Chapter 2
Higher Education in Science and Engineering

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Highlights

Financing Higher Education

Tuition increases at colleges and universities in the United States have grown rapidly for the past two decades, although the rate of increase slowed in the past few years.

- ♦ Compared with the previous year, average tuition and fees rose 6.3% for academic year 2006–07 for in-state students in public 4-year colleges, 5.9% for students in private 4-year colleges, and 4.1% for students in public 2-year colleges.
- ♦ As state spending on higher education rose from FY 2005 to FY 2007, the rate of tuition increase at public 4-year colleges slowed.

Levels of debt for both undergraduate and graduate education are high.

- ♦ Among 2003–04 bachelor's degree recipients in all fields who took out loans, the median level of debt was $19,300.
- ♦ At the time of doctorate conferral, about half of 2005 S&E doctorate recipients reported having debt from either their undergraduate or graduate education: 27% reported undergraduate debt and 33% reported graduate debt.
- ♦ High levels of educational debt were most associated with graduate education: 10% of S&E doctorate recipients had more than $50,000 of graduate debt but only 1% had similar amounts of undergraduate debt.

In 2005, about 21% of full-time S&E graduate students received more than half of their financial support for graduate education from the federal government.

- ♦ Most (69%) S&E graduate students primarily funded by the federal government are funded under grants to universities for academic research.
- ♦ Fellowships and traineeships fund 22% of federally funded full-time S&E graduate students.
- ♦ Federal support for graduate education reaches relatively more students in the physical sciences; earth, atmospheric, and ocean sciences; agricultural sciences; biological sciences; and engineering. Relatively few students receive federal support in mathematics, computer sciences, social sciences, psychology, and medical/other life sciences.

Higher Education Faculty

The types of assignments and methods used to grade students vary by discipline.

- ♦ Most (83%) instructional faculty use lecture/discussion as the primary instructional method for undergraduate classes.
- ♦ More than half of natural sciences and engineering faculty require their undergraduate students to participate in group projects (compared with 48% of social and behavioral sciences faculty), and more than 60% require lab assignments (compared with 24% of social and behavioral sciences faculty).
- ♦ The use of term papers increased in all disciplines between 1992 and 2003. Social and behavioral sciences faculty are more likely than faculty in other S&E fields to require written work of their students: 85% of social and behavioral sciences faculty require term papers of their undergraduate students compared with 76% of agricultural/biological/health sciences faculty and 57% of physical/mathematics/computer sciences/engineering faculty.

Higher Education Enrollments

Enrollment in U.S. higher education is projected to continue rising because of increases in the U.S. college-age population.

- ♦ Enrollment rose from 12.7 million in 1986 to 16.9 million in 2004.
- ♦ The number of individuals ages 20–24 in the U.S. population is projected to rise through 2050 although the demographic composition will shift.
- ♦ Increased enrollment in higher education is projected to come mainly from minority groups, particularly Asians and Hispanics.

S&E graduate enrollment in the United States continued to rise, reaching a new peak of 583,200 in fall 2005.

- ♦ Following a long period of growth, graduate enrollment in S&E declined in the latter half of the 1990s then increased steadily since 1999.
- ♦ In fall 2005, graduate enrollment increased in most S&E fields except computer sciences and engineering.
- ♦ Graduate enrollment in computer sciences and engineering decreased in the past 2 years because of declining foreign student enrollment.

Total enrollment of foreign S&E graduate students dropped in fall 2005 for the second year in a row, but first-time full-time enrollment increased in 2005 after 3 years of decline.

- ♦ S&E graduate students on temporary visas increased from 20% to 25% of all S&E graduate students from 1985 to 2005.
- ♦ The number of first-time full-time S&E graduate students with temporary visas declined 18% from 2001 through 2004 but increased 4% in fall 2005.

Higher Education Degrees

The number of S&E bachelor's and master's degrees awarded annually continued to rise, reaching record highs in 2005.

♦ The numbers of S&E bachelor's and master's degrees awarded reached new peaks of 466,000 and 120,000, respectively, in 2005.

♦ Most S&E fields (except computer sciences) experienced increases in the number of degrees awarded in 2005.

♦ In computer sciences, the number of bachelor's degrees increased sharply from 1998 to 2004 but decreased in 2005.

Women earned more than half of all bachelor's degrees and S&E bachelor's degrees in 2005 but major variations persist among fields.

♦ Women earned more than half of bachelor's degrees in psychology (78%), agricultural sciences (51%), biological sciences (62%), chemistry (52%), and social sciences (54%).

♦ Men earned the majority of bachelor's degrees awarded in engineering (80%), computer sciences (78%), and physics (79%).

Blacks, Hispanics, and American Indians/Alaska Natives choose S&E fields at the same rate as whites.

♦ Among bachelor's degree recipients, about one-third of the degrees earned by every racial/ethnic group (except Asians/Pacific Islanders) are in S&E. Asians/Pacific Islanders, as a group, earn almost half of their bachelor's degrees in S&E.

Students in the United States on temporary visas earned only a small share (4%) of S&E bachelor's degrees in 2005.

♦ The number of S&E bachelor's degrees awarded to students on temporary visas increased over the past two decades from 14,100 in 1985 to 18,400 in 2005.

♦ In 2005, these students earned 8% of bachelor's degrees awarded in computer sciences and 7% in engineering.

Master's degrees in S&E fields increased from 70,600 in 1985 to 120,000 in 2005.

♦ Increases in master's degrees occurred in most major S&E fields.

♦ Master's degrees in engineering and physical sciences decreased from 1995 to 2002 but increased in recent years, and master's degrees in computer sciences generally increased through 2004 but dropped in 2005.

The number and percentage of master's degrees awarded to women in all major S&E fields (with the exception of computer sciences) have increased since 1985.

♦ Since 1985, the number of S&E master's degrees earned by women more than doubled, rising from 22,300 in 1985 to 53,000 in 2005.

♦ In computer sciences, the number of master's degrees awarded to women increased through 2004 but dropped in 2005, and the percentage of degrees awarded to women dropped from 34% in 2001 to 29% in 2005.

♦ The number of master's degrees earned by men grew more slowly from 48,200 in 1985 to 67,000 in 2005, with most of the growth occurring between 2002 and 2004.

The number of S&E master's degrees awarded increased for all racial/ethnic groups from 1985 to 2005.

♦ The proportion of master's degrees in S&E fields earned by U.S. citizen and permanent resident racial and ethnic minorities increased over the past two decades.

♦ Asians/Pacific Islanders accounted for 7% of master's degrees in 2005, an increase from 5% in 1985. Blacks and Hispanics also registered gains during this period (from 3% to 6% for blacks and from 2% to 4% for Hispanics). American Indians/Alaska Natives earned 0.4% of S&E master's degrees in 1985 and 2005.

♦ The percentage of S&E master's degrees earned by white students fell from 68% in 1985 to 47% in 2005. Meanwhile, the percentage of degrees earned by minorities and temporary residents increased, and the number of S&E master's degrees earned by white students dropped from 1996 to 2002 before increasing again.

Foreign students make up a much higher proportion of S&E master's degree recipients than they do of bachelor's or associate's degree recipients.

♦ During the past two decades, the share of S&E master's degrees earned by temporary residents rose from 19% to 28%.

♦ S&E master's degrees awarded to students on temporary visas rose from approximately 12,500 in 1985 to about 33,500 in 2005 and increased in most S&E fields during that period.

The number of S&E doctorates awarded by U.S. academic institutions reached a new peak of almost 30,000 in 2005.

♦ The largest growth in the number of doctorate awards was in engineering and the biological and agricultural sciences.

♦ Virtually all of the growth reflected higher numbers of S&E doctorates earned by temporary visa holders.

Students on temporary visas earned more than a third (36%) of all S&E doctorates awarded in the United States in 2005.

- The number of S&E doctorates earned by temporary residents rose to a new peak of 10,800 in 2005.
- Temporary residents earned half or more of all U.S. doctorates in engineering, mathematics, computer sciences, physics, and economics in 2005.

Most foreign recipients of U.S. S&E doctorates plan to stay in the United States after graduation.

- Among 2002–05 graduates, 74% of foreign S&E doctorate recipients with known plans reported they planned to stay in the United States and 49% had accepted firm offers of employment.
- The percentage of students who had firm plans to remain in the United States dropped after 2001, then increased in 2005.
- More than 90% of 2002–05 U.S. S&E doctoral recipients from China and 88% of those from India reported plans to stay in the United States, and 60% and 63%, respectively, reported accepting firm offers for employment or postdoctoral research in the United States. The percentages of U.S. S&E doctorate recipients from China and India with definite plans to stay in the United States dropped from 1998–2001 to 2002–05. The decreases were almost entirely among doctorate recipients in computer sciences and engineering.

The number of doctorate recipients with S&E postdoctoral appointments at U.S. universities more than doubled in the past two decades.

- Temporary visa holders accounted for 55% of S&E postdocs in academic institutions in fall 2005.
- More than two-thirds of S&E postdocs in academic institutions are in the biological, medical, and other life sciences fields.

Global S&E Education

Educational attainment of the U.S. population has long been among the highest in the world, but other countries are catching up.

- The United States continues to have the highest percentage of the population ages 25–64 with a bachelor's degree or higher. However, among the population ages 25–34, the United States (30%) lags behind Norway (37%), Israel (34%), the Netherlands (32%), and South Korea (31%) in the percentage with at least a bachelor's degree.
- The United States ranks 4th (behind Russia, Israel, and Canada) in the population ages 25–64 with any postsecondary degree (including 2-year and 4-year or higher degrees), and it ranks 10th (behind Russia, Canada, Japan, Israel, South Korea, Sweden, Belgium, Ireland, and Norway) in the population ages 25–34 with any postsecondary degree.

Global competition for foreign students increased in the past two decades.

- The U.S. share of foreign students declined in recent years, although the United States remains the predominant destination for foreign students (accounting for 22% of internationally mobile students in 2004).
- The United Kingdom, Germany, and France also attract large numbers of foreign students, accounting for 11%, 10%, and 9%, respectively, of internationally mobile students in 2004.

Introduction

Chapter Overview

The importance of higher education in S&E is increasingly recognized around the world for its impact on innovation and economic development. S&E higher education provides the advanced skills needed for a competitive workforce and, particularly in the case of graduate S&E education, the research necessary for innovation.[1]

A number of key influences shape the nature of U.S. S&E higher education and its standing in the world. In recent years, demographic trends and world events contributed to changes in both the numbers and types of students participating in U.S. higher education. After declining in the 1990s, the U.S. college-age population is currently increasing and is projected to increase for the next decade. The composition of the college-age population is also changing, with Asians and Hispanics becoming an increasing share of the population. Recent enrollment and degree trends, to some extent, reflect these changes. For example, graduate S&E enrollment and the number of S&E degrees at all levels are up, and the proportion of S&E degrees earned by minorities is increasing.

In the 1990s, the number of foreign students coming to the United States for higher education study, particularly from countries in Asia, increased substantially. Increases in foreign students contributed to most of the growth in overall S&E graduate enrollments in recent years. After September 11, 2001, the number of foreign students coming to the United States for graduate education dropped for several years, but these numbers increased in 2005 (although they have not yet regained earlier levels).

Finally, global competition in higher education is increasing. Although the United States has historically been a world leader in providing broad access to higher education and in attracting foreign students, many other countries are expanding their own higher education systems, providing expanded educational access to their own population, and attracting larger numbers of foreign students. The effects of these trends on foreign student enrollment in U.S. institutions remain to be seen.

Chapter Organization

This chapter describes characteristics of the U.S. higher education system as well as trends in higher education worldwide. It begins with characteristics of U.S. higher education institutions providing S&E education, including trends in tuition and fees, financial support, and debt levels. Trends in student involvement in higher education, including freshmen interest and enrollment in S&E fields, degree completions, and postdoctoral study are discussed along with trends by sex, race/ethnicity, and citizenship. The chapter highlights the flows of foreign students into the United States by country and their intentions to remain in this country. The chapter then presents various international higher education indicators, including comparative S&E degree production in several world regions and the growing dependence of all industrialized countries on foreign S&E students. Additional state data on tuition charges, enrollment, and degrees granted are available in chapter 8, State Indicators.

The U.S. Higher Education System

Higher education in S&E has been receiving increasing attention as an important component contributing to the nation's maintenance of a strong economic position in the world (NSB 2003). A number of recent reports (AACU 2007; BEST 2004; COSEPUP 2006; NAE 2005; NSB 2004a; Project Kaleidoscope 2006) called for increasing the quantity, quality, and diversity of the students studying and graduating in S&E fields.

Institutions Providing S&E Education

The U.S. higher education system consists of a large number of academic institutions and a wide variety of institution types that provide broad access, advance the frontiers of knowledge, and strive to meet students' changing needs through new forms of teaching and learning (U.S. Department of Education 2006). Among the approximately 4,300 postsecondary degree-granting institutions in the United States in the 2005–06 academic year, 71% offered bachelor's or higher degrees and 29% offered associate's degrees as the highest degree awarded (NCES 2007). In 2005, these institutions awarded more than 2 million bachelor's or higher degrees (about 614,000 in S&E) plus about 641,000 associate's degrees (46,000 in S&E).

Research Institutions

Research institutions, although few in number, are the leading producers of S&E bachelor's, master's, and doctoral degrees. In 2005, research institutions (i.e., doctorate-granting institutions with very high research activity) awarded 69% of S&E doctoral degrees, 42% of master's degrees, and 36% of bachelor's degrees in S&E fields. (See sidebar "Carnegie Classification of Academic Institutions.") Master's colleges and universities awarded another 28% of S&E bachelor's degrees and 24% of S&E master's degrees in 2005. Baccalaureate colleges were the source of relatively few S&E bachelor's degrees (13%) (appendix table 2-1).

Community Colleges

Community colleges figure broadly in answering the nation's need for well-prepared technicians, and as the initial (and sometimes only) college experience for many students who are the first in their family to seek education beyond high school (Adelman 2005) or who have limited funds or ability to leave a given geographic area for a college education. *Community colleges* (also known as *associate's colleges* and *2-year institutions*) are the largest segment of the higher education enterprise in the United States. In 2004, they enrolled 6.3 million students, about 60% of whom were enrolled part time.

Carnegie Classification of Academic Institutions

The 2005 version of the Carnegie Foundation for the Advancement of Teaching's basic classification scheme for colleges and universities is more complex than previous versions and includes subcategories, new names, and new criteria for categories. Academic institutions are categorized primarily on the basis of highest degree conferred, level of degree production, and research activity. In this report, several categories have been aggregated for statistical purposes. The following are characteristics of those groups:

Doctorate-granting universities include institutions that award at least 20 doctoral degrees per year. They include three subgroups based on level of research activity: very high research activity, high research activity, and doctoral/research universities.

Master's colleges and universities include institutions that award at least 50 master's degrees and fewer than 20 doctoral degrees per year.

Baccalaureate colleges include institutions in which baccalaureate degrees represent at least 10% of all undergraduate degrees and that award fewer than 50 master's degrees or 20 doctoral degrees per year.

Associate's colleges include institutions in which all degrees are at the associate's level or bachelor's degrees account for less than 10% of all undergraduate degrees.

Special focus institutions are those in which at least 75% of degrees are concentrated in a single field or a set of related fields.

Tribal colleges are colleges and universities that are members of the American Indian Higher Education Consortium.

Although community colleges are not major sources of S&E degrees, they provide S&E coursework that is affordable, remedial, and potentially transferable, and they play a role in developing public scientific literacy. They also serve as a bridge for students who go on to major in S&E fields at 4-year institutions. Almost 29% of students who began at a community college in the 1995–96 academic year had transferred to 4-year institutions as of 2001 (Berkner, He, and Cataldi 2003).

Several efforts are underway to improve community college students' transition to 4-year institutions. Four-year institutions and private foundations are directing a portion of their entering student scholarship funds and recruitment efforts to community college student transfers. The impetus for these efforts is a desire to meet students' need for financial assistance coupled with the perception that community college transfers generally do well on transferring (Fischer 2007a; Suggs 2005; Blanton 2007). A recent study of Latino(a)s' pathway to graduate school reinforces that view (de los Santos and de los Santos 2005). (See sidebar "Community Colleges and Latinos.") Another factor in the ability of transfer students to obtain a bachelor's degree within 4–6 years of transfer is the number of transfer credits accepted by the 4-year colleges to which they transfer (Doyle 2006). Many states have adopted articulation policies (i.e., policies among institutions to accept the transfer credits) to encourage transfer of students from 2-year to 4-year colleges (NCES 2005a).

Community college courses play a large role in mathematics preparation of undergraduates. In fall 2005, 1.7 million students were enrolled in mathematics and statistics courses at public 2-year colleges (an increase of 26% from fall 2000); this includes 42,000 high school students who took dual-enrollment math courses on a high school campus and received course credit at both the high school and the community college. Two-year colleges taught about 47% of all undergraduates enrolled in courses in the nation's mathematics departments and programs. Although enrollment in elementary statistics courses in 4-year colleges and universities grew by 9% from fall 2000 to fall 2005, community college enrollment in those courses grew by 58% (Kirkman et al. 2007).

In addition to their traditional roles, community colleges are beginning to offer a limited number of 4-year degrees (AASCU 2004), to examine closely their role in teacher preparation, and to develop some dual-credit programs with neighboring high schools. With the exception of those related to teacher preparation, the 4-year degrees offered at

Community Colleges and Latinos

Latinos share many risk factors associated with educational attainment with community college students in general. Community college students are more likely than 4-year college students to be from households with low incomes, to be from groups currently underrepresented in S&E fields, to be the first in their family to attend college, to have dependents to support, to be older than the average college student, to exhibit lower achievement in high school, and to delay attendance at college rather than go directly from high school to college (Bailey 2004).

Latino students, as well as black and American Indian/Alaska Native students, are more likely than white or Asian students to attend community colleges. More than half (53%) of Latino undergraduates in 2004 were enrolled in community colleges compared with 41% of white students (NSF/SRS 2007a). At Arizona State University, which has a large Latino population, 67% of all students and 73% of the Latino bachelor's degree recipients in 2002–03 attended one or more of the local community colleges (Maricopa Community Colleges) before obtaining their degree (de los Santos and de los Santos 2005).

community colleges generally are in high-demand fields and are issued as bachelor of applied science degrees. (See, for example, the approximately 30 such programs offered in Florida's community college system [Fischer 2007b].)

Community colleges provide the science and mathematics coursework for many elementary and secondary science and mathematics teachers. They increasingly offer coursework for K–8 teachers and provide programs in which preservice education students can complete their entire mathematics courses or licensure requirements. Thirty percent of community colleges reported that they offer mathematics programs for preservice elementary school teachers and 19% reported preservice middle school licensure-oriented programs. In fall 2000, teacher certification programs were almost entirely limited to 4-year colleges and universities; however, by fall 2005, several community colleges offered courses and programs that would lead directly to certification of primarily K–8 teachers (Kirkman et al. 2007).

Community colleges also offer dual enrollment (high school and community college) courses in mathematics, including college algebra, precalculus, calculus, and statistics. Fifty percent of community colleges report having such courses. Most of them are taught on the high school campus by high school teachers, and usually the college and high school mathematics departments come to mutual agreement about factors such as syllabuses and textbooks (Kirkman et al. 2007).

U.S. Higher Education Faculty

S&E faculty constituted about half of the approximately 1.1 million instructional faculty in U.S. institutions in fall 2003. Most S&E faculty have doctoral or first professional degrees, and the number and percentage of S&E faculty with doctoral or first professional degrees is increasing. About 305,000 doctoral S&E faculty (about 60% of all S&E faculty) taught in U.S. universities in 2003, up from 249,000 in 1992 (appendix table 2-2). The largest fraction of doctoral S&E faculty (43%) taught agricultural, biological, or health sciences; another third (34%) taught physical sciences,[2] mathematics, computer sciences, or engineering; and 23% taught social and behavioral sciences. This section deals with the teaching aspects of S&E faculty. Additional information about faculty employment can be found in chapter 3 (Science and Engineering Labor Force), and information about trends in academic employment of doctoral faculty and faculty research can be found in chapter 5 (Academic Research and Development).

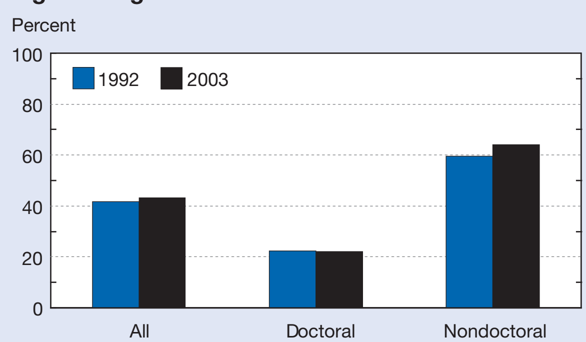
About 40% of S&E faculty have a master's or bachelor's degree as their highest degree. The number of S&E faculty with master's or bachelor's degrees who taught in U.S. colleges or universities rose from 174,000 in 1992 to 202,000 in 2003. Almost half are physical, mathematical, computer sciences, and engineering faculty (mainly computer sciences and mathematics faculty). In contrast to S&E faculty, about 60% of the approximately 586,000 non-S&E faculty in 2003 had master's or bachelor's degrees (appendix table 2-2).

Part-time faculty are an increasing portion of all instructional faculty in the United States. The overall increase in part-time faculty from 1992 to 2003 was almost entirely accounted for by an increase in the percentage of nondoctoral faculty (from 60% in 1992 to 64% in 2003) (figure 2-1). Among doctoral faculty, there was no increase in the percentage of faculty employed part time between 1992 and 2003. Most doctoral S&E faculty (about 80%) are employed full time (appendix table 2-2). In contrast, the majority of faculty with bachelor's and master's degrees (both S&E and non-S&E) are employed part time.

The types of institutions in which doctoral and nondoctoral S&E faculty teach differ. Close to half (47%) of full-time doctoral S&E faculty (and more than half of full-time doctoral life sciences faculty) teach in research institutions (appendix table 2-3).[3] In contrast, 11% of full-time nondoctoral S&E faculty teach in research institutions. Most nondoctoral S&E faculty and almost half of part-time S&E faculty teach in public 2-year institutions (table 2-1).

Most (62%) full-time S&E faculty taught only undergraduates in 2003, while 25% taught only graduate students, and the remainder taught both undergraduate and graduate students (appendix table 2-4). In 2003, about two-thirds of physical sciences/mathematics/computer sciences/engineering and social/behavioral sciences faculty taught only undergraduate students. A far higher percentage of agricultural/biological/health sciences faculty (42%) than of other S&E faculty (13%) taught only graduate students. Full-time nondoctoral S&E faculty taught undergraduates almost exclusively. Among full-time doctoral S&E faculty, almost one-third taught only graduate students, slightly more than half (51%) taught only undergraduate students, and the remainder taught both undergraduate and graduate students. From 1992 to 2003, the percentage of doctoral faculty who taught only undergraduates declined and the percentage who taught only graduate or first professional students (e.g., law or medical students) increased, particularly among full-time doctoral agricultural/biological/health sciences faculty.

Figure 2-1
Higher education faculty employed part time, by highest degree: Fall 1992 and fall 2003



SOURCE: National Center for Education Statistics, National Survey of Postsecondary Faculty, 1993 and 2004, special tabulations (2006).

Science and Engineering Indicators 2008

Table 2-1
Higher education faculty, by teaching field, highest degree, employment status, and institution type: Fall 2003
(Percent)

Faculty characteristics	Number	Research institutions	Other institutions	Public 2-year institutions
S&E	505,300	29.3	42.1	28.7
Full time	322,500	38.1	44.3	17.6
Part time	182,700	13.6	38.2	48.3
Doctorate/first professional degree	304,600	43.3	48.3	8.5
Other high degree	200,700	8.0	32.6	59.4
Non-S&E	587,800	16.7	53.1	30.2
Full time	297,300	23.4	56.9	19.7
Part time	290,500	9.9	49.1	41.0
Doctorate/first professional degree	236,100	26.5	63.0	10.5
Other high degree	351,700	10.2	46.4	43.5

NOTES: Institution type based on 1994 Carnegie classification. See National Science Board, *Science and Engineering Indicators 2006* (NSB 06-01A) for characteristics of these institution types.

SOURCE: National Center for Education Statistics, 2004 National Survey of Postsecondary Faculty, special tabulations (2006).

Science and Engineering Indicators 2008

Undergraduate S&E faculty increasingly rely on teaching assistants (TAs) to help with their courses. More than one-third of full-time undergraduate S&E faculty used TAs in 2003, up from 26% in 1992 (appendix table 2-5). The use of TAs is higher for doctoral faculty than for nondoctoral faculty, and is especially prevalent among doctoral faculty in the aggregate physical sciences/mathematics/computer sciences/engineering fields (54%). Only 16% of full-time nondoctoral S&E faculty and 18% of full-time non-S&E faculty use TAs in their undergraduate classes. Among all undergraduate faculty, primary instruction methods differ by discipline. (See sidebar "Primary Instruction Methods of Undergraduate Faculty.")

Trends in Undergraduate Education

The recent Spellings Commission report called for higher education in the United States to improve access for all students, reform the financial aid system, provide better assessments of learning outcomes, improve the quality of instruction, meet changing employer needs, and improve accountability (U.S. Department of Education 2006). Several other recent reports (BEST 2004; COSEPUP 2006; NAE 2005; Project Kaleidoscope 2006) called for reforms to undergraduate S&E education, including increasing opportunities for students to engage in original research, developing a more global perspective, broadening the diversity of S&E majors, and encouraging interdisciplinary approaches. These reports also called for improvement in teaching through incorporation of new technologies and findings from education research and assessment, and broadening education to include non-science-based skills. In recent years, new approaches to undergraduate education have been developed in a wide variety of disciplines and types of institutions. (See sidebar "Interdisciplinary Degree Programs" for ways in which some of these changes are being manifested in new programs. See sidebar "Nontechnical Skills Employers Expect of New Entrants to the Workforce" for information about what employers expect undergraduate education to provide.)

A number of recent developments, including research (both general and discipline specific) on S&E undergraduate education, published outcomes from initiatives begun earlier to improve the delivery of S&E education (AAAS 2004; Boylan 2006; Clewell et al. 2006; Lattuca, Terenzini,

Primary Instruction Methods of Undergraduate Faculty

Most (83%) instructional faculty use lecture/discussion as the primary instructional method for undergraduate classes (Chen 2002). The types of assignments and methods used to grade students vary by discipline. More than half of faculty in the natural sciences* and engineering require their undergraduate students to participate in group projects (compared with 48% of social and behavioral sciences faculty) and more than 60% require lab assignments (compared with 24% of social and behavioral sciences faculty) (appendix table 2-6).

Social and behavioral sciences faculty are more likely than faculty in other S&E fields to require written work of their students: 85% of social and behavioral sciences faculty require term papers of their undergraduate students compared with 76% of agricultural/biological/health sciences faculty and 57% of physical/mathematical/computer sciences/engineering faculty. The use of term papers increased in all disciplines between 1992 and 2003.

* Natural sciences include agricultural, biological, health, physical, earth, atmospheric, and ocean sciences; mathematics; and computer sciences.

Interdisciplinary Degree Programs

In response to the increasing interdependence of S&E disciplines, programs and courses within higher education increasingly reflect interdisciplinary approaches. In one notable interdisciplinary field, neuroscience, the number of doctorates awarded increased from 308 in 1995 to 689 in 2005 (NORC 2006). New interdisciplinary approaches are exemplified in the multidisciplinary doctorate program being adapted at the University of California at Santa Barbara, the Economics and Environmental Science PhD Training Program (www.ees.ucsb.edu/). Students earn a doctorate in either economics or in one of the natural sciences. Students in both fields are required to fulfill requirements in their own discipline as well as interdisciplinary courses. They design and conduct thesis research projects that span the two disciplines and include faculty from both departments as advisors.

At the undergraduate level, some interdisciplinary approaches include efforts to design courses and programs around an inherently interdisciplinary discipline (such as bioinformatics or nanotechnology) as a means of developing students' abilities with allied disciplines. Others involve developing programs whose implementation is enhanced by knowledge, habits of mind, and work approaches from many disciplines. As an example of the first, a broad spectrum of physics and biology faculty in New Mexico are developing a collaborative educational network. This network uses an interdisciplinary approach to produce materials about nanoscience appropriate for use in undergraduate courses in both biology and physics as a means of introducing nanoscience into two diverse disciplines. Biology faculty are developing a knowledge base in physics and physics faculty are developing a knowledge base in biology through joint attendance at workshops and development of course materials. As an example of the second, tissue engineering is being introduced to biology and engineering students in a joint biology/mechanical engineering course at the University of South Carolina–Columbia. Senior-level students are designing bioreactors in their laboratory course and then using the experience to design experiments in courses at their own and other institutions.

and Volkwein 2006; Lopatto 2004; NAE 2005), a growing body of literature of efforts to change undergraduate education, the emergence of the National Science Digital Library (http://nsdl.org/), increasing availability of assessment and evaluation tools, and new technologies available to undergraduate students, help to inform undergraduate education reform efforts.

Several efforts to improve engineering education have been introduced by professional societies, the National Academy of Engineering, and ABET (the accrediting body for postsecondary degree-granting programs in engineering) (Lattuca, Terenzini, and Volkwein 2006; NAE 2005). In 1996, ABET adopted a new set of standards for engineering programs called Engineering Criteria 2000 (EC2000). These new standards focused on assessing learning outcomes and broadening the set of skills required to include communication, working in teams, and ethics. Another project, Engineer of 2020, is an effort by the National Academy of Engineering to look at the future of engineering, including skills that may be needed in coming years. The project envisions that graduates in 2020 will need such traits as strong analytical skills, creativity, ingenuity, professionalism, and leadership (NAE 2005).

In mathematics, special interest groups focusing on educational issues at the undergraduate level have been formed at the Mathematical Association of America. In biology,

Nontechnical Skills Employers Expect of New Entrants to the Workforce

Employers believe that in order for the United States to compete in a global economy, the entering workforce should possess certain skills beyond expertise in their major field (AACU 2005; Bollag 2005; Conference Board 2006; NACE 2005; SCANS 1991). Some of the most important of these skills include good written and oral communication, critical thinking, the ability to work in teams, good interpersonal skills, and professionalism/work ethic.

The Conference Board (2006) recently found that too few college graduates excel in these areas. The majority of employers reported that 2- and 4-year college graduates were "adequate" in terms of general preparation for entry-level jobs. However, only 10% reported that 2-year graduates and 24% reported that 4-year graduates were "excellent." In addition, more than one-fourth of employers reported that 4-year college graduates and almost half reported that 2-year college graduates were deficient in written communication. When asked about future skill needs, employers reported that the following basic knowledge and applied skills are expected to increase in importance: knowledge of foreign languages, making appropriate choices concerning health and wellness, and creativity/innovation.

Beyond attitudinal surveys, there is little current quantitative evidence of the effectiveness of postsecondary education, whether for specific knowledge and skills related to a field of study or for workplace readiness (Swyer, Millet, and Payne 2006; U.S. Department of Education 2006). However, efforts are under way to provide such evidence.

several new or upgraded education journals have been introduced in recent years, for example, *CBE Life Sciences Education, Microbiology Education, Biochemistry and Molecular Biology Education,* and Education Forum section in *Science*. Across fields, science departments are beginning to build science education positions into their departmental structure, hiring people with a strong research degree within the discipline and interest and expertise in educational research (Bush et al. 2006; NAS 2006). These types of positions have a relatively long history in mathematics and physics but are only beginning to be widely introduced in disciplines such as biology, chemistry, or earth sciences.

In the federal government, the Academic Competitiveness Council recently focused attention on the effectiveness of federal agency programs in science, technology, engineering, and mathematics (STEM) education (U.S. Department of Education 2007). Nine federal agencies administer 43 programs aimed at improving STEM undergraduate education, including increasing numbers and retention in STEM fields, increasing diversity, and improving content and pedagogy. The council advocated more rigorous evaluation of these programs, particularly of long-term student outcomes.

Financing Higher Education

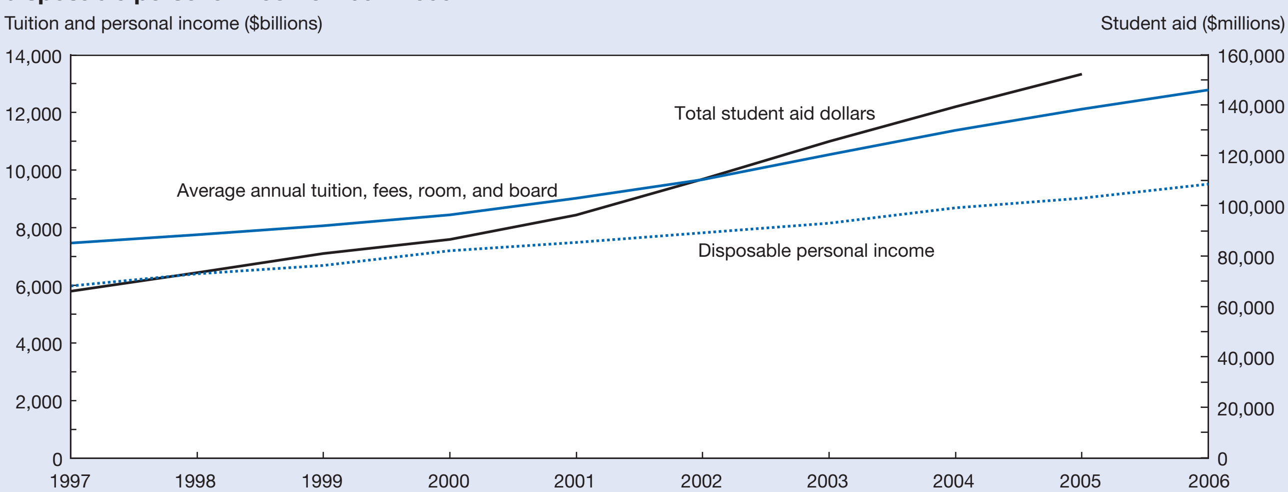
Rising costs of higher education and increases in student debt over the past two decades raised questions about affordability and access in U.S. higher education institutions (NSB 2003). Public institutions account for about 40% of all degree-granting higher education institutions in the United States and enroll almost 80% of all undergraduates. In the past, these institutions were funded primarily through state expenditures. In recent years, the percentage of funding coming from state expenditures has declined, state per-student spending has declined, and tuition has increased. This section examines trends in tuition levels (including net price to students by family income), need-based and merit-based financial aid, financial support for undergraduate and graduate education, and student debt.

Tuition

Tuition and fee increases at colleges and universities in the United States have grown rapidly for the past two decades, rising well above increases in disposable income. However, student aid increased even faster than tuition (figure 2-2). Tuition and fee increases reached double-digit rates in 2003–04, although the rate of increase slowed in the past few years (table 2-2). In the 2006–07 academic year, average tuition and fees, compared with the previous year, rose 6.3% for in-state students at public 4-year colleges, 5.9% for students in private 4-year colleges, and 4.1% for students at public 2-year colleges (College Board 2006a).

As state spending rose from FY 2005 to FY 2007, the rate of increase of tuition and fees at public 4-year colleges slowed. Fluctuations in state spending, however, do not completely explain variations in tuition and fees. Other contributors to tuition and fee increases include rising prices of goods and services purchased by colleges and universities as measured by the Higher Education Price Index, which have risen faster in recent years than the Consumer Price Index (CPI). From academic years 2000–01 to 2005–06, the prices paid by colleges and universities for utilities, salaries, fringe benefits, and supplies and materials rose faster than the CPI (College Board 2006a).

Figure 2-2
Average annual tuition, fees, room, and board for public 4-year institutions, total student aid dollars, and disposable personal income: 1997–2006



SOURCES: College Board, Trends in College Pricing 2006; and Bureau of Economic Analysis, National Income and Product Accounts Table 2.1, http://www.bea.gov/national/nipaweb/SelectTable.asp?Selected=N, accessed 13 April 2007.

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Table 2-2
Average annual published tuition and fee charges: 1996–97 to 2006–07

	Private 4-year		Public 4-year		Public 2-year		Private 4-year		Public 4-year		Public 2-year	
Academic year	Charges (current US$)	Annual change (%)	Charges (current US$)	Annual change (%)	Charges (current US$)	Annual change (%)	Charges (2006 constant US$)	Annual change (%)	Charges (2006 constant US$)	Annual change (%)	Charges (2006 constant US$)	Annual change (%)
1996–97	12,994	na	2,975	na	1,465	na	16,843	na	3,856	na	1,899	na
1997–98	13,785	6.1	3,111	4.6	1,567	7.0	17,480	3.8	3,945	2.3	1,987	4.6
1998–99	14,709	6.7	3,247	4.4	1,554	-0.8	18,355	5.0	4,052	2.7	1,939	-2.4
1999–2000	15,518	5.5	3,362	3.5	1,649	6.1	18,935	3.2	4,102	1.2	2,012	3.8
2000–01	16,072	3.6	3,508	4.3	1,642	-0.4	18,965	0.2	4,139	0.9	1,938	-3.7
2001–02	17,377	8.1	3,766	7.4	1,608	-2.1	19,962	5.3	4,326	4.5	1,847	-4.7
2002–03	18,060	3.9	4,098	8.8	1,674	4.1	20,379	2.1	4,624	6.9	1,889	2.3
2003–04	18,950	4.9	4,645	13.3	1,909	14.0	20,931	2.7	5,131	11.0	2,109	11.6
2004–05	20,045	5.8	5,126	10.4	2,079	8.9	21,568	3.0	5,516	7.5	2,237	6.1
2005–06	20,980	4.7	5,492	7.1	2,182	5.0	21,781	1.0	5,702	3.4	2,265	1.3
2006–07	22,218	5.9	5,836	6.3	2,272	4.1	22,218	2.0	5,836	2.4	2,272	0.3

na = not applicable

NOTE: Enrollment data weighted.

SOURCE: College Board, Trends in College Pricing 2006.

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Students typically do not pay the full tuition and fee charges, which averaged $5,836 for in-state students at public 4-year colleges, $22,218 for students at private 4-year colleges, and $2,272 for students at public 2-year colleges during the 2006–07 academic year (table 2-2). The net price of an undergraduate college education is defined as the published price minus the average grant aid and tax benefits that students receive. Student aid (grant aid and tax benefits) averaged $3,100 at public 4-year institutions, $9,000 at private 4-year institutions, and $2,200 at public 2-year institutions in 2006–07.

In 2006–07, the net price was about $2,700 at public 4-year institutions, $13,200 at private 4-year institutions, and under $100 at public 2-year colleges (College Board 2006a).[4] The net price at public 4-year institutions (in inflation-adjusted dollars) fell between 1997–98 and 2002–03 but rose through 2006–07, while the net price at private 4-year institutions rose between 1997–98 and 2006–07. The net price of college for low-income students did not increase over the past decade. For middle-income students, the net price of college also remained stable after accounting for grants and loans (with the bulk of aid in the form of loans). Thus, middle-income students subsequently had higher levels of debt from educational loans. From 1993 to 2004, the percentage of degree recipients who borrowed and their median amount of debt both increased (American Council on Education 2005).

Graduate tuition varies more than undergraduate tuition. Graduate tuition is typically per credit, which varies by academic institution and often varies within an institution depending on the school, department, or degree program, and sometimes the stage of the program (e.g., first-year, dissertation). Furthermore, the number of credits required for graduation and thus the total tuition varies by the length of the program (e.g., 1-year master's, 2-year master's, doctoral). On average, the cost of attendance was $24,000 for full-time graduate students in public institutions and $35,800 for those in private institutions for the 2003–04 academic year (Redd 2006).

The number of students who pay tuition also varies by enrollment status, institution, discipline, and type of funding. In some disciplines, most full-time students receive financial assistance in the form of fellowships, teaching assistantships, or research assistantships, and many may receive tuition waivers. However, school-to-school differences exist even within disciplines, and master's level students are generally treated differently from doctoral candidates. In other disciplines, students are largely self-supported and do not receive tuition waivers. (See sidebar, "Cost of Higher Education Internationally.")

Undergraduate and Graduate Student Financial Support Patterns

Financial Support for Undergraduate Education. As tuition increased in the 1990s, students increasingly relied on financial aid (especially loans) to finance their education. Financial aid for undergraduate students is mainly in the form of grants, student loans (federal or private), and work study. A financial aid package may contain one or more of these kinds of support. In the 2003–04 academic year, about one-third of all undergraduate students received no financial aid, about half received grants, and about one-third took out loans (NCES 2005a). A higher percentage of undergraduates in private, nonprofit 4-year institutions (83%) than of those in public 4-year

Cost of Higher Education Internationally

Unlike the United States, many countries historically did not charge tuition for higher education. In the past decade, however, most instituted some form of cost sharing, either tuition or fees (Preston 2006). Imposition of tuition and fees has been a response to a growing need for additional revenue, growth in enrollment, and competing demands on public funding. For example, tuition was first instituted in China in 1997, in Great Britain in 1998, in Austria in 2001, and in some German states in 2006 (Johnstone 2003; Kehm 2006). In the Scandinavian countries, tuition remains free but students are charged for room and board. In some countries in East Asia and Latin America, public institutions remain free but because enrollment is limited, expansion of higher education has been primarily through private institutions that charge tuition and fees. In most countries where tuition is charged, students are offered some form of low-cost loans for higher education (Johnstone 2003).

The initiation of tuition and fees and increases in tuition in some countries have raised concerns about affordability. For example, in China in 2000, the government set annual tuition at about 5,000 yuan (about U.S. $600), which is considered high given the average urban per capita income of 10,493 yuan (U.S. $1,313) and the average farmer's income of 3,256 yuan (U.S. $407) (OBHE 2003; Shinan 2006). In Canada, average undergraduate tuition increased at an average of 7% annually since 1990–91, almost 4 times the average rate of inflation (Statistics Canada 2006). Canadian public colleges are seen by some as less affordable than those in the United States because even though tuition is lower, U.S. public colleges provide far more money in the form of grants than do Canadian colleges (Birchard 2006; Usher and Steele 2006). Direct comparisons of affordability across countries are difficult because tuition, financial assistance, and policies for providing public subsidies vary widely among countries and even within some countries depending on citizenship (OECD 2006). Table 2-3 shows average amounts of tuition by country. Countries with higher tuition fees do not necessarily provide greater amounts of financial support to students, and countries with low tuition may have substantial proportions of students receiving scholarships and grants (OECD 2006).

Table 2-3
Estimated average annual tuition fees of tertiary-type A educational institutions for full-time students, by type of institution: Academic year 2004
(U.S. dollars)

Country	Public institutions	Private institutions
OECD countries		
Australia	5,289	13,420
Austria	853	800
Belgium (Flemish)[a]	540	536
Belgium (French)[a]	658	751
Canada	3,267	NA
Czech Republic	None	3,449
Denmark	None	NA
Finland	None	None
France	156–462	500–8,000
Germany	NA	NA
Greece	NA	NA
Hungary	351	991
Iceland	None	3,000 (2,100–4,400)
Ireland	NA	NA
Italy	983	3,992
Japan	3,747	5,795 (4,769–25,486)
Korea	3,623 (1,955–7,743)	6,953 (2,143–9,771)
Luxembourg	na	na
Mexico	NA	NA
Netherlands	na	1,565
New Zealand[b]	2,538	3,075
Norway	None	4,000–6,500
Poland	NA	NA
Portugal	868	3,803
Slovak Republic	None	NA
Spain	801 (668–935)	NA
Sweden	None	None
Switzerland	566–1,132	NA
Turkey	274	9,303–11,961
United Kingdom	na	1,794
United States	4,587	17,777
Partner countries		
Chile	3,845	3,822
Israel	2,300	2,442

NA = not available; na = not applicable; OECD = Organisation for Economic Co-operation and Development

[a]Tuition fees same in public and private institutions, but distribution of students differs between public and private institutions, explaining why weighted average not same.
[b]Tertiary-type A includes advanced research programs.

NOTES: Academic year 2004 refers to 2003–04 school year. U.S. dollars converted using purchasing power parities (PPPs). PPPs are currency conversion rates that both convert to common currency and equalize purchasing power of different currencies and eliminate differences in price levels between countries in process of conversion. Amounts of tuition fees and associated proportions of students should be interpreted with caution because result from weighted average of main tertiary-type A programs and do not cover all educational institutions. However, figures reported can be considered good proxies and show difference among countries in tuition fees charged by main educational institutions for majority of students.

SOURCE: OECD, Education at a Glance: OECD Indicators 2006 (2006), http://www.oecd.org/edu/eag2006. See Annex 3 for notes, accessed 13 April 2007.

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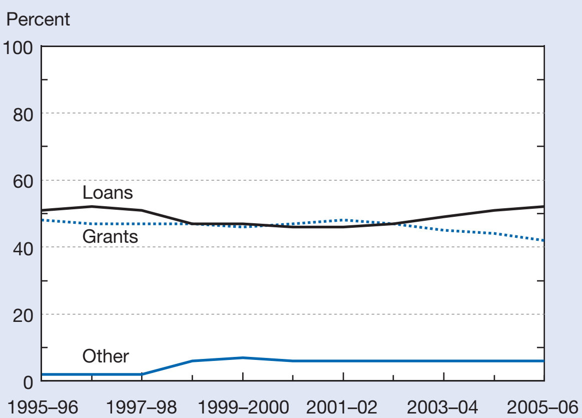
(69%) or public 2-year institutions (47%) received some type of financial aid, either grants (73% compared with 52% and 40%, respectively) or loans (56% compared with 45% and 12%, respectively). The percentage of full-time undergraduates who had federal loans increased from 31% in 1992–93 to 48% in 2003–04 (NCES 2006), and the average amount of loans increased. In recent years, students have increasingly relied on private loans, which typically have much higher interest rates. At the same time, the percentage of students who are supported by grants alone or in combination with other mechanisms decreased (College Board 2006b) (figure 2-3).

Financial aid packages are often awarded on the basis of either need or academic merit, although some forms of aid combine both criteria. Need-based financial aid, which was the norm through the 1980s, aims to increase access for students who otherwise could not afford to attend college. In recent years, an increasing number of financial aid programs and increasing dollar amounts focused on academic merit in an effort to attract top students. Merit-based aid (i.e., aid for which recipients are selected on the basis of test scores, performance, class rank, grade point average, or other achievement) makes up an increasing percentage of state grants, rising from 9% in 1984–85 to 27% in 2004–05. The number of federal Pell Grant (which are based on financial need) recipients increased over time, but the average amount of aid per recipient decreased in recent years in both current and inflation-adjusted dollars (College Board 2006b).

Financial Support for S&E Graduate Education. About one-third of S&E graduate students are self-supporting; that is, they rely primarily on loans, their own funds, or family funds for financial support. The other two-thirds receive primary financial support from a wide variety of sources: the federal government, university sources, employers, nonprofit organizations, and foreign governments.

Figure 2-3
Grants and loans as percentage of undergraduate student aid: 1991–92 to 2005–06



NOTES: Estimated 2004–05 data; preliminary 2005–06 data.

SOURCE: College Board, Trends in Student Aid: 2006, Trends in Higher Education Series (2006).

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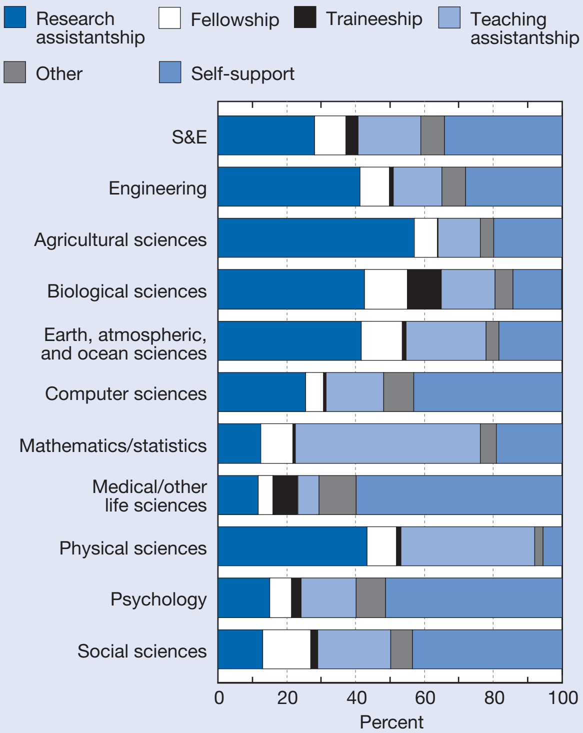
Support mechanisms include research assistantships (RAs), teaching assistantships (TAs), fellowships, and traineeships. Sources of funding include federal agency support, nonfederal support, and self-support. Nonfederal support includes state funds, particularly in the large public university systems; these funds are affected by the condition of overall state budgets. Most graduate students, especially those who pursue doctoral degrees, are supported by more than one source or mechanism during their time in graduate school and some receive support from several different sources and mechanisms in any given academic year.

Other than self-support, RAs are the most prevalent primary mechanism of financial support for S&E graduate students. The percentage of full-time S&E graduate students supported primarily by RAs increased in the late 1980s, rising from 24% in 1985 to roughly 27%–29% from 1988 through 2005. Although the number of full-time S&E graduate students relying primarily on fellowships and TAs rose over the past two decades, an increase in overall graduate enrollment meant that the percentage of students supported by these mechanisms stayed flat or declined. In 2005, 18% of full-time S&E graduate students were primarily supported through TAs and 13% were primarily supported through either traineeships or fellowships (appendix table 2-7).

Primary mechanisms of support differ widely by S&E field of study (appendix table 2-8). For example, in 2005, full-time students in physical sciences were financially supported mainly through RAs (43%) and TAs (39%) (figure 2-4). RAs also were important in agricultural sciences (57%); biological sciences (43%); earth, atmospheric, and ocean sciences (42%); and engineering (41%). In mathematics, however, primary student support is through TAs (54%) and self-support (19%). Full-time students in the social and behavioral sciences are mainly self-supporting (47%) or receive TAs (19%), and students in medical/other life sciences are mainly self-supporting (60%).

The federal government served as the primary source of financial support for about 21% of full-time S&E graduate students in 2005 (appendix table 2-9). The federal government plays a substantial role in supporting S&E graduate students in some mechanisms and fields, and a smaller role in others. For example, in 2005, the federal government funded 67% of S&E graduate students on traineeships, 51% of those with RAs, and 23% of those with fellowships. Federal financial support for graduate education reaches relatively more students in the physical sciences; earth, atmospheric, and ocean sciences; agricultural sciences; biological sciences; and engineering. Relatively fewer students in mathematics, computer sciences, social sciences, psychology, and medical/other life sciences receive federal support (figure 2-5). Appendix table 2-9 provides detailed information by field and mechanism. (See "Expenditures by Field and Funding Source" in chapter 5 for information on federal academic R&D funding by discipline.)

Figure 2-4
Full-time S&E graduate students, by field and mechanism of primary support: 2005



NOTE: Self-support includes any loans (including federal) and support from personal or family financial contributions.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-8.

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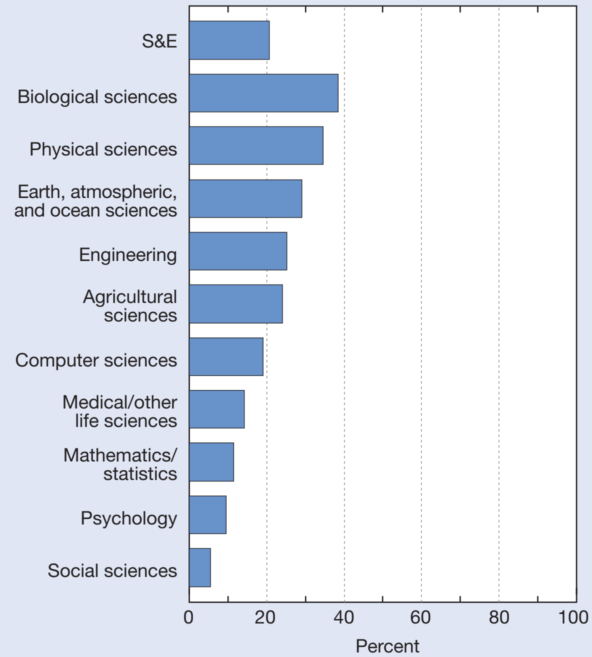
Figure 2-5
Full-time S&E graduate students with primary support from federal government, by field: 2005



SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-9.

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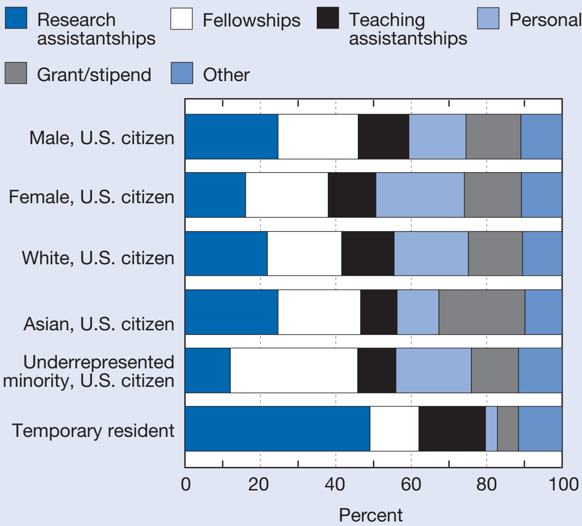
Most federal financial support for graduate education is in the form of research assistantships funded through grants to universities for academic research. Research assistantships are the primary mechanism of support for 69% of federally supported full-time S&E graduate students, up from 62% two decades earlier. Fellowships and traineeships are the means of funding 22% of the federally funded full-time S&E graduate students, and federally funded fellowships and traineeships fund 4% of all full-time S&E graduate students. The share of federally supported S&E graduate students receiving traineeships declined from 18% in 1985 to 12% in 2005. For students supported through nonfederal sources in 2005, TAs were the most prominent mechanism (40%), followed by RAs (31%) (appendix table 2-7).

The National Institutes of Health (NIH) and the National Science Foundation (NSF) support most of the full-time S&E graduate students whose primary support comes from the federal government. In 2005, they supported about 26,800 and 20,400 students, respectively. Trends in federal agency support of graduate students show considerable increases from 1985 to 2005 in the proportion of students funded (NIH, from 23% to 32%; NSF, from 21% to 24%). Support from the U.S. Department of Defense declined during the 1990s (from 15% to 11% of federally supported graduate students), offsetting to some extent the increasing percentage that received NSF support (appendix table 2-10).

For doctoral degree students, notable differences exist in primary support mechanisms by sex, race/ethnicity, and citizenship (figure 2-6). In 2005, male U.S. citizens were more likely to have been supported by RAs (25%) and female U.S. citizens were more likely to have supported themselves from personal sources of funds (23%). Among U.S. citizens, whites and Asians/Pacific Islanders were more likely than other racial/ethnic groups to have had primary support from RAs (22% and 25%, respectively), and underrepresented minorities depended more on fellowships (34%). The primary source of support for doctoral degree students with temporary visas was an RA (49%) (appendix table 2-11).

U.S. citizen white and Asian/Pacific Islander men, as well as foreign doctoral degree students, are more likely than U.S. citizen white and Asian/Pacific Islander women and underrepresented minority doctoral degree students of both sexes to receive doctorates in engineering and physical sciences, fields largely supported by RAs. Women and underrepresented minorities are more likely than other groups to receive doctorates in social sciences and psychology, fields in which self-support is prevalent. Differences in type of support by sex, race/ethnicity, or citizenship remain, however,

Figure 2-6
Primary mechanisms of support for S&E doctorate recipients, by citizenship, sex, and race/ethnicity: 2005



NOTES: Personal sources include personal savings, other personal earnings in graduate school, other family earnings or savings, and loans. Other includes employer reimbursement or assistance, foreign support, traineeships, other assistantships, and other and unknown sources. S&E includes health fields (i.e., medical and other life sciences). U.S. citizen total includes unknown sex. Underrepresented minority includes blacks, Hispanics, American Indians/Alaska Natives, Native Hawaiians/other Pacific Islanders, and multiple races/ethnicities.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2007).

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even accounting for doctorate field (NSF/SRS 2000). These differences in type of support have potential consequences for levels of debt and long-term career success (Nettles and Millett 2006).

Undergraduate and Graduate Debt

Undergraduate debt. Undergraduate major has relatively little effect on undergraduate debt (NSF/SRS 2006a); however, levels of debt vary by type of institution and state. Levels of undergraduate debt for students from public colleges and universities are almost as high as those for students from private colleges and universities. The median level of debt for 2003–04 bachelor's degree recipients who took out loans was $19,300 overall; $19,500 for those who graduated from private nonprofit institutions and $15,500 for those who graduated from public colleges and universities (College Board 2006b).

Levels of debt vary widely by state. Average debt for 2005 graduates of public 4-year colleges and universities ranged from $23,198 in Iowa to $11,067 in Utah (Burd 2006; Project on Student Debt 2006). Average debt for graduates of private nonprofit colleges and universities ranges from $32,504 in Arizona to $13,309 in Utah. Levels of debt are not necessarily higher in states where the cost of living is high, and are not necessarily higher in schools in which tuition is high. Some low-tuition schools with large numbers of low-income students report high levels of average student debt. See "Higher Education" in chapter 8 (State Indicators) for additional state indicators dealing with higher education.

Debt Levels of S&E Doctorate Recipients. At the time of doctoral degree conferral, about half of S&E doctorate recipients have debt related to either their undergraduate or graduate education. About a fourth have some undergraduate debt and about a third owe money directly related to graduate education. In 2005, 27% of S&E doctorate recipients reported having undergraduate debt and 33% reported having graduate debt. For some, debt levels were high, especially for graduate debt: 1% reported more than $50,000 of undergraduate debt and 10% reported more than $50,000 of graduate debt (appendix table 2-12).

Levels of debt vary widely by doctorate fields. High levels of graduate debt were most common among doctorate recipients in psychology, social sciences, and medical/other health sciences. Psychology doctorate recipients were most likely to report having graduate debt and also high levels of debt.[5] In 2005, 26% of psychology doctoral degree recipients compared with 10% of all S&E doctoral degree recipients reported graduate debt of more than $50,000. Doctorate recipients in engineering; biological sciences; computer sciences; earth, atmospheric, and ocean sciences; mathematics; and physical sciences were least likely to report graduate debt. Although men and women differed little in level of debt, blacks and Hispanics had higher levels of graduate debt than whites, even accounting for differences in field of doctorate (NORC 2006).

Debt levels in non-S&E graduate/professional fields. Average student loan debt was higher for students graduating with law degrees, medical degrees, and other health degrees than it was for those with doctoral degrees in 2003–04. Law graduates from public institutions averaged $51,200, medical doctors averaged $78,400, and other health graduates averaged $66,000 in cumulative student loan debt, compared with $39,000 for doctoral degree recipients. Debt for those with degrees from private institutions was even higher (Redd 2006).

Debt burden. Graduates with relatively high post-college earnings may find it easier to pay off education-related debt than those with lower earnings, given similar amounts of debt and similar interest rates. Because starting salaries in the humanities and social sciences are relatively low and debt is relatively high, debt burden (loan payments as a percent of salary) of master's and doctoral graduates in the humanities and social sciences is higher than in other fields (although debt burden of law students is also high). Debt burden is lower in the natural sciences, life sciences, and engineering (Redd 2006).

Higher Education Enrollment in the United States

Recent higher education enrollments reflect the expanding U.S. college-age population. This section examines trends in undergraduate and graduate enrollment by type of institution, field, and demographic characteristics. For information on enrollment rates of high school seniors, see "Transition to Higher Education" in chapter 1.

Overall Enrollment

Over the past two decades, enrollment in U.S. institutions of higher education rose fairly steadily from 12.7 million students in 1986 to 16.9 million in 2004 (appendix table 2-13), despite declines in the college-age population in the mid-1990s. More than 6 million students (about 38% of all students enrolled in higher education institutions in the United States) were enrolled in 2-year institutions in 2004. Research universities (doctorate-granting universities with very high research activity) and master's-granting universities together accounted for another 37% of all students enrolled (6.2 million) (appendix table 2-13). (See sidebar "Carnegie Classification of Academic Institutions" for definitions of the types of academic institutions.)

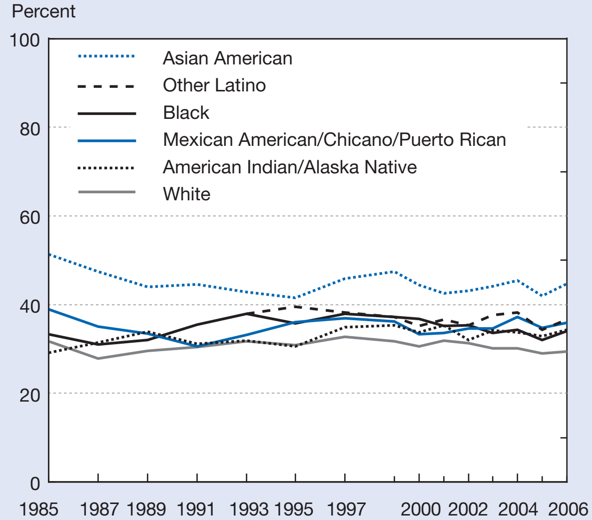
Enrollment in higher education is projected to increase in coming years because of increases in the college-age population (NCES 2005b). These projections are based primarily on population projections but also incorporate information about household income (a measure of ability to pay) and age-specific unemployment rates (a measure of opportunity costs).[6] According to Census Bureau projections, the number of college-age (ages 20–24) individuals is expected to grow from 20.8 million in 2005 to 26.3 million by 2050 (appendix table 2-14). Increased enrollment in higher education is projected to come mainly from minority groups, particularly Asians and Hispanics. From 2000 to 2050, the Asian and Hispanic college-age populations are projected to more than double, while the black and white non-Hispanic college-age populations are projected to rise by 48% and 0.5%, respectively (appendix table 2-14).

Undergraduate Enrollment in S&E

Freshmen Intentions to Major in S&E

Since 1972, the annual Survey of the American Freshman, National Norms, which is administered by the Higher Education Research Institute at the University of California at Los Angeles, asked freshmen at a large number of universities and colleges about their intended majors. The data provided a broadly accurate picture of degree fields several years later.[7] For at least the past two decades, about one-third of all freshmen planned to study S&E. In 2006, about one-third of white, black, Hispanic, and American Indian freshmen and 45% of Asian freshmen reported that they intended to major in S&E (figure 2-7). The proportions planning to major in S&E were higher for men in every racial/ethnic group (appendix table 2-15). For most racial/ethnic groups, about 10%–16% planned to major in social/behavioral sciences, about 6%–8% in engineering, about 8%–10% in biological/agricultural sciences, 1%–2% in computer sciences, 2%–3% in physical sciences,[8] and 1% in mathematics or statistics. Higher proportions of Asian freshmen than of those from other racial/ethnic groups planned to major in biological/agricultural sciences (17%) and engineering (12%). The percentages of all freshmen intending to major in engineering or computer sciences dropped in recent years, while the percentage intending to major in biological/agricultural sciences increased.

Figure 2-7
Freshmen intending S&E major, by race/ethnicity: Selected years, 1985–2006



SOURCE: Higher Education Research Institute, University of California at Los Angeles, Survey of the American Freshman: National Norms, special tabulations (2007).

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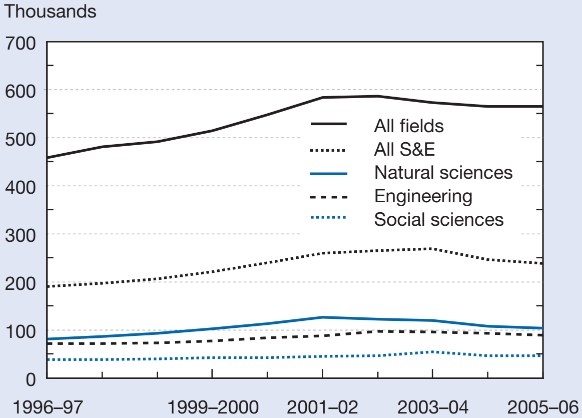
The demographic composition of students planning S&E majors has become more diverse over time. Women constituted 39% of freshmen planning S&E majors in 1985, but this proportion rose to 47% in 2006. White students declined from 84% in 1985 to 72% in 2006. On the other hand, the proportion of Asian students increased from 4% to 12%, Hispanic students from 2% to 9%, and American Indian students from 1% to 2% (appendix table 2-16). Black students increased from 10% to 11% of freshmen intending to major in S&E.

Foreign Undergraduate Enrollment

The total number of foreign students (undergraduate, graduate, and other) enrolled in U.S. academic institutions held steady in 2005–06 after 2 consecutive years of decline. The number of foreign students in S&E fields dropped in 2005–06 for the second year in a row (figure 2-8). Enrollment of new foreign students increased 5%, suggesting that total foreign enrollment is likely to increase in coming years. The number of foreign undergraduates decreased 1%, the fourth con-

Figure 2-8
Foreign students, by field of study: 1996–97 to 2005–06



NOTES: Foreign students include both undergraduate and graduate students. Natural sciences include physical, biological, earth, atmospheric, ocean, agricultural, and computer sciences and mathematics. Social sciences include psychology.

SOURCE: Institute of International Education, Open Doors (various years).

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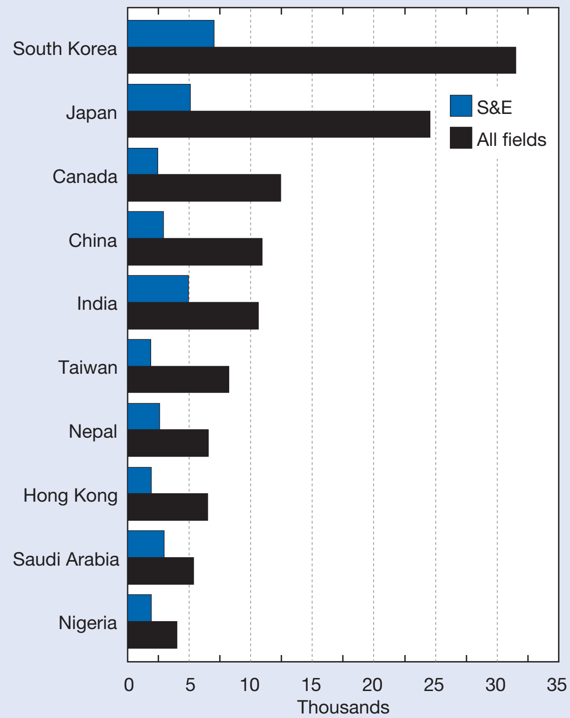
Figure 2-9
Foreign undergraduate student enrollment in U.S. universities, by field (S&E and all fields) for top 10 places of origin: April 2007



SOURCE: Bureau of Citizenship and Immigration Services, Student and Exchange Visitor Information System database, special tabulations (2007). See appendix table 2-17.

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secutive decline after record increases during the 1990s (IIE 2006). Decreases in foreign enrollments from 2001 through 2005 have been attributed to increased opportunity for higher education in the home country, competition from other countries for foreign students, rising U.S. tuition, and difficulties in obtaining U.S. visas (IIE 2005). Recently, adjustments to visa requirements made it easier for students to obtain visas, and their number increased. Declines in particular fields may also be due to declining job opportunities in those fields. Among all foreign students (undergraduate and graduate), the number of those studying the physical sciences dropped 4%, mathematics 5%, engineering 5%, and computer sciences 12% in 2005–06 compared with the preceding year. Other S&E fields experienced increases in foreign students; for example, agricultural sciences and biological and biomedical sciences each increased 5% and psychology increased 3% (IIE 2006).

South Korea (31,500), Japan (24,500), Canada (12,400), China (10,900), and India (10,600) accounted for the largest numbers of foreign undergraduates in the United States in April 2007 and were among the top countries sending foreign undergraduates in S&E fields (figure 2-9; appendix table 2-17). Saudi Arabia and Nepal, which accounted for fewer total undergraduates in the United States, were also among the top countries sending foreign undergraduates in S&E fields.

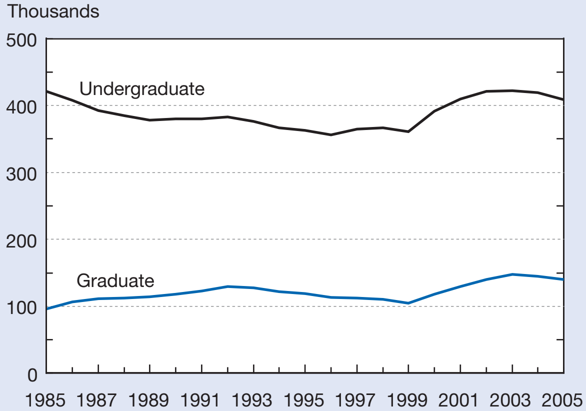
Enrollment by Field

For the most part, undergraduate enrollment data are not available by field; however, annual data on engineering enrollment are available from the Engineering Workforce Commission, and the Conference Board of Mathematical Sciences compiles data on enrollment in mathematics and statistics every 5 years.

Engineering. Undergraduate engineering enrollment declined through most of the 1980s and 1990s, rose from 2000 through 2003, and declined slightly in recent years. Undergraduate engineering enrollment declined from 420,900 students in 1985 to about 361,400 students by 1999 before rebounding to about 422,000 in 2003. By 2005, it declined to 409,300 (figure 2-10; appendix table 2-18). The declines in undergraduate engineering enrollment in recent years were evident for both men and women and for most racial/ethnic groups (NSF/SRS 2007a). Graduate engineering enrollment rose since the late 1990s, reaching a new peak of 147,900 in 2003, then declined to 139,800 in 2005 (figure 2-10; appendix table 2-19).

Mathematics and Statistics. Undergraduate enrollment in mathematics and statistics departments declined slightly between fall 2000 and fall 2005 in 4-year colleges and universities, and increased 26% in public 2-year colleges. More than half of student enrollment in mathematics courses in 2-year colleges is in precollege (or remedial) mathematics (Kirkman et al. 2007). The number of students taking precollege level courses (remedial courses) in mathematics at 4-year colleges and universities dropped from 261,000 in fall 1990 to 201,000 in fall 2005. During the same period,

Figure 2-10
U.S. engineering enrollment, by level: 1985–2005



NOTE: Enrollment data include full- and part-time students.

SOURCE: Engineering Workforce Commission, Engineering & Technology Enrollments, Fall 2005, American Association of Engineering Societies (2006). See appendix table 2-19.

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the number of students taking precollege level mathematics courses at 2-year colleges increased from 724,000 to 965,000 (table 2-4). The decline at 4-year institutions may reflect the policies of some states to move state-supported remedial education to 2-year institutions. Efforts are currently under way in at least 26 states to improve communication between high schools and colleges and to better align high school graduation standards to skills required for college entry (Cohen et al. 2006).

Graduate Enrollment in S&E

Graduate S&E educational institutions are a major source of both the high-skilled workers of the future and of the research needed for a knowledge-based economy. This section presents data on trends in graduate S&E enrollment, including trends in first-time enrollment of foreign students after September 11, 2001.

Enrollment by Field

S&E graduate enrollment in the United States reached a new peak of 583,200 in fall 2005. Following a long period of growth that began in the 1970s, graduate enrollment in S&E declined in the latter half of the 1990s but increased steadily since 1999 (appendix table 2-20). Growth occurred through 2005 in most major S&E fields, with two notable exceptions. In computer sciences, enrollment increased through 2002, and in engineering, through 2003. Enrollment in both areas then declined through 2005, with the decline attributable to foreign student enrollment. The number of full-time students enrolled for the first time in S&E graduate departments offers a good indicator of developing trends. The number of first-time full-time S&E graduate students also reached a new peak (110,400) in 2005. It declined in the mid-1990s in all major S&E fields but increased in most science fields through 2005 (appendix table 2-21). Growth was greatest in biological sciences, medical/other life sciences, and social and behavioral sciences. First-time full-time graduate enrollment declined in recent years in engineering; computer sciences; mathematics; earth, atmospheric, and ocean sciences; and agricultural sciences.

First-time full-time graduate enrollment, particularly in engineering and computer sciences, often follows trends in employment opportunities. When employment opportunities are plentiful, recent graduates often forego graduate school, but when employment opportunities are scarce, further training in graduate school may be perceived as a better option. Figure 2-11 shows trends in unemployment rates and first-time full-time graduate enrollment in engineering and computer sciences. Enrollment in S&E fields that offer fewer employment opportunities at the bachelor's level (e.g., biological sciences) does not follow this trend.

Enrollment by Sex and Race/Ethnicity

The recent increase in S&E graduate enrollment overall occurred across all major U.S. citizen and permanent resident demographic groups: women, minorities, and white men. The number of women enrolling in graduate science programs increased for the past two decades except for a

Table 2-4
Enrollment in mathematics courses, by type of school and course level: Fall 1990, 1995, 2000, and 2005
(Thousands)

Type of school/course level	1990	1995	2000	2005
4-year colleges and universities				
All mathematics courses	1,619	1,469	1,614	1,607
Precollege mathematics courses	261	222	219	201
Public 2-year college mathematics programs				
All mathematics courses	1,241	1,384	1,273	1,580
Precollege mathematics courses	724	800	763	965

NOTE: Includes distance learning.

SOURCE: Kirkman E, Lutzer KJ, Maxwell JW, Rodi SB, CBMS [Conference Board for Mathematical Sciences] 2005: Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States, Fall 2005 CBMS Survey, American Mathematical Society (2007), http://www.ams.org/cbms/, accessed 3 April 2007.

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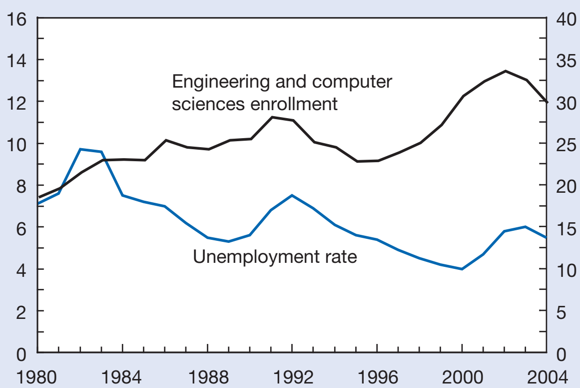
Figure 2-11
First-time full-time graduate enrollment in engineering and computer sciences and unemployment rate of all workers: 1980–2004



SOURCES: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov. Unemployment rates from Bureau of Labor Statistics, Current Population Survey, Table 1. Employment status of the civilian noninstitutional population, 1940 to date, ftp://ftp.bls.gov/pub/special.requests/lf/aat1.txt, accessed 3 April 2007. See appendix table 2-21.

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decline in computer sciences enrollment since 2002. In contrast, the number of male S&E graduate students declined from 1993 through the end of that decade before increasing in recent years (appendix table 2-20).

The long-term trend of women's rising proportions in S&E fields also continued. Women made up 36% of S&E graduate students in 1985 and 49% in 2005, although large variations among fields persist. In 2005, women constituted the majority of graduate enrollment in psychology (76%), medical/other life sciences (78%), biological sciences (56%), and social sciences (54%). They constituted considerable proportions of graduate students in mathematics (37%), chemistry (40%), and earth, atmospheric, and ocean sciences (46%). However, their percentage in computer sciences (25%) remains unchanged since 1985 and their percentages in engineering (22%) and physics (20%) remain low (appendix table 2-20).

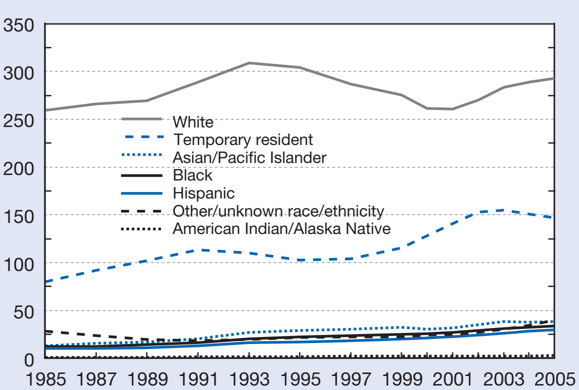
The proportion of underrepresented minority (black, Hispanic, and American Indian/Alaska Native) students in graduate S&E programs increased from about 6% in 1985 to about 11% in 2005.[9] Increases occurred in all major science fields and in engineering during that period (appendix table 2-22). In 2005, blacks, Hispanics, and American Indians/Alaska Natives as a group made up 6%–7% of graduate enrollment in many S&E fields (engineering; mathematics; physical sciences; earth, atmospheric, and ocean sciences; and computer sciences), 8%–9% of graduate enrollment in agricultural and biological sciences, 14% in medical/other life sciences, 17% in social sciences, and 19% in psychology.

The number of white S&E graduate students decreased from 1994 to 2001 in most S&E fields and then increased through 2005, while the numbers of black, Hispanic, and American Indian/Alaska Native students increased steadily from 1985 through 2005 (figure 2-12). The long-term rise in the numbers of black, Hispanic, and American Indian/Alaska Native graduate students occurred in most S&E fields with the exceptions of engineering and mathematics. In those two fields, enrollment reached a plateau in the 1990s before rising again from 2000 through 2005. In computer sciences, enrollment of blacks and American Indians/Alaska Natives peaked in the early 2000s as it did for all other racial/ethnic groups, then declined (although Hispanic enrollment in computer sciences continued to rise). The number of Asian/Pacific Islander S&E graduate students increased every year since 1985 with the exception of 2000 and 2004. As was the case for all racial/ethnic groups, Asian enrollment in graduate engineering programs dropped in the mid-1990s, increased through 2003, then declined again. Asians/Pacific Islanders accounted for about 7% of S&E graduate enrollment in 2005 (appendix table 2-22).

Foreign Student Enrollment

Foreign graduate student enrollment in S&E grew from 79,900 in 1985 to 154,900 in 2003 before declining through 2005. Despite the decline, the number of foreign S&E graduate students in 2005 (146,700) was higher than in 2001. Foreign students increased from 20% to 25% of all S&E graduate students from 1985 to 2005 (appendix table 2-22). The concentration of foreign enrollment was highest in engineering (45%), computer sciences (43%), physical sciences (40%), and mathematics (37%).

Figure 2-12
S&E graduate enrollment, by citizenship and race/ethnicity: Selected years, 1985–2005



SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, Integrated Science and Engineering Resources Data System (WebCASPAR), http://webcaspar.nsf.gov.

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First-time full-time enrollment of foreign S&E graduate students increased 4% in fall 2005, the first increase since September 11, 2001, although numbers remain below those of 2001 (appendix table 2-23). The number of first-time full-time foreign students declined 18% from 2001 through 2004. Declines were concentrated mainly in engineering (down 26%) and computer sciences (down 36%); these fields are heavily favored by foreign students. First-time full-time foreign enrollment increased 5% in biological sciences and 1% in medical/other life sciences from 2001 through 2004. Foreign students' share of first-time full-time S&E graduate enrollment dropped from 35% in fall 2000 to 27% in fall 2005, with most of the decrease in computer sciences (from 71% to 56%) and engineering (61% to 51%) (appendix table 2-23).

According to data collected by the Institute of International Education, the overall number of foreign graduate students in all fields decreased 2% from academic year 2004–05 to 2005–06, with all of the decrease occurring among master's degree students. The proportion of foreign master's degree students decreased 5% and that of foreign doctoral students increased 6%. India, China, South Korea, Taiwan, and Canada are the top places of origin for foreign graduate students. More than half of all foreign graduate students are studying S&E. More recent data from the Bureau of Citizenship and Immigration Services show an increase in foreign graduate students from April 2006 to April 2007, with foreign enrollment in S&E fields growing 8% (appendix table 2-24). Most of the growth was in computer sciences (up 14%) and engineering (up 10%). In April 2007, India accounted for 66,500 foreign graduate students with 70% in S&E fields. China accounted for 48,300 foreign graduate students with 67% in S&E. In contrast, less than half of graduate students from South Korea, Taiwan, and Canada were studying S&E fields. Business accounts for large numbers of graduate students from South Korea and Taiwan, and education accounts for large numbers of graduate students from Canada.

Persistence, Retention, and Attainment in Higher Education and in S&E

Many students who start out in undergraduate or graduate programs drop out before completing a degree. This section examines differences between S&E and non-S&E students in persistence and completion of higher education.

Undergraduate Retention

S&E students persist and complete undergraduate programs at about the same rate as non-S&E students. Six years after enrollment in a 4-year college or university in 1995–96, about 60% of both S&E and non-S&E students had completed a bachelor's degree. Another 13%–17% were still enrolled and may eventually have earned a bachelor's degree, and about 20% had not completed any degree and were no longer enrolled (table 2-5).

Undergraduate field switching out of S&E is about equally matched by entry into S&E fields as a whole. Among postsecondary students who began at 4-year colleges or universities in 1995–96, 26% reported an S&E major, 44% reported a non-S&E major, and 31% were missing data on major or had not declared a major. Of those for whom data on major are available and reported, 37% reported an S&E major. Six years later, among those who had attained a bachelor's degree, 39% were S&E majors. Although about 30% of agricultural/biological sciences majors, 20% of engineering/computer sciences/mathematics/physical sciences majors, and 30% of social sciences majors eventually switched to non-S&E majors before earning a bachelor's degree, 43% of those with initially missing or undeclared majors and 14% of those with initial non-S&E majors switched into S&E fields before earning their bachelor's degrees (table 2-6).

Within S&E fields, undergraduate attrition out of agricultural/biological sciences and physical/mathematics/computer sciences/engineering fields is greater than transfers into those fields, and transfers into social/behavioral sciences are greater

Table 2-5
Persistence and outcome of postsecondary students beginning 4-year colleges or universities in 1995: 2001
(Percent)

		Cumulative persistence outcome 2001				
Major in 1995	Number	Bachelor's	Associate's or certificate	Still enrolled	No longer enrolled	Missing
All majors	1,369,400	58.0	6.6	14.4	20.8	0.3
Agricultural/biological sciences	115,300	60.8	4.0	16.7	18.2	0.3
Physical/math/computer sciences/engineering	153,600	59.4	7.3	14.1	19.2	0.1
Social and behavioral sciences	82,600	62.4	3.4	14.7	19.1	0.5
Non-S&E	599,000	57.7	7.6	13.2	21.2	0.2
Missing/undeclared	418,900	56.3	6.1	15.5	21.7	0.4

NOTE: Physical sciences include earth, atmospheric, and ocean sciences.

SOURCE: National Center for Education Statistics, 2001 Beginning Postsecondary Students Longitudinal Study, special tabulations (2007).

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Table 2-6
Field switching among postsecondary students beginning 4-year colleges and universities in 1995: 2001
(Percent)

		Major when last enrolled in 2001				
Major in 1995	Number	Agricultural/ biological sciences	Physical/math/ computer sciences/ engineering	Social and behavioral sciences	Non-S&E	Missing/ undeclared
All majors	1,369,400	9.9	13.1	15.9	61.1	0.1
Agricultural/biological sciences	115,300	48.9	9.1	11.5	30.5	0.0
Physical/math/computer sciences/engineering	153,600	5.6	71.4	3.5	19.6	0.0
Social and behavioral sciences	82,600	3.0	3.2	64.1	29.6	0.0
Non-S&E	599,000	3.4	2.7	8.1	85.9	0.0
Missing/undeclared	418,900	11.0	9.4	22.7	56.7	0.2

NOTE: Physical sciences include earth, atmospheric, and ocean sciences.

SOURCE: National Center for Education Statistics, 2001 Beginning Postsecondary Students Longitudinal Study, special tabulations (2007).

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than attrition. Among postsecondary students who began at 4-year colleges or universities in 1995–96 and for whom data on major are available and reported, 12% reported an agricultural/biological sciences major, 16% reported a physical sciences/mathematics/computer sciences/engineering major, and 9% reported a social/behavioral sciences major. Six years later, among those who had attained a bachelor's degree, 10% were agricultural/biological sciences majors, 13% were physical sciences/mathematics/computer sciences/engineering majors, and 16% were social/behavioral sciences majors. (See sidebar "Effects of Research Experiences on Interest, Retention, and Success.")

Graduate Retention

S&E bachelor's degree recipients are more likely to enroll in and complete graduate training than bachelor's degree recipients in most other fields. Fifty-seven percent of 1992–93 bachelor's degree recipients in natural sciences and mathematics and 50% of those with bachelor's degrees in social and behavioral sciences enrolled in graduate school by 2003, compared with 25%–43% of graduates in most other fields (including 39% of engineering graduates). Education graduates also had a high percentage enrolling in graduate school (50%). Forty percent of natural sciences and mathematics bachelor's degree recipients completed an advanced degree program within 10 years, compared with 17%–31% of graduates in other fields, and 9% had completed a doctoral degree compared with up to 3% of graduates in other fields (table 2-7). Not all of those who completed an advanced degree completed it in an S&E field. The majority of S&E bachelor's degree recipients who earn additional degrees earn them in non-S&E fields (e.g., business, law, or medicine). About one-fourth earn additional degrees in the same S&E field, and the remainder earn them in other S&E fields (NSF/SRS 2006b).

Graduate completion rates are roughly comparable to undergraduate completion rates. Among students enrolled in doctoral programs in the early 1990s, about 60% completed doctorates within 10 years. Completion rates vary by discipline, with 64% of engineering students, 62% of life sciences students, and 55% of physical and social sciences students completing doctorates within 10 years (CGS 2005). Timing of graduate attrition varies by discipline. Early attrition from doctoral programs is more common in engineering, physical sciences, and mathematics, and later attrition is more common in humanities and social sciences.

U.S. Higher Education Degree Awards

The number of degrees awarded by U.S. academic institutions has been increasing over the past two decades both in S&E and non-S&E fields. For information on the labor market conditions for recent S&E graduates, see "Labor Market Conditions for Recent S&E Graduates" in chapter 3 (Science and Engineering Labor Force) and "Trends in Academic Employment of Doctoral Scientists and Engineers" in chapter 5 (Academic Research and Development).

S&E Associate's Degrees

Community colleges are often an important and relatively inexpensive gateway for students entering higher education. Associate's degrees, largely offered by 2-year programs at community colleges, are the terminal degree for some people, but others continue their education at 4-year colleges or universities and subsequently earn higher degrees.[10] Associate's degrees in S&E or engineering technology accounted for about 12% of all associate's degrees in 2005.

S&E associate's degrees from all types of academic institutions rose from 26,500 in 1985 to 45,700 in 2005. The increase in the late 1990s and the early 2000s is mainly attributable to computer sciences, which represented 61% of all S&E associate's degrees by 2005. In contrast, the number of associate's degrees awarded in engineering mainly

Effects of Research Experiences on Interest, Retention, and Success

Opportunities for students to engage in early experiences as a working scientist or engineer have been in existence for some time. However, formal studies of the outcomes of such opportunities were not undertaken until fairly recently. There is now a growing body of literature that examines the results of such efforts and analyzes them for their effect on at least one of the following outcomes: student attitudes toward science, student research skills, student confidence in his or her ability to become a scientist or engineer, and retention of students within the field, including entry into graduate school or graduation with a doctorate. In general, each study found increases in students' understanding of the scientific process, the way in which research is done, and, to varying degrees, their commitment to majoring in science or engineering, to entering a science or engineering career, and to enrolling in a science or engineering graduate program.

These research experiences are often either hands-on research opportunities (participation in an active research laboratory or a didactic laboratory course specifically devoted to working on ongoing research projects) or literature-based research opportunities (participation in a class designed around seminar-type discussion of ongoing research topics or analysis of papers from the primary literature). In engineering, these experiences generally include a freshman design course and/or a sophomore or junior internship.

A recent comparison of results from nine studies of undergraduate hands-on research experiences (Boylan 2006) reveals some overall consistencies in findings but also some interesting variations. Students who participated in an undergraduate research experience reported, in general, a greater interest in STEM research, greater understanding of the research process and the strategies and tools that scientists use to solve problems, and a broader sense of career options in the field (particularly true of the life sciences when students switched from purely medical to broader career goals). The size of the effect on changes in career or graduate education goals are, to some extent, less consistent. One study (Hunter, Laursen, and Seymour 2007) focused on a small set of institutions and found that participating students with high grade point averages were already committed to a career in S&E and so the research experience, although affirming, did not seem to have a large effect on subsequent entry into a graduate program. Other studies (Barlow and Villarejo 2004; Clewell et al. 2006; Price 2005; Russell, Hancock, and McCullough 2007; Summers and Hrabowski 2006) found that students with a broader range of abilities as well as underrepresented minority students were more likely to stay in or switch to an S&E major and to pursue S&E graduate education.

Table 2-7
1992–93 bachelor's degree recipients, by graduate enrollment status, highest degree attained, and baccalaureate degree major: 2003
(Percent)

Baccalaureate degree major	Enrollment in graduate program: All ever enrolled	Completed	Currently enrolled	Left without completing	Highest degree attained: Bachelor's degree[a]	Advanced degree: All	Master's degree	First professional degree	Doctoral degree
All majors	40.1	24.8	5.9	9.4	74.4	25.6	19.7	4.0	1.9
Business and management	25.4	16.6	3.2	5.6	83.3	16.7	14.7	1.8	0.2
Education	50.3	28.3	8.1	13.9	71.1	28.9	26.3	1.5	1.1
Engineering	39.2	24.5	5.4	9.3	74.2	25.9	22.2	0.9	2.7
Health	36.5	22.0	6.5	8.0	77.9	22.1	19.4	2.1	0.6
Public affairs/social services	36.3	20.6	6.2	9.5	79.4	20.6	18.2	1.8	0.6
Humanities	42.6	25.5	7.1	10.1	73.0	27.1	21.5	4.3	1.2
Social and behavioral sciences	49.8	30.3	8.7	10.8	68.6	31.4	21.8	7.2	2.3
Natural sciences and mathematics	56.7	38.6	6.4	11.7	60.3	39.7	18.7	12.0	9.0
Other	34.4	21.7	4.2	8.6	77.6	22.4	18.0	3.4	1.0

[a]Includes postbaccalaureate certificates.

SOURCE: National Center for Education Statistics (NCES), Where Are They Now? A Description of 1992–93 Bachelor's Degree Recipients 10 Years Later, NCES 2007-159 (2006).

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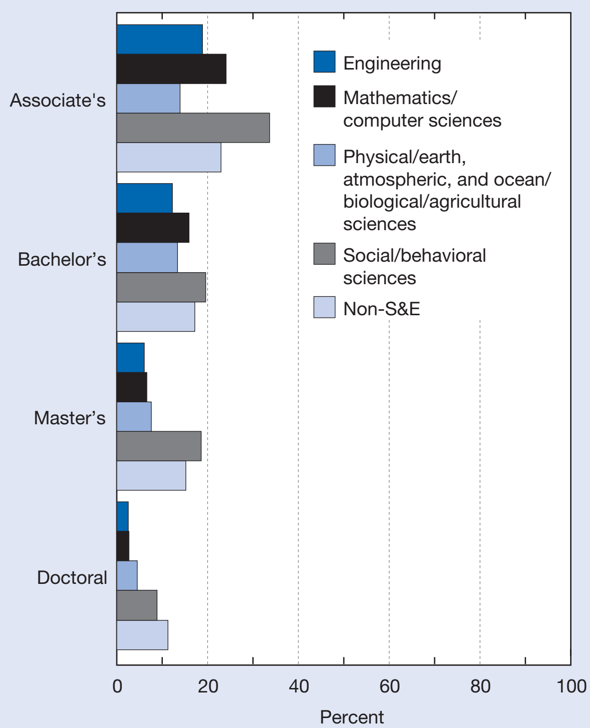
decreased. Degrees earned in engineering technology (not included in S&E degree totals because of their practice-focused nature) declined from 53,700 in 1985 to 28,800 in 2005 (appendix table 2-25).

Women earned 40% of S&E associate's degrees in 2005, down from 45% in 1985 and less than their percentage of S&E bachelor's degrees (50%). As is the case with men, the largest number of S&E associate's degrees earned by women are in computer sciences (appendix tables 2-25).

Trends in the number of associate's degrees earned by students' race/ethnicity are shown in appendix table 2-26.[11] Students from underrepresented groups earn a considerably higher proportion of associate's degrees than they do of bachelor's or more advanced degrees (figure 2-13). In 2005, they earned more than one-third of all associate's degrees in social and behavioral sciences and almost one-quarter of all associate's degrees in mathematics and computer sciences. The percentage of computer sciences associate's degrees earned by these students almost doubled since 1985.

Figure 2-13
Underrepresented minority share of S&E degrees, by degree level and field: 2005



NOTE: Underrepresented minority includes black, Hispanic, and American Indian/Alaska Native.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, WebCASPAR database, http://webcaspar.nsf.gov. See appendix tables 2-26, 2-28, 2-30, and 2-32.

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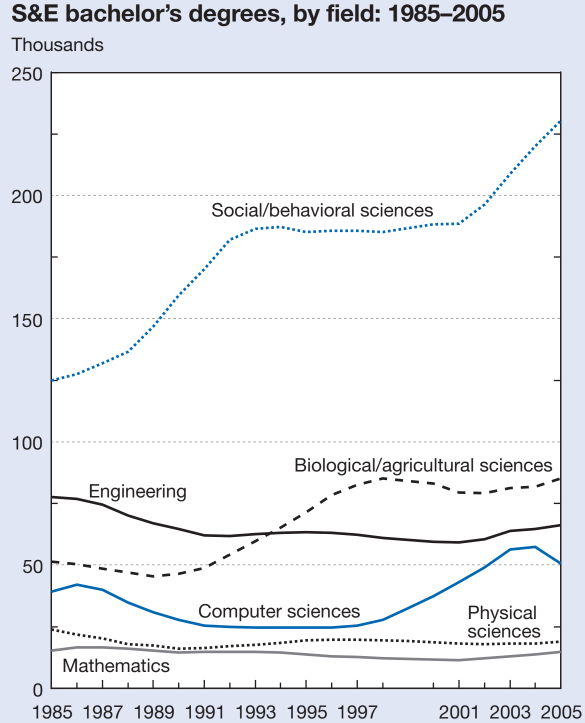
S&E Bachelor's Degrees

The baccalaureate is the most prevalent degree in S&E, accounting for 70% of all S&E degrees awarded. S&E bachelor's degrees consistently accounted for roughly one-third of all bachelor's degrees for the past two decades. Except for a brief downturn in the late 1980s, the number of S&E bachelor's degrees has risen steadily from 332,300 in 1985 to 466,000 in 2005 (appendix table 2-27).

Trends in the number of S&E bachelor's degrees vary widely among fields (figure 2-14). The number of bachelor's degrees earned in engineering, which peaked in 1985, dropped through most of the 1990s before increasing again through 2005. In computer sciences, the number of bachelor's degrees increased sharply from 1998 to 2004 but fell in 2005. Except for slight dips in the late 1980s and from 1999 to 2002, bachelor's degrees in biological/agricultural sciences have been increasing, reaching a new peak in 2005. The number of social and behavioral sciences degrees awarded rose in the late 1980s and again in the 2000s, reaching a new peak in 2005 (appendix table 2-27).

Figure 2-14
S&E bachelor's degrees, by field: 1985–2005



NOTES: Physical sciences include earth, atmospheric, and ocean sciences. Data not available for 1999.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-27.

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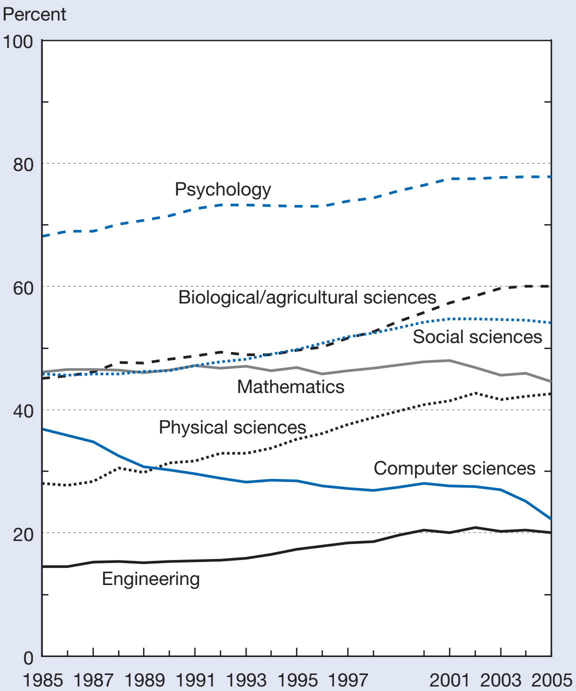
S&E Bachelor's Degrees by Sex

Women outnumbered men in undergraduate education since 1982 and earned 58% of all bachelor's degrees in 2005; they earned about half of all S&E bachelor's degrees since 2000. Within S&E, men and women tend to study different fields. Men earned a majority of bachelor's degrees awarded in engineering, computer sciences, and physics (80%, 78%, and 79%, respectively). Women earned more than half of bachelor's degrees in psychology (78%), agricultural sciences (51%), biological sciences (62%), chemistry (52%), and social sciences (54%) (appendix table 2-27). The share of bachelor's degrees awarded to women increased in almost all major S&E fields during the past two decades. One notable exception, however, is computer sciences. From 1985 through 2005, the proportion of computer sciences bachelor's degrees awarded to women dropped from 37% to 22% (figure 2-15). Among fields with notable increases in the proportion of bachelor's degrees awarded to women are earth, atmospheric, and ocean sciences (from 25% to 42%); agricultural sciences (from 35% to 51%); and chemistry (from 36% to 52%).

The number of S&E bachelor's degrees awarded to women as well as the total number of bachelor's degrees in all fields rose from 1985 through 2005, with a brief drop in numbers of engineering and natural sciences degrees in the late 1980s and early 1990s and another decline in 2005. In contrast, the number of S&E bachelor's degrees awarded to men as well as the total number of bachelor's degrees in all fields reached a plateau in the 1990s but increased from 2002 through 2005. The flat numbers of S&E bachelor's degrees awarded to men in the 1990s masked several divergent trends. The number of engineering, physical sciences, and social and behavioral sciences degrees awarded to men dropped in the 1990s, while the number of bachelor's degrees in agricultural and biological sciences generally increased in the 1990s.[12]

Figure 2-15
Female share of S&E bachelor's degrees, by field: 1985–2005



NOTES: Physical sciences include earth, atmospheric, and ocean sciences. Data not available for 1999.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-27.

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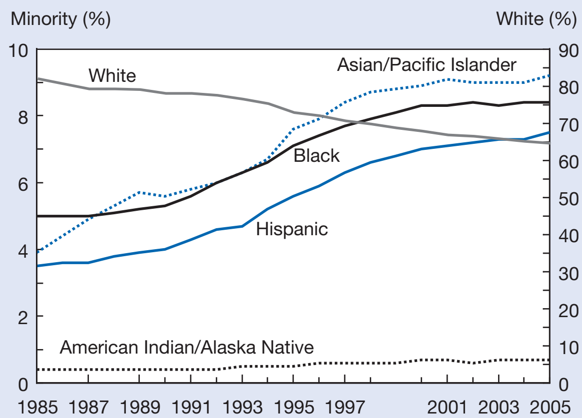
S&E Bachelor's Degrees by Race/Ethnicity

The racial/ethnic composition of those earning S&E bachelor's degrees changed over the past two decades, reflecting both population change and increasing college attendance by members of minority groups.[13] Between 1985 and 2005, the proportion of S&E degrees awarded to white students declined from 82% to 65%. The proportion awarded to Asians/Pacific Islanders increased from 4% to 9%, to black students from 5% to 8%, to Hispanic students from 4% to 8%, and to American Indian/Alaska Native students from 0.4% to 0.7% (figure 2-16). The number of S&E bachelor's degrees earned by white students decreased in the 1990s as their numbers in the college-age population dropped, but rose again through 2005. The number of S&E bachelor's degrees earned by students of unknown race/ethnicity also increased. See sidebar "Increase in Student Nonreporting of Race/Ethnicity."

Figure 2-16
Minority share of S&E bachelor's degrees, by race/ethnicity: 1985–2005



NOTE: Data not available for 1986, 1988, and 1999.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-28.

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Increase in Student Nonreporting of Race/Ethnicity

For several years, the number and percentage of students not reporting race/ethnicity on their college applications and thus the number and percentage of students of unknown race/ethnicity in federal surveys of higher education enrollment and degrees have increased. In 2005, about 25,700 S&E bachelor's degree recipients (almost 6% of the total) were of unknown race/ethnicity, up from about 3,700 (1% of the total) in 1985 (appendix table 2-28). At some colleges and universities, the percentage of students who decline to report race/ethnicity is as high as 25% (JBHE 2005). How the unknown category is treated in data reporting can affect estimates of the composition of the student body and trends in minority enrollment or degree attainment. Inclusion of these students in counts of "minority" students or omitting these students from totals or calculations of percentages inflates the number and fraction of minority students.

Level of selectivity of the school is a factor, with the most selective colleges and universities having a higher percentage of students not reporting race than is the case for colleges and universities in the United States overall (JBHE 2005). Most students of unknown race/ethnicity are white and another substantial number are thought to be multiple race (Linneman and Chatman 1996; Smith et al. 2005). The reluctance of white students to report race/ethnicity on college admissions forms may reflect a belief that their race/ethnicity would negatively affect admissions decisions. Thus, timing of collection of race/ethnicity data seems to be a factor in the number of students who do or do not report (Smith et al. 2005). Schools that collect race/ethnicity data after students matriculate generally have lower percentages of students not reporting race/ethnicity.

Despite considerable progress for underrepresented minority groups between 1985 and 2005 in earning bachelor's degrees in any field, the gap in educational attainment between young minorities and whites continues to be wide. The percentage of blacks ages 25–29 with a bachelor's or higher degree rose from 12% in 1985 to 18% in 2005, whereas the percentage of Hispanics ages 25–29 with a bachelor's or higher degree was 11% in 1985 and 2005 (NCES 2006). For whites ages 25–29, this percentage rose from 24% in 1985 to 34% in 2005. Differences in completion of bachelor's degrees in S&E by race/ethnicity reflect differences in high school completion rates, college enrollment rates, and college persistence and attainment rates. In general, blacks and Hispanics are less likely than whites and Asians/Pacific Islanders to graduate from high school, to enroll in college, and to graduate from college (see "Transition to Higher Education" in chapter 1 for information on immediate post-high school college enrollment rates). Among those who do enroll in or graduate from college, however, blacks, Hispanics, and American Indians/Alaska Natives are about as likely as whites to choose S&E fields; Asians/Pacific Islanders are more likely than members of other racial/ethnic groups to choose these fields. For Asians/Pacific Islanders, almost half of all bachelor's degrees received are in S&E, compared with about one-third of all bachelor's degrees earned by each of the other racial/ethnic groups.

The contrast in field distribution among whites, blacks, Hispanics, and American Indians/Alaska Natives on the one hand and Asians/Pacific Islanders on the other is apparent within S&E fields as well. White, black, Hispanic, and American Indian/Alaska Native S&E baccalaureate recipients share a similar distribution across broad S&E fields. In 2005, between 9% and 12% of all baccalaureate recipients in each of these racial/ethnic groups earned their degrees in the social sciences; 4% to 5%, in the biological sciences; and 3% to 4% in engineering and in computer sciences. Asian/Pacific Islander baccalaureate recipients earned higher proportions of their baccalaureates in biological sciences, computer sciences, and engineering (appendix table 2-28).

For all racial/ethnic groups (except white), the total number of bachelor's degrees, the number of S&E bachelor's degrees, and the number of bachelor's degrees in most S&E fields (except computer sciences) generally increased over the past two decades. After steep increases since the late 1990s, students in each racial/ethnic group earned sharply fewer bachelor's degrees in computer sciences in 2005. For white students, the total number of bachelor's degrees, the number of S&E bachelor's degrees, and the number of bachelor's degrees in most S&E fields, generally dropped between 1993 and 2001 and increased since then. The number of computer science bachelor's degrees earned by white students dropped in 2004 and 2005 (appendix table 2-28).

Bachelor's Degrees by Citizenship

Over the past two decades, students on temporary visas in the United States consistently earned a small share (4%) of S&E degrees at the bachelor's level. However, they earned 8% of bachelor's degrees awarded in computer sciences in 2005 and 7% of those awarded in engineering. The number of S&E bachelor's degrees awarded to students on temporary visas increased over the past two decades from about 14,100 in 1985 to 18,400 in 2005. Trends in the number of degrees by field generally followed the pattern noted above for all racial/ethnic groups except whites (appendix table 2-28).

S&E Master's Degrees

Master's degrees are often the terminal degree for students in some fields, for example, engineering and geology. In other fields, master's degrees are a step toward a doctoral degree, and in yet others, master's degrees are awarded when students fail to advance to the doctoral level. A relatively new development, professional master's degrees, often stress interdisciplinary training and preparation for work in emerging fields (NSB 2006).

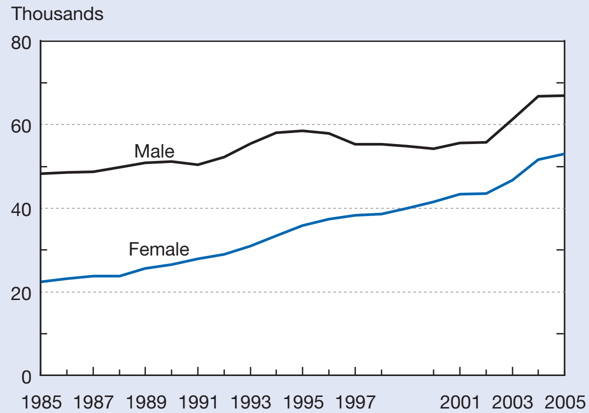
Master's degrees in S&E fields increased from 70,600 in 1985 to 120,000 in 2005 (appendix table 2-29). Increases occurred in most major S&E fields. Master's degrees in engineering and physical sciences dipped from 1995 to 2002 but increased in recent years, and master's degrees in computer sciences generally increased through 2004 but dropped in 2005 (figure 2-17).

Master's Degrees by Sex

Since 1985, the number of S&E master's degrees earned by women more than doubled, rising from 22,300 to 53,100 in 2005 (figure 2-18). The number of master's degrees earned by men grew more slowly from 48,200 in 1985 to 67,000 in 2005, with most of the growth between 2002 and 2004. As a result, the percentage of women earning master's degrees rose steadily during the past two decades. In 1985, women earned 32% of all S&E master's degrees; by 2005, they earned 44% (appendix table 2-29).

Women's share of S&E master's degrees varies by field. In 2005, women earned a majority of master's degrees in psychology (79%), biological sciences (60%), social sciences (56%), and agricultural sciences (53%); they earned their lowest share in engineering, although their share in 2005 (22%) was higher than their share in 1985 (11%) (appendix table 2-29). The number and percentage of master's degrees awarded to women in all major S&E fields (with the exception of computer sciences) increased since 1985. In computer sciences, the number of master's degrees awarded to women increased through 2004 but dropped in 2005, and the percentage of degrees awarded to women dropped from 34% in 2001 to 28% in 2005.

Figure 2-18
S&E master's degrees, by sex: 1985–2005



NOTE: Data not available for 1999.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-29.

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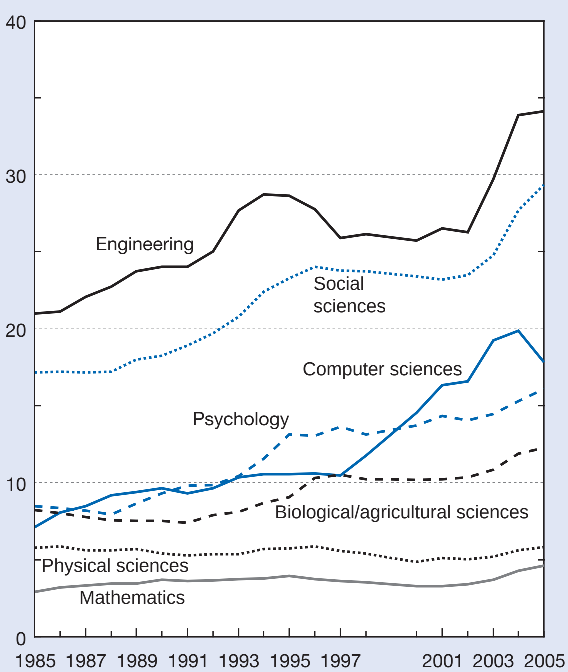
Master's Degrees by Race/Ethnicity

The number of S&E master's degrees awarded increased for all racial/ethnic groups from 1985 to 2005, although degrees to white students dropped from 1996 to 2002 before increasing again (figure 2-19).[14] Trends in the number of master's degrees by field were similar for most racial/ethnic groups except white. For most groups, the number of master's degrees in engineering, biological sciences, and social and behavioral sciences generally rose throughout the period 1985–2005. The number of master's degrees in physical sciences generally dropped, especially from 1995 to 2005, and the number of master's degrees in computer sciences generally increased but dropped sharply in 2005. Master's degrees awarded to American Indian/Alaska Native students generally followed this pattern except for drops in most fields in 2005. Master's degrees awarded to Asian/Pacific Islander students generally followed this pattern except for a drop in the number of engineering degrees from 1997 to 2002. For white students, the number of master's degrees awarded in most S&E fields dropped in the mid-1990s through 2002 before increasing again through 2005. As was the case for most racial/ethnic groups, the number of computer science

Figure 2-17
S&E master's degrees, by field: 1985–2005



NOTES: Physical sciences include earth, atmospheric, and ocean sciences. Data not available for 1999.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-29.

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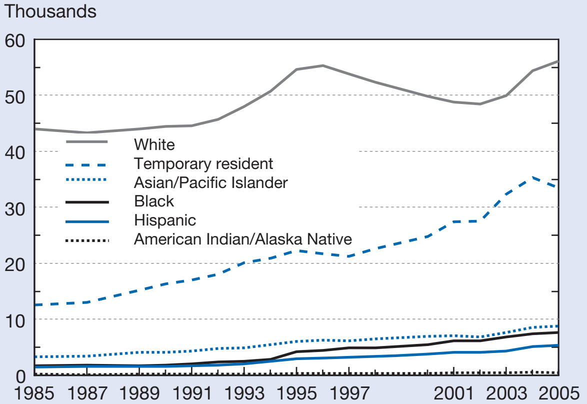
Figure 2-19
S&E master's degrees, by race/ethnicity and citizenship: 1985–2005



NOTES: Race/ethnicity includes U.S. citizens and permanent residents. Underrepresented minority includes black, Hispanic, and American Indian/Alaska Native. Data not available for 1986, 1988, and 1999.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-30.

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master's degrees earned by white students rose through 2004 but dropped sharply in 2005 (appendix table 2-30).

The proportion of master's degrees in S&E fields earned by U.S. citizen and permanent resident racial and ethnic minorities increased over the past two decades. Asians/Pacific Islanders accounted for 7% of master's degrees in 2005, up from 5% in 1985. Blacks and Hispanics also registered gains during this period (from 3% to 6% for blacks and from 2% to 4% for Hispanics). American Indians/Alaska Natives earned 0.4% of S&E master's degrees in 1985 and 2005. The percentage of S&E master's degrees earned by white students fell from 68% in 1985 to 47% in 2005 as the percentage of degrees earned by minorities and temporary residents increased (appendix table 2-30).

Master's Degrees by Citizenship

S&E master's degrees awarded to students on temporary visas rose from approximately 12,500 in 1985 to about 33,500 in 2005, and increased in most S&E fields during that period. The number of degrees generally rose through 2004 but dropped in 2005, especially in computer sciences and engineering. The number of physical sciences and biological sciences master's degrees earned by students on temporary visas dropped in the mid-1990s but increased from 2002 to 2005.

Foreign students make up a much higher proportion of S&E master's degree recipients than they do of bachelor's or associate's degree recipients. During the past two decades, the share of S&E master's degrees earned by temporary residents rose from 19% to 28%. Their degrees are heavily concentrated in computer sciences and engineering, where they earned 42% and 44%, respectively, of all master's degrees awarded in 2005 (appendix table 2-30). Within engineering, students on temporary visas earned more than half of master's degrees in chemical engineering (51%) and in electrical engineering (55%). Temporary residents also earned a high share of master's degrees in economics (49%).

S&E Doctoral Degrees

Global economic competition and the spreading conviction that highly educated workforces are key to successfully building growth economies increased interest both in the United States and abroad in the supply of foreign and domestic doctorate recipients and their migration across borders.

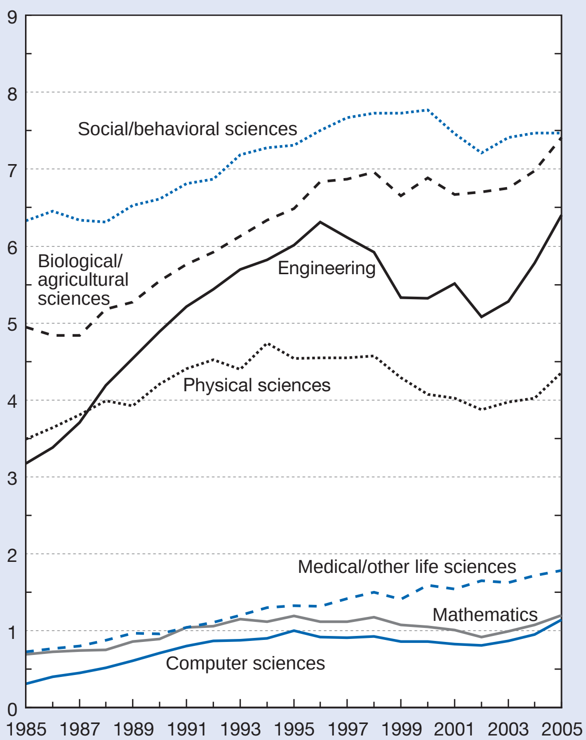
The number of S&E research doctorates conferred annually by U.S. universities reached a new peak of almost 30,000 in 2005.[15] After rising from the mid-1980s through 1998, the number of S&E doctorates declined through 2002 but increased in recent years. (For information on employment of recent doctorate recipients, see "Labor Market Conditions for Recent S&E Graduates" in chapter 3, Science and Engineering Labor Force, and "Trends in Academic Employment of Doctoral Scientists and Engineers" in chapter 5, Academic Research and Development.) The increases through the mid-1990s as well as the recent growth through 2005 largely reflected growth in the number of foreign degree recipients. The largest increases were in engineering and biological/agricultural sciences (figure 2-20). The 2003 through 2005 increases in earned doctorates reflect more degrees earned by both U.S. citizens and non-U.S. citizens (see the discussion in this chapter on foreign S&E doctorate recipients).

Doctoral Degrees by Sex

Among U.S. citizens, the proportion of S&E doctoral degrees earned by women has risen considerably in the past two decades, reaching a record high of 46% in 2005 (appendix table 2-31). During this period, women made gains in all major fields. However, as figure 2-21 shows, considerable differences by field continue. Women earn half or more of doctorates in non-S&E fields, in social/behavioral sciences, and in life sciences, but they earn considerably less than half of doctorates in physical sciences (29%), math/computer sciences (24%), and engineering (20%) (appendix table 2-31). Although the percentages of degrees earned by women in these fields is low, they are substantially higher than was the case in 1985 (16%, 17%, and 9%, respectively).

The increase in the proportion of S&E doctoral degrees earned by women resulted from both an increase in the number of women and a decrease in the number of men earning such degrees. The number of U.S. citizen women earning doctorates in S&E increased from 4,400 in 1985 to 7,500 in 2005 (appendix table 2-31). Meanwhile, the number of S&E doctorates earned by U.S. citizen men declined from 9,300 in 1985 to 8,600 in 2005. The increase in the number of S&E doctorates earned by women occurred in most major S&E fields. For example, the number of engineering doctorates earned by U.S. citizen women increased from 119 in 1985 to 396 in 2005; biological sciences doctorates from 1,032 to 2,024; physical sciences doctorates from 323 to 516; and social/behavioral sciences doctorates from 2,224 to 3,117. A decrease in the number of doctorates earned by men after the mid-1990s occurred in non-S&E fields as well as in engineering and in most science fields (except for biological sciences and medical/other life sciences).[16]

Figure 2-20
S&E doctoral degrees earned in U.S. universities, by field: 1985–2005



NOTE: Physical sciences include earth, atmospheric, and ocean sciences.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-31.

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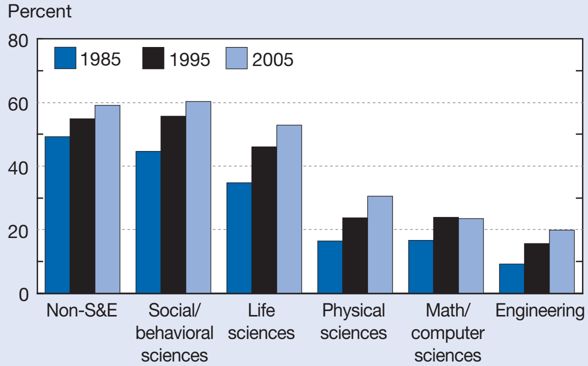
Doctoral Degrees by Race/Ethnicity

The number and proportion of doctoral degrees in S&E fields earned by U.S. citizen underrepresented minorities also increased over the past two decades. Blacks, Hispanics, and American Indians/Alaska Natives together earned almost 1,600 S&E doctorates in 2005, accounting for 5% of all S&E doctorate degrees earned that year, up from 3% in 1985. (Their share of S&E doctorate degrees earned by all U.S. citizens rose from 4% to 10% in the same period.) Gains by all groups contributed to this rise. The number of S&E degrees earned by blacks and Hispanics more than doubled in this period and the number of S&E degrees earned by American Indians/Alaska Natives increased from 43 to 70 (figure 2-22).

The underrepresented minority share of doctorates in some S&E fields is greater than in others. In 2005, blacks, Hispanics, and American Indians/Alaska Natives as a group earned 11% of doctoral degrees in psychology, 9% in medical/other life sciences, 8% in social sciences, and 6% in biological sciences. In most other S&E fields they earned approximately 3% of doctoral degrees awarded in 2005 (appendix table 2-32). In non-S&E fields, they earned 11% of doctorates in 2005. Among U.S. citizens only, they earned 15% of non-S&E doctorates.

In the mid-1990s, the number of doctoral degrees earned by Asian/Pacific Islander U.S. citizens showed a steep increase. Asians/Pacific Islanders earned more than 4% of

Figure 2-21
U.S. citizen female share of doctoral degrees, by field: 1985, 1995, and 2005



NOTES: Physical sciences include earth, atmospheric, and ocean sciences. Life sciences include biological sciences, agricultural sciences, and medical/other life sciences.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-31.

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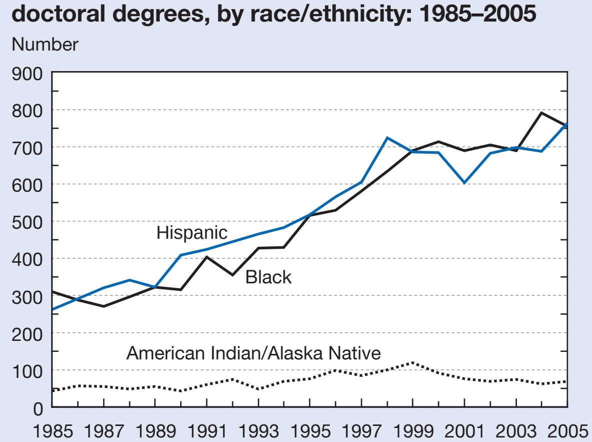
Figure 2-22
U.S. citizen underrepresented minority S&E doctoral degrees, by race/ethnicity: 1985–2005



SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-32.

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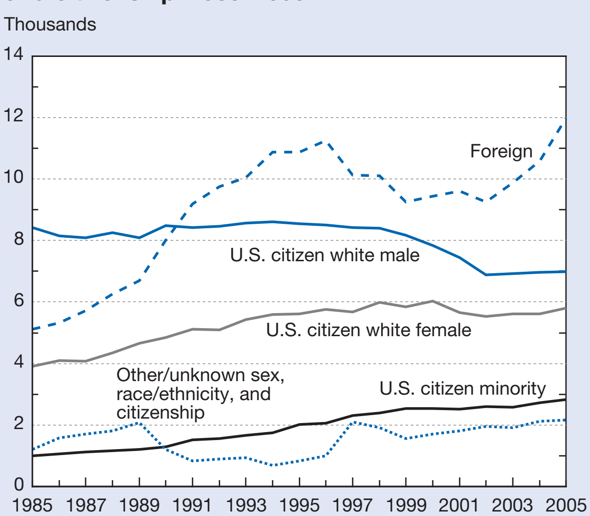
S&E doctorates in 2005, up from 2% in 1985. They earned relatively larger shares of doctoral degrees in biological sciences (7%) and medical sciences (8%), and relatively smaller shares in agricultural sciences (1%) and earth, atmospheric, and ocean sciences (2%).

The number of S&E doctorates earned by white U.S. citizens remained relatively stable over the past two decades, fluctuating from around 12,000 to 14,000 degrees awarded annually; however, the proportion of S&E doctoral degrees earned by white U.S. citizens decreased. The share of all doctoral S&E degrees earned by white U.S. citizens decreased from 63% in 1985 to 43% in 2005 as the number and percentage of S&E doctorates earned by non-U.S. citizens and minorities increased, and the white U.S. citizen share of degrees awarded to all U.S. citizens declined from 90% to 79% as the number and percentage of S&E doctorates earned by minorities increased (appendix table 2-32). Although the total number of doctoral S&E degrees earned by white U.S. citizens remained fairly stable over the past two decades, the number of S&E doctoral degrees earned by white male U.S. citizens declined in the mid-1990s through 2002 (from about 8,600 in 1994 to 6,900 in 2002) and remained around that same number through 2005 (figure 2-23). The number of degrees earned by white U.S. citizen females generally increased over much of the past three decades, with the exception of brief declines in 2001 and 2002. The drop in doctoral degrees to whites corresponds to the earlier drop in the college age population mentioned previously in this chapter.

Figure 2-23
S&E doctoral degrees, by sex, race/ethnicity, and citizenship: 1985–2005



NOTES: Foreign includes permanent and temporary residents. Minority includes Asian/Pacific Islander, black, Hispanic, and American Indian/Alaska Native.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-32.

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Although the number of white women in the college age population dropped, the percentages of white women in that age group earning doctorates in general and in S&E fields specifically both increased.

Foreign S&E Doctorate Recipients

Foreign students, even those who stay in the United States after graduation, contribute to science in their own countries by collaborating in increasingly global scientific networks, generating new knowledge, and helping to increase scientific capacity (NSB 2000, 2002, 2004b, 2006; Wagner 2007).

Noncitizens, primarily those with temporary visas, account for the bulk of the growth in S&E doctorates awarded by U.S. universities from 1985 through 2005. During this period, the number of S&E doctorates earned by U.S. citizens fluctuated from approximately 14,000 to about 17,000, while the number earned by temporary residents rose from 4,200 to a peak of 10,800 in 2005. The temporary resident share of S&E doctorates rose from 21% in 1985 to 36% in 2005. The number of S&E doctorates earned by students with permanent resident visas increased from about 1,000 in 1985 to a peak of 3,614 in 1995, before falling to about 1,200 in 2005 (appendix table 2-32). (In the mid-1990s, the number of doctorates awarded to students with permanent resident visas showed a steep increase when a large number of Chinese doctoral degree students on temporary visas shifted to permanent resident status under the 1992 Chinese Student Protection Act.)

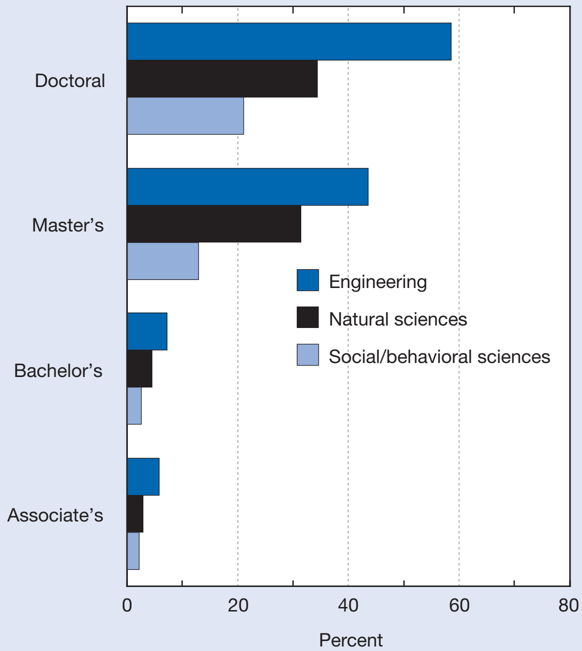
Foreign students on temporary visas earn a larger proportion of their degrees at the doctoral level than at any other level (figure 2-24). Their proportion in some fields is even higher. For example, in 2005, foreign students on temporary visas earned half or more of doctoral degrees awarded in engineering, mathematics, computer sciences, physics, and economics. They earned considerably lower proportions of doctoral degrees in other S&E fields, for example, 26% in biological sciences, 22% in medical/other life sciences, and 6% in psychology (appendix table 2-32).

Countries/Economies of Origin

The top 10 foreign countries/economies of origin of foreign S&E doctorate recipients together accounted for 65% of all foreign recipients of a U.S. S&E doctorate from 1985 to 2005 (table 2-8). All but 2 of those top 10 countries are located in Asia. The major Asian countries/economies sending doctoral degree students to the United States have been, in descending order, China, Taiwan, South Korea, and India. (Canada and Mexico were also among the top 10.)

Asia. The number of U.S. S&E doctorates earned by students from Asia increased from the mid-1980s until the mid- to late 1990s, followed by a brief decline and then increases in recent years (figure 2-25). Most of these degrees were awarded in engineering and biological and physical sciences (table 2-9). From 1985 to 2005, students from four Asian countries/economies (China, Taiwan, India, and South Korea) earned more than half of U.S. S&E doctoral degrees award-

Figure 2-24
Foreign share of U.S. S&E degrees, by degree and field: 2005



NOTES: Foreign includes temporary residents only. Natural sciences include physical, biological, earth, atmospheric, ocean, agricultural, and computer sciences and mathematics.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, WebCASPAR database, http://webcaspar.nsf.gov. See appendix tables 2-26, 2-28, 2-30, and 2-32.

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Table 2-8
Foreign recipients of U.S. S&E doctorates, by country/economy of origin: 1985–2005

Country/economy	Number	Percent
All foreign recipients	189,346	100.0
Top 10 total	122,046	64.5
China	41,677	22.0
Taiwan	19,187	10.1
South Korea	18,872	10.0
India	18,712	9.9
Canada	6,231	3.3
Turkey	3,957	2.1
Thailand	3,479	1.8
Iran	3,386	1.8
Japan	3,295	1.7
Mexico	3,250	1.7
All others	67,300	35.5

NOTE: Foreign doctorate recipients include permanent and temporary residents.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2006).

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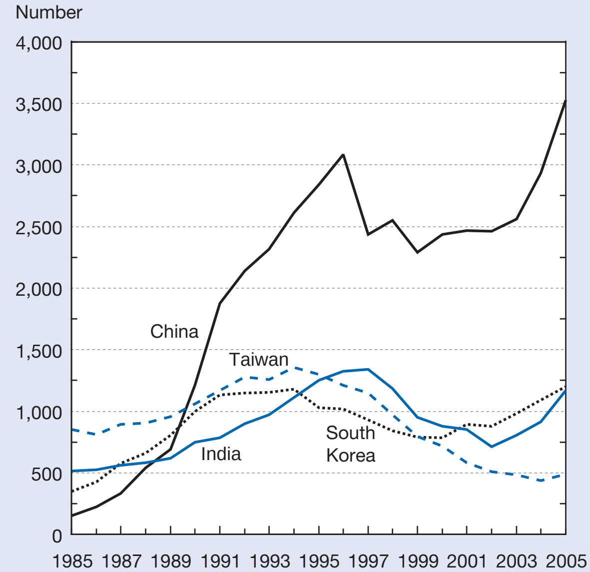
Figure 2-25
U.S. S&E doctoral degree recipients, by selected Asian country/economy of origin: 1985–2005



NOTE: Degree recipients include permanent and temporary residents.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2007).

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ed to foreign students (98,400 of 189,300), almost four times more than students from Europe (25,500).

China had the largest number of students earning U.S. S&E doctorates during the 1985–2005 period. These students received almost 42,000 S&E doctoral degrees from U.S. universities, mainly in biological and physical sciences and engineering (table 2-9). The number of S&E doctorates earned by Chinese nationals increased from 151 in 1985 to more than 3,500 in 2005 (figure 2-25).[17]

Students from Taiwan received the second-largest number of S&E doctorates at U.S. universities. Between 1985 and 2005, students from Taiwan earned more than 19,000 S&E doctoral degrees, mainly in engineering and biological and physical sciences (table 2-9). In 1985, they earned more U.S. S&E doctoral degrees than students from India and China combined. The number of U.S. S&E doctoral degrees earned by students from Taiwan increased rapidly for almost a decade, from 854 in 1985 to more than 1,300 at its peak in 1994. However, as universities in Taiwan increased their capacity for advanced S&E education in the 1990s, the number of students from Taiwan earning S&E doctorates from U.S. universities declined to 488 in 2005 (figure 2-25).

Students from India earned more than 18,700 S&E doctoral degrees at U.S. universities over the period. Like students from China and Taiwan, they mainly earned doctorates in engineering and biological and physical sciences. They also earned by far the largest number (1,515) of U.S. doctoral degrees awarded to any foreign group in computer sciences.

Table 2-9
Asian recipients of U.S. S&E doctorates, by field and country/economy of origin: 1985–2005

Field	Asia	China	Taiwan	India	South Korea
All fields	153,117	44,345	22,914	21,623	24,139
S&E	130,426	41,677	19,187	18,712	18,872
Engineering	48,166	12,784	8,816	8,172	7,273
Science	82,260	28,893	10,371	10,540	11,599
Agricultural sciences	5,313	1,313	709	434	728
Biological sciences	20,973	9,957	2,658	2,668	2,132
Computer sciences	5,850	1,360	970	1,515	745
Earth, atmospheric, and ocean sciences	2,947	1,345	388	243	366
Mathematics	6,236	2,692	739	575	829
Medical/other life sciences	4,026	813	753	727	413
Physical sciences	19,735	8,934	2,234	2,479	2,429
Psychology	2,005	297	297	238	318
Social sciences	15,175	2,182	1,623	1,661	3,639
Non-S&E	22,691	2,668	3,727	2,911	5,267

NOTE: Foreign doctorate recipients include permanent and temporary residents.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2006).

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The more than decade-long increase in U.S. S&E doctorates earned by students from India ended in 1997, followed by 5 years of decline (figure 2-25). The number of S&E doctoral degrees earned by students from India increased from 2003 through 2005.

Students from South Korea earned almost 19,000 U.S. S&E doctorates from 1985 to 2005, mainly in engineering and biological, social, and physical sciences. The number of S&E doctoral degrees earned by South Korean students increased from about 350 in 1985 to 1,178 in 1994, declined to a low of about 800 in the late 1990s, and increased to 1,200 in 2005 (figure 2-25).

Europe. European students earned far fewer U.S. S&E doctorates (25,500) than did Asian students (130,400) between 1985 and 2005, and they tended to focus less on engineering than did their Asian counterparts (table 2-10). Western European countries whose students earned the largest number of U.S. S&E doctorates from 1985 to 2005 were Germany, the United Kingdom, Greece, Italy, and France, in that order. From 1985 to 1993, Greece and the United Kingdom were the primary European countries of origin; thereafter, their numbers of doctoral degree recipients declined. The numbers of U.S. S&E doctorate recipients from Germany, Italy, and France generally increased over the past two decades, although doctorate recipients from Germany declined in recent years (figure 2-26). Scandinavians received fewer U.S. doctorates than did students from the other European regions, with a field distribution roughly similar to that for other Western Europeans (table 2-10).

The number of Central and Eastern European students earning S&E doctorates at U.S. universities increased from fewer than 70 in 1985 to more than 800 in 2005 (figure 2-27). A higher proportion of Central and Eastern European U.S. doctorate recipients (88%) than of Western European doctorate recipients (73%) earned their doctorates in S&E fields. Western Europeans earned U.S. S&E doctorates mainly in engineering and biological, physical, and social sciences. Central and Eastern Europeans earned U.S. S&E doctorates mainly in engineering, biological sciences, physical sciences, and mathematics (table 2-10).

North America. The Canadian and Mexican shares of U.S. S&E doctoral degrees were small compared with those from Asia and Europe. The number of U.S. S&E degrees earned by students from Canada increased from less than 200 in 1985 to almost 400 in 2005. In all, 64% of Canadian doctoral degree students in U.S. universities earned S&E doctorates, mainly in social and biological sciences (figure 2-28; table 2-10). Mexican doctoral degree students in U.S. universities are more concentrated in S&E fields than are Canadian students: 85% of doctoral degrees earned by Mexican students at U.S. universities were in S&E fields, mainly engineering and agricultural, biological, and social sciences. The number of doctoral degree recipients from Mexico increased from 111 in 1985 to more than 200 in 2005.

Stay Rates

Of the approximately 3.4 million immigrant scientists and engineers residing in the United States in 2003, about 30% initially came to the United States for educational opportunities and then remained in this country (NSF/SRS 2007b). This section examines data on foreign S&E doctorate recipients' plans for staying in the United States at the time of doctorate receipt. Chapter 3 provides data based on examination of Social Security records on the percentage of foreign students with U.S. S&E doctorates who remain in the U.S. labor force up to 5 years after graduation.

Table 2-10
European and North American recipients of U.S. S&E doctorates, by field and region/country of origin: 1985–2005

Field	Europe[a]				North America		
	All	Western	Scandinavia	Central and Eastern	All	Canada	Mexico
All fields	32,974	22,380	1,990	8,604	13,601	9,778	3,823
S&E	25,465	16,341	1,514	7,610	9,481	6,231	3,250
Engineering	5,189	3,439	275	1,475	1,585	848	737
Science	20,276	12,902	1,239	6,135	7,896	5,383	2,513
Agricultural sciences	734	553	60	121	796	251	545
Biological sciences	3,655	2,386	215	1,054	1,823	1,274	549
Computer sciences	1,233	743	70	420	262	181	81
Earth, atmospheric, and ocean sciences	982	680	81	221	360	214	146
Mathematics	2,591	1,250	107	1,234	483	306	177
Medical/other life sciences	578	462	65	51	566	477	89
Physical sciences	5,216	2,822	222	2,172	1,038	765	273
Psychology	969	768	88	113	865	779	86
Social sciences	4,318	3,238	331	749	1,703	1,136	567
Non-S&E	7,509	6,039	476	994	4,120	3,547	573

[a]See figure 2-27 notes for countries included in Western Europe, Scandinavia, and Central and Eastern Europe.

NOTE: Foreign doctorate recipients include permanent and temporary residents.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2006).

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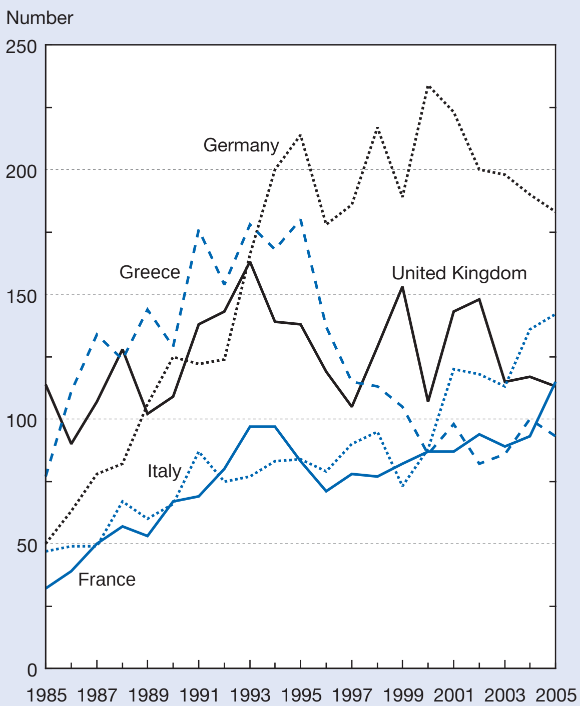
Figure 2-26
U.S. S&E doctoral degree recipients, by selected Western European country: 1985–2005



NOTE: Degree recipients include permanent and temporary residents.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2007).

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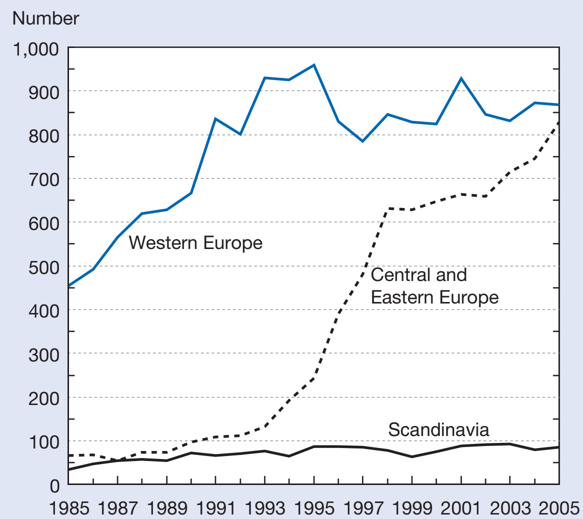
Figure 2-27
U.S. S&E doctoral degree recipients from Europe, by region: 1985–2005



NOTES: Degree recipients include permanent and temporary residents. Western Europe includes Andorra, Austria, Belgium, France, Germany, Gibraltar, Greece, Ireland, Italy, Luxembourg, Malta, Monaco, Netherlands, Portugal, Spain, and Switzerland. Central and Eastern Europe includes Albania, Bulgaria, Czech Republic, Slovakia, Hungary, Poland, Romania, Russia, Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Tadjikistan, Turkmenistan, Ukraine, Uzbekistan, Yugoslavia, Bosnia-Herzegovina, Croatia, Macedonia, and Serbia-Montenegro. Scandinavia includes Denmark, Finland, Iceland, Norway, and Sweden.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2007).

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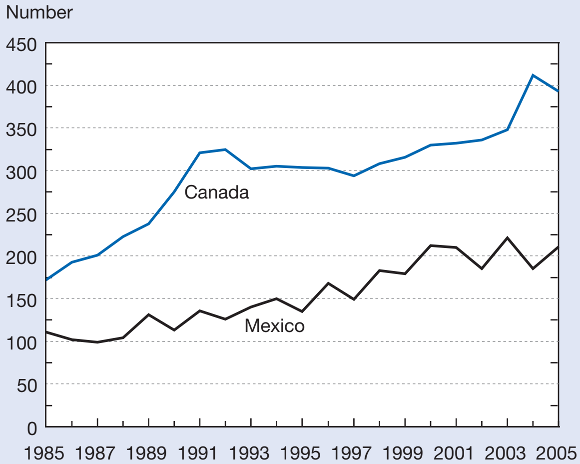
Figure 2-28
U.S. S&E doctoral degree recipients from Canada and Mexico: 1985–2005



NOTE: Degree recipients include permanent and temporary residents.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2007).

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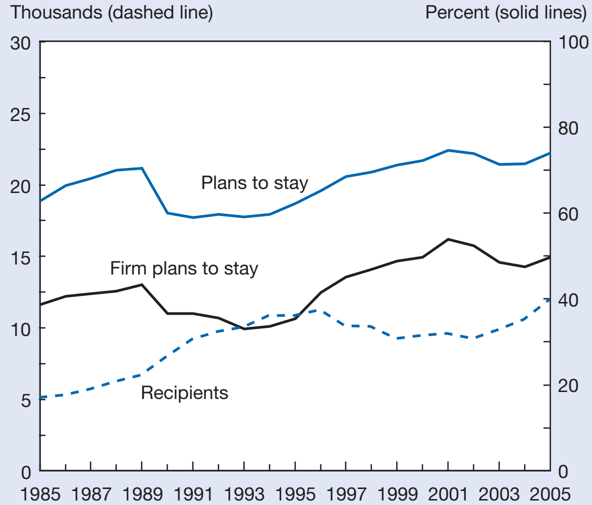
Figure 2-29
Plans of foreign recipients of U.S. S&E doctorates to stay in United States: 1985–2005



NOTES: Degree recipients include permanent and temporary residents. See appendix table 2-33 for plans to stay by place of origin and field of study in 4-year increments.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2007).

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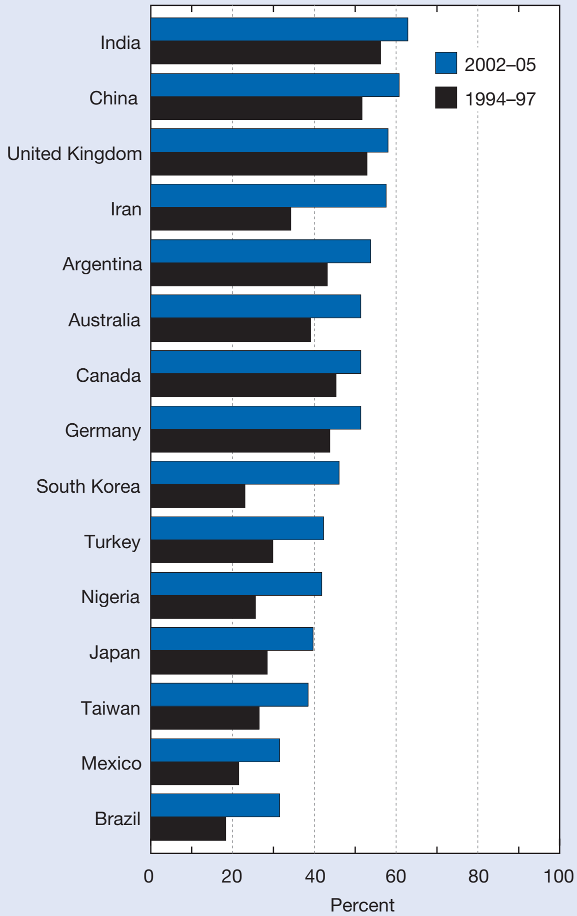
At the time of doctorate receipt, almost three-quarters of foreign recipients of U.S. S&E doctorates plan to stay in the United States and about half had either accepted an offer of postdoctoral study or employment or are continuing employment in the United States. Until the early 1990s, about half of foreign students who earned S&E degrees at U.S. universities reported that they planned to stay in the United States after graduation, and about one-third said they had firm offers for postdoctoral study or employment (NSB 1998). In the 1990s, however, these percentages increased substantially. In the 1994–97 period, for example, of the foreign S&E doctoral degree recipients who reported their plans, 71% planned to remain in the United States after receiving their degree and 39% already had firm offers for postdoctoral study or employment. In the 2002–05 period, 74% of foreign doctoral recipients in S&E fields with known plans intended to stay in the United States and 49% had firm offers to do so (appendix table 2-33). Higher percentages of foreign doctorate recipients in physical sciences and mathematics/computer sciences and lower percentages of those in social/behavioral sciences reported firm plans to stay. The percentage of students who had firm plans to remain in the United States dropped after 2001 but increased in 2005 (figure 2-29).

Stay rates vary by place of origin. In the 2002–05 period, more than 90% of U.S. S&E doctoral recipients from China and 88% of those from India reported plans to stay in the United States, and 60% and 63%, respectively, reported accepting firm offers for employment or postdoctoral research in the United States (figure 2-30; appendix table 2-33). China and India are the two major countries of origin from which the percentage of U.S. S&E doctorate recipients with definite plans to stay in the United States dropped from 1998–2001 to 2002–05. The drops were almost entirely among computer science doctorate recipients from India and engineering doctorate recipients from India and China. Stay rates for Chinese and Indian U.S. doctorate recipients in the biological/agricultural/health sciences and physical/earth/atmospheric/ocean sciences increased or stayed about the same from 1998–2001 to 2002–05, and those in social/behavioral sciences stayed about the same or dropped slightly.

Doctorate recipients from Taiwan, Japan, and South Korea were less likely than those from India and China to stay in the United States. Over the same 2002–05 period, 39% of S&E doctoral degree recipients from Taiwan, 41% of those from Japan, and 43% of those from South Korea reported accepting firm offers to remain in the United States.

Among U.S. S&E doctoral degree recipients from Europe, a relatively high percentage from the United Kingdom planned to stay, whereas smaller percentages from Greece, Italy, and Spain (compared with other Western European countries) planned to stay after graduation. The percentage of 2002–05 doctoral degree students who had firm plans to stay in the United States was higher for Canada (51%) than for Mexico (31%) (appendix table 2-33).

Figure 2-30
Short-term stay rates of foreign recipients of U.S. S&E doctorates, by place of origin: 1994–97 and 2002–05



NOTES: Short-term stay rates are those with firm commitments of postaward or postdoctoral employment. Longer-term stay rates may differ. See appendix table 2-33 for plans to stay by place of origin and field of study in 4-year increments.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, special tabulations (2007).

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Postdocs in U.S. Higher Education

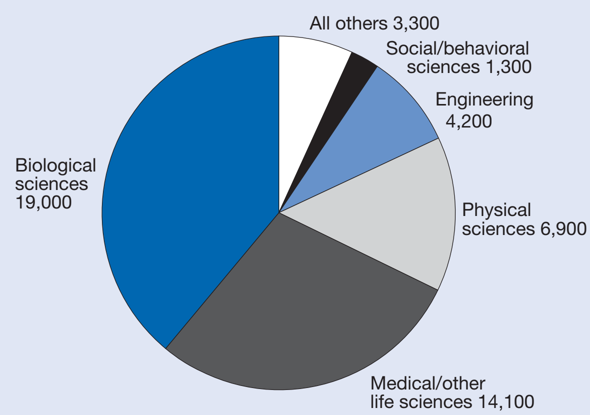
Postdoctoral fellowships provide recent doctorate recipients with "an opportunity to develop further the research skills acquired in their doctoral programs or to learn new research techniques" (Association of American Universities 1998). Typically, postdoctoral fellows or "postdocs" have temporary appointments involving full-time research or scholarship whose purpose is to further their education and training. The titles associated with these positions and the conditions of employment vary widely. The status of postdoctoral fellows within the academic hierarchy is not well defined and varies among institutions, although the concept that the postdoctoral experience represents the last step on a person's training for becoming an independent investigator and faculty member is generally accepted (COSEPUP 2000). Postdoctoral fellows are also important contributors to academic research. They bring a new set of techniques and perspectives to the laboratory that broadens the experience of the research team and can make them more competitive for additional research funding. Chapter 3 provides more detail on postdoctoral employment, including reasons for and length of postdoc position as well as salaries and subsequent employment. Chapter 5 provides more detail on postdocs in the academic R&D setting.

Since 1985, the number of doctoral degree recipients with science, engineering, and health postdoctoral appointments at U.S. universities more than doubled from 22,400 to 48,700 in 2005 (appendix table 2-34). More than two-thirds of those were in biological, medical, and other life sciences (figure 2-31).[18]

Noncitizens account for much of the increase in the number of S&E postdocs, especially in biological sciences and medical and other life sciences. The number of S&E postdocs with temporary visas at U.S. universities increased from approximately 8,900 in 1985 to 27,000 in 2005. The number of U.S. citizen and permanent resident S&E postdocs at these institutions increased more modestly from approximately 13,500 in 1985 to 21,700 in 2005 (figure 2-32; appendix table 2-34). Temporary visa holders accounted for 55% of S&E postdocs in 2005.

An increasing share of academic S&E postdocs are funded through federal research grants. In fall 2005, 57% of S&E postdocs at U.S. universities were funded through this mechanism, up from 50% in 1985. Federal fellowships and traineeships funded a declining share of S&E postdocs—14%

Figure 2-31
Postdoctoral students at U.S. universities, by field: 2005



SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-34.

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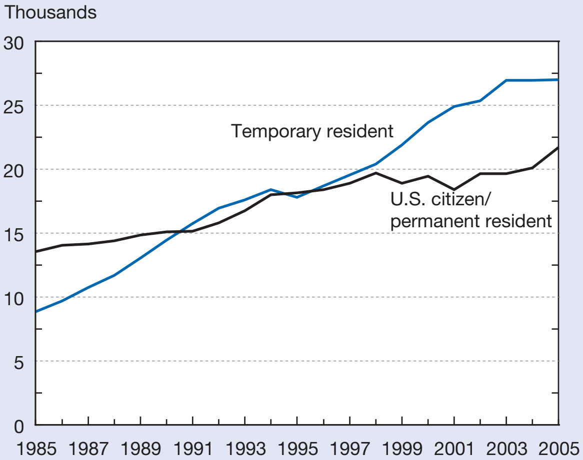
Figure 2-32
Postdoctoral students at U.S. universities, by citizenship status: 1985–2005



SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-34.

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in 2005, down from 22% in 1985. In 2005, the remainder (about 30%) of S&E postdocs were funded through nonfederal sources (table 2-11).

Global Trends in Higher Education in S&E

In the 1990s, many countries worldwide expanded their higher education systems as well as access to higher education in their country. At the same time, flows of students worldwide increased, particularly from developing countries to more developed countries, and from Europe and Asia to the United States. More recently, a number of countries adopted policies to encourage the return of students who studied abroad, to attract foreign students, or both.

Educational Attainment

Educational attainment of the U.S. population has long been among the highest in the world, but other countries are now catching up (OECD 2006). The United States continues to have the highest percentage of the population ages 25–64 with a bachelor's degree or higher, although among the younger age group (ages 25–34), the United States (30%) lags behind Norway (37%), Israel (34%), the Netherlands (32%), and South Korea (31%) in the percentage of the population with at least a bachelor's degree (figure 2-33; appendix table 2-35).

The percentage of the population with postsecondary degrees of any sort increased greatly in Europe and in many Asian countries over the past decade. Many other countries, including Russia, Israel, Belgium, Canada, Finland, and Sweden have traditionally had relatively high percentages of the population with education levels broadly comparable to U.S. associate's degrees (*tertiary type B* in international classification). Recently, increases in population shares with this level of education have occurred in France, Ireland, Japan, and South Korea, among other countries; these increases are often accompanied by increases in those with bachelor's level qualifications (*tertiary type A*) or better. In total postsecondary education attainment of the population ages 25 to 64 (including 2-year and 4-year or higher degrees), the United States ranks 4th (behind Russia, Israel, and Canada), and it ranks 10th (behind Russia, Canada, Japan, Israel, South Korea, Sweden, Belgium, Ireland, and Norway) in the percentage of the younger population (ages 25–34) with any postsecondary degree (appendix table 2-36).

First University Degrees in S&E Fields

In 2004, almost 11 million students worldwide earned a first university degree[19] with almost 4 million of these in S&E fields (appendix table 2-37). These worldwide totals include only countries for which relatively recent data are available (primarily countries in the Asian, European, and American regions), and therefore are likely an underestimation. Asian universities accounted for 1.7 million of the world's S&E

Table 2-11
Source of funding of S&E postdoctoral students: 1985–2005
(Percent distribution)

Source	1985	1987	1989	1991	1993	1995	1997	1999	2000	2001	2002	2003	2004	2005
All sources	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Federal fellowships	10.6	9.5	9.4	9.0	8.5	8.8	9.0	9.4	9.1	8.3	8.7	7.9	7.9	7.9
Federal traineeships	11.3	10.6	8.9	8.8	8.5	7.6	7.2	6.6	6.0	5.7	6.0	5.7	5.5	5.8
Federal research grants	50.0	50.9	51.6	51.8	52.1	51.9	51.7	53.2	54.5	54.7	55.8	56.0	57.9	56.6
Nonfederal sources	28.1	29.1	30.1	30.5	30.9	31.6	32.1	30.7	30.3	31.3	29.5	30.4	28.8	29.8

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, Integrated Science and Engineering Resources Data System (WebCASPAR) database, http://webcaspar.nsf.gov.

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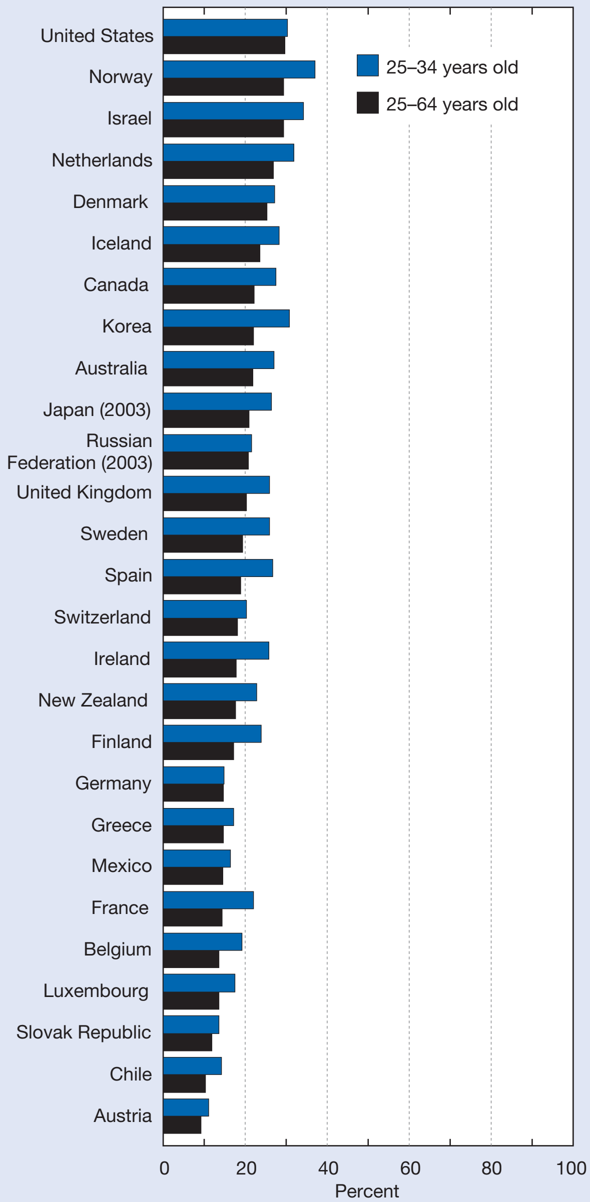
Figure 2-33
Attainment of tertiary-type A and advanced research programs, by country and age group: 2004



NOTES: Tertiary-type A programs (International Standard Classification of Education [ISCED] 5A) largely theory-based and designed to provide sufficient qualifications for entry to advanced research programs and professions with high skill requirements such as medicine, dentistry, or architecture and have a minimum duration of 3 years' full-time equivalent, although typically last ≥4 years. In United States, correspond to bachelor's and master's degrees. Advanced research programs are tertiary programs leading directly to award of an advanced research qualification, e.g., doctorate.

SOURCE: Organisation for Economic Co-operation and Development (OECD), Education at a Glance: OECD Indicators 2006 (2006).

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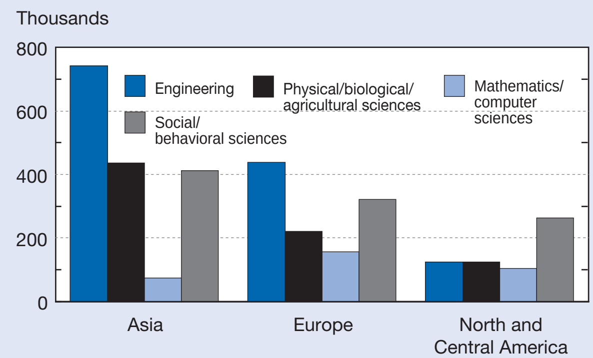
first university degrees in 2004, more than 700,000 of them in engineering (figure 2-34). Students across Europe (including Eastern Europe and Russia) earned more than 1 million S&E degrees, and students in North and Central America more than 600,000 in 2004.

In the United States, S&E degrees are about one-third of U.S. bachelor's degrees. In several countries/economies around the world, the proportion of first degrees in S&E fields, especially engineering, is higher. More than half of first degrees were in S&E fields in Japan (63%), China (56%), Singapore (59%), Laos (57%), and Thailand (69%). Many of these countries/economies traditionally awarded a large proportion of their first degrees in engineering. In the United States, about 5% of all bachelor's degrees are in engineering. However, in Asia, 20% are in engineering, and in many other countries worldwide, more than 10% are in engineering. About 12% of all bachelor's degrees in the United States and worldwide are in natural sciences (physical, biological, computer, and agricultural sciences, and mathematics).

The number of first university S&E degrees awarded in China, South Korea, and the United Kingdom more than doubled between 1985 and 2005; those in the United States generally increased; and those in Japan decreased in recent years (appendix table 2-38). In China, the number of first university degrees in engineering more than doubled between 2000 and 2004 and quadrupled over the past two decades (figure 2-35). Degrees in the physical and biological sciences also greatly increased in China in those years. (See sidebars "Recent Developments in Higher Education in China" and "Recent Developments in Higher Education in India") In South Korea, the number of first university degrees in engineering doubled

Figure 2-34
First university S&E degrees in Asia, Europe, and North and Central America, by field: 2004



NOTE: Physical sciences include earth, atmospheric, and ocean sciences.

SOURCES: Organisation for Economic Co-operation and Development, Education Online Database, http://www.oecd.org/education/database/; United Nations Educational, Scientific, and Cultural Organization (UNESCO), Institute for Statistics, special tabulations (2006); and national sources. See appendix table 2-37 for countries/economies included in each region.

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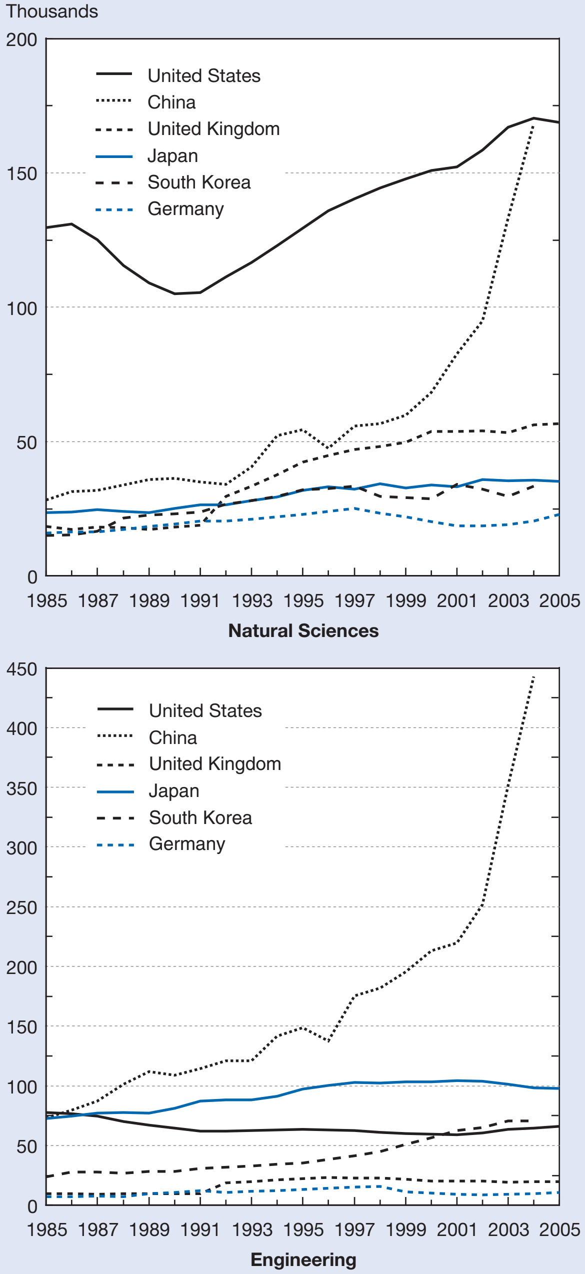
Figure 2-35
First university natural sciences and engineering degrees, by selected countries: 1985–2005



NOTES: Natural sciences include physical, biological, earth, atmospheric, ocean, agricultural, and computer sciences and mathematics. German degrees include only long university degrees required for further study.

SOURCES: China—National Bureau of Statistics of China, *China Statistical Yearbook*, annual series (Beijing) various years; Japan—Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Higher Education Bureau, Monbusho Survey of Education; South Korea—Organisation for Economic Co-operation and Development, Education Online Database, http://www.oecd.org/education/database; United Kingdom—Higher Education Statistics Agency; Germany—Federal Statistical Office, Prüfungen an Hochschulen; and United States—National Science Foundation, Division of Science Resources Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-38.

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between 1995 and 2005 and increased almost threefold between 1985 and 2005. In both the United States and United Kingdom, the number of first university degrees in mathematics/computer sciences and social/behavioral sciences generally increased over the past two decades, while the number awarded in physical/biological sciences and engineering dipped in recent years (although in the United States, degrees in those disciplines have since rebounded). In Japan, the number of first university S&E degrees rose in the 1990s but decreased from 2002 through 2005. In Germany, the number of first university S&E degrees dropped from 1997 through 2001 but increased in recent years.

Global Comparison of Participation Rates by Sex

Women earned half or more of first university degrees in S&E in many countries around the world in 2004, including the United States, Canada, Greece, Portugal, Panama, and several countries in Asia, the middle East, and Eastern

Recent Developments in Higher Education in China

Major education reform efforts in China began in the late 1990s. These efforts focused on consolidating and strengthening higher education institutions, expanding disciplines offered, increasing funding, and improving teaching. As a consequence, enrollment in higher education in China increased sharply (Hsiung 2007). Since 1998, undergraduate enrollment in colleges and universities increased from 0.3 million to 13.3 million in 2004, and 4-year degrees increased from 405,000 to 1.2 million (National Bureau of Statistics of China 2005). Although enrollment and degree production increased exponentially, the per capita rate of college attendance remains low (Hsiung 2007). In addition to expansion of 4-year colleges and universities, vocational and technical education also expanded. The number of vocational and technical schools increased from 101 in 1998 to 872 in 2004, and enrollments rose to 5.96 million students (45% of all college students) in 2004 (Hsiung 2007). Current reform efforts focus on improving quality of instruction, slowing the growth in college enrollment to 5% per year, and targeting advanced education.

The increased growth in enrollment and degree production over the past few years has increasingly been outside of S&E fields. Historically, almost half of bachelor's recipients in China earned degrees in engineering, but although the numbers of degrees in engineering have increased, the percentage has been steadily decreasing over time. In 1994, 46% were in engineering; by 2004, 37% were in engineering (appendix table 2-38) as the number and percentage of degrees in business, literature, education, and law increased.

Recent Developments in Higher Education in India

Over the past two decades, higher education in India expanded rapidly (Agarwal 2006). Enrollment increased from 2.8 million in 1980 to 9.9 million in 2003 (Ministry of Science and Technology 2006). Most of the growth is due to an increase in the number of private colleges, many of which are polytechnics and industrial training institutes. Foreign education providers also increased their presence. In 2005, 131 foreign providers of higher education, mainly from the United States and United Kingdom, enrolled students mostly in vocational or technical fields (Agarwal 2006). Despite high numbers of students enrolled, the percentage of the college age population who enroll in higher education in India is low (13%) (Thorat 2006).

The growth of higher education in India resulted in several challenges, including questions of adequacy of facilities, space, and resources; institutional quality and standards; and quality of faculty and instructional methods (Chatterjea and Moulik 2006). There is wide disparity in the perceived quality of schools. The Indian Institutes of Management and the Indian Institutes of Technology are generally regarded as top-quality schools. According to Giridharadas (2006), graduates of second-tier schools face high unemployment as their knowledge and skills are considered not up to par. Another observer (Agarwal 2006) states that the expansion of higher education also resulted in mismatches between supply and demand. He reported that in 2001, about 17% of higher education graduates were unemployed and nearly 40% were not, or were not fully, productively employed.

Although data on enrollments are available, up-to-date definitive statistics on Indian higher education degrees are not. Higher education institutions are not required to provide information and response rates to voluntary data collections are low.

Europe. A number of countries in Europe are not far behind, with more than 40% of first university S&E degrees earned by women. In many Asian and African countries, women generally earn about one-third or less of the first university degrees awarded in S&E fields (appendix table 2-39). In the United States, Canada, Japan, and many smaller countries, over half of the S&E first university degrees earned by women are in the social and behavioral sciences. In a few countries (e.g., El Salvador, South Korea, and several countries in Eastern Europe), more than 40% of S&E first university degrees earned by women are in engineering, compared with 6% in the United States.

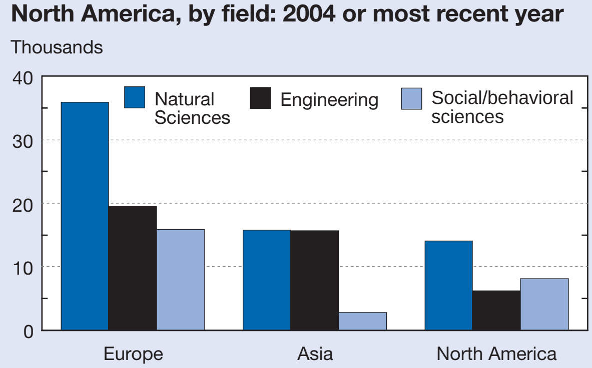
Global Comparison of S&E Doctoral Degrees

Almost 150,000 S&E doctoral degrees were earned worldwide in 2004. Of these, more than 80% were earned outside the United States (appendix table 2-40). The United States awarded the largest number of S&E doctoral degrees (more than 26,000), followed by Russia (16,000), China (almost 15,000), and Germany (more than 12,000). Close to 40% of these S&E doctoral degrees in the United States and worldwide were earned in the physical/biological sciences. Figure 2-36 shows the breakdown of S&E doctoral degrees by major region and selected fields.

Women earned 37% of S&E doctoral degrees awarded in the United States and about 34% of those earned worldwide in 2004. The percentage of S&E doctoral degrees earned by women varied widely by country/economy, from less than 20% in South Korea, Taiwan, Japan, Iran, and Ghana, to more than 50% in Kyrgyzstan, the Philippines, Uganda, Portugal, Latvia, and Lithuania (appendix table 2-41).

The number of S&E doctoral degrees awarded in the United Kingdom and in many Asian countries rose steeply in the past two decades (appendix tables 2-42 and 2-43). The United States awards the largest number of natural sciences and engineering doctoral degrees, but China is catching up (figure 2-37). In the United Kingdom, as well as in Germany and the United States, most S&E doctoral degrees are in the physical and biological sciences. The numbers of doctoral degrees in those fields stagnated or declined from the late 1990s through 2005, although the number of these degrees in the United States experienced a recent upturn. Most of the recent growth in S&E doctoral degrees in the United Kingdom was due to an increase in the number of social and behavioral sciences doctorates.

Figure 2-36
S&E doctoral degrees earned in Europe, Asia, and North America, by field: 2004 or most recent year



NOTES: Natural sciences include physical, biological, earth, atmospheric, ocean, agricultural, and computer sciences and mathematics. Asia includes China, India, Japan, South Korea, and Taiwan. Europe includes Western, Central, and Eastern Europe. North America includes United States and Canada.

SOURCES: Organisation for Economic Co-operation and Development, Education Online Database; United Nations Educational, Scientific, and Cultural Organization (UNESCO), Institute for Statistics database, http://www.unesco.org/statistics, accessed 3 April 2007; and national sources. See appendix table 2-40.

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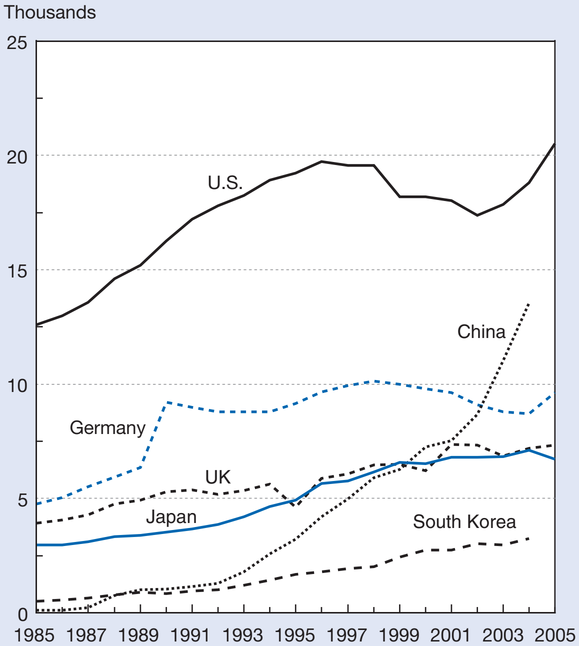
Figure 2-37
Natural sciences and engineering doctoral degrees, by selected country: 1985–2005



UK = United Kingdom

NOTE: Natural sciences and engineering include physical, biological, earth, atmospheric, ocean, agricultural, and computer sciences; mathematics; and engineering.

SOURCES: China—National Research Center for Science and Technology for Development; United States—National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates; Japan—Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Higher Education Bureau, Monbusho Survey of Education; South Korea—Organisation for Economic Co-operation and Development, Education Online database, http://www.oecd.org/education/database/; United Kingdom—Higher Education Statistics Agency; and Germany—Federal Statistical Office, Prüfungen an Hochschulen. See appendix tables 2-42 and 2-43.

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In Asia, China was the largest producer of S&E doctoral degrees (almost 15,000). The number of S&E doctorates awarded in China rose more than sixfold between 1993 and 2004, and the number of S&E doctorates awarded in South Korea, Taiwan, and Japan also greatly increased. In China, South Korea, Japan, and Taiwan, more than half of S&E doctorates were awarded in engineering. In India, the number of S&E doctoral degrees rose more modestly, although there was still a 58% increase from 1985 through 2003, and most doctorates were awarded in the physical and biological sciences (appendix table 2-43).

Global Student Mobility

International migration of students and highly skilled workers expanded in the past two decades, and countries are increasingly competing for foreign students. In particular, migration of students occurred from developing countries to the more developed countries, and from Europe and Asia to the United States. Some migrate temporarily for education, whereas others remain permanently. Some of the factors that influence the decision to migrate are economic opportunities, research opportunities, research funding, and climate for innovation in the country of destination (OECD 2004).

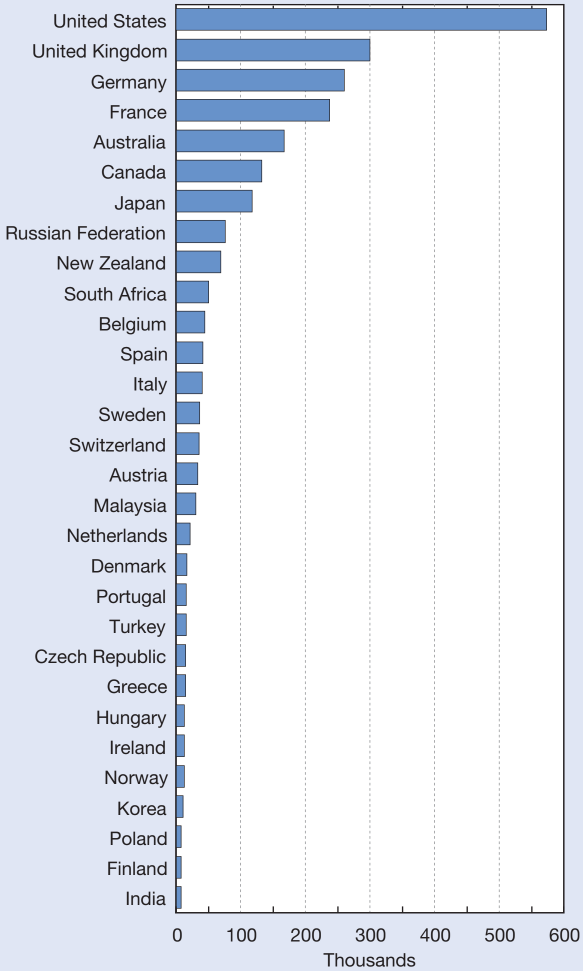
The population of individuals ages 20–24 (a proxy for the college-age population) decreased in Europe, the United States, China, and Japan in the 1990s and is projected to continue decreasing in Europe and Japan (appendix table 2-44). Some countries expanded recruitment of foreign students as their own populations of college-age students decreased, both for attraction of highly skilled workers and also for increased revenue for colleges and universities. (See sidebar "Transnational Higher Education.")

The U.S. share of foreign students worldwide declined in recent years, although the United States remains the destination of the largest number of foreign students worldwide (both undergraduate and graduate) of all Organisation for Economic Co-operation and Development (OECD) countries (figure 2-38). In 2004, the United States received 22% of foreign students worldwide, down from 25% in 2000 (OECD 2006). Other countries that are among the top destinations for foreign students include the United Kingdom (11%), Germany (10%), and France (9%). Although they have lower numbers of foreign students than the United States, several other countries have higher percentages of higher education

Transnational Higher Education

Universities in the United States and abroad are establishing branch campuses and programs in other countries. In the past, cross-border higher education largely involved study abroad programs. More recently, it involved establishing programs for foreign students in their home countries. For countries in which these branch campuses are established, these efforts provide a means to curb "brain drain," increase educational opportunities, and potentially attract more international students (McBurnie and Ziguras 2006). Some of the major sites for transnational delivery of higher education include China, India, and Singapore. For countries that establish branch campuses abroad, the benefits of these efforts include increased enrollment and revenue, greater opportunities for student and staff mobility, and prestige. The major countries providing transnational higher education include the United States, Canada, the United Kingdom, and Australia. The United States accounts for the majority of institutions offering transnational delivery (Verbik and Merkley 2006). Problems with this type of delivery include issues of governance, quality control, and access; the stability of the institution; and the range of disciplines offered.

Figure 2-38
Foreign students enrolled in tertiary education, by country: 2004



NOTES: Austria excludes tertiary-type B programs, e.g., associate's. Poland excludes advanced research programs, e.g., doctorate.
SOURCE: Organisation for Economic Co-operation and Development (OECD), Education at a Glance: OECD Indicators 2006 (2006).

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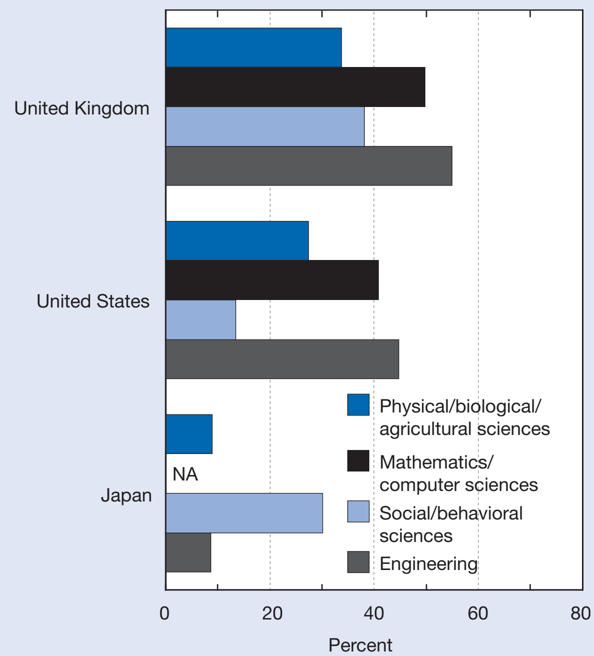
students (both undergraduate and graduate) who are foreign. In Australia 17% of students in higher education are foreign; in Switzerland and the United Kingdom, 13%; and in Austria, 11%, compared with 3% in the United States. Many countries (the United Kingdom, Germany, France, and New Zealand) recently instituted policies to help facilitate immigration of foreign students (Suter and Jandl 2006). Major policy efforts in Europe promoted increased international mobility of students. In the European Union, a substantial number of foreign students come from other European Union countries, but large numbers are also from Eastern Europe, Africa, and Asia, especially China and India (Kelo, Teichler, and Wächter 2006; Suter and Jandl 2006).

Foreign student enrollment in the United Kingdom increased in the past decade. The proportion of foreign students studying S&E fields in the United Kingdom also increased, especially at the graduate level, with increasing flows of students from China and India. From 1994 to 2005, foreign students increased from 29% to 43% of all graduate students studying S&E in the United Kingdom. In graduate engineering, foreign student enrollment more than doubled from 9,300 (35% of enrollment) to 21,400 (55% of enrollment) (figure 2-39; appendix table 2-45). Students from China, Greece, India, and Pakistan accounted for most of the increase in foreign graduate engineering enrollment. The prime minister's current Initiative for International Education calls for attracting an additional 100,000 international students by 2011 and provides about $48 million in funding to increase the number of international students in the United Kingdom. It also calls for diversifying the countries from which they draw students and also maintaining quality. The previous initiative (which exceeded its goals), called for increasing the number of students by 75,000 between 1999

Figure 2-39
S&E foreign graduate student enrollment, by selected industrialized country and field: 2005



NA = not available

NOTES: Physical sciences include earth, atmospheric, and ocean sciences. Japanese data include mathematics in natural sciences and computer sciences in engineering. Foreign graduate enrollment in U.S. data includes temporary residents only; United Kingdom and Japanese data include permanent and temporary residents.

SOURCES: United States—National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov; United Kingdom—Higher Education Statistics Agency, special tabulations (2007); Japan—Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, special tabulations (2007). See appendix tables 2-22, 2-45, and 2-46.

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and 2005. An increase in foreign students results in revenue for higher education institutions. Additionally, foreign students are allowed to work in the United Kingdom for up to 12 months after graduation under certain circumstances (British Council 2007).

About 100,000 foreign students studied in Japanese universities in 2005, almost 60,000 of them in S&E fields. Foreign S&E student enrollment in Japan is concentrated at the undergraduate level, accounting for 69% of all foreign S&E students. Foreign undergraduates, however, represent only 3% of all undergraduate S&E students. Although smaller in number, foreign graduate students account for 13% of graduate S&E students in Japan. About 18,000 foreign S&E graduate students were enrolled in Japanese universities in 2005, more than half of them from China (appendix table 2-46).

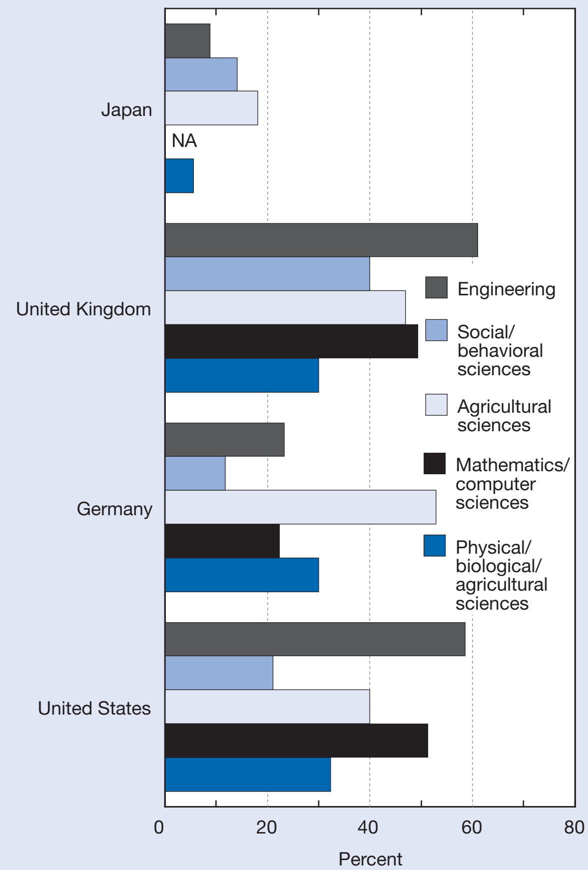
Foreign students are an increasing share of enrollment in Canadian universities. Foreign S&E students accounted for about 7% of undergraduate and 23% of graduate S&E enrollment in Canada in 2004, up from 5% and 22% in 1994. At both the undergraduate and graduate levels, foreign S&E students are higher percentages of students in mathematics/computer sciences and engineering than they are in other fields. Asian countries/economies were the top places of origin of foreign S&E graduate and undergraduate students in Canada. China alone accounts for 19% of foreign S&E graduate students and 15% of foreign S&E undergraduate students in Canada. The United States is also among the top countries of origin of foreign students, accounting for 5% of foreign S&E graduate students and 10% of foreign S&E undergraduate students in Canada (appendix table 2-47).

Australia actively recruited foreign students in recent years. Foreign students accounted for 15% of S&E undergraduate and 32% of S&E graduate students in Australian universities in 2005 (appendix table 2-48). At both the undergraduate and graduate levels, foreign S&E students are concentrated in mathematics/computer sciences and engineering. About three quarters of foreign students (in all fields) in Australia are from Asia, mainly China and India (IIE 2007).

International Comparison of Foreign Doctoral Degree Recipients

As in the United States, foreign students are a large share of S&E doctoral degree recipients in the United Kingdom. In 2005, 42% of S&E doctorates from the United Kingdom and 41% of S&E[20] doctorates from U.S. universities were awarded to foreign students (both permanent and temporary visa holders). In both countries, foreign students accounted for more than 60% of the doctorates awarded in engineering. Foreign students account for about 10% of S&E doctorate recipients in Japan and 25% in Germany (figure 2-40; appendix table 2-49).

Figure 2-40
S&E doctoral degrees earned by foreign students, by selected industrialized country and field: 2005 or most recent year



NA = not available

NOTES: Physical sciences include earth, atmospheric, and ocean sciences. Japanese data for university-based doctorates only; exclude *ronbun hakase* doctorates awarded for research within industry. Japanese data include mathematics in natural sciences and computer sciences in engineering. For each country, data are for doctoral recipients with foreign citizenship, including permanent and temporary residents.

SOURCES: Germany—Federal Statistical Office, Prüfungen an Hochschulen 2005; Japan—Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, special tabulations; United Kingdom—Higher Education Statistics Agency, special tabulations (2007); United States—National Science Foundation, Division of Science Resources Statistics, Survey of Earned Doctorates, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-49.

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Conclusion

S&E higher education in the United States is attracting growing numbers of students. The number of bachelor's degrees and master's degrees awarded in all fields and in S&E fields continues to rise, reaching new peaks in 2005. Graduate enrollment in S&E fields is also increasing, reaching a new peak in 2005. After declining in the late 1990s and early 2000s, the number of S&E doctorates awarded increased in the past several years.

Most of the growth in S&E education occurred in science fields. In engineering, bachelor's and master's degrees increased in recent years, but have not yet attained the levels of the 1980s. Engineering enrollment, both undergraduate and graduate, and engineering doctorates declined somewhat in recent years. Computer science enrollments and degrees followed trends similar to those of engineering.

Foreign student enrollment in graduate S&E programs dropped in recent years. The number of entering foreign students dropped after September 11, 2001, and only began to rise again in 2005. Students on temporary visas earned about one-third of S&E doctorates in the United States in 2003 and more than half of the engineering doctorates. An increasing fraction of them stay in the United States: about three-quarters of foreign doctoral degree recipients in 2003 planned to stay in the United States after graduation.

Globalization of higher education continues to expand. Although the United States continues to attract the largest number and fraction of foreign students worldwide, both numbers and percentages decreased in recent years. Most countries in Europe and several in Asia expanded access to higher education, resulting in increases in educational attainment since 1990. Some of the reduction in foreign students in the United States may be due to increased opportunities for students in their home countries. Some may also be due to increased competition for foreign students from other countries. Universities in several other countries, including Australia, the United Kingdom, Canada, Japan, and Germany, expanded their enrollment of foreign S&E students.

Notes

1. New efforts to develop indicators of the linkage between human capital (e.g., degrees granted, size and flows of the scientific work force) and growth in high- and medium-high technology-intensive manufacturing industries are underway (Hansen et al. 2007). Preliminary results indicate a significant correlation between doctorates awarded in natural sciences and engineering per capita population and productivity (measured by patent applications per capita population) in high and medium-high technology-intensive manufacturing industries.

2. *Physical sciences* include earth, atmospheric, and ocean sciences.

3. Research institutions are classified according to the 1994 Carnegie classification. See *Science and Engineering Indicators 2006* (NSB 2006) for definitions of the various classification categories.

4. Financial aid is calculated for all full-time students, both in state and out of state, so net price may be underestimated.

5. For information on debt levels of clinical versus nonclinical psychology doctorates in 1993–96, see "Psychology Doctorate Recipients: How Much Financial Debt at Graduation?" (NSF 00-321) at http://www.nsf.gov/statistics/issuebrf/sib00321.htm.

6. Based on previous projections, NCES has estimated that the mean absolute percentage error for bachelor's degrees projected 9 years out was 8.0.

7. The number of S&E degrees awarded to a particular freshmen cohort is lower than the number of students reporting such intentions and reflects losses of students from S&E, gains of students from non-S&E fields after their freshman year, and general attrition from bachelor's degree programs. (See sidebar "Persistence, Retention, and Attainment in Higher Education and in S&E.")

8. *Physical sciences* include earth, atmospheric, and ocean sciences.

9. Data for racial/ethnic groups are for U.S. citizens and permanent residents only.

10. About 17% of 2001 and 2002 S&E bachelor's degree recipients had previously earned an associate's degree (NSF 2006a).

11. Data for racial/ethnic groups are for U.S. citizens and permanent residents only.

12. See the NSF report series *Science and Engineering Degrees* (http://www.nsf.gov/statistics/degrees/) for longer degree trends and *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2007* (http://www.nsf.gov/statistics/women/) for more detail on enrollments and degrees by sex and by race/ethnicity.

13. Data for racial/ethnic groups are for U.S. citizens and permanent residents only.

14. Data for racial/ethnic groups are for U.S. citizens and permanent residents only.

15. Data on doctorates comes from the NSF Survey of Earned Doctorates, which collects data on research doctorates only (i.e., doctorates that require original research and typically entail writing a dissertation). The survey does not collect data on professional degrees (e.g., M.D., D.D.S., J.D., Psy.D., and D.Min.). For the most recent data available, including data by detailed field and data on math and science education doctorates, see http://www.nsf.gov/statistics/doctorates/.

16. See the NSF report series *Science and Engineering Degrees* (http://www.nsf.gov/statistics/degrees/) for longer degree trends and *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2007* (http://www.nsf.gov/statistics/women/) for more detail on enrollments and degrees by sex and by race/ethnicity.

17. The number of doctoral S&E degrees earned by students in Chinese universities continued to increase throughout this period, from 125 in 1985 to 14,858 in 2004.

18. For more information about the distribution of postdoc positions according to sex, see *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2007* at http://www.nsf.gov/statistics/wmpd.

19. A first university degree refers to the completion of a terminal undergraduate degree program. These degrees are classified as level 5A in the International Standard Classification of Education, although individual countries use different names for the first terminal degree (e.g., laureata in Italy, diplome in Germany, maitrise in France, and bachelor's degree in the United States and in Asian countries).

20. Excluding doctorates in medical/health fields.

Glossary

Debt burden: Student loan payments as a percent of salary.

Dual enrollment courses: Classes taken on a high school campus for which a student receives course credit at both the high school and community college levels.

First university degree: A terminal undergraduate degree program; these degrees are classified as level 5A in the International Standard Classification of Education, although individual countries use different names for the first terminal degree (e.g., laureata in Italy, diplome in Germany, maitrise in France, and bachelor's degree in the United States and in Asian countries).

Internationally mobile students: Those individuals who are not citizens of the country in which they study.

Net price: The published price of an undergraduate college education minus the average grant aid and tax benefits that students receive.

Stay rate: The proportion of students on temporary visas who have plans to stay in the United States immediately after degree conferral.

Tertiary type A programs: Higher education programs that are largely theory-based and designed to provide sufficient qualifications for entry to advanced research programs and to professions with high skill requirements, such as medicine, dentistry, or architecture, and have a minimum duration of 3 years, although they typically last 4 or more years. These correspond to bachelor's or master's degrees in the United States.

Tertiary type B programs: Higher education programs that focus on practical, technical, or occupational skills for direct entry into the labor market and have a minimum duration of 2 years. These correspond to associate's degrees in the United States.

Underrepresented minority: Blacks, Hispanics, and American Indians/Alaska Natives are considered to be underrepresented minorities in S&E.

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