Chapter 2
Higher Education in Science and Engineering

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Highlights

Characteristics of the U.S. Higher Education System

Research institutions are the leading producers of S&E degrees at the bachelor's, master's, and doctoral levels, but other types of institutions are also important in the education of S&E graduates.

- Baccalaureate colleges are the source of relatively few S&E bachelor's degrees, but are a more prominent source of future S&E doctorate recipients.
- Master's colleges and universities awarded more than one-third of S&E bachelor's and master's degrees in 2009.
- Nearly one in five U.S. citizen/permanent residents who received a doctoral degree from 2005 to 2009 had earned some college credit from a community or 2-year college.

Over the past decade in the United States, tuition and fees for colleges and universities have grown faster than median income.

- In the 2007–08 academic year, two-thirds of all undergraduates received some kind of financial aid and 39% took out loans to finance their education.
- At the time of doctoral degree conferral, 45% of 2009 S&E doctorate recipients had debt related to their undergraduate or graduate education.

In 2009, the federal government was the primary source of financial support for 18% of full-time S&E graduate students.

- In 2009, the federal government funded 63% of S&E graduate students on traineeships, 49% of those with research assistantships, and 23% of those with fellowships.
- Graduate students in the biological sciences, the physical sciences, and engineering received relatively more federal financial support compared with those in computer sciences, mathematics, other life sciences, psychology, and social sciences.

Undergraduate Education, Enrollment, and Degrees

Enrollment in U.S. higher education rose from 14.5 million in fall 1994 to 20.7 million in fall 2009.

- Between 2007 and 2009, enrollment increased faster than in most previous years.
- Enrollment in higher education is projected to grow through 2019 because of increases in the college-age population.
- Postsecondary enrollment is projected to increase for all racial/ethnic groups, except for whites. The percentage for white students is projected to decrease from 63% in 2008 to 58% in 2019, reflecting demographic changes.

The number of S&E bachelor's degrees has risen steadily over the past 15 years, reaching a new peak of about half a million in 2009.

- With the exception of computer sciences, most S&E fields experienced increases in the number of degrees awarded in 2009. In computer sciences, the number of bachelor's and master's degrees awarded decreased sharply from 2004 to 2007, but then remained stable through 2009.
- Women have earned about 57% of all bachelor's degrees and half of all S&E bachelor's degrees since the late 1990s. In general, men earn a majority of bachelor's degrees in engineering, computer sciences, and physics. More women than men earn degrees in chemistry; biological, agricultural, and social sciences; and psychology.
- In the last 10 years, the proportion of S&E bachelor's degrees awarded to women has not grown measurably and has declined in computer sciences, mathematics, and engineering.

The racial/ethnic composition of those earning S&E bachelor's degrees is changing, reflecting both population change and an increase in college attendance by members of minority groups.

- For all racial/ethnic groups, the total number of bachelor's degrees earned, the number of S&E bachelor's degrees earned, and the number of bachelor's degrees in most S&E fields have generally increased since 2000.

Undergraduate students majoring in S&E fields persist and complete their degrees at a higher rate than non-S&E students.

- Six years after enrolling in a 4-year college or university in academic year 2003–04, 63% of undergraduates with an S&E major had completed a bachelor's degree, compared to 55% of students with other majors.
- Among students who began 4-year colleges in 2003–04, the proportion majoring in S&E in 2009 was higher than the proportion majoring in S&E in 2004. Thus, the number of students switching majors out of S&E fields was lower than the number entering S&E fields as a whole.
- Within S&E, undergraduate attrition out of engineering was greater than transfers into this field, and transfers into social/behavioral sciences exceeded attrition. About 10% of engineering majors switched to mathematics or physical or computer sciences majors.

Graduate Education, Enrollment, and Degrees

The proportion of women and minorities in S&E graduate education has been growing steadily but slowly.

- Nearly half of the 611,600 S&E graduate students enrolled in the United States in fall 2009 were women, with considerable field variation.
- Women continued to enroll at disproportionately lower rates in engineering, computer sciences, physical sciences, and economics.
- In 2009, underrepresented minority students (blacks, Hispanics, and American Indians/Alaska Natives) made up 12% of students enrolled in graduate S&E programs, with Asian/Pacific Islanders representing 6% and whites 48%. Temporary residents accounted for remainder of graduate S&E enrollment.

The number of total foreign graduate students continued to increase through fall 2010, with all of the increase occurring in S&E fields.

- About 60% of all foreign graduate students in the United States in 2010 were enrolled in S&E fields, compared with 32% at the undergraduate level.
- Most of the growth in the number of foreign graduate students in S&E between 2009 and 2010 occurred in engineering and computer sciences.
- India and China were the countries of origin for nearly two-thirds of the foreign S&E graduates in the United States in November 2010.

Master's degrees awarded in S&E fields increased from 120,200 in 2007 to 134,000 in 2009, after holding steady for the previous 3 years.

- Increases occurred in most major science fields.
- The number and percentage of master's degrees awarded to women in most major S&E fields have increased since 2000.
- The number of S&E master's degrees awarded increased for all racial/ethnic groups from 2000 to 2009. During this period, the proportion earned by blacks and Hispanics increased, that of Asians/Pacific Islanders and American Indians/Alaska Natives remained flat, and that of whites decreased.

In 2009, U.S. academic institutions awarded 41,100 S&E doctorates.

- The number of S&E doctorates conferred annually by U.S. universities increased steeply (43%) from 2003 to 2007, then flattened and declined slightly in 2009.
- Among fields that award large numbers of doctorates, the biggest increases between 2000 and 2009 were in engineering (47%) and biological sciences (49%).

Students on temporary visas earned high proportions of U.S. S&E doctorates and dominated degrees in some fields. They also earned large shares of the master's degrees in S&E fields.

- Foreign students earned 57% of all engineering doctorates, 54% of all computer science degrees, and 51% of physics doctoral degrees. Their overall share of S&E degrees was one-third.
- After a 64% growth from 2002 to 2008, the number of temporary residents earning S&E doctoral degrees declined by about 4% in 2009 to 13,400.
- In 2009, temporary visa students earned 27% of S&E master's degrees, receiving 46% of those in computer sciences, 43% of those in engineering, and 36% of those in physics.

International S&E Higher Education

In 2008, about 5 million first university degrees were awarded in S&E worldwide. Students in China earned about 23%, those in the European Union earned about 19%, and those in the United States earned about 10% of these degrees.

- The number of S&E first university degrees awarded in China and Taiwan more than doubled between 2000 and 2008. Those awarded in the United States and many other countries generally increased. Those awarded in France, Spain, and Japan decreased in recent years.
- S&E degrees continue to account for about one-third of all bachelor's degrees awarded in the United States. In Japan and China, more than half of first degrees were awarded in S&E fields in 2008.
- In the United States, about 4% of all bachelor's degrees awarded in 2008 were in engineering. This compares with about 19% throughout Asia and 31% in China specifically.

In 2008, the United States awarded the largest number of S&E doctoral degrees of any individual country, followed by China, Russia, Germany, and the United Kingdom.

- The number of S&E doctoral degrees awarded in China, the United States, and Italy has risen substantially in recent years; S&E doctorates awarded in India, Japan, South Korea, and many European countries have risen more modestly. The number in Russia increased from 2002 to 2007, but fell sharply in 2008.
- In 2007, China overtook the United States as the world leader in the number of doctoral degrees awarded in the natural sciences and engineering.
- Women earned 41% of S&E doctoral degrees awarded in the United States in 2008, about the same as women's percentages in Australia, Canada, the European Union, and Mexico.

International student mobility expanded over the past two decades and countries are increasingly competing for foreign students.

- The United States remains the destination for the largest number of foreign students worldwide (undergraduate and graduate), although its share of foreign students worldwide decreased from 24% in 2000 to 19% in 2008.
- Some countries expanded recruitment of foreign students as their own populations of college-age students decreased, both to attract highly skilled workers and to increase revenue for colleges and universities.
- In addition to the United States, other countries that are among the top destinations for foreign students include the United Kingdom, Germany, and France.

Introduction

Chapter Overview

Higher education performs a number of societal functions, including developing human capital, building the knowledge base (through research and knowledge development), and disseminating, using, and maintaining knowledge (OECD 2008). S&E higher education provides the advanced skills needed for a competitive workforce and, particularly in the case of graduate-level S&E education, the research capability necessary for innovation. This chapter focuses on the development of human capital by higher education.

Indicators presented in this chapter are discussed in the context of national and global events, including changing demographics, increasing foreign student mobility, and global competition in higher education. The U.S. college-age population is currently increasing and projected to continue to grow for the next decade. Its composition 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.

As the world becomes more interconnected, more students travel to study in a different country, and more countries invest in their higher education systems. Increases in foreign students contributed to most of the growth in overall S&E graduate enrollment in the United States in recent years. Despite a decline in the number of foreign students coming to the United States after 11 September 2001, foreign graduate student enrollment in S&E has recovered. 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 providing expanded educational access to their own population and attracting growing numbers of foreign students. The effects of these trends, as well as the effects of the recent global financial crisis on domestic and foreign student enrollment in U.S. institutions, remain to be seen.

Chapter Organization

This chapter describes characteristics of the U.S. higher education system and trends in higher education worldwide. It begins with an overview of the characteristics of U.S. higher education institutions providing instruction in S&E, followed by a discussion of characteristics of undergraduate and graduate education. Trends are discussed by field and demographic group, with a focus on the flow of foreign students into the United States by country. The chapter then presents various international higher education indicators, including comparative S&E degree production in several world regions and indicators that measure the growing dependence of all industrialized countries on foreign S&E students.

The data in this chapter come from a variety of federal and nonfederal sources, primarily from surveys conducted by the National Science Foundation's (NSF) National Center for Science and Engineering Statistics (NCSES) and the National Center for Education Statistics (NCES) at the U.S. Department of Education. Data also come from international organizations, such as the Organisation for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), and individual countries. Most of the data in the chapter are from censuses of the population—for example, all students receiving degrees from U.S. academic institutions—and are not subject to sampling variability.

The U.S. Higher Education System

Higher education in S&E is important because it produces an educated S&E workforce and an informed citizenry. It has also been receiving increased attention as an important component of U.S. economic competitiveness. In his 24 February 2009 address to a joint session of Congress, President Barack Obama called for every American to commit to at least 1 year of education or career training after completing high school. This section discusses the characteristics of U.S. higher education institutions providing S&E education and the financing of higher education.

Institutions Providing S&E Education

The U.S. higher education system consists of a large number of diverse academic institutions that vary in their missions, learning environments, selectivity, religious affiliation, types of students served, types of degrees offered, and sector (public, private nonprofit, or private for-profit) (NCES 2010a). Among the approximately 4,500 postsecondary degree-granting institutions in the United States in the 2009–10 academic year, 62% offered bachelor's or higher degrees, 31% offered associate's degrees, and 8% offered degrees that were at least 2-year but less than 4-year as the highest degree awarded (NCES 2010b). In 2009, U.S. academic institutions awarded more than 3.1 million associate's, bachelor's, master's, and doctoral degrees; 23% of the degrees were in S&E (appendix table 2-1).

Doctorate-granting institutions with very high research activity are the leading producers of S&E degrees at the bachelor's, master's, and doctoral levels. In 2009, these research institutions awarded 75% of doctoral degrees, 42% of master's degrees, and 38% of bachelor's degrees in S&E fields. (See sidebar "Carnegie Classification of Academic Institutions.") Master's colleges and universities awarded another 29% of S&E bachelor's degrees and 26% of S&E master's degrees in 2009. Baccalaureate colleges were the source of relatively few S&E bachelor's degrees (12%) (appendix table 2-1), but they produce a large proportion of future S&E doctorate recipients. When adjusted by the number of bachelor's degrees awarded in all fields, baccalaureate colleges as a group yield more future S&E doctorates per hundred bachelor's degrees awarded than other types of institutions, except research universities (NSF/NCSES 2008).

Carnegie Classification of Academic Institutions

The Carnegie Classification of Institutions of Higher Education is widely used in higher education research to characterize and control for differences in academic institutions.

The 2010 classification update retains the same structure initially adopted in 2005 and illustrates the most current landscape of U.S. colleges and universities. Compared with the 2005 update, there are 483 newly classified institutions in the 2010 classifications (from a universe of 4,633). More than three-quarters of the new institutions (77%) are from the private for-profit sector, 19% from the private nonprofit sector, and 4% from the public institution sector.

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 characteristics of those aggregated groups are as follows:

- *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 (108 institutions), high research activity (99 institutions), and doctoral/research universities (90 institutions).
- *Master's colleges and universities* include the 727 institutions that award at least 50 master's degrees and fewer than 20 doctoral degrees per year.
- *Baccalaureate colleges* include the 808 institutions for 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 the 1,920 institutions at which all degrees awarded are associate's degrees or at which bachelor's degrees account for less than 10% of all undergraduate degrees.
- *Special-focus institutions* are the 851 institutions in which at least 75% of degrees are concentrated in a single field or a set of related fields (e.g., medical schools and medical centers, schools of engineering, and schools of business and management).
- *Tribal colleges* are the 32 colleges and universities that are members of the American Indian Higher Education Consortium.

*Research activity is based on two indices (aggregate level of research and per capita research activity) derived from a principal components analysis of data on R&D expenditures, S&E research staff, and field of doctoral degree. See http://classifications.carnegiefoundation.org for more information on the classification system and on the methodology used in defining the categories.

Community Colleges

Community colleges (also known as public 2-year colleges or associate's colleges) play a key role in increasing access to higher education for all citizens. These institutions serve diverse groups of students and offer a more affordable means of participating in postsecondary education. They are likely to serve groups with lower college attendance rates in past generations. Community colleges are important in preparing students to enter the workforce with certificates or associate's degrees and in preparing students to transition to 4-year colleges or universities (Karp 2008). They provide the education needed for S&E or S&E-related occupations that require less than a bachelor's degree, and they provide the first 2 years of many students' education before they transfer to an S&E program at a 4-year college or university.

In the 2008–09 academic year, there were more than 1,000 community colleges in the United States. These colleges enrolled about 7.2 million students, or about a third of all postsecondary students. Nearly six out of ten of these students were enrolled part-time (NCES 2011a). With the economic recession, enrollment in community colleges increased by about 800,000 students between 2007 and 2009 (NCES 2009a and 2011a).

Community colleges play a significant role in the education of individuals with advanced S&E credentials. Among U.S. citizen and permanent resident S&E doctorate holders who received their doctorates between 2005 and 2009, nearly one in five indicated they had earned college credit from a community or 2-year college (table 2-1). According to data from the National Survey of Recent College Graduates, in the last decade, the proportion of recent bachelor's S&E graduates who reported ever attending a community college increased (table 2-2). Forty-six percent of 2006 and 2007 S&E graduates indicated they had attended a community college (49% of the bachelor's recipients and 35% of the master's recipients). Graduates in engineering and physical sciences[1] were the least likely to have attended a community college. Between 1999 and 2008, the proportion of S&E graduates who attended community colleges increased in the life sciences, social sciences, mathematics, and computer sciences (figure 2-1).

In 2008, female S&E bachelor's and master's degree recipients were more likely to have attended a community college than their male counterparts (table 2-3). Attendance was also higher among U.S. citizens and permanent visa holders than among temporary visa holders. Attendance was higher for Hispanic and black S&E graduates than for whites or Asians. The likelihood of attending a community college before receiving an S&E bachelor's or master's degree was related to parental education level. More than half of the S&E graduates who reported that their fathers or mothers had less than a high school diploma attended a community college, compared to about one-third of those whose fathers or mothers had a professional or a doctoral degree.

Over the last 10 years, the top reason for attending a community college among science and engineering graduates

Table 2-1

U.S. citizen/permanent resident S&E doctorate recipients who reported earning college credit from a community or 2-year college, by race/ethnicity: 2005–09

Race/ethnicity	All	Earned college credit from a community or 2-year college: Yes	No	Percent yes
All races/ethnicities	87,790	17,033	70,757	20
American Indian/Alaska Native	313	122	191	39
Asian	8,783	1,158	7,625	13
Black	3,982	706	3,276	18
Hispanic	4,529	1,024	3,505	23
White	67,250	13,369	53,881	20
Native Hawaiian/Other Pacific Islander	200	50	150	25
Unknown/unreported	2,733	604	2,129	22

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of Survey of Earned Doctorates, 2005–09.

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Table 2-2

Community college attendance among recent recipients of S&E bachelor's and master's degrees, by degree level and degree year: 1999–2008

Degree level	1999		2001		2003		2006		2008	
	Recent degree recipients	Attended community college (%)	Recent degree recipients	Attended community college (%)	Recent degree recipients	Attended community college (%)	Recent degree recipients	Attended community college (%)	Recent degree recipients	Attended community college (%)
All graduates	900,400	41	918,400	44	958,400	45	1,634,200	45	1,138,400	46
Bachelor's	743,400	43	758,300	46	794,400	47	1,343,000	47	934,300	49
Master's	157,000	35	160,100	34	164,000	34	291,200	34	204,100	35

NOTES: Recent graduates are those who earned degrees in the 2 academic years preceding survey year, or, for 2006 survey year, in the 3 preceding academic years. For 2006, recent graduates are those who earned degrees between 1 July 2002 and 30 June 2005. Data rounded to the nearest 100. Detail may not add to total because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of National Survey of Recent College Graduates, 1999, 2001, 2003, 2006, and 2008.

Science and Engineering Indicators 2012

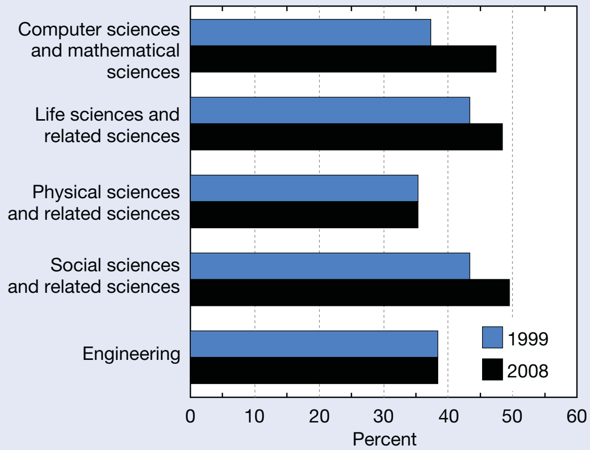
remained the same—earning credits for a bachelor's degree (figure 2-2). However, the prevalence of other reasons for attending a community college changed over time. The importance of community colleges as bridges between high school and college in the form of dual enrollment programs increased from 13% in 1999 to 28% in 2008. Attending a community college to facilitate a change in fields or for financial reasons also became more important, while gaining skills and knowledge in their fields, having opportunities to increase advancement, or attending for leisure or personal interest became less important.

For-Profit Institutions

Two-year, for-profit institutions enroll considerably fewer students than community colleges. Over the past 10 years, however, the number of for-profit institutions has grown rapidly and the number of degrees they awarded has more than doubled (NCES 2010c; appendix table 2-2). A large part of that increase is accounted for by the growth of University of Phoenix Online Campus. In 2009, about 2,900 academic institutions in the United States operated on a for-profit basis. About half of these institutions offer less-than-2-year programs and fewer than half are degree-granting institutions. Of the degree-granting institutions, close to half award associate's degrees as their highest degree (NCES 2010b).

In 2009, for-profit academic institutions awarded between 1% and 5% of S&E degrees at the bachelor's, master's, and doctoral levels, and 31% of S&E degrees at the associate's level. Computer sciences accounted for 91% of the associate's degrees and 67% of the bachelor's degrees awarded by for-profit institutions in science and engineering fields in 2009 (appendix table 2-3). For-profit institutions award relatively few S&E master's and doctoral degrees; those degrees are mainly in psychology. In 2009, degrees in psychology represented 51% of the master's and 81% of the doctoral degrees awarded by for-profit institutions in science and engineering fields.

Figure 2-1
Community college attendance among recent recipients of S&E degrees, by field of highest degree: 1999 and 2008



NOTE: Recent graduates are those who earned degrees in the 2 academic years preceding survey year.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Survey of Recent College Graduates, 1999 and 2008.

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Online and Distance Education

Online education and distance education enable institutions of higher education to reach a wider audience by expanding access to students in remote geographic locations and providing greater flexibility for students who have time constraints, physical impairments, responsibility for caring for dependents, etc. Online education is a relatively new phenomenon and online enrollment has grown substantially in recent years. In 2007–08, about 4.3 million undergraduate students (20% of all undergraduates) took at least one distance education course, up from 2.9 million (16% of all undergraduates) in 2003–04. In addition, nearly 800,000 (22%) of all postbaccalaureate students took distance education courses in 2007–08 (NCES 2011b).[2]

At the undergraduate level, students at private for-profit 4-year institutions were more likely to participate in distance education courses than students at public or private not-for-profit institutions (appendix table 2-4). Similarly, a higher proportion of students at private for-profit 4-year institutions took their entire program through distance education than students at any other type of institution. Most institutions, for-profit institutions in particular, believe that online education will be a critical part of their long-term strategy (Allen and Seaman 2010).

In recent years, academic institutions have begun developing online courses for public access—examples include the Open Learning Initiative at Carnegie Mellon and the MIT OpenCourseWare.[3] Other kinds of initiatives involve working with faculty and organizations such as the National Center for Academic Transformation to redesign courses to incorporate the use of information technology.

Table 2-3
Community college attendance among recent recipients of S&E degrees, by sex, race/ethnicity, and citizenship status: 2008

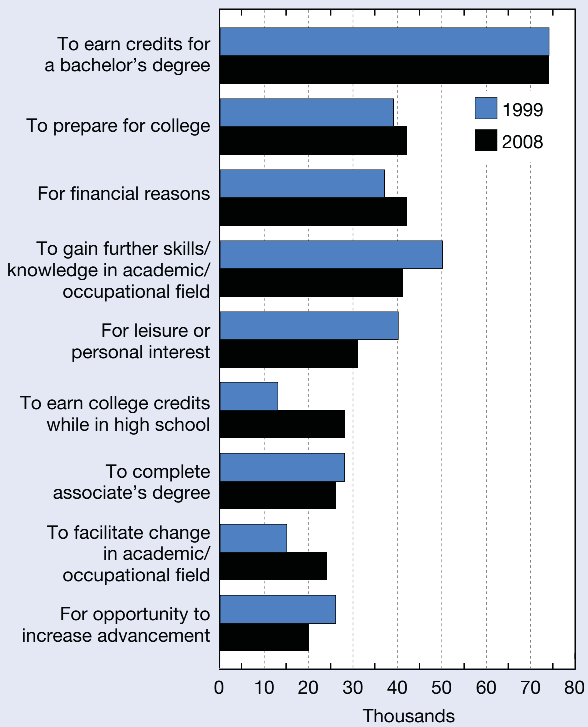
Characteristic	Number	Percent
All graduates	1,138,400	46
Sex		
Female	570,500	49
Male	567,900	43
Race/ethnicity		
American Indian/Alaska Native	2,000	61
Hispanic	98,000	53
Black	73,400	51
White	713,900	45
Asian	192,800	43
Native Hawaiian/other Pacific Islander	6,800	66
Multiple race	51,500	45
Citizenship status		
U.S. citizen	1,029,500	48
Permanent visa	30,900	46
Temporary visa	78,000	17
Father's education		
Less than high school	68,800	55
High school diploma or equivalent	203,500	50
Some college, vocational, or trade school	219,900	54
Bachelor's	294,400	45
Master's	181,500	41
Professional degree	81,800	31
Doctorate	70,100	36
Not applicable	18,400	46
Mother's education		
Less than high school	77,500	58
High school diploma or equivalent	232,000	50
Some college, vocational, or trade school	268,000	51
Bachelor's	312,700	42
Master's	180,400	41
Professional degree	32,700	31
Doctorate	27,400	34
Not applicable	7,700	56

NOTES: Recent graduates are those who earned degrees between 1 July 2006 and 30 June 2007. Data rounded to nearest 100.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of National Survey of Recent College Graduates, 2008.

Science and Engineering Indicators 2012

Figure 2-2
Reasons for attending community college among recent S&E graduates: 1999 and 2008



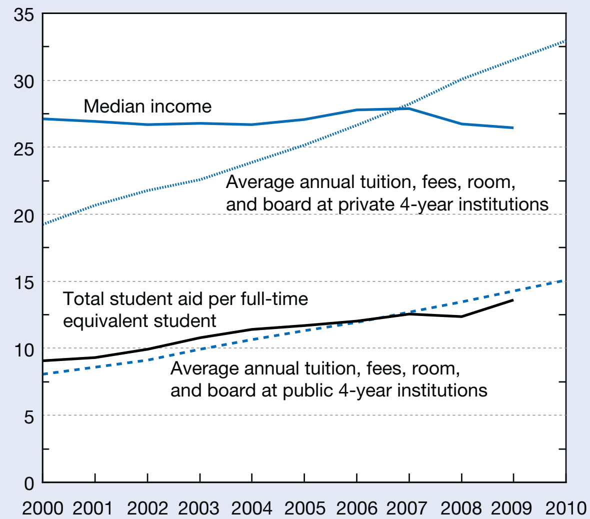
NOTE: Recent graduates are those who earned degrees in the 2 academic years preceding survey year.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Survey of Recent College Graduates, 1999 and 2008.

Science and Engineering Indicators 2012

Figure 2-3
Average annual tuition, fees, room, and board for public and private 4-year institutions, total student aid dollars, and median income: 2000–10

Constant 2010 dollars (thousands)



NOTE: Data on median income and total student aid per full-time equivalent student not available for 2009–10.

SOURCES: College Board, *Trends in College Pricing 2010;* and Census Bureau, Historical Income Tables, Table P-7, http://www.census.gov/hhes/www/income/data/historical/people/P07AR_2009.xls, accessed 15 March 2011.

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Financing Higher Education

Cost of Higher Education

Affordability and access to U.S. higher education institutions are perennial concerns (NCPPHE 2008; NSB 2003). For at least the past 10 years, tuition and fees for colleges and universities in the United States have grown rapidly, faster than median income (figure 2-3). In the 2010–11 academic year, average tuition and fees for 4-year colleges rose faster than inflation. While the Consumer Price Index increased by 1.2% between July 2009 and July 2010 (College Board 2010a), average tuition and fees rose 7.9% from the previous academic year for in-state students at public 4-year colleges, 4.5% for students in private nonprofit 4-year colleges, and 6% for students at public 2-year colleges. Another inflation index, the Higher Education Price Index, which measures the average relative level in the price of a fixed-market basket of goods and services purchased by colleges and universities each year, rose 0.9% in fiscal year 2010 (Commonfund Institute 2010).

In the 5-year interval between 2005–06 and 2010–11, average published tuition and fees rose much faster than other prices in the economy. However, compared to 5 years ago, estimated average net tuition and fees (i.e., the published prices minus grant aid and tax benefits) are lower for all sectors. Large increases in federal Pell grants and veterans' benefits in 2009–10 and the passage of the American Recovery and Reinvestment Act of 2009 largely drove the decline in average net prices (College Board, 2010a). According to the College Board (2010b), in the coming years, rising tuition prices are likely to continue in response to state reductions in higher education funding (see sidebar "State Appropriations to Public Research Universities: A Volatile Decade"), but the rate of increase in grant funds is not likely to keep pace.

Undergraduate Financial Support Patterns and Debt

Financial Support for Undergraduate Education. With rising tuition, students increasingly rely on financial aid (particularly loans) to finance their education. Financial aid for undergraduate students comes mainly in the form of grants, student loans, and work study. A financial aid package may contain one or more of these kinds of support. In the 2007–08 academic year, two-thirds of all undergraduate students received some kind of financial aid: 52% received grants and 39% took out loans (NCES 2009b). A higher proportion of undergraduates in private for-profit institutions (96%) and in nonprofit 4-year institutions (85%) than those

State Appropriations to Public Research Universities: A Volatile Decade

Increases in the number of students seeking an affordable college education and competing demands on state government budgets have affected the resources available for state-funded higher education. Because funding for major state research universities has been a particular focus of concern, this sidebar examines trends in state support for these institutions between 2002 and 2010.[4] Data cover 101 public research universities with broad educational missions (i.e., excluding free-standing medical and engineering schools when possible). These institutions are either the leading recipient of academic R&D funding in their state or among the nation's top 100 recipients of academic R&D funding to public universities.

According to data collected by the U.S. Department of Education's National Center for Education Statistics and Illinois State University's Center for the Study of Education Policy (CSEP), total state funding in current dollars for these 101 universities, including state appropriations and state operating grants and contracts, grew during the period of 2002 through 2010 from $23.8 billion in 2002 to $25.8 billion in 2010.[5] Funding fluctuated over this period, dipping in the early years and then rising until 2008 when it began to fall sharply. In constant dollars, this represented a decline of 10% (figure 2-A). As a percentage of the universities' total revenues, state funding declined from 28% in 2001 to 19% in 2009.

In constant dollars, 72 of the 101 universities experienced an overall reduction in state appropriations. More than half of the universities, 54, had reductions of more than 10%. For 29 institutions, state appropriations in 2010 were between 90% and 110% of the 2002 level. The remaining 18 universities received increases of more than 10%.

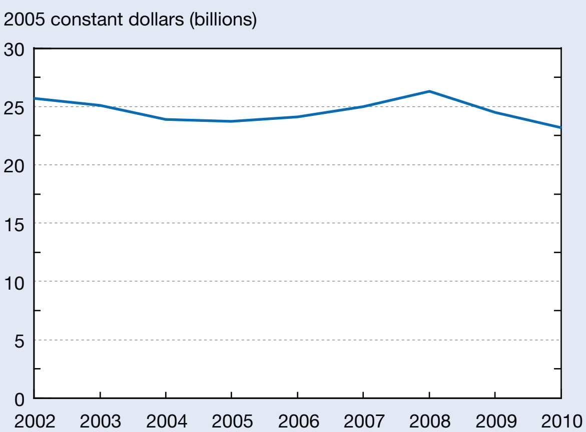
Funding changes varied widely by institution and by state. For example, all of the nine research universities in California experienced reductions ranging from 17% to 35%. By contrast, the four State University of New York (SUNY) campuses received substantial increases ranging from 71% to 171%. In Texas, three universities had very different funding trends: the University of Texas at Dallas experienced a 19% increase, Texas A&M a 12% decrease, and the University of Texas at Austin had a 3% decrease. In Michigan, the University of Michigan–Ann Arbor experienced a 28% decrease and Michigan State University had a 21% decrease.

While the value of overall state funding declined nationally, enrollment was growing consistently. As a result, state funding per enrolled student dropped in constant dollars by 20%, going from $10,195 per student in 2002 to $8,157 per student in 2010 (figure 2-B).

Preliminary data prepared by CSEP—available by state but not by university—suggest a continuing state funding decline. In particular, between 2009 and 2011, 35 of the 50 states reported reductions in state appropriations and other state support, ranging from less than 1% to more than 28%.

Additional indicators of state-level trends in the affordability of higher education, including state appropriations for operating expenses as a percentage of GDP and average undergraduate charges at public 4-year institutions, can be found in chapter 8.

Figure 2-A
State appropriations to major public research universities: 2002–10



NOTE: Data for 2010 are preliminary.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System; Illinois State University, Center for the Study of Education Policy.

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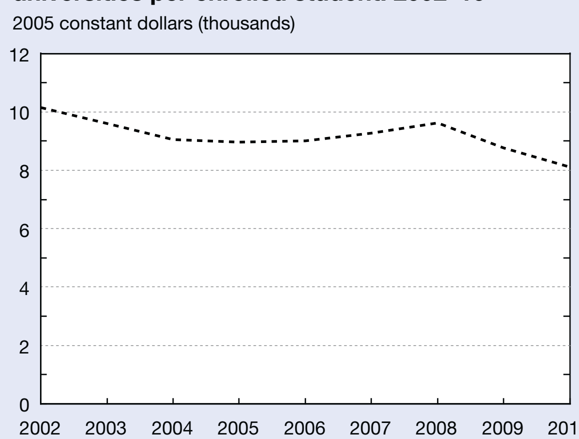
Figure 2-B
State appropriations to major public research universities per enrolled student: 2002–10



NOTE: Data for 2010 are preliminary.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System; Illinois State University, Center for the Study of Education Policy.

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in public 4-year (71%) or public 2-year institutions (48%) received some type of financial aid.

Undergraduate Debt. Undergraduate debt does not vary by undergraduate major (NSF/NCSES 2010a); 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 2007–08 bachelor's degree recipients who took out loans was $20,000 for those who graduated from public colleges and universities and $24,600 for those who graduated from private nonprofit institutions. Students who attend private for-profit institutions are more likely to borrow than those who attend public and private nonprofit institutions (College Board 2010b).

Levels of debt varied widely by state. Average debt for 2009 graduates of public 4-year colleges and universities ranged from $14,739 in California to $29,675 in New Hampshire. Average debt for graduates of private nonprofit colleges and universities ranged from $11,312 in Utah to $32,434 in Rhode Island (Project on Student Debt 2009).

Graduate Financial Support Patterns and Debt

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

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 (37%), RAs are the most prevalent primary mechanism of financial support for all full-time S&E graduate students. In 2009, 27% of full-time S&E graduate students were supported primarily by RAs, 18% were supported primarily through TAs, and 12% relied primarily on fellowships or traineeships (table 2-4).

Primary mechanisms of support differ widely by S&E field of study (appendix table 2-5). For example, in fall 2009, full-time students in physical sciences were financially supported mainly through RAs (42%) and TAs (38%) (figure 2-4, appendix table 2-5). RAs also were important in agricultural sciences (51%); earth, atmospheric, and ocean sciences (40%); biological sciences (39%); and engineering (40%). In computer science, more than half (51%) of full-time students were supported primarily through TAs and another 22% were self-supported. Full-time students in mathematics and the social and behavioral sciences were mainly self-supporting (48% respectively) or received TAs (15% and 19% respectively). Students in medical/other life sciences were mainly self-supporting (62%).

The federal government plays a substantial role in supporting S&E graduate students through some mechanisms in some fields, and a smaller role in others. Federal financial support for graduate education reaches relatively more students in the biological sciences; the physical sciences;

Table 2-4
Full-time S&E graduate students, by source and mechanism of primary support: 2009

Source	All	Research assistantship	Fellowship	Traineeship	Teaching assistantship	Other	Self-support[a]
				Number			
All sources	441,743	120,008	38,115	12,799	78,317	29,791	162,713
Federal	81,205	58,341	8,592	8,068	1,248	4,956	NA
Nonfederal	197,825	61,667	29,523	4,731	77,069	24,835	NA
				Percent			
All sources	100.0	27.2	8.6	2.9	17.7	6.7	36.8
Federal	100.0	71.8	10.6	9.9	1.5	6.1	NA
Nonfederal	100.0	31.2	14.9	2.4	39.0	12.6	NA

NA = not available

[a]Includes any loans (including federal) and support from personal or family financial contributions.

NOTES: S&E includes health fields (i.e., medical sciences and other life sciences). These fields reported separately in National Science Foundation, National Center for Science and Engineering Statistics, Graduate Students and Postdoctorates in Science and Engineering (annual series). S&E excludes fields that were collected in this survey (architecture, communication, and family and consumer sciences/human sciences) that are not included in other tables in this report from other data sources. Self-support not included in federal or nonfederal counts. Percentages may not add to 100% because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering 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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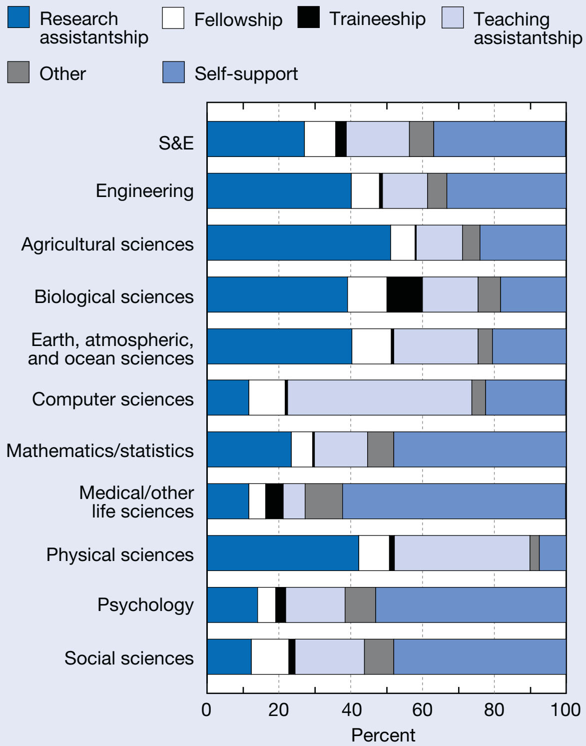
Figure 2-4
Full-time S&E graduate students, by field and mechanism of primary support: 2009



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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, 2009 Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-5.

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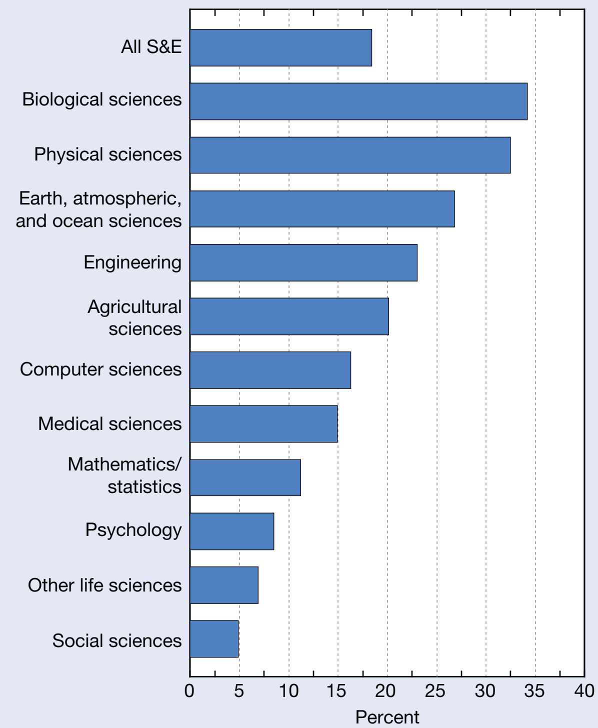
Figure 2-5
Full-time S&E graduate students with primary support from federal government, by field: 2009



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, 2009 Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-6.

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the earth, atmospheric, and ocean sciences; and engineering. Relatively fewer students in computer sciences, mathematics, other life sciences, psychology, and social sciences receive federal support (figure 2-5). Appendix table 2-6 provides detailed information by field and mechanism.

The federal government was the primary source of financial support for 18% of full-time S&E graduate students in 2009 (appendix table 2-6). In 2009, the federal government funded 63% of S&E graduate students on traineeships, 49% of those with RAs, and 23% of those with fellowships. Most federal financial support for graduate education is in the form of RAs funded through grants to universities for academic research. RAs are the primary mechanism of support for 72% of federally supported full-time S&E graduate students. Fellowships and traineeships are the means of funding for 21% of the federally funded full-time S&E graduate students. For students supported through nonfederal sources in 2009, TAs were the most prominent mechanism (39%) followed by RAs (31%) (table 2-4).

The National Institutes of Health (NIH) and NSF support most of the full-time S&E graduate students whose primary support comes from the federal government. In 2009, these institutions supported about 26,400 and 21,600 students respectively. NIH funded about 75% of such students in the biological sciences, 64% of those in the medical sciences, and 40% of those in psychology. NSF supported nearly 60% of students in computer sciences or mathematics; nearly 50% of those in earth, atmospheric, and ocean sciences; and 34% of those in engineering (appendix table 2-7).

For doctoral degree students, notable differences exist in primary support mechanisms by type of doctorate-granting institution. In 2009, RAs were the primary support mechanism for S&E doctorate recipients from research universities (i.e., doctorate-granting institutions with very high research activity, which receive the most federal funding). For those from medical schools, which are heavily funded by NIH, fellowships or traineeships accounted for the main source of support. Students at less research-intensive universities relied mostly on personal funds (table 2-5). These differences by type of institution hold for all S&E fields (NSF/NCSES 2000). As noted earlier in this chapter, the majority of S&E doctorate recipients (about 75%) received their doctorate from research universities with very high research activity.

Table 2-5
Primary support mechanisms for S&E doctorate recipients, by 2010 Carnegie classification of doctorate-granting institution: 2009

Mechanism	All institutions	Research universities (very high research activity)	Research universities (high research activity)	Doctoral/research universities	Medical schools and medical centers	Other/not classified
Doctorate recipients (*n*)	35,564	27,166	5,275	1,123	1,184	816
All mechanisms (%)	100.0	100.0	100.0	100.0	100.0	100.0
Fellowship or traineeship	21.9	23.6	13.6	12.9	32.9	14.5
Grant	5.9	6.1	3.3	1.6	16.3	4.3
Teaching assistantship	15.2	15.2	21.3	8.8	1.6	4.5
Research assistantship	32.6	35.7	26.3	10.1	25.8	13.0
Other assistantship	0.6	0.5	1.1	0.4	0.7	0.5
Personal	10.2	6.8	18.0	39.3	10.6	31.5
Other	3.1	2.6	4.8	6.8	3.3	4.4
Unknown	10.6	9.6	11.7	20.2	8.8	27.3

NOTES: Personal support mechanisms include personal savings, other personal earnings, other family earnings or savings, and loans. Traineeships include internships and residency. Other support mechanisms include employer reimbursement or assistance, foreign support, and other sources. Percentages may not add to 100% because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of Survey of Earned Doctorates.

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Notable differences also exist in primary support mechanisms for doctoral degree students by sex, race/ethnicity, and citizenship. In 2009, among U.S. citizens and permanent residents, men were more likely than women to be supported by RAs (29% compared with 22%) and women were more likely than men to support themselves from personal sources (19% compared with 12%). Also, among U.S. citizens and permanent residents, whites and Asians were more likely than other racial/ethnic groups to receive primary support from RAs (27% and 33%, respectively), whereas underrepresented minorities depended more on fellowships or traineeships (38%). The primary source of support for doctoral degree students with temporary visas was an RA (50%) (appendix table 2-8).

To some extent, the sex, citizenship, and racial/ethnic differences in types of support mechanisms are related to differences in field of study. White and Asian men, as well as foreign doctoral degree students, are more likely than white and Asian 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. However, differences in type of support by sex, race/ethnicity, or citizenship remain, even after accounting for doctorate field (NSF/NCSES 2000, NSB 2010).

Debt Levels of S&E Graduate Students. At the time of doctoral degree conferral, 45% of S&E doctorate recipients have debt related to their undergraduate or graduate education. In 2009, 27% of S&E doctorate recipients reported having undergraduate debt and 32 % reported having graduate debt. For some, debt levels were high, especially for graduate debt: 4% reported more than $40,000 of undergraduate debt and 6% reported more than $70,000 of graduate debt (appendix table 2-9).

Levels of debt vary widely by doctorate field. In 2009, 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.[6] In 2009, 20% of psychology doctoral degree recipients reported graduate debt of more than $70,000. Doctorate recipients in mathematics; computer sciences; physical sciences; engineering; biological sciences; and earth, atmospheric, and ocean sciences were least likely to report graduate debt. A higher percentage of doctorate recipients in non-S&E fields (49%) than those in S&E fields (32%) reported graduate debt.

Although men and women differed little in level of debt, U.S citizens and permanent residents accumulated more debt than temporary visa holders, and blacks and Hispanics had higher levels of graduate debt than whites, even accounting for differences in field of doctorate (NSF/NCSES 2010b).

The proportion of S&E master's recipients with debt increased between 2000 and 2008 (table 2-6). In 2000, about 40% of all master's students had incurred debt while studying for their master's degree, with no meaningful differences between those in S&E and non-S&E. By 2008, this proportion had increased to 51% among S&E master's recipients and 58% among those in non-S&E fields. Among graduates who had incurred debt, there was a statistically significant increase in the amount of the debt for those in non-S&E fields, but not for S&E students.[7]

Table 2-6
Master's degree recipients with debt from graduate student loans upon graduation and average amount owed, by broad field: 1999–2000 and 2007–08

	1999–2000[a]		2007–08[b]	
Field	With debt from master's degree program (%)	Average amount owed (constant 2000 dollars)[c]	With debt from master's degree program (%)	Average amount owed (constant 2000 dollars)[c]
All fields	40.1	23,366	53.8	28,375
S&E	41.1	22,954	51.3	27,282
Non-S&E	40.2	22,452	57.9	30,000

[a]Data as of late 2000.
[b]Data as of late 2008.
[c]Average excludes respondents who did not owe any money from their master's degree program upon graduation.

NOTE: Debt is total amount owed on all loans for graduate education.

SOURCE: U.S. Department of Education, National Center for Education Statistics, special tabulations (2011) of 1999–2000 and 2007–08 National Postsecondary Student Aid Study (NPSAS: 2000 and NPSAS: 2008), http://nces.ed.gov/datalab/index.aspx.

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Undergraduate Education, Enrollment, and Degrees in the United States

Undergraduate education in S&E courses prepares students majoring in S&E for the workforce. It also prepares nonmajors to become knowledgeable citizens with a basic understanding of science and mathematics concepts. This section includes indicators related to enrollment and intentions to major in S&E fields, recent trends in the number of earned degrees in S&E fields, and persistence and retention in undergraduate education and in S&E.

Undergraduate Enrollment in the United States

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

Overall Enrollment

Over the last 15 years studied, enrollment in U.S. institutions of higher education at all levels rose from 14.5 million students in fall 1994 to 20.7 million in fall 2009, with most of the growth occurring in the last 10 years (appendix table 2-10). In 2009, the types of institutions enrolling the most students were associate colleges (8.2 million, 40% of all students enrolled), master's colleges/universities (4.7 million, 23%), and doctorate-granting universities with very high research activity (2.8 million, 14%). Between 1994 and 2009, enrollment nearly doubled at doctoral/research universities and increased by about 50% or more at associate's colleges, master's colleges, and medical schools/medical centers (appendix table 2-10). (See sidebar "Carnegie Classification of Academic Institutions" for definitions of the types of academic institutions.) These trends are expected to continue for the near future.

On the basis of demographics, household income, and age-specific unemployment rates,[8] NCES projects that undergraduate enrollment in higher education will increase 16% between 2008 and 2019 (NCES 2011c).[9] According to Census Bureau projections, the number of college-age individuals (ages 20–24) is expected to grow from 21.8 million in 2010 to 28.2 million by 2050 (appendix table 2-11). Enrollment of first-time freshmen is projected to increase by 13% between 2008 and 2019, although the number of high school graduates is projected to change little because of relatively flat numbers of 18-year-olds during this period (NCES 2011c).

Increased enrollment in higher education at all levels is projected to come mainly from minority groups, particularly Hispanics. Enrollment of all racial/ethnic groups is projected to increase, but the percentage for whites is projected to decrease from 63% in 2008 to 58% in 2019, whereas the percentages for blacks and Hispanics are projected to increase from 14% and 12% respectively, to 15% for both groups. (For further information on assumptions underlying these projections, see "Projection Methodology" in *Projections of Education Statistics to 2019* [NCES 2011c], http://nces.ed.gov/pubs2011/2011017.pdf, accessed 14 March 2011.)

Undergraduate Enrollment in S&E

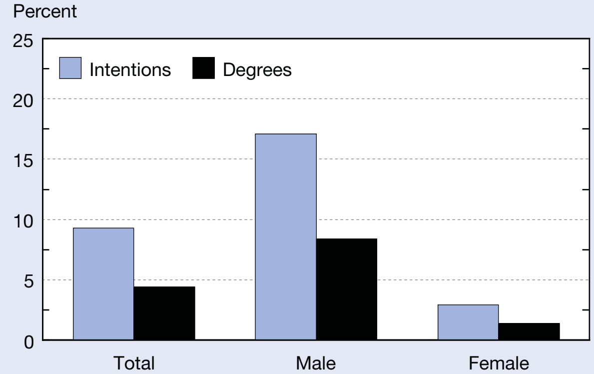
Freshmen Intentions to Major in S&E. Since 1972, the annual Survey of the American Freshman, National Norms, administered by the Higher Education Research Institute at the University of California–Los Angeles, has asked freshmen at a large number of universities and colleges about their intended majors.[10] The data have proven to be a broadly accurate picture of trends in degree fields several years later.[11] Between 1972 and 2007, about one-third of all freshmen planned to study S&E; this proportion gradually rose to 38% by 2010. Increases in the proportion of freshmen planning to major in biological/agricultural sciences in recent years account for most of this growth. In 2010, about 11% of freshmen intended to major in each of the following disciplines:

biological/agricultural sciences, social/behavioral sciences, and engineering. Between 1% and 3% intended to major in physical sciences, computer sciences, and mathematics/statistics (appendix table 2-12).

In 2010, about one in three white, black, and Hispanic freshmen; 28% of American Indian/Alaska Native freshmen; and 49% of Asian American/Asian freshmen reported that they intended to major in S&E (figure 2-6). The proportions planning to major in S&E were higher for men than for women in every racial/ethnic group (appendix table 2-12). For most racial/ethnic groups, about 10%–16% planned to major in social/behavioral sciences, about 6%–15% in engineering, about 9%–18% in biological/agricultural sciences, 2%–3% in computer sciences, 2%–3% in physical sciences, and 1% in mathematics or statistics. Higher proportions of Asian American/Asian freshmen than of those from other racial/ethnic groups p lanned to major in biological/agricultural sciences (18%) and engineering (15%). The percentage of all freshmen intending to major in computer sciences has dropped in recent years, whereas the percentage intending to major in biological/agricultural sciences has increased. (See appendix table 2-19 and the section on "S&E Bachelor's Degrees" for trends in bachelor's degrees.)

Generally, the percentages of students earning bachelor's degrees in particular S&E fields are similar to the percentages planning to major in those fields, with the exception of engineering and social/behavioral sciences. (See section on "Persistence and Retention in Undergraduate Education and S&E.") The percentage of students earning bachelor's degrees in engineering is smaller than the percentage planning to major in it for men and women as well as for all ethnic/racial groups, but the difference is larger for blacks (figures 2-7 and 2-8). The percentage earning bachelor's degrees in

Figure 2-7
Engineering: Freshmen intentions and degrees, by sex



NOTES: Data for freshmen intentions are for 2003; data for degrees are for 2009. Degrees do not reflect the same student cohort.

SOURCES: Higher Education Research Institute, University of California at Los Angeles, Survey of the American Freshman: National Norms, special tabulations (2011); National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix tables 2-12 and 2-18.

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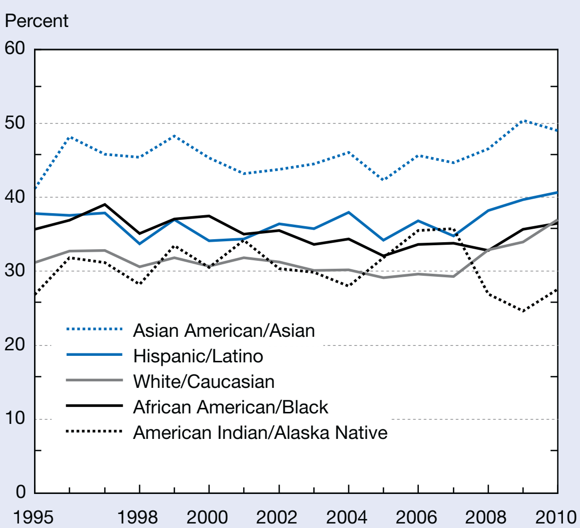
Figure 2-6
Freshmen intending S&E major, by race/ethnicity: 1995–2010



NOTES: In 2001 Native Hawaiian/Pacific Islander was added as a category under Asian American/Asian.

SOURCE: Higher Education Research Institute, University of California at Los Angeles, Survey of the American Freshman: National Norms, special tabulations (2011). See appendix table 2-12.

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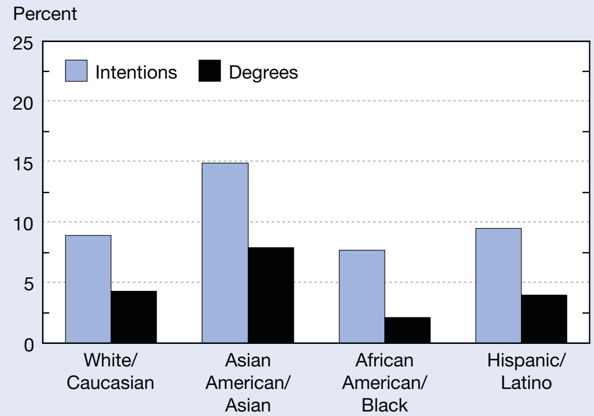
Figure 2-8
Engineering: Freshmen intentions and degrees, by race/ethnicity



NOTES: Data for freshmen intentions are for 2003; data for degrees are for 2009. Degrees do not reflect the same student cohort. Asian American/Asian includes Native Hawaiian/Pacific Islander.

SOURCES: Higher Education Research Institute, University of California at Los Angeles, Survey of the American Freshman: National Norms, special tabulations (2011); National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix tables 2-12 and 2-19.

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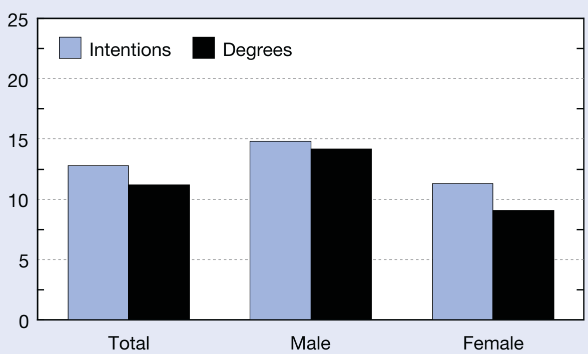
social/behavioral sciences is larger than previous years' percentages planning to major in those fields. The proportion earning bachelor's degrees in the natural sciences is smaller than the proportion planning to major in these fields for women, blacks, and Hispanics (figures 2-9 and 2-10).

The demographic composition of students planning to major in S&E has become more diverse over time. The proportion of white students planning to major in S&E declined from 77% in 1995 to 71% in 2010. On the other hand, the proportion of Asian American/Asian students increased from 7% to 12% and the proportion of Hispanic students increased from 5% to 13%. American Indian/Alaska Native and black students accounted for roughly 2% and 11%, respectively, of freshmen intending to major in S&E in both 1995 and 2010 (appendix table 2-13).

Foreign Undergraduate Enrollment.[12] In the 2009–10 academic year, the number of foreign students enrolled in bachelor's degree programs in U.S. academic institutions rose 5% from the previous year, to approximately 206,000 (IIE 2010). This continues a 3-year trend in which foreign student enrollment has risen after a 4-year decline (between the 2001–02 and 2005–06 academic years). The number of foreign undergraduates enrolled in 2009–10 was 5% above the peak in 2001–02. Among new foreign undergraduates, enrollment decreased 3% in 2009–10, the first decline in 5 years following a 20% increase in 2008–09. The countries that accounted for the largest numbers of foreign undergraduates enrolled in a U.S. institution in 2009–10 were China (almost 40,000), South Korea (36,200), India (15,200), Canada (13,600), and Japan (13,100). The number of Chinese undergraduates increased 52% over the previous year, and the numbers of South Korean and Indian undergraduates decreased 2% and 3% respectively. Among all foreign students (undergraduate and graduate) in 2009–10, the number of those studying agricultural sciences increased 15%; engineering, 7%; and mathematics and computer sciences, 8%. The physical and life sciences decreased 1% compared with the preceding year (IIE 2010).

More recent data from the Bureau of Citizenship and Immigration Services show a 7% increase in undergraduate enrollment of S&E foreign students in the U.S. from November 2009 to November 2010, mostly in engineering, social sciences, and mathematics. China, South Korea, Canada, Japan, and India were among the top countries sending foreign undergraduates in fall 2010, and were also among the top countries sending foreign S&E undergraduates (figure 2-11; appendix table 2-14). Although Nepal and Saudi Arabia sent comparatively fewer total undergraduates, they were also among the top countries sending foreign undergraduates in S&E fields—more than Canada and Japan. About one-third of all foreign students in undergraduate programs at U.S. institutions are enrolled in S&E fields.[13] Undergraduate foreign enrollment in S&E has increased each year between 2006 and 2010, while growth in non-S&E fields has slowed down (table 2-7).

Figure 2-9
Natural sciences: Freshmen intentions and degrees, by sex



NOTES: Data for freshmen intentions are for 2003; data for degrees are for 2009. Degrees do not reflect the same student cohort.

SOURCES: Higher Education Research Institute, University of California at Los Angeles, Survey of the American Freshman: National Norms, special tabulations (2011); National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix tables 2-12 and 2-18.

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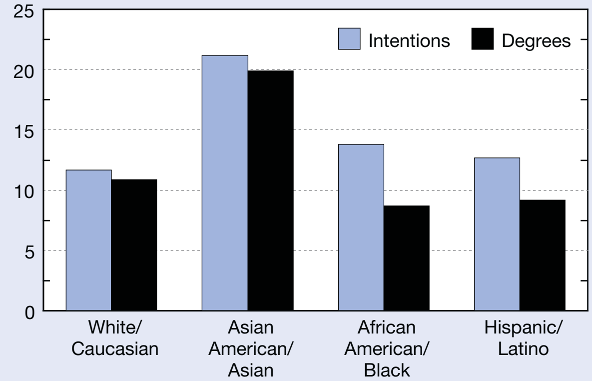
Figure 2-10
Natural sciences: Freshmen intentions and degrees, by race/ethnicity



NOTES: Data for freshmen intentions are for 2003; data for degrees are for 2009. Degrees do not reflect the same student cohort. Asian American/Asian includes Native Hawaiian/ Pacific Islander.

SOURCES: Higher Education Research Institute, University of California at Los Angeles, Survey of the American Freshman: National Norms, special tabulations (2011); National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix tables 2-12 and 2-19.

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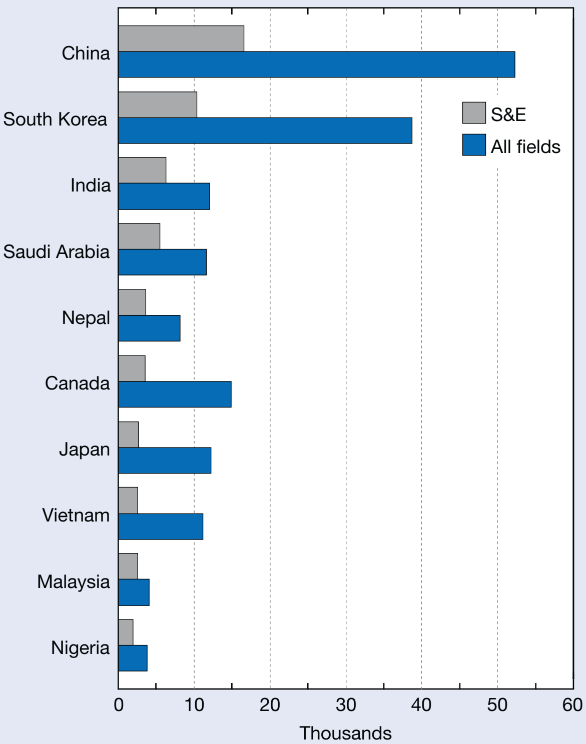
Figure 2-11
Foreign undergraduate student enrollment in U.S. universities, by top 10 places of origin and field: November 2010



SOURCE: Bureau of Citizenship and Immigration Services, Student and Exchange Visitor Information System database, special tabulations (2011). See appendix table 2-14.

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Engineering Enrollment. For the most part, students do not declare majors until their sophomore year, therefore, undergraduate enrollment data are not available by field. However, engineering is an exception. Engineering programs generally require students to declare a major in the first year of college, so engineering enrollment data can serve as an early indicator of both future undergraduate engineering degrees and student interest in engineering careers. The Engineering Workforce Commission administers an annual fall survey that tracks enrollment in undergraduate and graduate engineering programs (EWC 2010).

Undergraduate engineering enrollment was flat in the late 1990s, increased from 2000 to 2003, declined slightly through 2006, and rose for the next 3 years to a peak of 468,100 in 2009 (figure 2-12; appendix table 2-15). The number of undergraduate engineering students increased 15% between 2006 and 2009, with particularly steep increases in 2007 (7%) and 2009 (6%). Full-time freshman enrollment followed a similar pattern, reaching 114,700 in 2009—the highest since 1982. These trends correspond with declines in the college-age population through the mid-1990s, particularly the drop in white 20–24-year-olds, who account for the majority of engineering enrollment (NSF/NCSES 2011). Similar trends in undergraduate engineering enrollment are reported by the American Society for Engineering Education (Gibbons 2009).

Undergraduate Degree Awards

The number of undergraduate degrees awarded by U.S. academic institutions has been increasing over the past two decades in both S&E and non-S&E fields. These trends are expected to continue at least through 2019 (NCES 2011c).

Table 2-7
Foreign students enrolled in U.S. higher education institutions, by broad field and academic level: 2006–10

Level and field	2006	2007	2008	2009	2010
All fields					
All levels	525,470	548,090	568,400	585,510	592,790
Undergraduate	256,090	266,870	281,550	291,440	295,550
Graduate	269,380	281,210	286,840	294,070	297,240
S&E fields					
All levels	232,780	240,130	248,260	259,200	269,350
Undergraduate	74,740	77,150	81,700	86,950	93,230
Graduate	158,040	162,980	166,560	172,250	176,120
Non-S&E fields					
All levels	292,680	307,960	320,130	326,300	323,450
Undergraduate	181,340	189,730	199,850	204,480	202,320
Graduate	111,340	118,230	120,280	121,820	121,120

NOTES: Foreign doctorate recipients are those holding temporary visas. Undergraduate level includes associate's and bachelor's degrees; graduate level includes master's and doctoral degrees. Numbers rounded to nearest 10. Detail may not add to total because of rounding.

SOURCE: U.S. Department of Homeland Security, U.S. Immigration and Customs Enforcement, Student and Exchange Visitor Information System database, special tabulations (2010).

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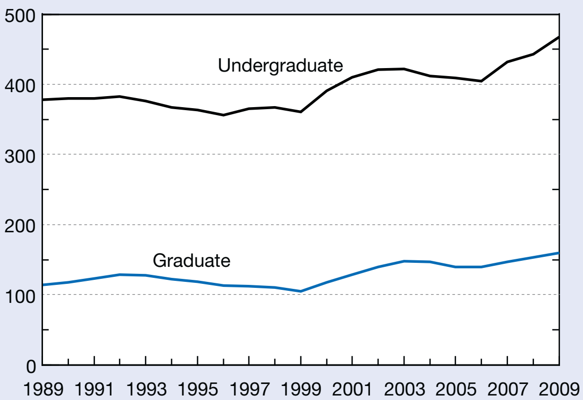
Figure 2-12
U.S. engineering enrollment, by level: 1989–2009



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

SOURCE: American Association of Engineering Societies, Engineering Workforce Commission, Engineering & Technology Enrollments (various years). See appendix tables 2-15 and 2-22.

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S&E Associate's Degrees

Community colleges often are 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, but others continue their education at 4-year colleges or universities and subsequently earn higher degrees.[14] Many who transfer to baccalaureate-granting institutions do not earn associate's degrees before transferring. Associate's degrees in S&E and engineering technology accounted for about 11% of all associate's degrees in 2009 (appendix table 2-16).

S&E associate's degrees from all types of academic institutions rose from 38,400 in 2000 to 62,800 in 2003, declined to 47,500 through 2007, and increased to 54,300 in 2009. The overall trend mirrors the pattern of computer sciences, which also peaked in 2003, declined through 2007, and increased through 2009. Associate's degrees earned in engineering technology (not included in S&E degree totals because of their applied focus) declined from about 40,500 in 2000 to 29,700 in 2006, but have since increased to 33,200 (appendix table 2-16).

In 2009, women earned 62% of all associate's degrees, up from 60% in 2000, and 40% of S&E associate's degrees, down from 48% in 2000. Most of the decline is attributable to a decrease in women's share of computer science degrees, from 42% in 2000 to 25% in 2009. In 2009, women's share of S&E associate's degrees rose slightly due largely to an increase in psychology degrees (appendix table 2-16).

Students from underrepresented groups (blacks, Hispanics, and American Indians/Alaska Natives) earn a higher proportion of associate's degrees than of bachelor's or more advanced degrees.[15] (See "S&E Bachelor's Degrees by Race/Ethnicity" and "Doctoral Degrees by Race/Ethnicity.") In 2009, underrepresented minorities earned 28% of S&E associate's degrees—more than one-third of all associate's degrees in social and behavioral sciences, and more than one-quarter of all associate's degrees in biological sciences, computer sciences, and mathematics (appendix table 2-17). In the last 10 years, the number of S&E associate's degrees earned by these students increased by 52%, compared with the overall national increase of 41%.

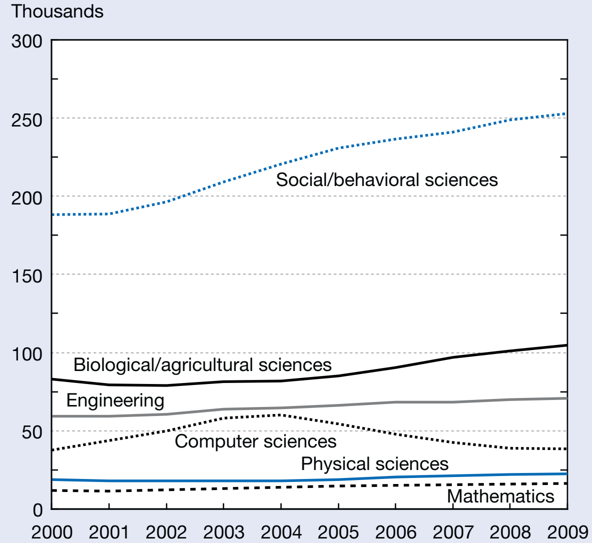
S&E Bachelor's Degrees

The baccalaureate is the most prevalent S&E degree, accounting for about 70% of all S&E degrees awarded. S&E bachelor's degrees have consistently accounted for roughly one-third of all bachelor's degrees for at least the past 10 years. The number of S&E bachelor's degrees awarded rose steadily from 399,000 in 2000 to 505,000 in 2009 (appendix table 2-18).

In the last decade, the number of bachelor's degrees awarded increased fairly consistently, though to different extents, in all S&E fields. The exception was computer sciences, where the number increased sharply from 1998 to 2004, dropped as sharply through 2008, and remained flat in 2009 (figure 2-13, appendix table 2-18).

S&E Bachelor's Degrees by Sex. Since 1982, women have outnumbered men in undergraduate education. They

Figure 2-13
S&E bachelor's degrees, by field: 2000–09



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

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-18.

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have earned relatively constant fractions of all bachelor's and S&E bachelor's degrees for several years (see sidebar "Gender Gap in Undergraduate Enrollment"). Since the late 1990s, women have earned about 57% of all bachelor's degrees and about half of all S&E bachelor's degrees. Among U.S. citizens and permanent residents, women also earn about half of all S&E bachelor's degrees (NSF/NCSES 2011).

Within S&E, men and women tend to study different fields. In 2009, men earned a majority of bachelor's degrees awarded in engineering, computer sciences, and physics (82%, 82%, and 81%, respectively). Women earned half or more of the bachelor's degrees in psychology (77%), agricultural sciences (51%), biological sciences (60%), chemistry (50%), and social sciences (54%) (appendix table 2-18).

In the last 10 years studied, changes have not followed a consistent pattern. The share of bachelor's degrees awarded to women declined in computer sciences (by 10%), mathematics (by 5%), and engineering (by 2%) (figure 2-14). Fields where the proportion of bachelor's degrees awarded to women grew during this period include astronomy (from 34% to 44%), atmospheric sciences (from 23% to 33%), agricultural sciences (from 46% to 51%), chemistry (from 47% to 50%), and anthropology (from 67% to 70%) (appendix table 2-18).

The number of bachelor's degrees awarded to men and women in S&E and in all fields increased in similar proportions between 2000 and 2009.[16]

Gender Gap in Undergraduate Education

A sizeable gender gap in college enrollment emerged in the 1980s and has widened since. By 1980, women achieved parity with men, receiving half of all college degrees. By 1990, women received 54% of college degrees and by the end of the millennium, 58%. The latest update of the American Council on Education (ACE) publication *Gender Equity in Higher Education* (King 2010) reports that the gender gap in the United States has largely stabilized.

According to disaggregated data from ACE, the size of the gender gap varies with race, ethnicity, age, income, and the financial independence of students pursuing higher education. It is close to zero among affluent families with parents who pay for their children's higher education. It is much larger for blacks and Hispanics, for low income families, and for independent students who pay for their own education.

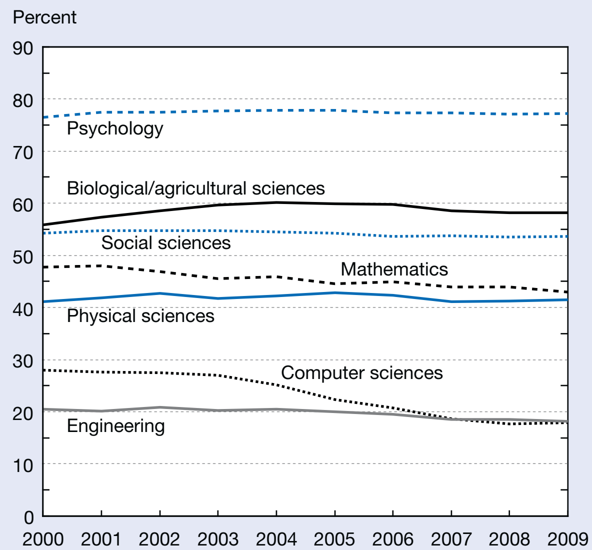
Several indicators point to the stabilization of the gender gap. First, the distribution of enrollment and undergraduate degrees by gender has remained consistent since around 2000. Second, the number of bachelor's degrees awarded to both men and women is on the rise. Third, for most racial/ethnic groups, the percentage of traditional-age, male undergraduates has been stable.

Hispanics are the exception. Despite a large increase in the number of degrees awarded to Hispanics of both genders in recent years, the bachelor's degree attainment rate for Hispanic males is the lowest of any major racial/ethnic group (10%) and has not changed much since the mid-1990s. This is due to immigration. Foreign-born Hispanics complete high school and college at much lower rates than their native-born peers, in particular male immigrants, who represent one out of every three Hispanic young adults.

S&E Bachelor's Degrees by Race/Ethnicity. The racial/ethnic composition of S&E bachelor's degree recipients has changed over time, reflecting population changes and increasing college attendance by members of minority groups.[17] Between 2000 and 2009, the proportion of S&E degrees awarded to white students among U.S. citizens and permanent residents declined from 71% to 66%, although the number of S&E bachelor's degrees earned by white students increased during that time (figure 2-15, appendix table 2-19). The proportion awarded to Hispanic students increased from 7% to 9% and to Asians/Pacific Islanders from 9% to 10%. The shares to black and American Indian/Alaska Native students have remained flat since 2000. The number of S&E bachelor's degrees earned by students of unknown race/ethnicity also increased.

Despite considerable progress over the past couple of decades for underrepresented minority groups earning

Figure 2-14
Women's share of S&E bachelor's degrees, by field: 2000–09



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

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-18.

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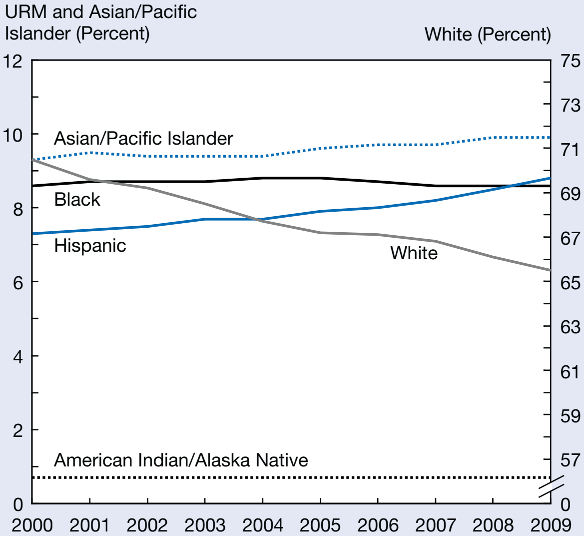
Figure 2-15
Share of S&E bachelor's degrees, by race/ethnicity: 2000–09



URM = underrepresented minorities (black, Hispanic, and American Indian/Alaska Native)

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-19.

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bachelor's degrees in any field, the gap in educational attainment between young minorities and whites continues to be wide. The percentage of the population ages 25–29 with bachelor's or higher degrees was 19% for blacks, 12% for Hispanics, and 37% for whites in 2009. These figures changed from 13%, 10%, and 26%, respectively, in 1989 (NCES 2010a). 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, Hispanics, and American Indian/Alaska Natives are less likely than whites and Asians/Pacific Islanders to graduate from high school, to enroll in college, and to graduate from college. (For information on immediate post-high school college enrollment rates, see chapter 1, "Transition to Higher Education.") Among those who do enroll in or graduate from college, blacks, Hispanics, and American Indians/Alaska Natives are about as likely as whites to choose S&E fields; and 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. However, the proportion of Asians/Pacific Islanders earning degrees in the social sciences is similar to other racial/ethnic groups (appendix table 2-19).

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 2009, between 9% and 11% of all baccalaureate recipients in each of these racial/ethnic groups earned their degrees in the natural sciences,[18] 3%–4% in engineering, and 15%–18% in the social and behavioral sciences. Asian/Pacific Islander baccalaureate recipients earned 20% of their bachelor's degrees in natural sciences and 8% in engineering (appendix table 2-19).

For all racial/ethnic groups, 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 (with the exception of computer sciences) has generally increased since 2000 (appendix table 2-19). Across all racial/ethnic groups, the number of degrees in computer sciences increased considerably through 2003–04 and then sharply declined through 2008. Except for Asians/Pacific Islanders, whose numbers in computer sciences continued to fall in 2009, the decline in other racial/ethnic groups stabilized. In the case of Hispanics, the number of computer science degrees awarded increased.

Bachelor's Degrees by Citizenship. Since 2000, students on temporary visas in the United States have consistently earned a small share (3%–4%) of S&E degrees at the bachelor's level. These students earned a larger share of bachelor's degrees awarded in economics and in electrical and industrial engineering in 2009 (about 9%). The number of S&E bachelor's degrees awarded to students on temporary visas increased from about 15,200 in 2000 to about 18,800 in 2004, and then declined to 17,100 in 2009 (appendix table 2-19).

Persistence and Retention in Undergraduate Education (S&E Versus Non-S&E Fields)

Many students who start out in undergraduate 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.

S&E students persist and complete undergraduate programs at a higher rate than non-S&E students. Six years after enrollment in a 4-year college or university in the 2003–04 academic year, 63% of S&E students had completed a bachelor's degree by spring 2009, compared to 55% of non-S&E students. About 12% of both S&E and non-S&E students were still enrolled and about 24% had not completed any degree and were no longer enrolled. Within S&E fields, persistence and completion is higher in agricultural, biological, and social sciences than in mathematics, and physical and computer sciences (table 2-8).

The number of undergraduates who switch out of S&E fields is lower than entry into S&E fields as a whole. Because many students begin college in the large pool of non-S&E and undeclared majors, even the relatively small proportion who later switch to S&E constitutes a large number. Among postsecondary students who began at 4-year

Table 2-8
Persistence and outcome of postsecondary students beginning 4-year colleges or universities in 2004: 2009

		Cumulative persistence outcome, 2009 (%)			
Major in 2004	Number	Bachelor's	Associate's or certificate	Still enrolled	No longer enrolled
All majors	1,657,800	57.8	6.2	12.2	23.7
S&E	397,500	63.3	4.5	11.7	20.5
Agricultural/biological sciences	80,600	71.4	3.1	10.2	15.3
Physical/math/computer sciences	85,300	51.7	7.4	11.3	29.5
Engineering	107,300	60.8	4.5	14.2	20.5
Social/behavioral sciences	124,300	62.4	3.4	14.7	19.1
Non-S&E	790,900	55.2	7.3	13.0	24.5
Missing/undeclared	469,400	57.5	5.9	11.3	25.3

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

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2003–04 Beginning Postsecondary Students Longitudinal Study, Second Follow-Up (BPS:04/09), http://nces.ed.gov/datalab/index.aspx.

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colleges or universities in 2003–04, 25% reported an S&E major, 47% reported a non-S&E major, and 28% were missing data on major or had not declared a major. In cases where data on major were available, 35% reported an S&E major. Six years later, among those who had attained a bachelor's degree, 34% were S&E majors. Although about 28% of agricultural/biological sciences majors, 31% of mathematics/physical/computer sciences majors, 22% of engineering majors, and 32% of social sciences majors eventually switched to non-S&E majors before earning a bachelor's degree, 35% of those with initially missing or undeclared majors and 15% of those with initial non-S&E majors switched into S&E fields before earning their bachelor's degrees (table 2-9).

Within S&E fields, undergraduate attrition out of agricultural/biological sciences, mathematics/physical/computer sciences, and engineering is greater than transfers into those fields, but transfers into social/behavioral sciences are greater than attrition. One in ten engineering majors switched into a mathematics/physical/computer sciences major.

Among postsecondary students who began at 4-year colleges or universities in 2003–04 for whom data are available and who reported a major, 7% reported an agricultural/biological sciences major or a mathematics/physical/computer sciences major respectively, 10% reported an engineering major, 11% reported a social/behavioral sciences major, and 65% reported a non-S&E major. Six years later, among those who had attained a bachelor's degree, 7% were agricultural/biological sciences majors, 6% were mathematics/physical/computer sciences majors, 6% were engineering majors, 16% were social/behavioral sciences majors, and 64% were non-S&E majors.

Table 2-9
Field switching among postsecondary students beginning 4-year colleges and universities in 2004: 2009

		Major when last enrolled in 2009 (%)					
Major in 2004	Number	Agricultural/ biological sciences	Physical/math/ computer sciences	Engineering	Social and behavioral sciences	Non-S&E	Undeclared/ not in degree program
All majors	1,387,700	6.8	5.7	5.8	15.5	60.7	5.6
S&E							
Agricultural/biological sciences	71,300	53.7	3.6	1.3	10.9	28.3	2.2
Physical/math/computer sciences	68,900	5.0	43.0	5.6	8.2	31.1	7.1
Engineering	95,500	2.7	10.1	55.9	3.5	22.3	5.4
Social/behavioral sciences	108,600	2.2	1.1	1.0	60.7	31.8	3.3
Non-S&E	651,500	3.5	2.5	1.5	7.7	79.4	5.4
Missing/undeclared	391,900	6.2	5.0	2.9	20.8	58.0	7.1

NOTES: Data excludes students who were not enrolled after July 2006, including those who had obtained their degree by that date. Physical sciences include earth, atmospheric, and ocean sciences. Social sciences include history.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2003–04 Beginning Postsecondary Students Longitudinal Study, Second Follow-Up (BPS:04/09), http://nces.ed.gov/datalab/index.aspx.

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Graduate Education, Enrollment, and Degrees in the United States

Graduate education in S&E contributes to global competitiveness, producing the highly skilled workers of the future and the research needed for a knowledge-based economy. In 2009, the Council of Graduate Schools and the Educational Testing Service formed a joint commission to investigate how graduate education can meet the challenges of the 21st century (see sidebar "The Path Forward: The Future of Graduate Education in the United States").

This section includes indicators related to graduate enrollment, recent trends in the number of earned degrees in S&E fields, and participation by women, minorities, and foreign students in graduate education in U.S. academic institutions.

Graduate Enrollment in S&E

There were 611,600 S&E graduate students enrolled in the United States in fall 2009; 48% of them were women (appendix table 2-20). The proportions of women graduate students enrolled in S&E differed considerably by field, with the lowest proportions in engineering (22%), computer sciences (26%), and physical sciences (33%). Women constituted the majority of graduate students in psychology (76%), medical/other life sciences (76%), biological sciences (57%), and social sciences (54%), and were close to half of graduate students in agricultural sciences (49%) and earth, atmospheric, and ocean sciences (46%). Among the social sciences, economics has an unusually low proportion of women (37%).

In 2009, underrepresented minority students (blacks, Hispanics, and American Indians/Alaska Natives) accounted for 12% of students enrolled in graduate S&E programs (appendix table 2-21). As a group, blacks, Hispanics, and American Indians/Alaska Natives made up 6%–7% of graduate enrollment in many S&E fields (engineering; mathematics; physical sciences; earth, atmospheric, and ocean sciences; and computer sciences), 9%–10% of graduate enrollment in agricultural and biological sciences, 15% in medical/other life sciences, 17% in social sciences, and 19% in psychology. Whites accounted for about 48% of S&E graduate enrollment in 2009 and Asians/Pacific Islanders for 6%.

Enrollment in engineering has been rising steadily in the last 20 years;[19] the number of full-time engineering students reached a new peak of 114,600 in 2009 (figure 2-12; appendix table 2-22). According to more recent data from the Engineering Workforce Commission and the American Society for Engineering Education (Gibbons 2009), graduate engineering enrollment continued to rise in 2009.

In 2009, approximately 130,000 full-time students were enrolled for the first time in S&E graduate programs—23% in engineering, 49% in the natural sciences, and 27% in the social and behavioral sciences (appendix table 2-23).

Foreign Student Enrollment

In 2009, 168,900 foreign students were enrolled in S&E graduate programs (appendix table 2-21). The concentration of foreign enrollment was highest in computer sciences, engineering, physical sciences, mathematics, and economics.[20] Those were also the fields with the highest share of enrollment of first-time, full-time S&E foreign graduate students (appendix table 2-23).

According to data collected by the Institute of International Education (IIE 2010), the overall number of

The Path Forward: The Future of Graduate Education in the United States

According to a 2010 report from the Commission on the Future of Graduate Education in the United States (Wendler et al. 2010), the main challenges facing graduate education and the U.S. educational system as a whole are as follows:

- In the future, larger numbers of children entering schools will come from families with less education. Consequently, fewer domestic students may have the levels of math and reading skills that will enable them to pursue higher education.
- Population growth by the year 2015 will result for the most part from international migration, according to estimates by the Census Bureau. This will result in a growing number of first generation college students, many of whom are likely to require additional educational preparation.
- The number of nontraditional students (students who are older, working adults) is growing. This population may see graduate education as a way to improve their employability rather than as a way to prepare for a first career.
- The level of degree attrition is high and time to degree is long, particularly for doctoral students.
- At the doctorate level, the decline in the availability of tenure track positions, which used to be an incentive for students who decided to pursue a doctorate, may result in many doctoral recipients looking for careers outside academia.

All of these changes indicate the need to reconsider how graduate students are financially supported and what kinds of additional resources they may need for success in graduate school. The changing demographics also may require a reconsideration of traditional time to degree expectations and career pathway opportunities.

foreign graduate students in all fields increased 4% from academic year 2008–09 to 2009–10. The number of new foreign graduate students declined slightly. India, China, South Korea, Taiwan, and Canada were the top countries/economies of origin for foreign graduate students.

More recent data from the Bureau of Citizenship and Immigration Services show a continuing increase in foreign graduate students from November 2009 to November 2010, with all of the increase occurring in S&E fields (table 2-7). About 60% of all foreign students in graduate programs at U.S. institutions were enrolled in S&E fields. In fall 2010, the number of foreign graduate students enrolled in S&E fields increased 2% over the previous year (appendix table 2-24). In absolute numbers, most of the growth was in computer sciences and engineering, but the increase in computer sciences was proportionately higher than in engineering. India and China accounted for nearly two-thirds of the foreign S&E graduates in the United States in November 2010. South Korea, Taiwan, and Turkey also sent large numbers of S&E graduate students, although South Korea and Taiwan sent far larger numbers of graduate students in non-S&E fields (primarily business and humanities).

S&E Master's Degrees

In some fields, such as engineering and geology, a master's degree is often the terminal degree for students. In other fields, master's degrees are a step toward doctoral degrees. Professional master's degree programs, which stress interdisciplinary training, are a relatively new direction in graduate education (for details on professional science master's degrees, see NSB 2010, page 2–22).

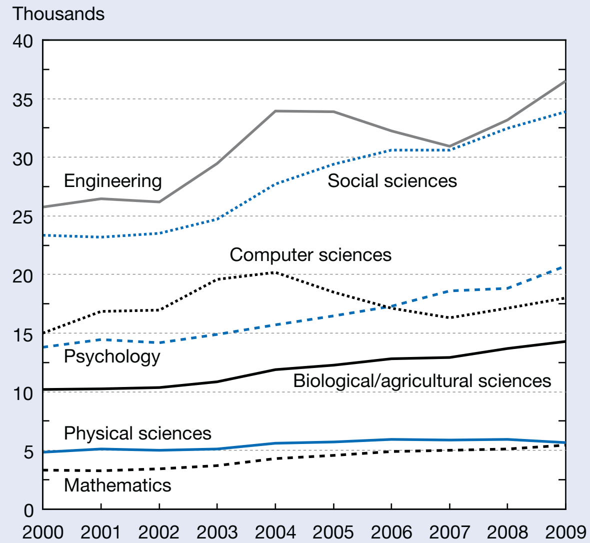
Master's degrees awarded in S&E fields increased from 96,200 in 2000 to about 120,900 in 2005, remained fairly consistent through 2007, but increased 12% in the years 2008–09 (appendix table 2-25). Since 2000, increases occurred in all major science fields. Master's degrees awarded in engineering and computer sciences declined between 2004 and 2007, but have since increased (figure 2-16).

Master's Degrees by Sex

The number of S&E master's degrees earned by both men and women rose between 2000 and 2009, but the number for women grew slightly faster (figure 2-17). In 2000, women earned 43% of all S&E master's degrees; by 2009, they earned 45% (appendix table 2-25). Among U.S. citizens and permanent residents, women earned about half of all S&E bachelor's degrees (NSF/NCSES 2011).

Women's share of S&E master's degrees varies by field. As with bachelor's degrees, in 2009, women earned a majority of master's degrees in psychology, biological sciences, social sciences, and agricultural sciences and a smaller share of master's degrees in engineering. Women's share of master's degrees in engineering in 2009, however, was slightly higher than their share in 2000 (appendix table 2-25). The number of master's degrees awarded to women in most major S&E fields increased fairly consistently throughout the last decade. In earth, atmospheric, and ocean sciences, and in the physical sciences, the numbers increased through 2006 but have since declined. In computer sciences, the numbers increased through 2004, declined sharply through 2007, but increased 14% in the years 2008–09.

Figure 2-16
S&E master's degrees, by field: 2000–09



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

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-25.

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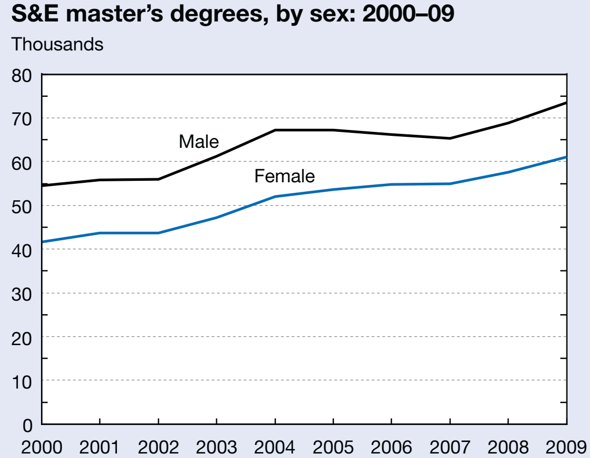
Figure 2-17
S&E master's degrees, by sex: 2000–09



SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-25.

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Master's Degrees by Race/Ethnicity

The number of S&E master's degrees awarded to U.S. citizens and permanent residents increased for all racial/ethnic groups between 2000 and 2009 (figure 2-18; appendix table 2-26).[21]

The proportion of master's degrees in S&E fields earned by U.S. citizens and permanent residents from underrepresented racial and ethnic minorities increased slightly over the 10 years studied. Blacks accounted for 10% of master's degree recipients in 2009, up from 8% in 2000, Hispanics from 5% in 2000 to 7% in 2009, and American Indians/Alaska Natives from 0.5% to 0.6%. The proportion of Asian/Pacific Islander recipients remained flat in this period.

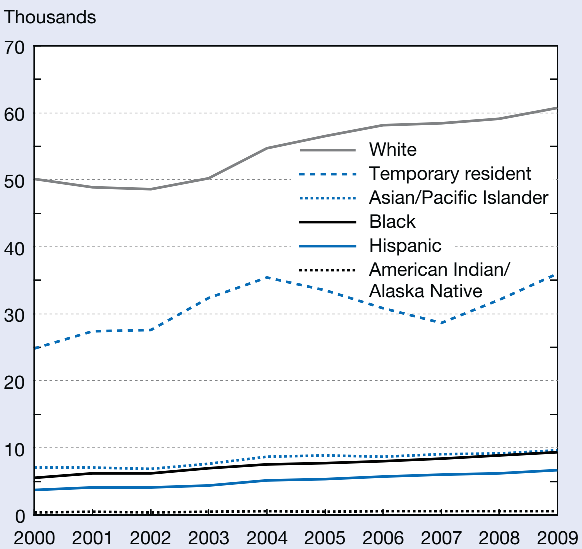
The percentage of S&E master's degrees earned by white students fell from 52% in 2000 to 45% in 2009, as the percentage of degrees earned by blacks, Hispanics, and temporary residents increased. The proportion of S&E master's degrees with other/unknown race increased from 5% to 9% between 2000 and 2009 (appendix table 2-26).

Master's Degrees by Citizenship

Foreign students make up a much higher proportion of S&E master's degree recipients than of bachelor's or associate's degree recipients. In 2009, foreign students earned 27% of S&E master's degrees. Their degrees were heavily concentrated in computer sciences, economics, and engineering, where they earned 46%, 45%, and 43%, respectively, of all master's degrees awarded in 2009 (appendix table 2-26). Within engineering, students on temporary visas earned more than half of the master's degrees in electrical and chemical engineering.

The number of S&E master's degrees awarded to students on temporary visas reached its highest point in the decade in 2009 (36,000), after a sharp decline between 2004 and 2007. Most of the drop during this time period was accounted for by decreases of temporary residents in the computer sciences and engineering fields, both of which rebounded by about one-third in the following 2 years.

Figure 2-18
S&E master's degrees, by race/ethnicity and citizenship: 2000–09



NOTE: Data on race/ethnicity include U.S. citizens and permanent residents.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-26.

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S&E Doctoral Degrees

Doctoral education in the United States prepares a new generation of faculty and researchers in academia, as well as a highly skilled workforce for other sectors of the economy. It also generates new knowledge important for the society as a whole and for U.S. competitiveness in a global knowledge-based economy. Over the years, numerous attempts have been made to measure the quality of doctoral education in the United States (Berelson 1960; Cartter 1966; NRC 1982; NRC 1995; Roose and Andersen 1970). For information on the latest assessment, see sidebar "The National Research Council Ratings: Measuring Scholarly Quality of Doctoral Programs."

The National Research Council Ratings: Measuring Scholarly Quality of Doctoral Programs

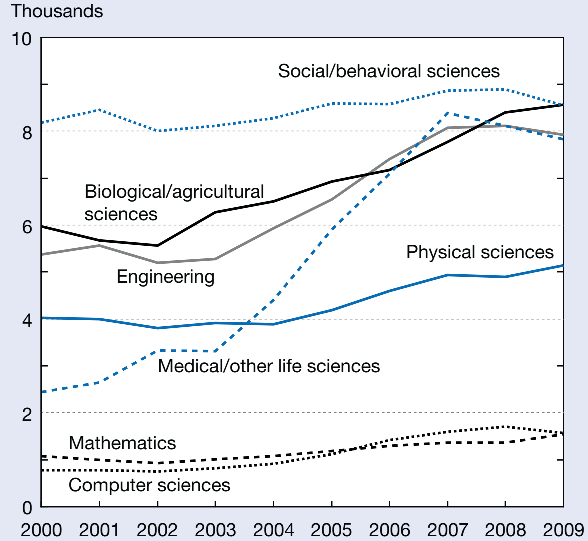
The National Research Council's *A Data-Based Assessment of Research Doctorate Programs in the United States* (NRC 2010), released in September 2010, is the latest attempt to measure the quality of U.S. doctoral education. The assessment sought to rely more heavily than past ratings on objective performance measures and to give less weight to faculty reputation. The study collected a wealth of data during the 2005–06 academic year, covering more than 5,000 programs in 62 fields at 212 universities.

Despite differences in the methodologies and the individual disciplines over time, the same universities—Harvard, Princeton, Stanford, University of California–Berkeley, MIT, and the California Institute of Technology—tend to have the top ranked departments (Jaschik 2010).

Not all observers agree that the latest ratings methodology is a clear improvement over past ratings. Major objections include (1) age of the data at the time of the release, (2) exclusion of books from the measure of faculty publication in some fields but not in others, and (3) disregard for the quality of the journals in which articles were published (Glenn 2010; Jaschik 2011).

The number of S&E doctorates conferred annually by U.S. universities increased rapidly between 2003 and 2007, but growth slowed in 2008, and the number declined slightly to 41,100 in 2009 (appendix table 2-27).[22] The growth through 2008 occurred among both U.S. citizens/permanent residents and temporary residents, although, in 2009, the number of temporary residents earning an S&E doctoral degree declined by about 4% (appendix table 2-28). The largest increases during the 2000–09 period were in engineering, biological/agricultural sciences, and medical/other life sciences (figure 2-19).

Figure 2-19
S&E doctoral degrees earned in U.S. universities, by field: 2000–09



NOTES: Physical sciences include earth, atmospheric, and ocean sciences. Data differ from doctoral degree data in other tables and figures in this report that are based on NSF Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical/other life sciences.

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

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Time to Doctoral Degree Completion

The time required to earn a doctoral degree and the success rates of those entering doctoral programs are concerns for those pursuing a degree, the universities awarding the degree, and the agencies and organizations funding graduate study. Longer times to degree mean lost earnings and a higher risk of attrition. Time to degree (as measured by time from graduate school entry to doctorate receipt) increased through the mid-1990s but has since decreased in all S&E fields from 7.7 to 7.0 years (appendix table 2-29). The physical sciences, mathematics, biological sciences, and engineering had the shortest time to degree, while the social sciences and medical/other life sciences had the longest.

Between 1995 and 2009, time to degree for doctorate recipients decreased in each of the Carnegie types of academic institutions awarding doctoral degrees (see sidebar "Carnegie Classification of Academic Institutions"). Time to degree was shortest at research universities with very high research activity (6.9 years in 2009, down from 7.7 years in 1995). Doctorate recipients at medical schools also finished quickly (6.8 years in 2009). Time to degree was longer at universities less-strongly oriented toward research (table 2-10).

Doctoral Degrees by Sex

Among U.S. citizens and permanent residents, the proportion of S&E doctoral degrees earned by women grew consistently between 2000 and 2007 (from 45% to 55%), but decreased slightly in 2008 and 2009 (appendix table 2-27). During this decade, women made gains in most major fields, but considerable differences continued in certain fields. In 2009, women earned half or more of doctorates in non-S&E fields, in social/behavioral sciences, and in medical/other life sciences. However, they earned considerably fewer than half of the doctorates awarded in physical sciences (33%), mathematics/computer sciences (26%), and engineering (25%) (appendix table 2-27). Although the percentages of degrees earned by women in physical sciences and engineering are low, they are higher than those earned in 2000 (26% and 19% respectively).

The number of S&E doctoral degrees earned by women grew faster than that of men. The number of U.S. citizen and permanent resident women earning doctorates in S&E increased from 8,700 in 2000 to 15,000 in 2009, while the number earned by men increased from 10,700 to 12,800 in the same time interval (appendix table 2-27). 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 and permanent resident women increased from approximately 500 in 2000 to 900 in 2009, biological sciences doctorates from 1,700 to 2,800, physical sciences doctorates from 600 to 800, and medical and other life sciences doctorates from 1,300 to 5,300. A decrease in the number of doctorates earned by men in the early years of the decade occurred in non-S&E fields and in most S&E fields (except for medical/other life sciences). Since 2005, the number of doctorates earned by U.S. citizen and permanent resident men has increased in all major S&E fields except for agricultural sciences and psychology.

Doctoral Degrees by Race/Ethnicity

The number and proportion of doctoral degrees in S&E fields earned by underrepresented minorities increased between 2000 and 2009. In 2009, blacks earned 1,451, Hispanics earned 1,335, and American Indians/Alaska Natives earned 154—accounting for 7% of all S&E doctoral degrees earned that year, up from 6% in 2000 (appendix table 2-28).[23] Their share of the S&E doctorates earned by

Table 2-10
Median number of years from entering graduate school to receipt of S&E doctorate, by 2010 Carnegie classification of doctorate-granting institution: 1995–2009

Year of doctorate	All institutions	Research universities (very high research activity)	Research universities (high research activity)	Doctoral/research universities	Medical schools and medical centers	Other/ not classified
1995	7.7	7.7	8.3	9.9	7.7	8.7
1996	7.7	7.7	8.6	9.2	7.7	8.7
1997	7.7	7.2	8.2	9.7	7.7	8.2
1998	7.3	7.2	8.2	9.2	6.9	7.7
1999	7.2	7.2	7.9	8.9	6.7	7.7
2000	7.5	7.2	8.2	9.2	7.2	7.9
2001	7.2	7.2	8.2	9.7	6.9	7.7
2002	7.5	7.2	8.2	9.9	6.9	7.7
2003	7.6	7.2	8.2	9.9	6.9	8.7
2004	7.2	7.0	8.0	9.2	6.9	7.6
2005	7.3	7.2	7.9	9.3	7.0	7.7
2006	7.2	7.0	7.9	9.0	6.9	7.5
2007	7.0	6.9	7.7	8.9	6.9	7.4
2008	7.0	6.9	7.7	8.9	6.7	7.4
2009	7.0	6.9	7.7	9.2	6.8	7.3

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of Survey of Earned Doctorates.

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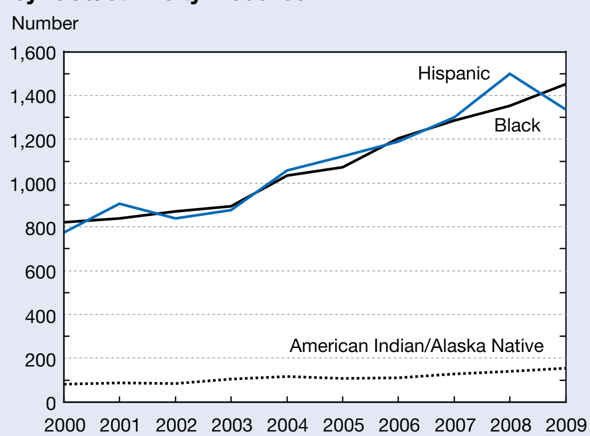
U.S. citizens and permanent residents rose from 9% to 11% in the same period. Gains by all groups contributed to this rise, although the number of S&E degrees earned by blacks and Hispanics rose considerably more than the number earned by American Indians/Alaska Natives (figure 2-20). Asian/Pacific Islander U.S. citizens and permanent residents earned 6% of all S&E doctorates in 2009, similar to 2000.

The number of S&E doctorates earned by white U.S. citizens and permanent residents increased between 2000 and 2009. The number of S&E doctoral degrees earned by white U.S. citizen and permanent resident men declined through 2003, then gradually increased (figure 2-21). The number of degrees earned by white U.S. citizen and permanent resident women increased through 2007, but declined somewhat in 2008 and 2009. As the number of S&E doctorates awarded to minorities and temporary residents increased, the proportion of S&E doctoral degrees earned by white U.S. citizens and permanent residents decreased from 54% in 2000 to 49% in 2009 (appendix table 2-28).

Foreign S&E Doctorate Recipients

Temporary residents earned approximately 13,400 S&E doctorates in 2009, up from 8,500 in 2000. Foreign students on temporary visas earned a larger proportion of doctoral degrees than master's, bachelor's, or associate's degrees (appendix tables 2-17, 2-19, 2-26, and 2-28). The temporary residents' share of S&E doctorates rose from 30% in 2000 to 33% in 2009. In some fields, foreign students earned sizeable shares of doctoral degrees. In 2009, foreign students on temporary visas earned half or more of doctoral degrees awarded in engineering, physics, computer sciences, and economics. They earned considerably lower proportions of doctoral degrees in other S&E fields, for example, 29% in biological sciences, 8% in medical/other life sciences, and 7% in psychology (appendix table 2-28).

Figure 2-20
S&E doctoral degrees earned by U.S. citizen and permanent resident underrepresented minorities, by race/ethnicity: 2000–09



NOTES: Data differ from doctoral degree data in other tables and figures in this report that are based on NSF Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical/other life sciences.

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

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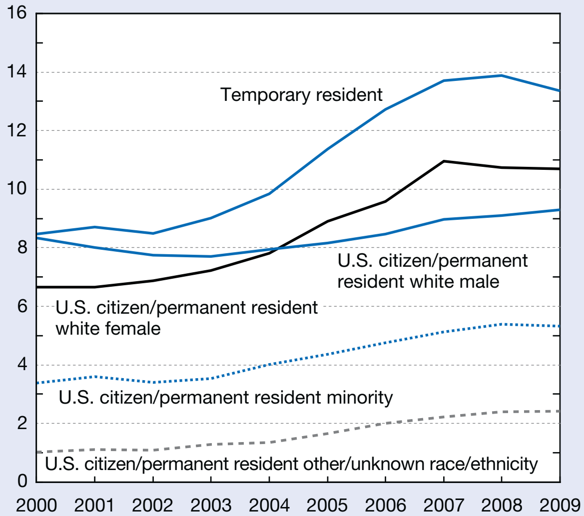
Figure 2-21
S&E doctoral degrees, by sex, race/ethnicity, and citizenship: 2000–09



NOTES: Minority includes Asian/Pacific Islander, black, Hispanic, and American Indian/Alaska Native. Data differ from doctoral degree data in other tables and figures in this report that are based on NSF Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical/other life sciences.

SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, Integrated Science and Engineering Resources Data System (WebCASPAR), http://webcaspar.nsf.gov. See appendix tables 2-27 and 2-28.

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Countries/Economies of Origin

The top 10 foreign countries/economies of origin of foreign S&E doctorate recipients together accounted for 67% of all foreign recipients of U.S. S&E doctoral degrees from 1989 to 2009 (table 2-11). Six out of those top 10 locations are in Asia. The Asian countries/economies sending the most doctoral degree students to the United States have been, in descending order, China, India, South Korea, and Taiwan.

Asia. From 1989 to 2009, students from four Asian countries/economies (China, India, South Korea, and Taiwan) earned more than half of U.S. S&E doctoral degrees awarded to foreign students (122,200 of 223,200)—almost 4 times more than students from Europe (30,000). Most of these degrees were awarded in engineering, biological sciences, and physical sciences (table 2-12).

Students from China earned the largest number of U.S. S&E doctorates awarded to foreign students during the 1989–2009 period (57,700), followed by those from India (24,800), South Korea (21,800), and Taiwan (17,800) (table 2-11). The number of S&E doctorates earned by students from China dropped in the late 1990s, increased through 2007, but declined nearly 13% in the following 2 years

Table 2-11
Foreign recipients of U.S. S&E doctorates, by country/economy of origin: 1989–2009

Country/economy	Number	Percent
All foreign recipients	223,245	100.0
Top 10 total	149,774	67.1
China	57,705	25.8
India	24,809	11.1
South Korea	21,846	9.8
Taiwan	17,848	8.0
Canada	7,193	3.2
Turkey	5,391	2.4
Thailand	4,003	1.8
Japan	3,806	1.7
Mexico	3,589	1.6
Germany	3,584	1.6
All others	73,471	32.9

NOTE: Foreign doctorate recipients include permanent and temporary residents.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of Survey of Earned Doctorates.

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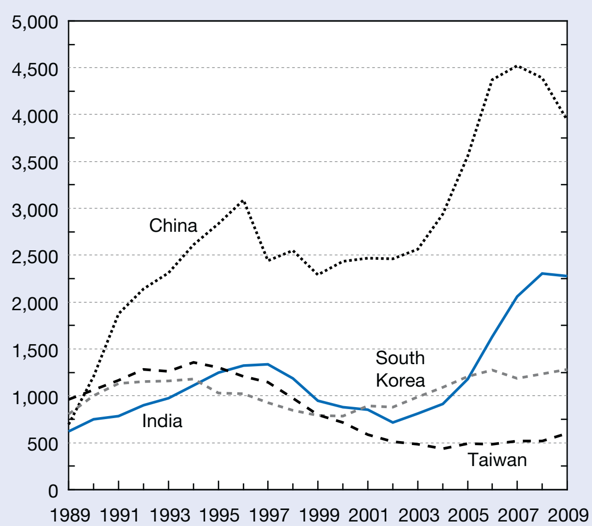
(figure 2-22). Over the 20-year period, however, the number of S&E doctorates earned by Chinese nationals increased nearly 6 times.[24] The number of S&E doctorates earned by students from India also declined in the late 1990s, but has

Figure 2-22
U.S. S&E doctoral degree recipients, by selected Asian country/economy of origin: 1989–2009



NOTE: Degree recipients include permanent and temporary residents.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010), Survey of Earned Doctorates.

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Table 2-12
Asian recipients of U.S. S&E doctorates, by field and country/economy of origin: 1989–2009

Field	Asia	China	India	South Korea	Taiwan
All fields	183,457	61,888	27,981	28,079	22,095
S&E	157,306	57,705	24,809	21,846	17,848
Engineering	58,557	38,903	13,847	13,356	9,992
Science	98,749	18,802	10,962	8,490	7,856
Agricultural sciences	5,905	1,726	632	838	678
Biological sciences	26,526	13,107	3,998	2,613	2,730
Computer sciences	8,462	2,831	2,147	937	916
Earth/atmospheric/ocean sciences	3,132	1,627	273	371	301
Mathematics	7,534	3,677	709	977	677
Medical/other life sciences	5,267	1,174	1,071	591	893
Physical sciences	22,581	11,220	2,851	2,627	1,867
Psychology	2,423	422	300	413	320
Social sciences	16,919	3,119	1,866	3,989	1,610
Non-S&E	26,151	4,183	3,172	6,233	4,247

NOTE: Includes permanent and temporary residents.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of Survey of Earned Doctorates.

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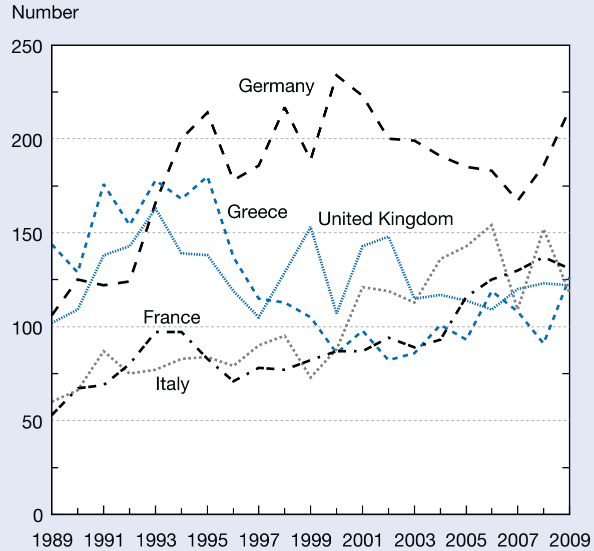
increased almost every year since 2002; over the last two decades it more than tripled. The number of S&E doctoral degrees earned by South Korean students also dipped in the late 1990s and then rose, but the number did not rise as dramatically as those for China and India. In 1989, students from Taiwan earned more U.S. S&E doctoral degrees than students from China, India, or South Korea. 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.

Europe. European students earned far fewer U.S. S&E doctorates than Asian students between 1989 and 2009, and they tended to focus less on engineering than did their Asian counterparts (tables 2-12 and 2-13). Western European countries whose students earned the largest number of U.S. S&E doctorates from 1989 to 2009 were Germany, the United Kingdom, Greece, Italy, and France, in that order. Individual country trends and patterns vary (figure 2-23).

The number of Central and Eastern European students earning S&E doctorates at U.S. universities increased from 74 in 1989 to more than 800 in 2009, approaching the number of those from Western Europe (figure 2-24). A higher proportion (87%) of Central and Eastern European doctorate recipients than of Western European or Scandinavian doctorate recipients (73% and 76% respectively) earned their doctorates in S&E fields, particularly in mathematics and physical sciences (table 2-13).

North America. Despite the proximity of Canada and Mexico to the United States, the shares of U.S. S&E doctoral degrees awarded to residents of these countries were small compared with those awarded to students from Asia and Europe. The number of U.S. S&E degrees earned by students from Canada doubled between 1989 and 2009, from about 240 to nearly 500. The number of doctoral degree recipients from Mexico increased through 2003, but has generally remained stable since then. In 2009, 193 S&E

Figure 2-23
U.S. S&E doctoral degree recipients, by selected Western European country: 1989–2009



NOTE: Degree recipients include permanent and temporary residents.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010), Survey of Earned Doctorates.

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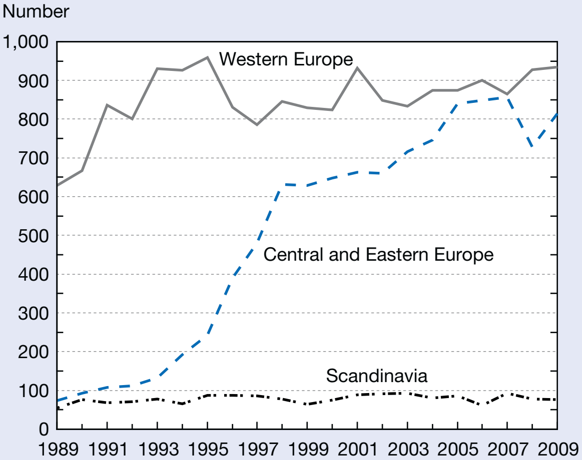
Figure 2-24
U.S. S&E doctoral degree recipients from Europe, by region: 1989–2009



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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010), Survey of Earned Doctorates.

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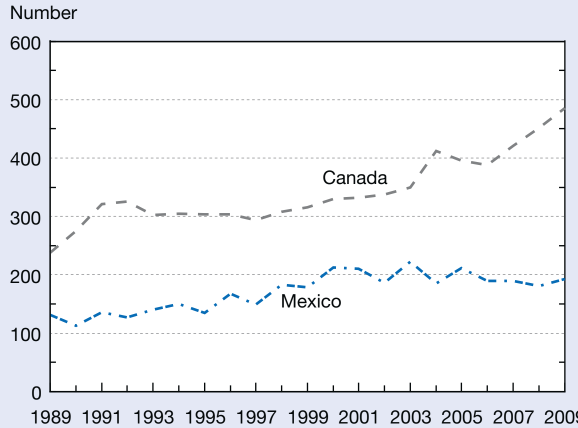
doctorate recipients from Mexico earned their degree in the United States (figure 2-25). A higher proportion of Mexican students (84%) than Canadian students (66%) earned U.S. doctorates in S&E fields (table 2-13). In particular, higher percentages of Mexican students than of Canadian students received U.S. doctoral degrees in engineering and agricultural sciences.

Figure 2-25
U.S. S&E doctoral degree recipients from Canada and Mexico: 1989–2009



NOTE: Degree recipients include permanent and temporary residents.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010), Survey of Earned Doctorates.

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Table 2-13
European and North American recipients of U.S. S&E doctorates, by field and region/country of origin: 1989–2009

	Europe[a]				North America		
Field	All countries	Western	Scandinavia	Central/Eastern	All countries	Canada	Mexico
All fields	38,644	24,433	2,151	12,060	15,275	10,943	4,283
S&E	29,988	17,852	1,632	10,504	10,802	7,193	3,589
Engineering	5,876	3,741	291	1,844	1,859	1,035	824
Science	24,112	14,111	1,341	8,660	8,943	6,158	2,765
Agricultural sciences	828	606	59	163	854	266	588
Biological sciences	4,534	2,753	258	1,523	2,109	1,513	589
Computer sciences	1,621	868	75	678	337	235	101
Earth/atmospheric/ocean sciences	1,075	720	80	275	375	236	138
Mathematics	2,957	1,305	105	1,547	526	330	195
Medical/other life sciences	700	531	76	93	638	540	96
Physical sciences	6,068	2,956	220	2,892	1,164	873	289
Psychology	1,124	823	114	187	962	873	84
Social sciences	5,205	3,549	354	1,302	1,978	1,292	685
Non-S&E	8,656	6,581	519	1,556	4,473	3,750	694

[a]See figure 2-20 notes for countries included in Western Europe, Scandinavia, and Central/Eastern Europe.

NOTE: Includes permanent and temporary residents.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of Survey of Earned Doctorates.

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International S&E Higher Education

In the 1990s, many countries expanded their higher education systems and access to higher education. At the same time, flows of students worldwide increased. More recently, a number of countries have adopted policies to encourage the return of students who studied abroad, to attract foreign students, or both.

Higher Education Expenditures

Increasingly, governments around the world have come to regard movement toward a knowledge-based economy as key to economic progress. Realizing that this requires a well-trained workforce, they have invested in upgrading and expanding their higher education systems and broadening participation. In most instances, government spending underwrites these initiatives. One indicator of the importance of higher education is the percentage of a nation's resources devoted to higher education, as measured by expenditures on tertiary education (education beyond high school) as a percentage of gross domestic product (GDP). In 2007, U.S. expenditures on tertiary education as a percentage of GDP were double the OECD average. The United States, Canada, and Korea spent the highest percentage of GDP on higher education (appendix table 2-30).

Another indicator of the growing importance of higher education is the change in expenditures for higher education over time. Expenditures for tertiary education rose more in the United States than in many other OECD countries between 1995 and 2000, but less in the United States than in other OECD countries between 2000 and 2007. From 1995 to 2000, educational expenditures in the United States increased faster than the OECD average and faster than most OECD countries. From 2000 to 2007, educational expenditures in the United States increased at a rate similar to the OECD average. During this period, several countries, including the United Kingdom and Poland, exceeded the OECD average increase in expenditures (appendix table 2-30).

Higher education funding data can vary between countries for reasons unrelated to actual expenditures, such as changes in measurement, prevalence of public versus private institutions (private institutions are much more prevalent in the United States than in other countries), types and levels of government funding included, and types and levels of education included. In several European countries, governments plan to cut their investments in higher education as a result of the global recession and fiscal crisis; the results of these policies remain to be seen.

Educational Attainment

Higher education in the United States expanded greatly after World War II and, for several decades, the United States' population led the world in educational attainment. In the 1990s, many countries in Europe and Asia also began to expand their higher education systems. Although the United States continues to be among those countries with the highest percentage of the population ages 25–64 with a bachelor's degree or higher, several other countries have surpassed the United States in the percentage of the younger population (ages 25–34) with a bachelor's degree or higher (figure 2-26; appendix table 2-31).[25]

First University Degrees in S&E Fields

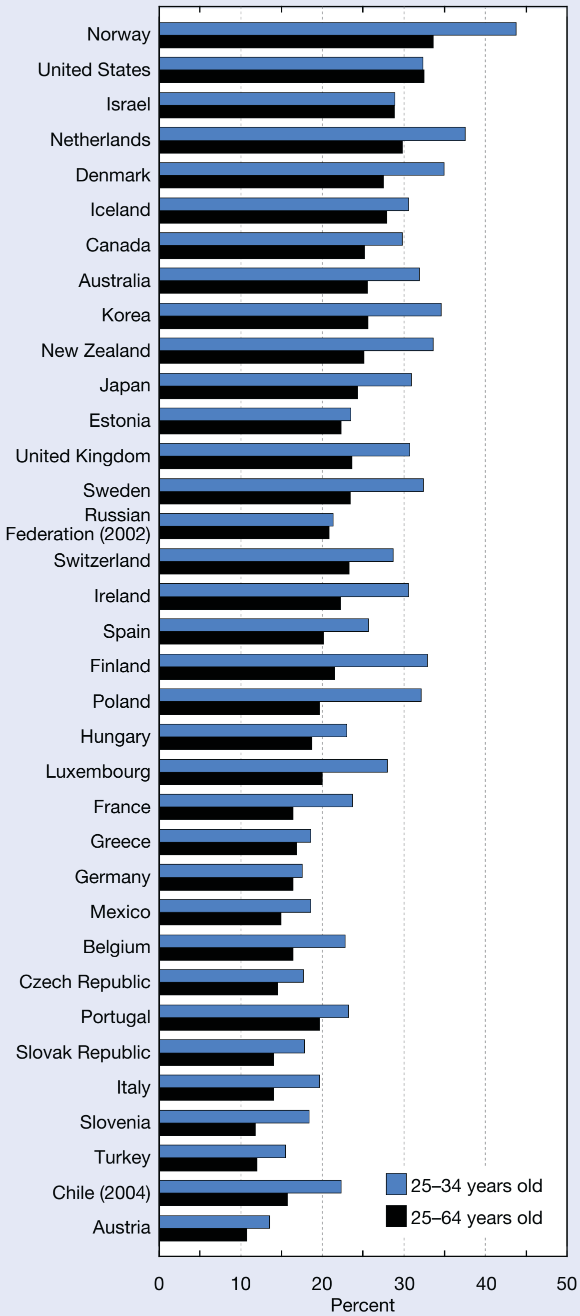
More than 14 million students worldwide earned first university degrees[26] in 2008, with about 5 million of these in S&E fields (appendix table 2-32). These worldwide totals include only countries for which relatively recent data are available (primarily countries in Asia, Europe, and the Americas) and are, therefore, an underestimation. Asian universities accounted for 2.4 million of the world's S&E first university degrees in 2008, more than 1 million of these in engineering. Students across Europe (including Eastern Europe and Russia) earned more than 1.2 million S&E degrees, and students in North and Central America earned nearly 700,000 in 2008.

In several countries/economies around the world, the proportion of first university degrees in S&E fields was higher than in the United States. More than half of first university degrees in Japan and China were in S&E fields, compared with about one-third in the United States. The disparity was especially large in engineering.[27] China has traditionally awarded a large proportion of its first university degrees in engineering, although the percentage has declined in recent years (appendix table 2-33). In the United States, about 4% of all bachelor's degrees are in engineering, compared with 19% in Asia, and approximately one-third in China (appendix table 2-32). About 11% of all bachelor's degrees awarded in the United States and worldwide are in natural sciences (physical, biological, computer, and agricultural sciences, and mathematics).

The number of S&E first university degrees awarded in China and Taiwan more than doubled between 2000 and 2008, and those in the United States and many other countries generally increased. Those awarded in Japan, France, and Spain decreased in recent years (appendix table 2-33). Natural sciences and engineering degrees account for most of the increase in S&E first university degrees in China. The number of natural sciences and engineering first university degrees in China rose sharply from 2002 to 2008, and more than tripled between 2000 and 2008 (figure 2-27). In comparison, the number awarded in Germany, Japan, South Korea, the United Kingdom, and the United States remained relatively flat. In China, degrees awarded increased faster than the population, which is also growing. In Japan and Europe degree trends may be influenced by declining populations.

In 1999, 29 European countries, through the Bologna Declaration, initiated a system of reforms in higher education in Europe. The goal of the Bologna Process is to harmonize certain aspects of higher education within participating countries so that degrees are comparable, credits

Figure 2-26
Attainment of tertiary-type A and advanced research programs, by country and age group: 2008



NOTES: Tertiary-type A programs (International Standard Classification of Education [ISCED] 5A) are 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 minimum duration of 3 years' full-time equivalent, although typically last ≥4 years. In the United States, they 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. See appendix table 2-33.

SOURCE: Organisation for Economic Co-operation and Development (OECD), Education at a Glance 2010: OECD Indicators (2010).

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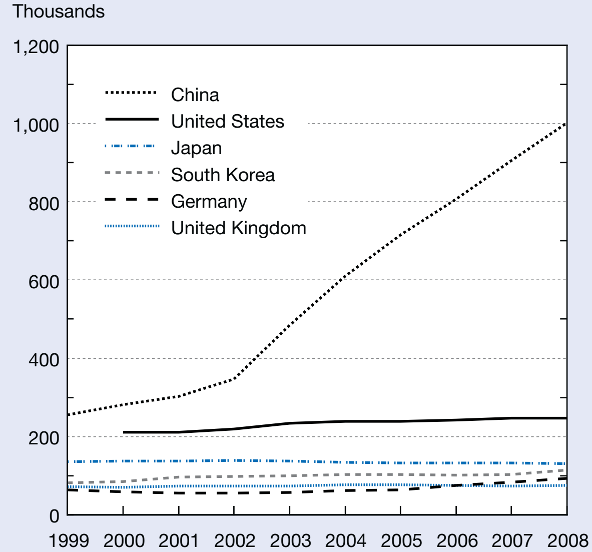
Figure 2-27
First university natural sciences and engineering degrees, by selected countries: 1999–2008



NOTES: Natural sciences include physical, biological, earth, atmospheric, ocean, and agricultural sciences; computer science; and mathematics. Data for U.S. not available for 1999.

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 and Germany—Organisation for Economic Co-operation and Development, Education Online Database, http://www.oecd.org/education/database; United Kingdom—Higher Education Statistics Agency; and United States—National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-33.

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are transferable, and students, teachers, and researchers can move freely from institution to institution across national borders (for information on reforms affecting degree awards in Europe, see sidebar "An Update on the Bologna Process"). The Bologna Process is also stimulating discussions about higher education in the United States (Adelman 2009).

S&E First University Degrees by Sex

Women earned half or more of first university degrees in S&E in many countries around the world in 2008, including the United States and a number of smaller countries. Several large 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 2-34).

In Canada, Japan, the United States, and many smaller countries, more than half of the S&E first university degrees earned by women were in the social and behavioral sciences. In South Korea, nearly half of the S&E first university degrees earned by women were in engineering, a much higher proportion than in Europe and the United States.

An Update on the Bologna Process

Ten years after the Bologna Declaration, the European Higher Education Area (EHEA) was launched and higher education reform in Europe had been extended to more than 45 participating countries. The *Trends 2010* report, published by the European University Association (Sursock and Smidt 2010), analyzes the implementation of the Bologna Process and its impact on higher education based on questionnaire responses from 821 universities, 27 university associations, and site visits to 16 countries.

Some of the key findings indicate that—

- The vast majority of the institutions had implemented the three degree cycles (bachelor's, master's, and doctorate). However, implementation of degree structures had been more difficult in certain regulated professions such as medicine, law, and engineering.
- At the bachelor's level there has been greater emphasis on increasing and widening access, on student-centered learning, and on flexible learning paths. The master's degree was introduced as a new, separate qualification across Europe, and so far it seems to be a very flexible degree, but one that is defined differently by different countries and institutions. At the doctorate level, schools have been expanding rapidly and more attention has been focused on the supervision and training of doctoral students.
- A growing majority of the universities used the credit-transfer system for all bachelor's and master's degrees.
- Bologna was a catalyst to improve the quality of teaching and move toward student-centered learning. The majority of the universities had reviewed curricula in all departments under the Bologna Process.
- Institutions identified internationalization as an important driver of change. More institutions are developing integrated internationalization approaches to teaching and research through strategic partnerships.
- Despite efforts to promote mobility across institutions and national borders, not much data were available on how mobility flows had changed during the Bologna Process.

Global Comparison of S&E Doctoral Degrees

About 194,000 S&E doctoral degrees were earned worldwide in 2008. The United States awarded the largest number of S&E doctoral degrees of any country (about 33,000),[28] followed by China (about 28,000), Russia (almost 15,000), Germany (about 11,000), and the United Kingdom (about 9,500) (appendix table 2-35). About 55,000 S&E doctoral degrees were earned in the European Union.

Women earned 41% of S&E doctoral degrees awarded in the United States in 2008, about the same percentage earned by women in Australia, Canada, the European Union, and Mexico. In the United States, women earned nearly half of the S&E doctoral degrees awarded to U.S. citizens and permanent residents.[29] Women earned more than half of S&E doctoral degrees in Portugal and less than one-quarter of S&E doctoral degrees in the Netherlands, South Korea, and Taiwan (appendix table 2-36).

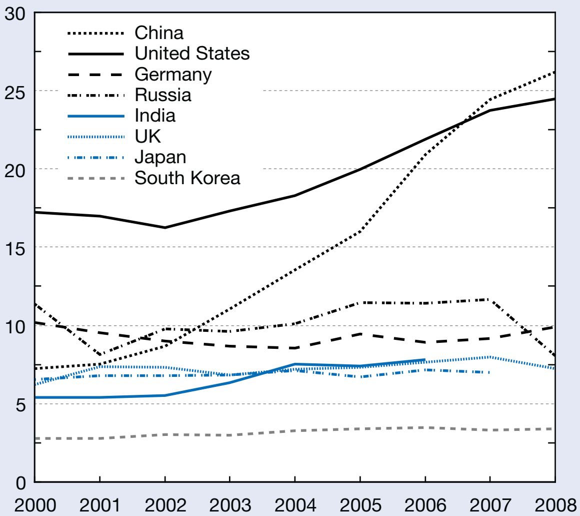
The number of S&E doctoral degrees awarded in China, Italy, and the United States has risen steeply in recent years; the number awarded in Russia increased considerably between 2002 and 2007, but decreased sharply in 2008 (appendix tables 2-37 and 2-38). Until 2006, the United States awarded the largest number of natural sciences and engineering doctoral degrees but, in 2007, China surpassed the United States (figure 2-28). In the United States, as well as in France, Germany, Italy, Spain, Switzerland, and the United Kingdom, the largest numbers of S&E doctoral degrees were awarded in the physical and biological sciences. The number of doctoral degrees awarded in S&E stagnated or declined in many of these countries between 2000 and 2004, although that number increased in later years in Italy, Switzerland, and the United States (appendix table 2-37).

In Asia, China was the largest producer of S&E doctoral degrees. As China's capacity for advanced S&E education increased, the number of S&E doctorates awarded rose from about 2,700 in 1994 to almost 28,500 in 2008 (appendix table 2-38), a substantially faster rate of growth when compared to the number of doctorates earned by Chinese citizens in the United States during the same period (figure 2-29). In 2007, the Chinese State Council Academic Degrees Committee announced that China would begin to limit admissions to doctoral programs and would focus more on quality of graduates (Mooney 2007). The number of S&E doctorates awarded in India, Japan, South Korea, and Taiwan also rose from 1994 to 2008, but at a lower rate. In China, Japan, South Korea, and Taiwan, more than half of S&E doctorates were awarded in engineering. In India, almost three-quarters of the S&E doctorates were awarded in the physical and biological sciences (appendix table 2-38).

Global Student Mobility

International migration of students has expanded in the past two decades, and countries are increasingly competing for foreign students. According to UNESCO, the number of internationally mobile students more than tripled between

Figure 2-28
Natural sciences and engineering doctoral degrees, by selected country: 2000–08



UK = United Kingdom

NOTES: Natural sciences and engineering include physical, biological, earth, atmospheric, ocean, and agricultural sciences; computer science; mathematics; and engineering. Data for India not available for 2007 and 2008; data for Japan not available for 2008.

SOURCES: China—National Bureau of Statistics of China; 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, and Organisation for Economic Co-operation and Development, Education Online database, http://www.oecd.org/education/ database/; and United States—National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, National Center for Science and Engineering Statistics, Integrated Science and Engineering Resources Data System (WebCASPAR), http://webcaspar.nsf.gov. See appendix tables 2-37 and 2-38.

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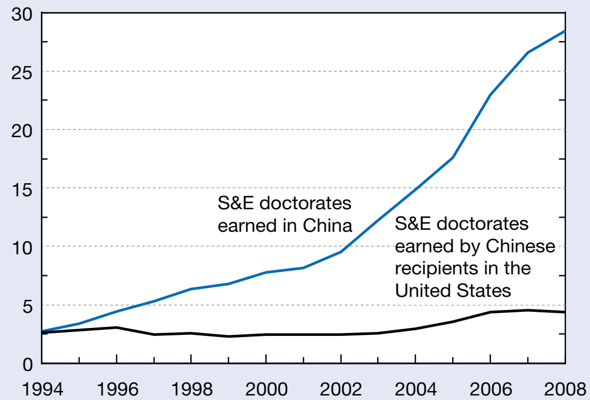
Figure 2-29
S&E doctoral degrees earned by Chinese students at home universities and U.S. universities: 1994–2008



NOTE: Degree recipients in the United States include permanent and temporary residents.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2010) of the Survey of Earned Doctorates; China—National Research Center for Science and Technology for Development and *Education Statistics Yearbook of China* (various years).

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1980 and 2009, to 3.4 million (UNESCO 2011).[30] In general, students migrate from developing countries to the more developed countries and from Europe and Asia to the United States. However, a few countries have emerged as regional hubs in their geographic regions, e.g., Australia, China, and South Korea for East Asia and South Africa for sub-Saharan Africa (UNESCO 2009).

Some students migrate temporarily for education, whereas others remain permanently. Some factors influencing the decision to seek a degree abroad include the policies of the countries of origin regarding sponsoring their citizens' study abroad; the tuition fee policies of countries of destination; the financial support the countries of destination offer to international students; and the cost of living and exchange rates that impact the cost of international education. The long-term return from international education also depends on how international degrees are recognized by the labor market in the country of origin (OECD 2010). In recent years, many countries, particularly English-speaking countries such as Australia, Canada, the United Kingdom, and the United States, have expanded their provision of transnational education, i.e., programs for foreign students in their home countries (see sidebar "Transnational Higher Education"). The influence of the worldwide economic and monetary crises that began in 2008 on future international flows of students is uncertain.

Some countries expanded recruitment of international students as their own populations of college-age students decreased, both to attract highly skilled workers and increase revenue for colleges and universities (OECD 2010). The population of individuals ages 20–24 (a proxy for the college-age population) decreased in China, Europe, Japan, and the United States in the 1990s and is projected to continue decreasing in China, Europe (mainly Eastern Europe), Japan, South Korea, and South America (appendix table 2-39). The U.S. population of 20–24-year-olds is projected to increase.

The United States remains the destination of the largest number of internationally mobile students (both undergraduate and graduate) of all countries (figure 2-30), although its share declined in recent years. In 2009, the United States received 20% of international students, down from 25% in 2000 (UNESCO 2011). Other top destinations for international students include the United Kingdom (12%), Germany (9%), and France (9%). Together with the U.S.,

Transnational Higher Education

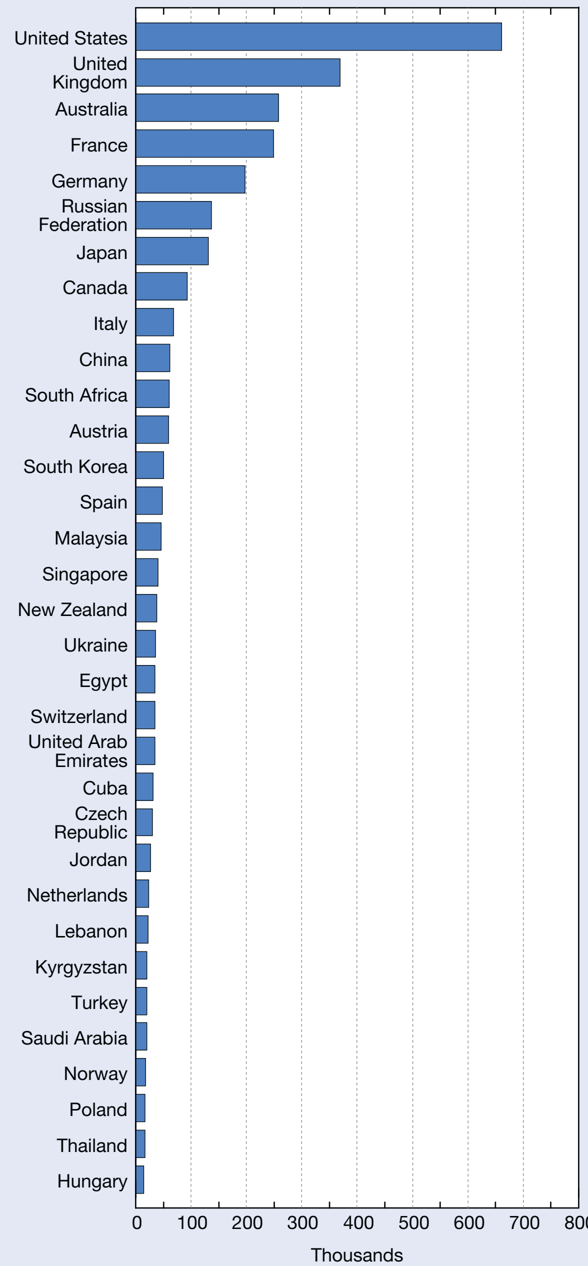
Although transnational higher education is not entirely new, the nature and scale of its global expansion are changing substantially (Naidoo 2009). Two growing trends are the establishment of branch campuses and collaborative programs such as joint/dual degrees.

According to research by the Observatory on Borderless Higher Education, between 2006 and 2009 the number of branch campuses increased by 43%, to 162 (Becker 2010). English-speaking countries dominate, led by U.S. institutions with 78 international branch campuses, followed by Australia (14), the United Kingdom (13), and France and India (11 each). The United States also led in campus growth between 2006 and 2009; American institutions sponsored 15 of the 49 branch campuses created during that time. The United Arab Emirates was the top host country, with 40 international branch campuses, two-thirds of which are located in Dubai International Academic City. China hosts 15 branch campuses, followed by Singapore and Qatar.

Branch campuses give foreign students the opportunity to earn a Western degree without leaving their home country. For the institution venturing into a new country, meeting enrollment and financial goals without diluting quality standards is often a challenge. Following the closures of several branch campuses, higher education institutions have become more aware of the long-term risks involved and more frequently look for sponsors or partners to share and reduce such risks.

Recent data on joint and dual degree programs are scarce. In these programs, students study at two or more institutions. After successfully completing the requirements, in dual degree programs they receive a separate diploma from each institution and in joint degree programs they receive a single diploma representing both institutions (CGS 2010). Two member surveys conducted by the Council of Graduate Schools in 2007 and 2008 show that, at the graduate level in the United States, dual degrees are more prevalent than joint degrees and that these collaborative programs are more common in universities with high international student enrollment. U.S. graduate schools are more likely to have established dual/joint degree programs with higher education institutions in Europe, with China and India in second place. The most common fields for dual degrees at the master's level are business, engineering, and the social sciences; at the doctoral level, they are engineering and physical sciences.

Figure 2-30
Internationally mobile students enrolled in tertiary education, by country: 2009



NOTES: Data based on the number of students who have crossed a national border and moved to another country with the objective of studying (i.e., mobile students). Data for Canada for 2007 exclude private institutions. Data for Netherlands and Germany exclude advanced research programs, e.g., doctorate. Data for Belgium exclude social advancement education. Data for Russia exclude tertiary-type B programs (e.g., associate's) in private institutions and advanced research programs (e.g., doctorate). Data for United Kingdom, United States, and Australia based on country of residence; data for Germany and Switzerland based on country of prior education; data from other countries based on country of citizenship.

SOURCE: UNESCO Institute for Statistics, *Global Education Digest* (2011).

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these countries receive more than half of all internationally mobile students worldwide.

Although Australia has a higher percentage (21%) of foreign higher education students (undergraduate and graduate) than the United States (3%), it has a lower share (7%) of foreign students worldwide.[31] Other countries with relatively high percentages of foreign higher education students include Austria (16%), the United Kingdom (15%), Switzerland (14%), and New Zealand (13%). In Switzerland and the United Kingdom, more than 40% of doctoral students are foreign. A number of other countries, including New Zealand, Austria, Australia, Belgium, Canada, and the United States, have relatively high percentages (more than 20%) of doctoral students who are foreign[32] (OECD 2010).

The United Kingdom has been actively expanding its position in international education, both by recruiting foreign students to study in the country and expanding its provision of transnational education (British Council 2011). Foreign student enrollment in the United Kingdom has been increasing, especially at the graduate level, with increasing flows of students from China and India (appendix table 2-40). In 2008, foreign students made up 47% of all graduate students studying S&E in the United Kingdom (an increase from 32% in 1998). Foreign students now account for nearly 60% of graduate students in mathematics, computer sciences, and engineering. Students from China and India accounted for most of the increase, but the number of graduate students from Nigeria, Pakistan, Germany, and the United States also increased. The percentage of foreign undergraduate students increased little.

Japan has increased its enrollment of foreign students in recent years and in 2008 announced plans to triple foreign enrollment in 12 years (McNeil 2008). In 2010, almost 70,000 foreign students were enrolled in S&E programs in Japanese universities, up from 57,000 in 2004. Foreign S&E student enrollment in Japan is concentrated at the undergraduate level, accounting for 67% of all foreign S&E students. Foreign nationals accounted for 3% of undergraduate and 16% of graduate S&E students in Japan. The vast majority of the foreign students were from Asian countries. In 2010, Chinese students accounted for 69% of the foreign S&E undergraduate students and 57% of graduate S&E students in Japan. South Koreans comprised 19% of the foreign undergraduates and 10% of the graduates. Indonesia, Vietnam, Malaysia, Thailand, Mongolia, and Nepal were among the top 10 countries of origin for both undergraduates and graduate students (appendix table 2-41).

Foreign students constitute an increasing share of enrollment in Canadian universities. Foreign S&E students accounted for about 7% of undergraduate and 22% of graduate S&E enrollment in Canada in 2008, up from 4% and 14% in 1999. In 2008, at both the undergraduate and graduate levels, the highest percentages of foreign S&E students were in mathematics/computer sciences and engineering. China was the top country of origin of foreign S&E students in Canada, accounting for 15% of foreign S&E graduate and 15% of undergraduate students. The United States was also among the top countries of origin of foreign students, accounting for 7% of foreign S&E graduate students and 10% of foreign S&E undergraduate students in Canada. About 10% of foreign S&E graduate students in Canada were from France and 9% from Iran. At the undergraduate level, 8% of Canada's foreign S&E undergraduate population was from France (appendix table 2-42).

Although foreign students make up a large share of U.S. higher education, U.S. students constitute a relatively small share of foreign students worldwide. About 52,328 U.S. students (in all fields) were reported as foreign students by OECD and OECD-partner countries in 2008, far fewer than the number of foreign students from China, France, Germany, India, Japan, or South Korea. The main destinations of U.S. students were the United Kingdom (13,900), Canada (9,900), Germany (3,300), France (3,200), Australia (3,100), New Zealand (2,900), Ireland (2,800)—mainly English-speaking countries (OECD 2010).

About 260,000 U.S. students from U.S. universities enrolled in study-abroad programs in the 2008–09 academic year, down slightly from 2007–08 (1%), but up 81% in the last 10 years (IIE 2010). Just over one-third enrolled in programs lasting one semester, a similar proportion in the summer term, and 12% in short-term programs (2–8 weeks). About 12% were graduate students; the rest were undergraduates, primarily juniors or seniors. About one-third were studying in S&E fields: 21% in social sciences, 7% in physical or life sciences, 3% in engineering, 2% in mathematics or computer sciences, and 1% in agricultural sciences.

Conclusion

S&E higher education in the United States is attracting growing numbers of students. The number of bachelor's and master's degrees awarded in all fields and in S&E fields continues to rise, having reached new peaks in 2009. Most of the growth in undergraduate S&E education occurred in science fields, in particular in the social and behavioral sciences. In engineering, bachelor's degrees increased since 2002 but have not yet reached the record high levels attained in the 1980s. Computer sciences degree awards dropped precipitously between 2004 and 2007, but have began to rebound since then. A growth in the number of master's degrees awarded occurred in all major S&E fields. The number of doctoral degrees awarded in all fields and in S&E increased between 2000 and 2008 and remained stable in 2009. In the last decade, growth in doctoral degrees awarded occurred mostly in the natural sciences and engineering fields.

Foreign graduate student enrollment in S&E recovered since early in the decade when the number of entering foreign students dropped after 11 September 2001.

Globalization of higher education continues to expand. Although the United States continues to attract the largest number and fraction of foreign students worldwide, its share of foreign students has decreased in recent years.

Universities in several other countries have expanded their enrollment of foreign S&E students.

Notes

1. The physical sciences include earth, atmospheric, and ocean sciences.

2. In this NCES report, distance education courses include live, interactive audio- or videoconferencing; prerecorded instructional videos; webcasts; CD-ROMs or DVDs; or computer-based systems accessed over the Internet. Distance education does not include correspondence courses.

3. For information on site traffic statistics at the MIT OpenCourseWare, see http://ocw.mit.edu/about/site-statistics.

4. In May 2010, an ad hoc committee of the National Academy of Sciences began a 2-year project to report on the top 10 actions that Congress, the federal government, state governments, research universities, and others could take to assure the ability of the American research university to maintain excellence in research and doctoral education. Among other areas, the committee is focusing on the financial capacity of public research universities in the United States.

5. 2010 data are preliminary.

6. Clinical psychology programs and programs that emphasize professional practice (professional schools and Psy.D. programs) are associated with higher debt, but even in the more research-focused subfields of psychology, lower percentages of doctorate recipients were debt free and higher percentages had high levels of debt than those in other S&E fields. 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 (accessed 20 June 2011).

7. In table 2-6, the difference in the average amount owed in constant 2000 dollars by S&E master's recipients between 2000 and 2008 was not statistically significant.

8. Household income is a measure of ability to pay and age-specific unemployment rates is a measure of opportunity costs.

9. Based on previous projections, NCES estimated that the mean absolute percentage error for enrollment in degree-granting institutions projected 9 years out was 10.1 (NCES 2011c).

10. These data are from sample surveys and are subject to sampling error. Information on estimated standard errors can be found in appendix E of the annual report *The American Freshman: National Norms Fall 2010,* published by The Cooperative Institutional Research Program of the Higher Education Research Institute, University of California–Los Angeles (http://gseis.ucla.edu/heri/pr-display.php?prQry=55, accessed 15 February 2011). Data reported here are significant at the .05 level.

11. 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.

12. The data in this section come from the Institute for International Education (IIE) and the Student and Exchange Visitor Information System (SEVIS). IIE conducts an annual survey of institutions during the fall of a specific year and the spring and summer of the following year. An international student in this survey is anyone studying at an institution of higher education in the United States on a temporary visa that allows academic coursework, primarily F and J visas. SEVIS collects administrative data, including all foreign national students enrolled in colleges and universities in the United States. SEVIS collects data for the fall and the spring of each year. Data on exchange visitors are not included in this chapter.

13. These data include foreign students pursuing both bachelor's and associate's degrees. Comparable data for U.S. citizen/permanent resident students do not exist. However, the proportion of S&E associate's and bachelor's degree awards for U.S. citizens and permanent residents is considerably lower.

14. About 14% of S&E bachelor's degree recipients who earned their degree between 1 July 1 2002 and 30 June 2005 had previously earned an associate's degree (National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System [SESTAT] 2006, special tabulation).

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

16. For longer trends in degrees, see NSB 2010. For more detail on enrollment and degrees by sex and by race/ethnicity, see *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2011* (NSF/NCSES 2011).

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

18. The natural sciences include agricultural; biological; computer; earth, atmospheric, and ocean; and physical sciences and mathematics.

19. The reason for the differences in the number of engineering students in appendix table 2-21 and appendix table 2-22 is because the Engineering Workforce Commission includes in its engineering counts computer science students enrolled in engineering schools. Data on graduate enrollment from the Survey of Graduate Students and Postdoctorates in Science and Engineering counts such students as computer science students.

20. See *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2011* (NSF/NCSES 2011) for more detail on enrollment of foreign students by sex.

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

22. At the doctorate level, the data on degrees awarded in the United States includes health fields because they

are research-oriented and not professional fields (as health fields are at the bachelor's and master's level). However, health fields at the doctorate level are not included in international comparisons because international sources cannot separate the MD degrees from the health fields, and the MDs are professional and not research degrees.

23. For the corresponding proportions in the 1990s see NSB 2008.

24. The number of S&E doctoral degrees earned by students in Chinese universities continued to increase throughout this period, from 1,894 in 1993 to 28,439 in 2008.

25. These data are based on national labor force surveys and are subject to sampling error; therefore, small differences between countries may not be meaningful. The standard error for the U.S. percentage of 25- to 64-year-olds with a bachelor's or higher degree is roughly 0.1, and the standard error for the U.S. percentage of 25- to 34-year-olds with a bachelor's or higher degree is roughly 0.4.

26. 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, *maîtrise* in France, and bachelor's degree in the United States and Asian countries).

27. Differences in the taxonomies of engineering programs and level of reporting detail across countries make exact comparisons difficult.

28. In international comparisons, S&E fields do not include medical or health fields.

29. This proportion excludes medical/other life sciences doctorate awards in the United States because international sources cannot separate the MD degrees from the health fields, and the MDs are professional and not research degrees.

30. Internationally mobile students are students who have crossed a national or territorial border for the purposes of education and are now enrolled outside their country of origin.

31. Foreign students are those who do not hold the citizenship of the country for which the data were collected.

32. In many OECD countries, students in S&E fields make up a considerable proportion of international students. No data are available by degree level and field of study.

Glossary

Distance education: Formal education process in which the student and instructor are not in the same place.

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

Internationally mobile students: Students who have crossed a national or territorial border for the purposes of education and are now enrolled outside their country of origin.

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

Online education: A type of distance education where the medium of instruction is computer technology via the Internet.

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. These programs have a minimum duration of 3 years, although they typically last 4 or more years and 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 programs correspond to associate's degrees in the United States.

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

References

Adelman C. 2009. *The Bologna Process for U.S. Eyes: Relearning Higher Education in the Age of Convergence.* Washington, DC: Institute for Higher Education Policy. http://www.ihep.org/assets/files/EYESFINAL.pdf. Accessed 23 March 2011.

Allen I, Seaman J. 2010. *Class Differences: Online Education in the United States, 2010.* Needham, MA: The Sloan Consortium.

Becker R. 2010. International branch campuses: New trends and directions. *International Higher Education* 58(Winter):2–3.

Berelson B. 1960. *Graduate Education in the United States.* New York: McGraw-Hill.

British Council. 2011. The Prime Minister's Initiative for International Education. http://www.britishcouncil.org/eumd-pmi2.htm. Accessed 20 June 2011.

Cartter AM. 1966. *An Assessment of Quality in Graduate Education.* Washington, DC: American Council on Education.

College Board. 2010a. *Trends in College Pricing: 2010.* New York.

College Board. 2010b. *Trends in Student Aid: 2010*. New York.

Commonfund Institute. 2010. 2010 Update: Higher Education Price Index. http://www.commonfund.org/CommonfundInstitute/HEPI/HEPI%20Documents/2010/CF_HEPI_2010.pdf. Accessed 27 January 2011.

Council of Graduate Schools (CGS) 2010. *Joint Degrees, Dual Degrees, and International Research Collaborations.* Washington DC.

Engineering Workforce Commission (EWC). 2010. *Engineering & Technology Enrollments, Fall 2009*. Washington, DC: American Association of Engineering Societies.

Gibbons MT. 2009. *Engineering by the Numbers.* Washington, DC: American Society for Engineering Education. http://www.asee.org/papers-and-publications/publications/college-profiles/2009-profile-engineering-statistics.pdf. Accessed 23 February 2011.

Glenn D. 2010. An elaborate ranking of doctoral programs makes its long-awaited debut. *Chronicle of Higher Education*. http://chronicle.com/article/An-Elaborate-Ranking-of/124633/?sid=at&utm_source=at&utm_medium=en/. Accessed 21 March 2011.

Institute of International Education (IIE). 2010. *Open Doors 2010: A Report on International Education Exchange.* http://www.iie.org/Research-and-Publications/Open-Doors/Data.aspx. Accessed 27 June 2011.

Jaschik S. 2010. You're not No. 1. *Inside Higher Ed.* http://www.insidehighered.com/layout/set/print/news/2010/09/29/rankings/. Accessed 21 March 2011.

Jaschik S. 2011. Sociologists blast doctoral rankings. *Inside Higher Ed*. http://www.insidehighered.com/layout/set/print/news/2011/03/21/sociologists_blast_rankings_of_doctoral_programs/. Accessed 21 March 2011.

Karp M. 2008. Towards a community college research agenda. Summary of the National Community College Symposium; June 19. Washington, DC. http://www.ed.gov/about/offices/list/ovae/pi/cclo/cc-sympsm-smmry10-29-08-final.pdf. Accessed 3 February 2011.

King J. 2010. *Gender Equity in Higher Education.* Washington, DC: American Council on Education.

McNeil D. 2008. Japan announces plan to enroll more foreign students. *Chronicle of Higher Education News Blog*, 28 July 2008. http://chronicle.com/news/article/4899/japan-announces-plan-to-enroll-more-foreign-students?utm_source=at&utm_medium=en. Accessed 17 January 2011.

Mooney P. 2007. China limits growth of universities. *Chronicle of Higher Education*. http://chronicle.com/article/China-Limits-Growth-of-Univ/11420/. Accessed 4 March 2011.

Naidoo V. 2009. Transnational higher education: A stock take of current activity. *Journal of Studies in International Education* 13(3): 310–330.

National Center for Education Statistics (NCES). 2009a. *Enrollment in Postsecondary Institutions, Fall 2007; Graduation Rates, 2003 & 2006 Cohorts; and Financial Statistics, Fiscal Year 2007.* NCES 2009-155. Washington, DC.

National Center for Education Statistics (NCES) 2009b. *Web Tables: Undergraduate Financial Aid Estimates by Type of Institution in 2007–2008.* NCES 2009-201. Washington, DC.

National Center for Education Statistics (NCES). 2010a. *The Condition of Education: 2010.* NCES 2010-031. Washington, DC.

National Center for Education Statistics (NCES). 2010b. *Postsecondary Institutions and Price of Attendance in the United States: Fall 2009, Degrees and Other Awards Conferred: 2008-2009, and 12-Month Enrollment: 2008–09*. NCES 2010-161. Washington, DC.

National Center for Education Statistics (NCES). 2010c. *Digest of Education Statistics: 2009.* NCES 2010-020. Washington, DC.

National Center for Education Statistics (NCES). 2011a. *Enrollment in Postsecondary Institutions, Fall 2009; Graduation Rates, 2003 & 2006 Cohorts; and Financial Statistics, Fiscal Year 2009.* NCES 2011-230. Washington, DC.

National Center for Education Statistics (NCES). 2011b. *The Condition of Education: 2011*. NCES 2011-033. Washington, DC.

National Center for Education Statistics (NCES). 2011c. *Projections of Education Statistics to 2019.* NCES 2011-017. Washington, DC. http://nces.ed.gov/pubs2011/2011017.pdf. Accessed 14 March 2011.

National Center for Public Policy and Higher Education (NCPPHE). 2008. *Measuring Up 2008: The National Report Card on Higher Education.* San Jose, CA. http://measuringup2008.highereducation.org/print/NCPPHEMUNationalRpt.pdf. Accessed 1 March 2011.

National Research Council 1982. *An Assessment of Research-Doctorate Programs in the United States.* Washington, DC: National Academies Press.

National Research Council 1995. *Research-Doctorate Programs in the United States: Continuity and Change.* Washington, DC: National Academies Press.

National Research Council 2010. *A Data-Based Assessment of Research-Doctorate Programs in the United States*. Washington, DC: National Academies Press.

National Science Board (NSB). 2003. The Science and Engineering Workforce: Realizing America's Potential. Special Report NSB 03-69. Arlington, VA: National Science Foundation.

National Science Board (NSB). 2008. *Science and Engineering Indicators 2008.* Two volumes (volume 1, NSB 08-01; volume 2, NSB 08-01A). Arlington, VA: National Science Foundation.

National Science Board (NSB). 2010. *Science and Engineering Indicators 2010*. NSB 10-01. Arlington, VA: National Science Foundation.

National Science Foundation, National Center for Science and Engineering Statistics (NSF/NCSES). 2000. Modes of Financial Support in the Graduate Education of Science and Engineering Doctorate Recipients. Special Report NSF 00-319. Arlington, VA.

National Science Foundation, National Center for Science and Engineering Statistics (NSF/NCSES). 2008. Baccalaureate Origins of S&E Doctorate Recipients. Special Report NSF 08-311. Arlington, VA.

National Science Foundation, National Center for Science and Engineering Statistics (NSF/NCSES). 2010a. *Characteristics of Recent Science and Engineering Graduates: 2006*. Detailed Statistical Tables NSF 10-318. Arlington, VA. Available at http://www.nsf.gov/statistics/nsf10318/. Accessed 25 February 2011.

National Science Foundation, National Center for Science and Engineering Statistics (NSF/NCSES). 2010b. Doctorate Recipients From U.S. Universities: 2009. Special Report NSF 11-306. Arlington, VA. Available at http://nsf.gov/statistics/nsf11306/. Accessed 4 January 2011.

National Science Foundation, National Center for Science and Engineering Statistics (NSF/NCSES). 2011. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2011*. Special Report NSF 11-309. Arlington, VA. Available at http://www.nsf.gov/statistics/wmpd/. Accessed 3 March 2011.

Organisation for Economic Co-operation and Development (OECD). 2008. *Education at a Glance: 2008*. Paris, France.

Organisation for Economic Co-operation and Development (OECD). 2010. *Education at a Glance: 2010*. Paris, France.

Project on Student Debt. 2009. *Student Debt and the Class of 2009*. http://projectonstudentdebt.org/files/pub/classof2009.pdf. Accessed 20 June 2011.

Roose KD, Andersen CJ. 1970. *A Rating of Graduate Programs*. Washington, DC: American Council on Education.

Sursock A, Smidt H. 2010. *Trends 2010: A Decade of Change in European Higher Education.* Brussels, Belgium: European University Association. http://www.eua.be/publications/eua-reports-and-studies.aspx Accessed March 1 2011.

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2009. *Global Education Digest 2009: Comparing Education Statistics Across the World*. http://unesdoc.unesco.org/=images/0018/001832/183249e.pdf. Accessed June 14 2011.

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2011. *Global Education Digest 2011*. Forthcoming.

Wendler C, Bridgeman B, Cline F, Millett C, Rock J, Bell N, McAllister P. 2010. *The Path Forward: The Future of Graduate Education in the United States*. Princeton, NJ: Educational Testing Service.