funding through research assistantships, both in science and engineering and in other fields. (See appendix table 4-1.) Students earning nonscience and engineering doctorates (37 percent of those awarded) were less likely to be supported primarily by research assistantships (about 4 percent) than those in science and engineering (28 percent of the men and 20 percent of the women). At the high end, almost 39 percent of all engineering doctorates and 37 percent of the physical sciences doctorates were primarily supported by research assistantships.

Doctoral students' reliance on teaching and research assistantships varied according to their citizenship, racial/ethnic, and disability status. (See appendix tables 4-2 and 4-3.) In all fields, students with disabilities received financial and need-based aid about as often as did others. (See appendix table 4-4.) Just over a tenth of recipients of U.S. doctorates awarded in science and engineering are supported mainly from teaching assistantships—the low is 3 percent (agriculture) and the high, 31 percent (mathematical and computer sciences).

Some racial/ethnic groups of U.S. citizens receiving science and engineering doctorates were more likely than others to cite assistantships as their major support (appendix table 4-2). Eleven percent of whites received teaching assistantships, compared to 10 percent of American Indians, 9 percent of Hispanics, 8 percent of Asians, and 6 percent of blacks. Research assistantships, which can be an important aspect of science and engineering training, were cited as primary support by 32 percent of Asians, 23 percent of whites, 17 percent of Hispanics, 15 percent of American Indians, and 9 percent of blacks earning doctorates in those fields.

Doctorate recipients with disabilities from all citizenship groups were less likely to have received assistantships of either sort than students without disabilities. In all fields, recipients with disabilities reported smaller percentages of teaching (9 percent compared

<sup>3</sup> In 1994, of 1,494 accredited engineering programs in over 300 institutions, 1,463 were accredited at the bachelor's ("basic") level and 31 at the master's ("advanced") level (Accreditation Board for Engineering, 1994, p. 47). Doctoral programs are not accredited.

with 12 percent) and research assistantships (13 percent compared with 19 percent) than other students. The differences were similar in science and engineering fields with regard to both kinds of assistantships. Within specific science and engineering fields, however, the picture was less consistent: students with disabilities reported higher percentages of research assistantships in physical, mathematical and computer sciences, biology, and the social sciences than other students; they did similarly well in teaching assistantships in physical science and engineering. (See appendix table 4-3.)

### Graduate Students' Attendance Patterns: Full- or Part-Time?

Largely because of the high cost of graduate school, many students choose to, or have no alternative but to, attend part time. Because of what Seymour and Hunter (in press) call the "disadvantage of time," the 4 percent of graduate students who have disabilities are less likely to attend graduate school full time and are more likely to attend several institutions than other students. (See box on page 32, chapter 3, and appendix table 4-4.) Although students with disabilities were slightly more likely to attend part time than others, they chose all fields at about the same rate as other students.

It is unsurprising that different kinds of doctorates take different kinds of students different amounts of time to earn. (See appendix table 4-5.) Students from all fields

needed a median 10.5 years to move from their baccalaureates to their terminal degrees. These figures were less for the science and engineering fields (9.1 years) and more for all other fields (15.7 years). Although the median time between bachelor's and doctorates for women was more than for men (12.2 compared to 9.9 years for all terminal degrees and 17.0 compared to 14.2 years for nonscience and engineering fields), both sexes finished their science and engineering degrees in about 9 years. Doctoral recipients with disabilities took longer to complete their degrees than others. (See appendix table 4-32.)

Students in all fields were registered for a median 7.1 years between baccalaureate and doctoral degrees. Although the median time was less in science and engineering, some variation by field occurs. Students earned their doctorates faster in chemistry than any other science and engineering field, spending just under 6 years in study after their bachelor's. Women, spending just over 5½ years, were quicker than men, who took slightly fewer than 6.<sup>4</sup>

<sup>4</sup> A study of doctoral graduates from nine of the University of California campuses between 1980 and 1988 bears out these patterns and adds analysis by racial/ethnic groups (Nerad 1991). Among its findings:

- Having dependents lengthened the time for completion of the doctorate.
- Having fellowships, loans, or assistantships shortened dramatically the time necessary.
- Relying on one's own resources increased completion time by 2.7 years for Asians, 2.8 years for whites, and 2.4 years for underrepresented minorities.

## Pluses and Minuses for Women Graduate Students in Physics

In 1993, graduate and undergraduate physics students provided information on the educational environment of physics departments nationwide (Curtin et al. 1995).<sup>5</sup> In addition, physics professionals conducted site visits to find ways to improve the climate for women in physics departments (Dresselhaus et al. 1995).<sup>6</sup> This project found "that the existing climate for women in physics departments adversely impacts their progress in attaining satisfactory career goals...identified a number of factors that create a poor climate...[and] suggested ways to address them and remove them" (p. 20). Among the problems is women's serious underrepresentation on physics faculties. (See text table 4-1.)

<sup>5</sup> The American Physical Society and the American Association of Physics Teachers, in collaboration with the American Institute of Physics, sent a questionnaire to 1,955 graduate students in physics. The sample drew from all women studying physics at the postbaccalaureate level (2,042 of them, foreign) and 2 of 11 men. The response rate was 60 percent (Curtin et al. 1995).

<sup>6</sup> Representatives of the American Physical Society and the American Association of Physics Teachers visited 15 campuses (10 of the visits were funded by the NSF) (Dresselhaus et al. 1995).

Graduate and undergraduate physics students<sup>7</sup> reported that only about one-third of the students said their departments encouraged self-confidence, and U.S. women rated them lowest in this area.

- Although over 60 percent of U.S. men reported collegial relationships with their advisors, just over half of U.S. females and male foreigners (and only 39 percent of foreign women) felt they were treated as colleagues.
- About 8 of 10 U.S. physics graduate students would go into the field again; fewer foreign students would do so—6 of 10 women and 7 of 10 men.
- Females are more likely than men to belong to study groups. (Curtin et al. 1995).
- Only about one third of the students said their departments encouraged self-confidence, and U.S. women rated them lowest in this area.

<sup>7</sup> Undergraduates were also surveyed, but the researchers found that the results might be unreliable because of problems with the sample frame and the questionnaire instrument.

## Pluses and Minuses for Women Graduate Students in Physics (*continued*)

Text table 4-1.

Academic rank by gender in PhD-granting physics departments, 1985<sup>a</sup> and 1994<sup>b</sup>

	Women			Men	
	N	Percent at rank	Percent of total at rank	N	Percent at rank
<b>1985</b>					
Full professor .....	44	33	2	2,832	63
Associate professor .....	23	17	3	793	18
Assistant professor .....	33	25	7	467	10
Other ranks .....	33	25	7	420	9
Total .....	133	100	3	4,512	100
<b>1994</b>					
Full professor .....	72	31	3	2,695	60
Associate professor .....	60	26	7	757	17
Assistant professor .....	60	26	10	532	12
Other ranks .....	37	16	7	533	12
Total .....	229	100	5	4,517	100

<sup>a</sup> Data from the 161 PhD-granting physics departments 1982–1983 through 1986–1987.<sup>b</sup> Data from 175 of the 183 PhD-granting physics departments 1993–1994.

SOURCE: Dresselhaus et al. 1995, p. 3.

### Citizenship Issues

U.S. universities occupy a position of world leadership in science and engineering doctoral education, awarding degrees to a diverse racial/ethnic group of citizens and foreign students. In 1992, whites constituted only 21 percent of the doctoral recipients who were non-U.S. citizens on temporary visas, whereas they were 88 percent of the U.S. citizens (NSF 1994, pp. 78–79). Noncitizens make up about 21 percent of the science and engineering graduate students and 33 percent of the engineers. (See appendix table 4-13.) They earned 42 percent of the doctorates in science and engineering (and 61 percent of those in engineering). (See appendix tables 4-1 and 4-2.) Data on race/ethnicity for science and engineering graduate students are available only for U.S. citizens, and—sometimes—foreign students on permanent visas; data on gender are available for all students.<sup>8</sup>

### Women

#### Enrollment

Of the total of 438,052 graduate students enrolled in science and engineering fields in 1993, 157,493 were women. (See appendix tables 4-6 to 4-8.)

The percentage of women in these combined fields has grown steadily though slowly over the past few years, from just over 32 percent in 1988 to 36 percent in 1993. (See figure 4-3.) In science fields (excluding engineering), 44 percent of the graduate students in 1993 were women, up from 40 percent in 1988. (See figure 4-3.) Although women's representation also improved in engineering—from 13 to 15 percent—women were most outnumbered there. Women continued to dominate psychology (70 percent) and several subfields in the social and biological sciences. (See figure 4-4.)

Women doing graduate work in science and engineering were only slightly more likely to attend part time than men, nearly closing the gap evident in 1982, when 63 percent of women, compared to 66 percent of men, attended full time. Under a third of all students in science went part time in 1993, compared to over a third in engineering. Sixty-six percent of women and 71 percent of men attended their science graduate classes on a full-time basis. (See appendix table 4-9.) These percentages have changed very little over the last 10 years. In 1982, 62 percent of the female graduate engineering students and 60 percent of the men were enrolled full time. (See NSF 1994, p. 63.) The few graduate students studying astronomy were most likely to be enrolled full time.

<sup>8</sup> Discussions of racial/ethnic groups here as elsewhere in this report are limited to data on U.S. citizens, with the exception of doctoral statistics. The latter sometimes include foreign nationals on permanent or temporary visas.

## Foreign Graduate Students: Stayers and Leavers

Of foreign students who graduated with science or engineering doctorates in 1984, fewer than half remained in the United States in 1992<sup>9</sup> (Finn et al. 1995). About 41–42 percent of students on temporary visas (48–49 percent of those on all visas) were still working in the United States 8 years after earning their doctorates. The study also found that “stay rates” varied by

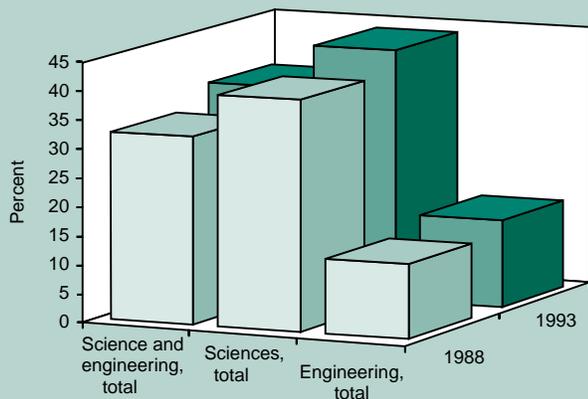
- field—engineering had the most stayers and social and life sciences the most leavers.
- country of origin—many students from India, the People’s Republic of China, and Iran stayed, and many from Korea, Japan, and Brazil, left.

They found no significant variation by

- salary or
- prestige of departments where students earned doctorates.

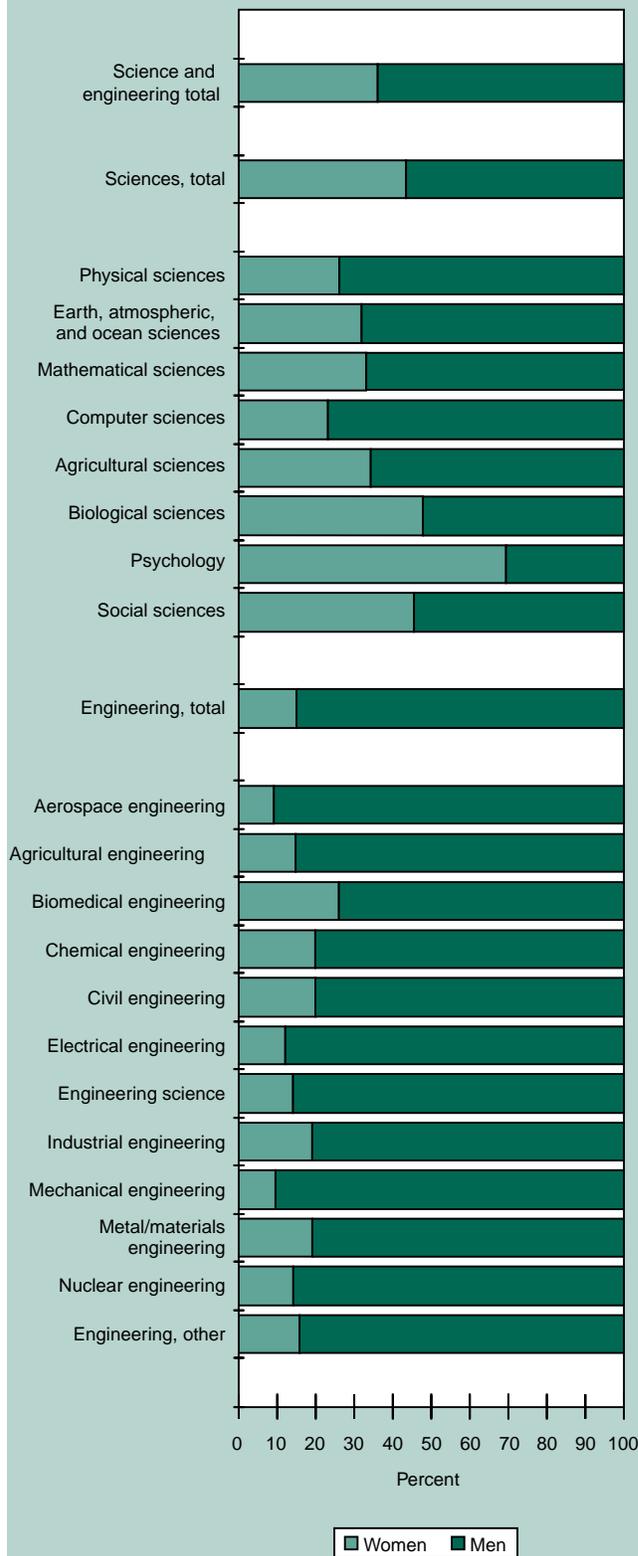
<sup>9</sup> The study used social security numbers to match doctoral graduates from abroad with U.S. earnings. If the Social Security Administration did not find evidence of an individual’s having earned at least \$5,000 in employment covered by social security, the researchers classified him or her as a “leaver.” They made adjustments, however, to take into account individuals working in jobs not covered by social security.

Figure 4-3. Women as a percentage of science and engineering graduate students, by broad area of study: Fall 1988 and 1993



See appendix table 4-8.

Figure 4-4. Percentage of science and engineering graduate students, by field and sex: Fall 1993



See appendix tables 4-7 and 4-8.

## Choice of Field

In 1993, female graduate students were considerably more likely to be enrolled in fields other than science and engineering than were men (Syverson and Maguire 1995, p. 4). Women were the majority in all other fields except business—ranging from 77 percent in the health fields to 55 percent in the humanities and arts.

Women's representation in science and engineering varied greatly by field. (See appendix tables 4-6 to 4-8.) In psychology, more than two-thirds of the graduate students in 1993 were women. Women were also in the majority in biometry/epidemiology, genetics, nutrition, and several social science fields. By contrast, only 14 percent of the graduate students in physics were women.

Among the engineering fields, the highest proportion of female graduate students in 1993 was in biomedical engineering, over one-fourth. This field was followed by chemical and civil engineering, each with a female enrollment of about 20 percent; metallurgical/materials engineering and industrial engineering/management science each enrolled about 19 percent women. At the other extreme, under 10 percent of the graduate students in the mechanical and aerospace engineering fields were women.

## Where They Study

Fifteen of the 20 universities enrolling the most women graduate students in science and engineering in 1993 were large state research institutions. The University of Minnesota (all campuses) enrolled the most women (2,000), followed by the University of Wisconsin (all campuses) (1,777). The private institution enrolling the most women was George Washington University (Washington, D.C.) (1,567). (See appendix table 4-11.)

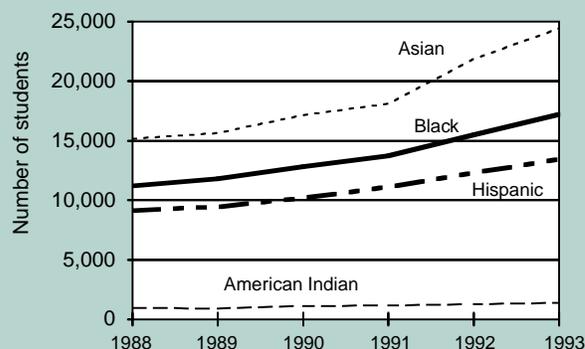
## Minorities

### Enrollment

Of the 332,525 U.S. citizens enrolled in graduate science and engineering programs in 1993 (both full and part time), 31,945, or 10 percent, were underrepresented minorities.<sup>10</sup> For blacks, the increase in graduate science and engineering enrollment from 1988 to 1993 was from 4 to 5 percent; for Hispanics the increase was from 3 to 4 percent; and American Indians remained under half a percentage point. Asians increased from 5 to 7 percent over those years. In 1993, whites and Asians made up 85 percent of the total enrollment. (See appendix table 4-12 and figure 4-5.)

<sup>10</sup> Better reporting of race/ethnicity, evidenced by declines in the numbers of students of "unknown race/ethnicity," could account for significant portions of the increase among underrepresented minorities. These increases may, therefore, reflect improvements in statistical quality rather than actual change.

Figure 4-5.  
Minority graduate students in science and engineering, by race/ethnicity: Fall 1988–1993



NOTE: U.S. citizens only

See appendix table 4-12.

## Choice of Field

The field choices of graduate students vary considerably by gender and among racial/ethnic groups. For example, 37 percent of Asian science and engineering graduate students were enrolled in engineering fields, compared with 22 percent of whites, 20 percent of Hispanics, 16 percent of American Indians, and 15 percent of blacks. (See figure 4-6.)

The 3,759 Asians enrolled in electrical engineering—almost 11 percent of all graduate students in this field—largely accounted for the heavy concentration of Asians in engineering.

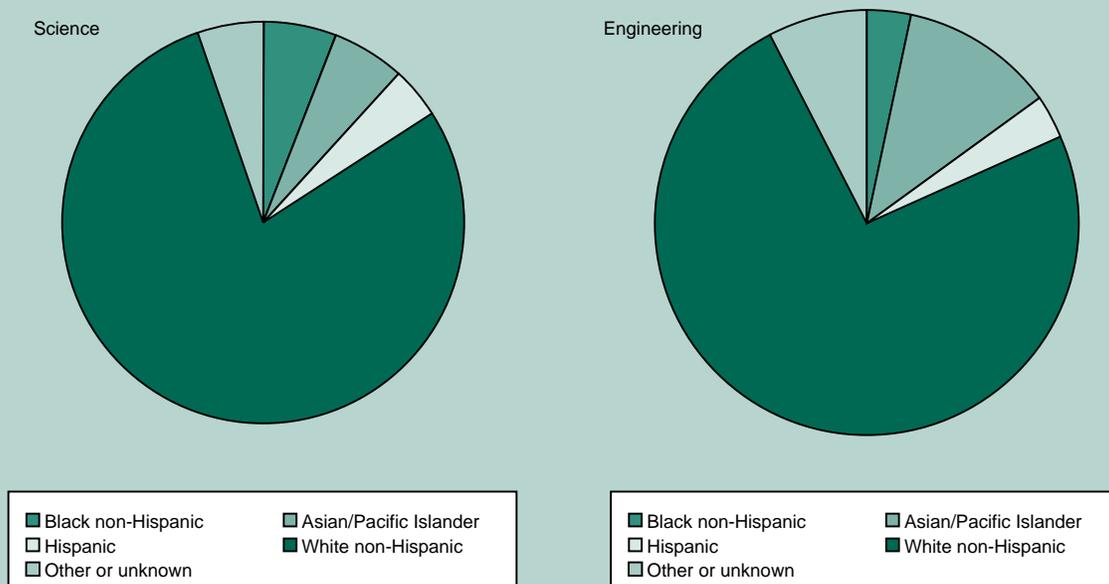
Conversely, 37 percent of all black graduate students in science and engineering were in social science fields, compared with 30 percent of American Indians and 30 percent of Hispanics, but only 12 percent of Asians. Similarly, only 6 percent of the Asian students (and 2 percent of noncitizens) were studying psychology, whereas psychology students represented 17 percent to 22 percent of the total number of science and engineering graduate students from all other racial/ethnic groups.

## Where They Study

The growing numbers<sup>11</sup> of members of minority racial/ethnic groups are differentially distributed around the country. Over 80 percent of blacks lived in metropolitan areas in 1990 (U.S. Department of Commerce 1993c), whereas nearly 9 of 10 Hispanics were concentrated in 10 states, mostly in the South and West (U.S.

<sup>11</sup> The 1990 census counted nearly 30 million blacks, an increase of about 4 million (1 percent) from 1980. The Hispanic population grew by 53 percent during those years. Both the numbers of Asians and Pacific Islanders and their percentage among groups in the U.S. population nearly doubled during that decade (from 3.7 to 7.3 million) (U.S. Department of Commerce 1993b, 1993c, 1993d, 1993e).

Figure 4-6.  
**Percentage distribution of graduate students in science and engineering, by race/ethnicity: Fall 1993**



NOTE: U.S. citizens only.

See appendix table 4-13.

Department of Commerce 1993e). Asians and Pacific Islanders also live mainly in the West (U.S. Department of Commerce 1993b, 1993e); so do American Indians, more than half of whom live in six states (Oklahoma, California, Arizona, New Mexico, Alaska, and Washington) (U.S. Department of Commerce 1993d). Graduate students are also regionally concentrated. Minorities—including Asians—made up more than one-fifth of total graduate science and engineering enrollment in Mississippi, California, the District of Columbia, Georgia, and Louisiana. (See appendix tables 4-14–4-17 and NSF 1994, pp. 295–298.) Such students are enrolled in just over 80 percent of the institutions offering graduate programs, 539 out of 665. The top 10 institutions enrolled 15 percent of all minority graduate science and engineering students; the top 20 enrolled 24 percent. (See NSF 1994, p. 69.)

### Blacks

In 1993, three historically black colleges and universities were among the 10 institutions with the largest proportions of black science and engineering graduate students. (See appendix table 4-15 and text table 4-2.) The 10 institutions with the highest black enrollment

accounted for 15 percent of all black graduate students in science and engineering fields, a proportion that has remained fairly steady for a decade.

The 25 historically black colleges and universities offering science and engineering graduate programs (4 percent of the 615 institutions offering master’s in science and engineering) in 1989 awarded one in five such degrees earned by blacks. Only four historically black colleges and universities award doctoral degrees in science and engineering (Trent and Hill 1994, p. 77).

### Hispanics

Eleven of the 50 universities that enrolled the most Hispanic graduate students were members of the Hispanic Association of Colleges and Universities. About a fifth of all Hispanic graduate students in science and engineering fields attended member institutions in both 1988 and 1993. Thirty-nine of the 50 institutions enrolling large numbers of Hispanic graduate students were located in the South, West, and Southeast, or in large urban centers such as New York or Los Angeles, where many Hispanics live. The 10 institutions with the highest Hispanic enrollment accounted for 22 percent of all Hispanic graduate students in science and engineering in the United States. Puerto Rican colleges and universities enrolled 13 percent of all Hispanic graduate

Text table 4-2.

**The top 10 universities enrolling Asian, black, Hispanic, and American Indian graduate students in science and engineering: 1993**

Academic institution	Number of graduate students
<b>Asian</b>	
San Jose State University .....	730
University of Southern California .....	656
University of California—Los Angeles .....	619
University of Houston.....	577
Stanford University.....	501
University of California—Berkeley .....	423
California State University—Long Beach .....	366
Polytechnic University .....	359
University of Illinois at Urbana—Champaign.....	340
Massachusetts Institute of Technology .....	329
<b>Black</b>	
Howard University.....	444
Chicago State University .....	351
Clark Atlanta University .....	275
Georgia Institute of Technology, all campuses .....	258
University of Michigan, all campuses .....	237
Jackson State University.....	217
New York University .....	214
Long Island University, all campuses .....	197
George Washington University .....	194
University of Maryland at College Park .....	186
<b>Hispanic</b>	
University of Puerto Rico—Rio Piedras campus.....	1,093
University of Puerto Rico—Mayaguez campus.....	345
Florida International University .....	248
University of California—Berkeley.....	198
University of Southern California .....	189
Texas A&M University, all campuses .....	183
Center for Advanced Studies on Puerto Rico and Caribbean.....	178
University of New Mexico, all campuses .....	172
University of Texas at Austin.....	168
University of Texas at El Paso .....	166
<b>American Indian</b>	
University of Oklahoma, all campuses .....	45
Northern Arizona University.....	33
Northeastern State University.....	26
University of Colorado, all campuses .....	25
Oklahoma State University, all campuses .....	25
Harvard University .....	23
Cornell University, all campuses.....	22
University of Arizona.....	21
University of Minnesota, all campuses .....	20
University of Washington .....	18

See appendix tables 4-14 to 4-17.

students in science and engineering fields. (See appendix table 4-16.) In 1992, Puerto Rico had the highest percentage of U.S. citizen minority graduates enrolled in science and engineering, 91 percent, virtually all Hispanic (NSF 1994, pp. 295–296).<sup>12</sup>

### American Indians

American Indians tended to concentrate their graduate study in science and engineering in the Southwest, and a fifth attended the 10 institutions with the highest American Indian enrollment. More American Indians enroll in graduate programs in California, the state having the second largest population of American Indians in the Nation, than in any other state. (See appendix table 4-17.)

### Asians

Some 13,000 Asians enrolled at the 50 universities having the most Asian graduate students in 1993. In comparison, about 15,400 underrepresented minorities attended the top 50 (in terms of concentrated enrollment) institutions for their respective groups. Seven of the top 10 universities, enrolling 3,872 of the top 10's 4,900 Asian graduate students, were in the western United States, where their population is concentrated. (See appendix table 4-14.)

### Students With Disabilities

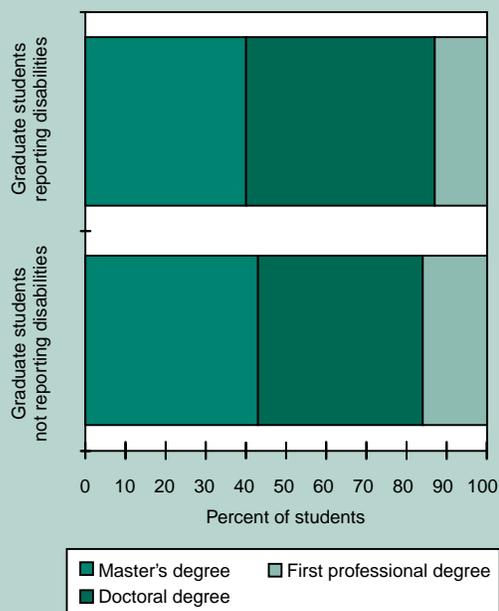
Four percent of postbaccalaureate students (including those planning master's, doctoral, and first-professional degrees) in 1993 reported a disability (Henderson 1995a, 1995b).<sup>13</sup> Proportionately, they are underrepresented compared with their 20 percent presence in the U.S. population. (See chapter 1.) Most graduate students with disabilities attended universities designed to serve all students.<sup>14</sup> Graduate students with disabilities had

<sup>12</sup> Through a special agreement between the Puerto Rican Planning Board designated by the governor as liaison to the Census Bureau, the U.S. Census has not asked a question about race in Puerto Rico since 1950 (personal communication, Lourdes Nieves Flaim, Census Bureau, October, 1995). The 1990 Census, however, asked whether respondents could speak Spanish and English (and, if English, with how much ease or difficulty). Ninety-eight percent of respondents said they could speak Spanish; 51 percent said they didn't speak English (U.S. Department of Commerce, Bureau of the Census 1993a). Thus, Hispanic students in Puerto Rico are part of the majority ethnic culture.

<sup>13</sup> Henderson's analysis is based on data from the U.S. Department of Education, National Center for Education Statistics, National Postsecondary Student Aid Study, 1992–1993. Respondents to this telephone survey, which did not provide telecommunications devices and therefore might underreport data for individuals who are deaf or hard-of-hearing, were undergraduate, graduate, and first-professional students. Among the questions probing demographic and enrollment characteristics was one inquiring if respondents had a "functional limitation, disability, or handicap." Each survey participant answering affirmatively then faced a set of six separate questions about particular disabilities. The National Center for Education Statistics weights responses to produce national estimates for the student population. See appendix A Technical Notes for more information.

<sup>14</sup> Most universities and colleges strive to support individuals with disabilities through special campus programs and offices. Gallaudet University (Washington, D.C.) enrolls large numbers of deaf and hard-of-hearing stu-

Figure 4-7.  
Degree aspirations of graduate students reporting disabilities



SOURCE: Henderson 1995a, p. 3.

similar degree aspirations to others (see figure 4-7), and students with and without disabilities gravitated toward similar fields—the three most popular were education, social behavior, and business/management. (See appendix table 4-18.)

Like undergraduates with disabilities, graduates with disabilities were more likely to be veterans than other students (Henderson 1995b, p. 7). And, because incidence of disability increases with age—persons over 70 *without* disabilities are in a minority group (Davies 1992, analyzing Kraus and Stoddard 1989)—students with disabilities at all postsecondary levels were more likely to be older than others.

Graduate students with disabilities—like all such Americans—benefited from dramatic improvements in assistive technology. The situation for individuals with disabilities in the 1990s, in contrast to their condition only two decades ago, is vastly improved:

Then, precollege education was open to some students with disabilities but certainly not all. At the postsecondary level, individual professors and administrators were sometimes supportive, but there were no national or campus policies to make programs accessible. Science and engineering programs, with strong components of

dents in several of its graduate programs, which also admit other students; the California State University at Northridge also serves this special population within its regular curriculums. Undergraduates who are deaf and hard-of-hearing, however, can choose to enroll in a number of postsecondary institutions designed to serve them. (See chapter 3.)

laboratory and field work, presented countless barriers...(Stern and Summers 1995).

In addition, professional scientific conferences and museums were often inaccessible, and “science employment was possible but often limited” (p. vi). Assistive technology was often both ineffective and underpublicized. By now stereotypes about the limitations of persons with disabilities in science ought to disappear in the face of “closer investigation” that confirms “that pursuit of intellectual interests can surpass any limitation of physical or sensory function” (Stern and Summers 1995, p. vi). However, this is still not the case.

## Outcomes: Master’s, Doctorates, and Postdoctorates in Science and Engineering

Degrees marking the formal outcomes of graduate education are important credentials for those pursuing science and engineering careers. Data on these outcomes provide benchmarks for measuring the progress of population groups in increasing their representation.

Graduate education has expanded significantly during the past 25 years. The overall trends in degree awards document the pattern of growth: for about 10 years, from approximately the mid-1960s until the mid-1970s, growth was sustained and rapid. From that point forward, increases occurred, but they were slower, limited to certain discipline areas, or marked by interim periods of decline.

One hundred and sixty-four percent more master’s degrees were awarded in 1993 than 1966; the percentage of doctorates went up by 121 percent during those years. The number of master’s degrees awarded in science and engineering fields rose more slowly than others—by 110 percent—whereas doctoral awards increased at about the same rate in both these broad fields and all disciplines.

Periods of expansion generally offer environments in which barriers may fall or ease. Although change has in fact occurred, during the last 25 years, the magnitudes of increases for underrepresented groups are strikingly different and in many instances do not approach the level of growth overall. The variety of factors influencing the outcomes for different groups makes generalizations difficult.

The proportion of women earning graduate science and engineering degrees has increased substantially, although it lags behind their presence in other fields, in which women earn more degrees than men at both the master’s and doctoral levels (60 percent of master’s degrees and 52 percent of doctorates). Generally, women have increased their earning of science and engineering graduate degrees, while men’s substantial majority of such degrees has declined slightly. In 1993,

women’s numbers had improved to 36 percent of the master’s and 30 percent of the doctorates; these figures were substantially different from 1966, when women earned 13 percent of science and engineering master’s degrees and 8 percent of such doctorates. When graduate degrees in all fields are counted, however, although men earned fewer than half the master’s, they earned 62 percent of the doctorates (contrast 1966, when men took 66 percent of the master’s and 88 percent of the doctorates). (See appendix table 4-19.)

Participation varies across racial/ethnic groups as well as by degree level. Over the last decade, however, increases occurred in total degree awards across all disciplines to members of all groups. In 1966, women earned 47,588 master’s degrees (34 percent of those awarded) and 2,086 doctorates (12 percent). By 1993, those numbers had climbed to 201,220 (54 percent) and 15,108 (38 percent).

## Master’s Degrees

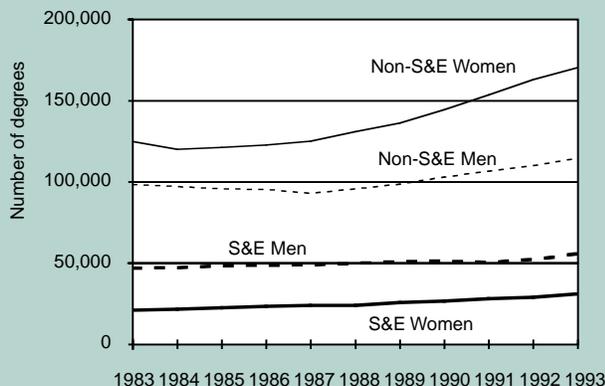
### Women

Women earned over half of the 370,973 master’s degrees awarded in all fields in 1993. (See appendix tables 4-20 and 4-22.) They first received a majority of all master’s degrees in 1981, earning more than half the nonscience and engineering degrees since 1975 (NSF 1994, p. 74). (See appendix table 4-19.) In science and engineering fields, both the number of women earning master’s degrees and their percentage of the total have risen steadily, increasing in the last 10 years to 30,971 (36 percent of degrees awarded). In contrast, the number of science and engineering degree awards to men reached a high in 1977, then bottomed out in 1981; in 1990, the number climbed above the 1977 level and has continued upward since then.

Women’s master’s awards varied by field. In the science fields excluding engineering, women steadily increased their share. By 1993, women accounted for 46 percent of science master’s degrees, up from 39 percent a decade earlier. Among the science fields, women were most heavily represented in psychology, earning almost 72 percent of the master’s degrees in 1993, up from 61 percent in 1983; biological/agricultural sciences (46 percent in 1993, 38 percent in 1983); and social sciences (almost 47 percent in 1993). Men were most overrepresented in earth, atmospheric, and ocean sciences (72 percent of the degrees) and the physical sciences (70 percent).

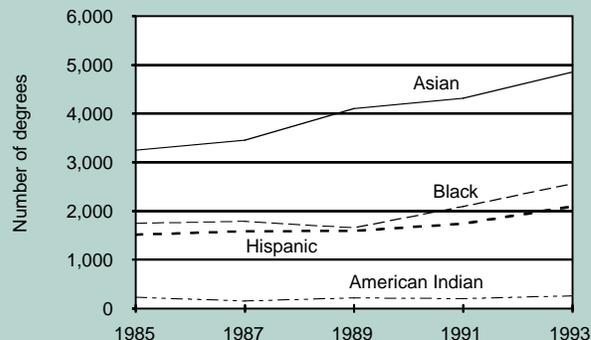
Women continued to be seriously underrepresented among engineering master’s degrees. Their percentage of master’s degrees overall did increase, however, from 9 percent in 1983 to 15 percent in 1993. (See figures 4-8 and 4-9.)

Figure 4-8. Master's degrees awarded in science and engineering (S&E) fields and in non-S&E fields, by sex: 1983–1993



See appendix table 4-20.

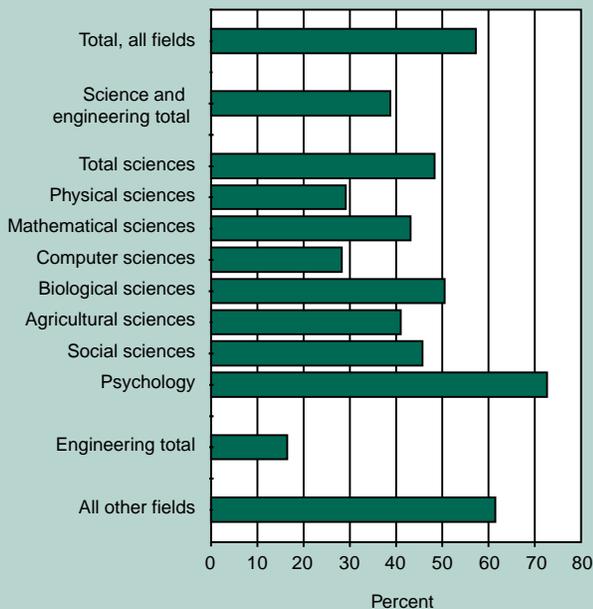
Figure 4-10. Master's degrees awarded to minorities in science and engineering fields, by race/ethnicity: 1985–1993 (selected years)



NOTE: U.S. citizens and permanent residents only.

See appendix table 4-21.

Figure 4-9. Percentage of master's degrees awarded to women, by field: 1993



See appendix table 4-20.

### Minorities

In 1993, U.S. citizens and permanent residents earned 81 percent of their master's degrees in fields other than science and engineering. Members of underrepresented minority groups earned 4,899 science and engineering master's degrees in 1993; Asians, 4,846 (each making up about 8 percent of the total master's

awarded in those fields). This was an increase for both groups, both in absolute numbers and proportions of the total: blacks, Hispanics, and American Indians together earned 7 percent in 1985, and Asians, about 6 percent. (See figure 4-10.)

Despite uneven growth during the last decade, some science and engineering disciplines granted substantially higher numbers of master's degrees. Different racial/ethnic groups gained at different rates—Asians earned 48 percent more master's degrees than in 1985; blacks, 47 percent; Hispanics, 38 percent; American Indians, 11 percent; and whites, 9 percent. (See appendix table 4-21.)

### Asians

Asian predominance among master's degree holders in engineering was more marked than in the combined fields. In 1985, Asians earned 11 percent of such degrees, compared with 5 percent for underrepresented minorities. In 1993, Asians held 13 percent, compared with 7 percent for blacks, Hispanics, and American Indians.

The science and engineering field with the largest number of awards at the master's degree level for all racial/ethnic groups except for Asians was social science; they earned only 3 percent of those degrees. Asians earned the highest proportion of all degrees in computer science (18 percent), followed by engineering (13 percent). (See appendix table 4-22.)

The gains were especially striking in computer science, in which Asians' proportion of all such degrees went up from 12 percent in 1985 to 18 percent in 1993, an 80 percent increase.

### Blacks

Numbers of science and engineering master’s degrees awarded to blacks continued to climb since 1989, growing by 47 percent between 1985 and 1993, with the greatest increases occurring in recent years. In 1993, blacks earned 18,897 master’s degrees in all fields, just over 6 percent of the total, a proportion that has remained relatively stable over the past 8 years. The biggest gains were in mathematical science (84 percent) and computer science and engineering (71 percent in each field).

### Hispanics

The overall growth trend for Hispanics earning master’s degrees in science and engineering was similar to that for blacks, and second only to Asians. Hispanics earned 2,092 science and engineering master’s degrees in 1993, 4 percent of the total, up 578 from 1985, when they held 3 percent of the total. In 1993, Hispanics earned over 11,000 master’s degrees in all fields, almost 4 percent of the total.

### American Indians

The few American Indians earning master’s degrees—1,344 in 1993, considerably less than 1 percent of total degrees awarded—makes comparisons and generalizations difficult. Only 253 American Indians earned master’s degrees in science and engineering in 1993; this figure was up slightly from 228 in 1985.

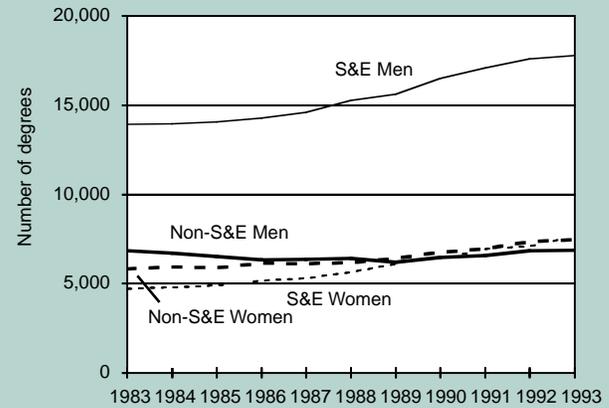
### Doctorates

Of the nearly 40,000 doctorates awarded in the United States in 1993, about two-thirds went to U.S. citizens and students on permanent visas, an increase from the over 25,000 awarded in 1983. Students from other nations and those of unknown citizenship status earned over 11,000 doctoral degrees that year. The percentage of students from abroad was higher in science and engineering than their presence in the general population of those receiving doctorates. Of the more than 25,000 doctorates awarded here in 1993 in science and engineering, 58 percent went to citizens and permanent residents. Over 60 percent of doctorates in engineering went to students from other nations and those of unknown citizenship status. Underrepresented U.S. minorities earned 8 percent of the total doctorates awarded to U.S. citizens, up from about 6 percent of the total in 1983. (See appendix tables 4-26 and 4-27.)

### Women

Women in all citizenship groups earned 15,108 of the 39,754 doctorates awarded in all fields in 1993, 38 percent of the total. (See appendix tables 4-23 and 4-24.)

Figure 4-11.  
**Doctoral degrees awarded in science and engineering fields and in non-S&E fields, by sex: 1983–1993**



See appendix table 4-23.

In fields other than science and engineering, women earned 52 percent of the doctorates awarded in 1993, up from 46 percent in 1983. The number of doctoral degrees in science and engineering awarded to women increased from 4,624 (4,500 science and 124 engineering) in 1983 to 7,537 in 1993 (7,016 and 521)—63 percent more degrees in 1993. (See figure 4-11.)

Important differences marked trends in science and engineering fields. Although the number of women earning doctorates in engineering remained small, it was over four times their total in 1983 and in terms of percentages of all engineering degrees awarded, was nearly double the 1992 percentage. (See appendix table 4-23 and text table 4-3.)

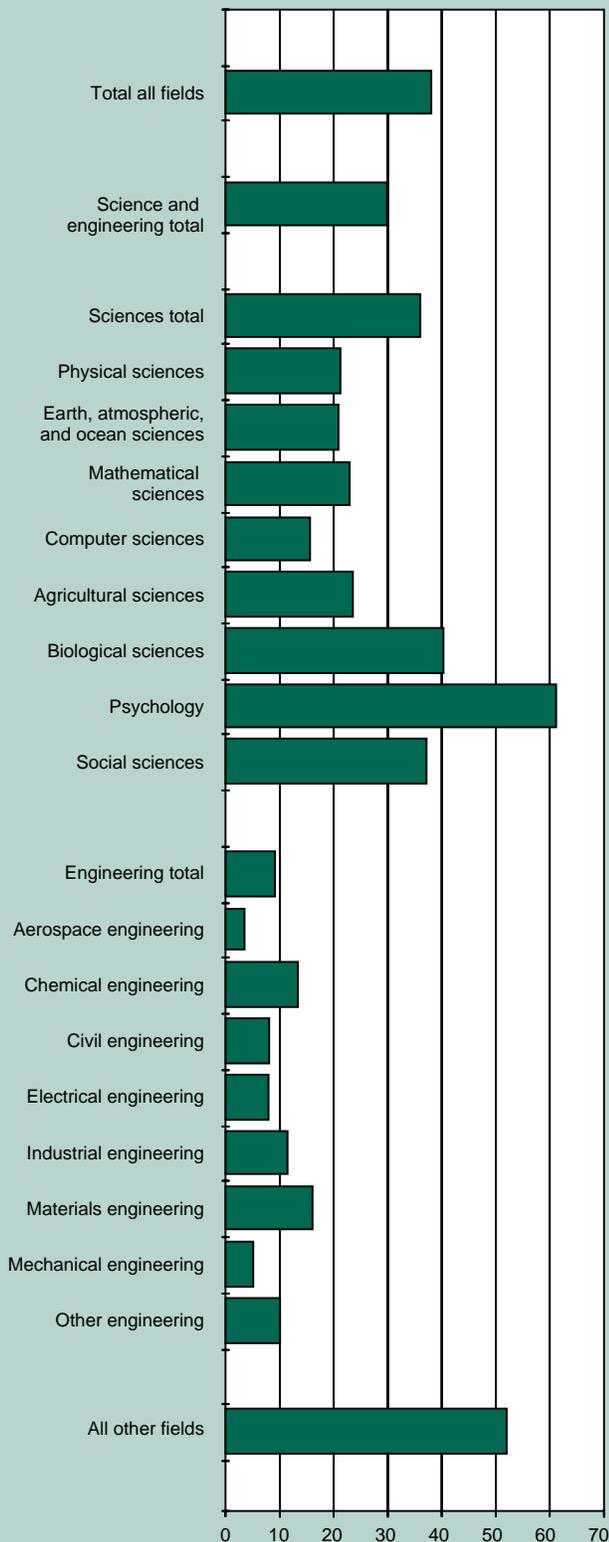
In 1993, women earned the highest percentage of doctorates in psychology (61 percent), the only broad science field in which women received a majority of the doctorates. Psychology was followed by biological sciences (40 percent of all awards went to women) and the social sciences (37 percent). (See figure 4-12.) Men, on the other hand, earned the highest percentage of doctorates in engineering (91 percent), computer sciences (84 percent), physical sciences (79 percent), earth sciences (79 percent), and mathematical sciences (77 percent).

Women earned more doctoral degrees in all science and engineering fields in 1993 than 1983. Although their

Text table 4-3.  
**Percentage of women doctorates in science and engineering, 1983 and 1993**

	1983	1993
Science and engineering.....	25	30
Science fields .....	29	36
Engineering .....	4	9

Figure 4-12.  
**Percentage of doctorates awarded to women, by field: 1993**



See appendix table 4-24.

numbers remained small in several science fields in 1993, they earned almost four times as many doctorates in computer science, almost twice as many in mathematics, and more than twice as many in the physical sciences as 10 years earlier. Men earned fewer degrees in agriculture and in psychology in 1993 than 1983.

### Where They Study

Women received the majority of doctorates awarded in science fields at two California universities—the California School of Professional Psychology and the United States International University. In no institution

### The Rites and Wrongs of Passage: Critical Transitions for Female PhD Students in the Sciences

Henry Etzkowitz, Carol Kemelgor, and Joseph Alonzo have identified several “critical transitions” in the graduate experience in science and engineering where PhD students are “propelled forward, pushed out, or dropped down to a lower level” (1995). When successfully negotiated, these “ceremonies”—

- taking the qualifying examination
- finding a research advisor
- arriving at a dissertation topic
- bringing work to the closure that earns the degree

—constitute the *rites* of passage to a doctorate. When too challenging, they turn into *wrongs* that can (and often do) impede progress. According to findings by Etzkowitz and his colleagues, many women science and engineering doctoral candidates find these initiations to be barriers.

*Rites and Wrongs* follows up earlier research<sup>15</sup> in which Etzkowitz and his colleagues interviewed 155 women doctoral candidates from a nationwide sample of science and engineering departments that included two that had graduated the most women; two that had graduated the fewest; and two that had shown the greatest improvement in increasing awards to women (1975–1990). In *Rites and Wrongs*, the researchers found that, “These academically superior women, who had typically been at the top of their undergraduate classes, were shocked upon entering graduate school to find themselves marginalized and isolated.”

<sup>15</sup> Etzkowitz, Kemelgor, Neuschatz, and Uzzi (1994) and Etzkowitz, Kemelgor, Neuschatz, Uzzi, and Alonzo (1994).

## The Rites and Wrongs of Passage: Critical Transitions for Female PhD Students in the Sciences

Although the “blind” grading of qualifying exams can lead to a welcome gender-neutral situation, “women tend to internalize difficulties and resort to self blame in contrast to men...” Female students often find it hard to establish the camaraderie with advisors so valuable to males and—without this collegiality—can fail to collect the advisor’s vital invitations to and introductions at conferences that place his/her “social capital...like a mantle around the student.” And, if these “issues of isolation, lack of direction, contacts, and conflict around...life choices continue to dominate, the student may withdraw before earning her degree.”

For many of the women with science and engineering doctorates tracked by Etzkowitz and his colleagues to postdegree placements and interviewed, “the overwhelming [graduate school] experience...is that of isolation and disconnection in their depart-

ments and, in the most severely negative academic environments, among themselves.”

Conclude Etzkowitz and his colleagues,

Critical transitions for women in science are not yet “rites of passage” into a welcoming community; transition points are often fraught with peril for female scientific careers. As women ascend the educational ladder, they increasingly find support at the early stages, only later to encounter the exercise of arbitrary authority or simple inattention to women’s needs.

On other barriers women face in science and engineering, see Etzkowitz and Kemelgor, with Neuschatz, Uzzi, Mulkey, Seymour, and Alonzo (in press).

did they earn the majority of degrees in engineering, earning none in 11 of the universities awarding women the most science and engineering doctorates and a high of 28 at Stanford University (14 percent of degrees conferred). (See appendix table 4-25.)

### Minorities

Since 1983, minorities—both Asian and other—increased the numbers of doctorates they earned and their percentage of the total degrees awarded. (See figure 4-13.) As was the case with master’s degrees, whites and Asians together accounted for most of the increase in numbers of science and engineering doctorates. In terms of proportional increase of groups of individuals earning such doctorates, however, whites gained the smallest percentage—8 percent—compared to 106 percent for Asians, 91 percent for Hispanics, 43 percent for American Indians, and 38 percent for blacks. For all of the underrepresented minorities, the numbers of science and engineering doctorate recipients in 1993 were very small: fewer than 600 went to Hispanics, fewer than 500 to blacks, and fewer than 50 to American Indians. Numbers of doctorates awarded to all groups increased between 1983 and 1993. (See appendix table 4-26.)

Foreign nationals with permanent visas increased both their numbers of earned doctorates and their proportion of the total awards over the decade. In science and engineering fields, they recorded the largest jump—733 more doctorates than 1983—a percentage rise from 6 to 10 percent of the doctorates awarded to U.S. citizens and permanent residents.

U.S. citizens and permanent residents earned well over 16,000 doctorates in science and engineering fields in 1993, 14 percent more than they had earned a decade earlier. Of this number, 16 percent were earned by minorities (6 percent by blacks, Hispanics, and American Indians). (See figure 4-14.) Asians increased their percentage substantially in science and engineering as well as other fields. (See appendix tables 4-26 and 4-27.)

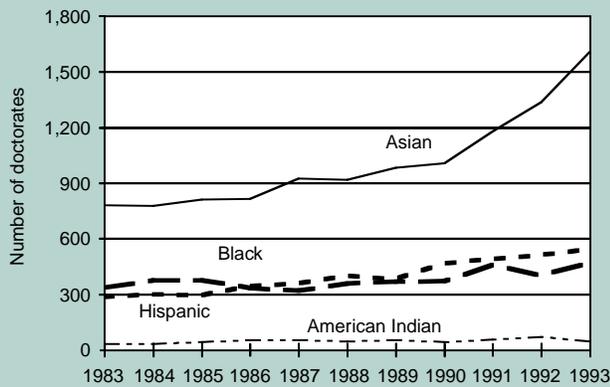
### Asians

Between 1983 and 1993, Asians increased their representation in doctorates in all fields, earning 891 degrees in 1993, over 3 percent of the total to U.S. citizens. Their number among doctorates awarded in science and engineering also increased, to 713 in 1993—5 percent of such doctorates awarded to citizens and permanent residents.

### Blacks

In 1993, although the proportion of doctorates earned by black U.S. citizens in all fields remained at the roughly 4 percent they held in 1983, they earned 184 more degrees. Their 2 percent proportion of science and engineering doctorates also remained steady over the decade; however, they earned 77 more degrees in 1993 than 1983. The most popular science and engineering field by far for black U.S. citizens and permanent residents at the doctorate level was psychology, which accounted for almost one-third of all of the science and engineering doctorates awarded. (See figure 4-15.)

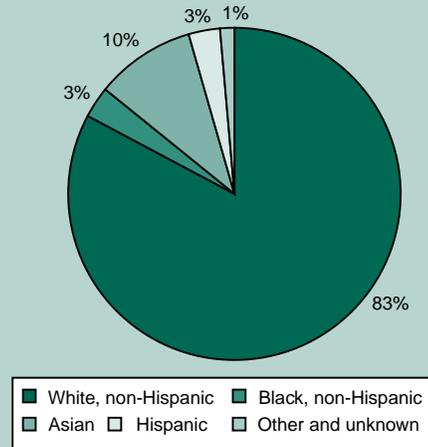
Figure 4-13.  
**Doctorates awarded to minorities in science and engineering fields, by race/ethnicity: 1983–1993**



NOTE: U.S. citizens and permanent residents only.

See appendix table 4-26.

Figure 4-14.  
**Percentage of U.S. citizen science and engineering doctorate recipients, by race/ethnicity: 1993**



See appendix table 4-26.

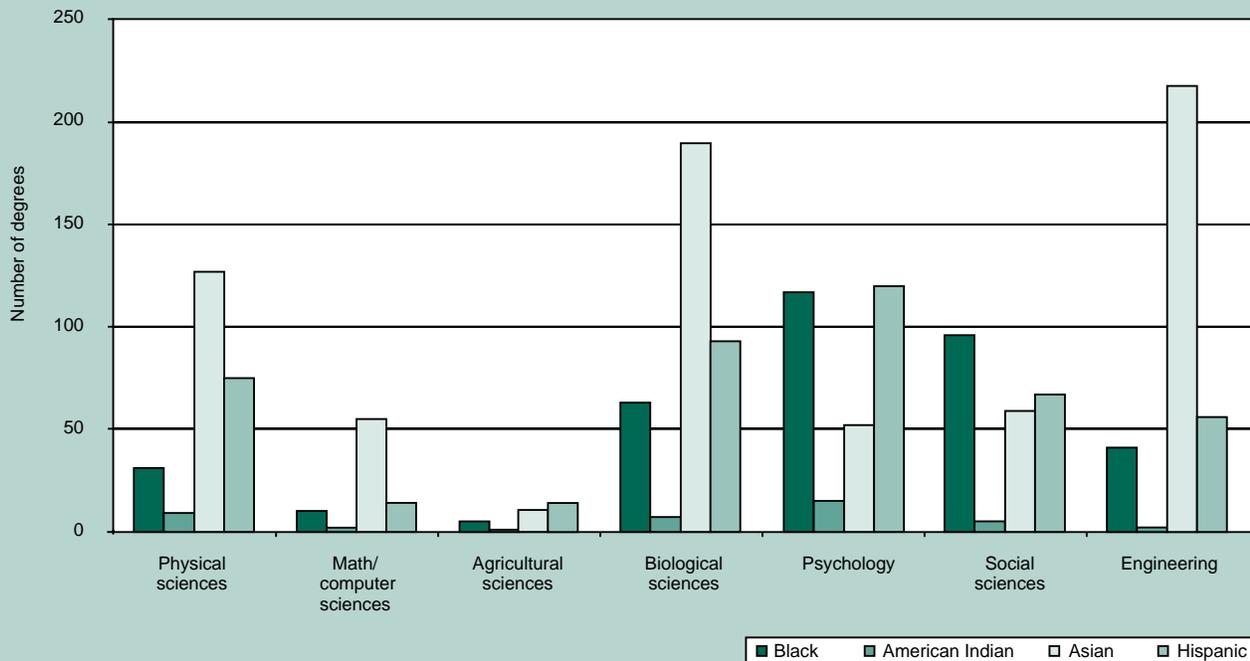
### Hispanics

In 1993, Hispanics earned 834 doctorates in all fields, just over 3 percent of the doctorates earned by all U.S. citizens. They increased both their total doctorates and percentage from 1983 (539 and 2 percent, respectively).

The number of science and engineering doctorates earned by Hispanics increased by 87 percent over the decade, though, as in the case of blacks, the numbers

remained relatively small. In science and engineering, Hispanics earned 446 of the doctorates to U.S. citizens in 1993, 3 percent of the total. In this area they also increased both their numbers—up from 239—and their proportion—up from 2 percent in 1983. The most popular science and engineering field at the doctorate level for Hispanics was psychology, the field chosen by 27 percent of Hispanics earning science and engineering doctorates.

Figure 4-15.  
**Science and engineering doctorate recipients, by field and race/ethnicity: 1993**



NOTE: U.S. citizens and permanent residents only.

See appendix table 4-27.

## American Indians

In 1993, only 119 American Indians earned doctorates in all fields (43 of them in science and engineering), in both cases, well under 1 percent of the total. The most popular field was psychology (37 percent of all science and engineering doctorates).

## Where They Study

Although doctoral education in the United States is a national resource, operating to some extent in a national market, awards of science and engineering doctorates to U.S. citizens show regional variations by race/ethnicity. Asians earned 44 percent of the doctorates to minorities who are U.S. citizens (and 5 percent of all doctorates to U.S. citizens). In only one case did more than two American Indians earn degrees from the same institution in 1993; in contrast, more than 120 Asians earned doctorates at three large California universities combined. Hispanics, who earned 3 percent of the science and engineering doctorates awarded in 1993 to U.S. citizens, were also concentrated in California at the University of California (Berkeley and Los Angeles campuses); nine or more of them also graduated from the University of Puerto Rico–Rio Piedras Campus, the University of Miami (Florida), two Texas universities, and Ohio State University. (See appendix table 4-28.) All these institutions except Ohio State are located in areas where many Hispanics live.

## Students With Disabilities

Individuals reporting disabilities earned only 329 science and engineering doctorates in 1993, just over 1 percent of the 25,184 total such degrees awarded. Two-hundred-and-eighty-four of those degrees were in science fields; 45 in engineering. Sixty-two percent of the science doctorates awarded to persons reporting disabilities were fairly evenly distributed across three fields—the biological and social sciences and psychology. (See appendix table 4-29.) Small as the numbers are, they represent an 18 percent increase over the 280 science and engineering doctorate earners with disabilities self-reporting the year before (NSF 1994, p. 83).<sup>16</sup>

Persons with disabilities are more likely than other doctorate earners to take their degrees in psychology (22 percent compared to 14 percent) and in the social sciences (20 percent compared to 14 percent) and less likely to take doctorates in engineering (14 percent compared to 23 percent).

The trend of respondents to report “other” or “unknown” when requested to identify their disabilities continued upward. Those reporting “other” disabilities

or not responding rose from 23 percent in 1988 to 40 percent in 1993. (See NSF 1994, p. 84, and appendix table 4-30.) This choice may reflect the growing number of individuals claiming learning and health-related disabilities as well as those unable or unwilling to define their disability within the other categories offered.

The race/ethnicity of U.S. citizens with disabilities holding doctorates in science and engineering parallels that of all who hold such degrees, with one exception. Asians earned 5 percent of all U.S. citizens’ doctorates in science and engineering. (See appendix table 4-26.) They constitute only 3 percent of the persons with disabilities earning doctorates in science and engineering. (See appendix table 4-31.)

Earning a doctorate generally takes longer for students with disabilities than for those without. Almost half of all graduate students with disabilities in 1993 spent more than 10 years completing their science and engineering doctorates; only a third of all graduate students in those fields spent as long. (See figure 4-16, box “Students With Disabilities Studying Science, Engineering, and Mathematics: The Time Disadvantage” on page 32, chapter 3.) For variations on time from baccalaureate to doctorate by sex and field, see appendix table 4-5.

## Postdoctorates

Postdoctorates offer individuals interim opportunities to continue their careers while searching for permanent appointments in academia or industry. Postdoctoral positions in science and engineering fields, which have increased in number since the mid-1980s,<sup>17</sup> have historically been more prevalent in scientific fields such as biological sciences than in engineering. Recent years have seen more postdoctoral students in other fields.

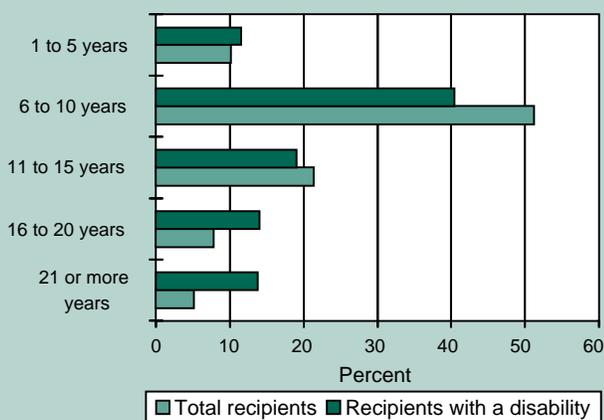
Since 1988, men have been appointed to more postdoctoral positions in all science and engineering fields than have women; however, the proportion of science and engineering postdoctorates awarded to women edged from 25 percent in 1988 to 28 percent in 1993. (See appendix table 4-33.) Asians holding doctoral degrees are more likely to enter postdoctoral training positions than blacks, Hispanics, or American Indians (Smith and Tang 1994, p. 107). Although postdoctoral appointments have continued to increase steadily, the largest proportionate gain between 1988 and 1993 occurred among the few women postdoctorates in anthropology, where their proportion went from 34 percent of the appointments to 56 percent.<sup>18</sup>

<sup>17</sup> Data on postdoctorates are collected neither by racial/ethnic group nor by disability status.

<sup>18</sup> 1991–1993 data from the American Anthropological Association report that women faculty in that field make up 35 percent of full professors, 31 percent of associates, and 31 percent of assistants (Givens and Jablonski 1995). This distribution among ranks is more uniform than that shown among the full-time ranked science and engineering faculty on appendix table 5-27.

<sup>16</sup> Changes in the willingness of respondents to identify themselves as having a disability may also account for some of this increase over time. (See chapter 3.)

Figure 4-16.  
Time between bachelor's and doctoral degrees, by disability status: 1993



See appendix table 4-32.

## References

- Accreditation Board for Engineering and Technology. 1994 (September). *Sixty-Second Annual Report*. Baltimore, MD: Accreditation Board for Engineering and Technology.
- Curtin, Jean M., Geneva Blake, and Christine J. Cassagnau. 1995 (May 13). *The Climate for Female Students in Physics Departments*. Paper delivered at a meeting on the Women, Gender, and Science Question, Minneapolis, MN.
- Davies, Daniel K. 1992 (September). *Understanding Disability in the Computing Profession* (survey conducted for the Association for Computing Machinery in cooperation with NSF). Colorado Springs, CO: Meeting the Challenge.
- Dresselhaus, Mildred S., Judy R. Franz, and Bunny C. Clark. 1995. *Improving the Climate for Women in Physics Departments: A Program of Site Visits Funded by the NSF*. College Park, MD: American Physical Society and American Association of Physics Teachers.
- Etzkowitz, Henry, Carol Kemelgor, and Joseph Alonzo. 1995. *The Rites and Wrongs of Passage: Critical Transitions for Female PhD Students in the Sciences*. Arlington, VA: Report to the NSF.
- Etzkowitz, Henry, Carol Kemelgor, Michael Neuschatz, and Brian Uzzi. 1994. Barriers to women's participation in academic science and engineering. In Willie Pearson, Jr., and Alan Fechter (Eds.), *Who Will Do Science? Educating the Next Generation* (pp. 43–67). Baltimore, MD: The Johns Hopkins University Press.
- Etzkowitz, Henry, Carol Kemelgor, Michael Neuschatz, Brian Uzzi, and Joseph Alonzo. 1994 (7 October). The paradox of critical mass for women in science. *Science*, 266: 51–54.
- Etzkowitz, Henry, and Carol Kemelgor, with Michael Neuschatz, Brian Uzzi, Lynn Mulkey, Elaine Seymour, and Joseph Alonzo. In press. *Athena Unbound: Overcoming Barriers to Women in Science*. Cambridge, England: Cambridge University Press.
- Finn, Michael G., Leigh Ann Pennington, Kathryn Hart Anderson. 1995 (April). *Foreign Nationals Who Receive Science or Engineering PhDs from U.S. Universities: Stay Rates and Characteristics of Stayers*. Unpublished technical report, Analysis and Evaluation Programs, Science/Engineering Education Division, Oak Ridge Institute for Science and Education, TN.
- Givens, David B., and Timothy Jablonski. 1995. 1995 survey of anthropology PhDs. In American Anthropological Association (Ed.), 1995–1996 AAA guide (pp. 306–317). Arlington, VA: American Anthropological Association.
- Henderson, Cathy. 1995a. Postsecondary students with disabilities: Where are they enrolled? *Research Briefs*, 6(6). Washington, DC: American Council on Education, Division of Policy Analysis and Research.
- Henderson, Cathy. 1995b. Special Report to the National Science Foundation on Postbaccalaureate Students With Disabilities. Unpublished manuscript.
- Kraus, Lewis E., and Susan Stoddard. 1989. *Chartbook on Disability in the United States* (InfoUse report). Washington, DC: U.S. National Institute on Disability.
- Nerad, Maresi. 1991. *Doctoral Education at the University of California and Factors Affecting Time-to-Degree*. Oakland: University of California, Office of the President.
- NSF. 1994. *Women, Minorities, and Persons With Disabilities in Science and Engineering: 1994* (NSF 94-333). Arlington, VA: National Science Foundation.
- Seymour, Elaine, and Ann-Barrie Hunter. In press. *Talking About Disability: The Education and Work Experiences of Graduates and Undergraduates With Disabilities in Science, Mathematics, and Engineering Majors*. Washington, DC: American Association for the Advancement of Science.

- Smith, Earl, and Joyce Tang. 1994. Trends in science and engineering doctorate production, 1975–1990. In Willie Pearson, Jr., and Alan Fechter (Eds.), *Who Will Do Science? Educating the Next Generation* (pp. 96–124). Baltimore, MD: The Johns Hopkins University Press.
- Stern, Virginia W., and Laureen Summers. 1995. *Resource Directory of Scientists and Engineers with Disabilities* (3rd ed). Washington, DC: American Association for the Advancement of Science.
- Syverson, Peter D., and Moira J. Maguire. 1995 (March). *Graduate Enrollment and Degrees: 1986 to 1993*. Washington, DC: Council of Graduate Schools.
- Trent, William, and John Hill. 1994. The contributions of historically black colleges and universities to the production of African American scientists and engineers. In Willie Pearson, Jr., and Alan Fechter (Eds.), *Who Will Do Science? Educating the Next Generation* (pp. 68–80). Baltimore, MD: The Johns Hopkins University Press.
- U.S. Department of Commerce, Bureau of the Census. 1993a (October). *1990 Census of Population: Social and Economic Characteristics: Puerto Rico*. Washington, DC: U.S. Department of Commerce.
- U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. 1993b. *We the American ... Asians*. Washington, DC: U.S. Department of Commerce.
- U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. 1993c. *We the American ... Blacks*. Washington, DC: U.S. Department of Commerce.
- U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. 1993d. *We the ... First Americans*. Washington, DC: U.S. Department of Commerce.
- U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. 1993e. *We the American ... Hispanics*. Washington, DC: U.S. Department of Commerce.