Please see chapter errata

Chapter 3
Science and Engineering Labor Force

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Highlights

Scope of the S&E Workforce

The S&E workforce has shown sustained growth for more than half a century.

- ♦ The number of workers in S&E occupations grew from about 182,000 in 1950 to 5.4 million in 2009. This represents an average annual growth rate of 5.9%, much greater than the 1.2% growth rate for the total workforce older than age 18 during this period.
- ♦ Workforce growth in S&E occupations from 2000 to 2009 was slower than in the two preceding decades. Nonetheless, at 1.4% annually, it exceeded the rate (0.2%) for the general workforce, which barely grew at all.

Many workers outside S&E occupations have S&E training or use related knowledge and skills in their jobs.

- ♦ Individuals with an S&E bachelor's degree or higher (17.2 million in 2008) or whose highest degree was in S&E (12.6 million in 2008) substantially outnumbered those working in S&E occupations.
- ♦ In 2008, about two-thirds of those with an S&E highest degree but not working in an S&E occupation reported that their job was either closely or somewhat related to their degree.

S&E Workers in the Economy

Scientists and engineers work for all types of employers.

- ♦ For-profit firms employed 59% of all individuals whose highest degree was in S&E but only 35% of those holding S&E doctorates.
- ♦ Academic institutions employed about 41% of individuals with S&E doctorates, including those in postdoc or other temporary positions.
- ♦ About 19% of workers whose highest degree was in S&E reported they were self-employed in 2008, with two-thirds in incorporated businesses.
- ♦ Small firms are important employers of those with S&E highest degrees. Firms with fewer than 100 persons employ 36% of them.

S&E Labor Market Conditions

Workers with S&E degrees or occupations tend to earn more than other comparable workers.

- ♦ Half of the workers in S&E occupations earned $73,290 or more in 2010, more than double the median earnings ($33,840) of the total U.S. workforce.
- ♦ Workers with S&E degrees, regardless of their occupations, earn more than workers with comparable-level degrees in other fields.
- ♦ Industries with above-average proportions of S&E jobs tend to pay higher average salaries to both their S&E and non-S&E workers.

People whose work is associated with S&E are less often exposed to unemployment.

- ♦ Unemployment rates for those in S&E occupations tend to be lower than those for all college-degreed individuals and much lower than those of persons with less than a bachelor's degree.
- ♦ Unemployment rates for S&E doctorate holders are generally much lower than for those at other degree levels.

Demographics of the S&E Workforce

Women remain underrepresented in the S&E workforce, although to a lesser degree than in the past.

- ♦ Women constituted 38% of employed individuals with a highest degree in an S&E field in 2008, but their proportion is smaller in most S&E occupations.
- ♦ From 1993 through 2008, growth occurred in both the share of workers with a highest degree in an S&E field who are women (increasing from 31% to 38%) and the share of women in S&E occupations (increasing from 21% to 26%).
- ♦ Female scientists and engineers are concentrated in different occupations than are men, with relatively high shares of women in the social sciences (53%) and biological and medical sciences (51%) and relatively low shares in engineering (13%) and computer and mathematical sciences (26%).

Race and ethnicity are salient factors in rates of participation in the S&E workforce.

- ♦ Hispanics, blacks, and American Indians/Alaska Natives make up a smaller share of the S&E workforce, with 9% of workers in S&E occupations and 11% of S&E degree holders in 2008, than their proportion in the general population, with 26% of U.S. residents from ages 20 to 70.
- ♦ Asians work in S&E occupations at higher rates (17%) than their representation in the U.S. working-age population (5%). Asians are particularly highly concentrated in computer and information science occupations (22% Asian).
- ♦ Within every S&E occupation, more than half of all workers are non-Hispanic whites.

A variety of indicators point to a decline during the recent economic downturn in the immigration of foreign scientists and engineers.

- ♦ After an upward trend in the number of temporary work visas issued to scientists and engineers for most of the decade, the number fell sharply in 2009. H-1B visas fell to 2003 levels, dropping to 72% of the number issued in 2007.

- Both the number and percentage of S&E doctoral degree recipients with temporary visas reporting plans to stay in the United States peaked in 2007 and declined in 2009 after rising since 2002.
- The proportion of S&E doctoral degree recipients with temporary visas who remained in the United States 5 years after receiving their degrees rose from 45% to 67% between 1989 and 2005 but fell to 62% in 2009.

The baby boom portion of the S&E workforce continues to age, nearing retirement.

- From 1993 to 2008, the median age of scientists and engineers in the U.S. workforce rose from 37 to 41. The proportion over age 50 increased from 18% to 27%.
- Between 1993 and 2008, increasing percentages of scientists and engineers in their 60s reported that they were still in the labor force. Whereas 59% of S&E degree holders between the ages of 60 and 64 were employed in 1993, the comparable percentage rose to 66% in 2006 before declining slightly in 2008.

Global S&E Labor Force

Worldwide, the number of workers engaged in research has been growing since at least 1995.

- Among countries with large numbers of researchers, growth has been most rapid in China, where the number of researchers tripled, and South Korea, where it doubled.
- The United States and the European Union experienced steady growth but at a lower rate than in China or South Korea; both increased from about 1 million in 1995 to nearly 1.5 million in 2007.
- Japan and Russia were exceptions to the worldwide trend: in Japan, the number of researchers remained essentially unchanged, and in Russia the number declined.

Among businesses located in the United States, R&D employment is disproportionately domestic.

- Although about one-third of total employment in these firms is located abroad, only one-quarter of R&D employment is in foreign locations.
- In manufacturing, the disparity between overall employment in foreign locations (41%) and R&D employment in these locations (25%) is substantial; for nonmanufacturing employment, the comparable proportions—24% for overall employment and 23% for R&D employment—are similar.

Preliminary 2009 data indicate a substantial shift in the balance between R&D employment by U.S. firms abroad and R&D employment by foreign firms in the United States.

- Whereas R&D employment abroad by U.S. multinational companies (MNCs) nearly doubled between 2004 and 2009, domestic R&D employment by these firms increased by less than 5% in the same period.
- U.S. MNCs employed many more R&D workers in foreign locations in 2009 than foreign firms employed in the United States. In contrast, these two numbers had been similar in 2004.

Introduction

Chapter Overview

Policymakers and researchers have increasingly emphasized the importance of skilled people—what social scientists refer to as human capital—to both innovation and economic growth. As technical content spreads throughout our knowledge-based economy, the knowledge and skills associated with science and engineering (S&E) are increasingly necessary for workers with formal training in S&E who work in non-S&E jobs as well as for those in occupations traditionally classified as part of the S&E labor force.

Chapter Organization

The chapter is divided into five sections. The first section defines the S&E labor force and reports on its size and growth. It analyzes the interplay among occupational roles, educational credentials, and use of S&E expertise on the job. This section also includes a chart describing the main sources of data on the U.S. S&E labor force.

Section two explores the distribution of S&E workers in the economy. It describes employment patterns by sector and industry, with some special emphasis on the role private-sector firms play as employers of scientists and engineers. This section also reports data on federal workers in S&E occupations, thereby showing the roles of scientists and engineers in both scientific and other federal agencies.

Section three looks at recent and long-term trends in the economic rewards of participating in the S&E labor force. It includes data on recent labor market conditions, earnings, unemployment, and workers unable to find jobs in their field. Where possible, it contrasts S&E and non-S&E degree holders at comparable degree and experience levels. The section also includes broader measures of labor underutilization that go beyond long- and short-term unemployment rates.

Labor force demographics are covered in section four, including the growing role of women, minorities, and immigrants in the S&E labor force. This section also examines the distribution of S&E workers across occupations, sectors, and industries by degree levels and fields. Data on the aging of the S&E labor force and on its retirement patterns also appear in this section.

In addition, section four features a detailed analysis of salary differences among different demographic groups. This analysis explores the role of factors that are relevant to a worker's productivity (e.g., years of experience) and factors that are not directly related to job skill (e.g., demographic or personal background characteristics, such as race/ethnicity and sex). Trends in salary differences are also considered.

The final section of the chapter deals with the global S&E labor force. Although there are indications that the global S&E labor force has grown, there is little solid worldwide data on this broader labor force or its characteristics. Several U.S. and international data sources are used in this section to present indicators of worldwide R&D employment, international employment by multinational companies, and international engagement by U.S. S&E workers.

Scope of the S&E Workforce

Measures of the S&E Workforce

The terms *scientist* and *engineer* can include very different sets of workers. This section presents three types of measures that can be used to estimate the size and describe the characteristics of the U.S. S&E labor force.[1] Different categories of measures are better adapted for addressing some questions than others, and not all general population and workforce surveys include questions in each category (table 3-1).

Occupation

U.S. federal occupation data classify workers by the activities or tasks they primarily perform in their jobs. The Occupational Employment Statistics (OES) survey administered by the Bureau of Labor Statistics (BLS) relies on employers to classify their workers using standard occupational definitions. National Science Foundation (NSF) and Census Bureau occupational data in this chapter come from surveys in which individuals (NSF) or members of their household (Census Bureau) supplied information about job titles and work activities. With this information, jobs can be coded into standard occupational categories. Differences between employer- and employee-provided information can affect the content of occupational data.

NSF has developed a widely used set of occupational categories that it calls *S&E occupations*. These occupations are generally associated with a bachelor's degree level of knowledge and education in S&E fields. A second category of occupations, *S&E-related occupations*, also requires some S&E knowledge or training, but not necessarily as a required credential for being hired or at the bachelor's degree level. Examples of such occupations are S&E technicians or managers of the S&E enterprise who may supervise people working in S&E occupations. Other occupations, although classified as *non-S&E*, may include individuals who use their S&E technical expertise in their work. Examples include technical writers who edit scientific publications and salespeople who sell specialized research equipment to chemists and biologists. The NSF occupational classification of S&E, S&E-related, and non-S&E occupations appears in table 3-2.

Other general terms, including science, technology, engineering, or mathematics (STEM), science and technology (S&T), and science, engineering, and technology (SET), are often used to designate the part of the labor force that works with S&E. These terms are broadly equivalent and have no standard definition.

In this chapter, the narrow classification of S&E occupations is sometimes expanded to include S&E technicians, computer programmers, and S&E managers. This broader grouping is referred to here as *STEM occupations*.

Education

The pool of S&E workers can also be identified by educational credentials. Individuals who possess an S&E degree, whose highest degree is in S&E, or whose most recent degree is in S&E may be qualified to hold jobs that require S&E knowledge and skills and may seek such jobs if they do not currently hold them. However, a focus on people with relevant educational credentials also includes individuals who hold jobs that are not generally identified with S&E and who are not likely to seek S&E jobs in the future. Furthermore, workers with degrees in S&E may not have kept up to date with the fields in which they were trained, may lack interest in working in jobs that require skills associated with S&E education, or may have advanced in their careers to a point where other skills have become more important.

S&E Technical Expertise

The S&E workforce may also be defined by the expertise required to perform a job or the extent to which job requirements are related to formal training in S&E. Many people, including some outside S&E occupations or without S&E degrees, report that their jobs require at least a bachelor's degree level of technical expertise in engineering, computer sciences, mathematics, the natural sciences, or social sciences, which we refer to in this report as *S&E technical expertise.* Unlike defining the S&E workforce by occupational groupings or educational credentials, defining it by the use of technical knowledge, skills, or expertise involves assessing the content and characteristics of individual jobs. However, it also involves asking survey respondents to make a complex judgment about their jobs and apply a criterion that they are likely to interpret differently.[2] A recent survey provides clues to how college-educated Americans understand job-related technical expertise. (See sidebar, "Technical Expertise on the Job.")

Table 3-1
Major sources of data on the U.S. labor force

Data source	Data collection agency	Data years	Major topics	Respondent	Coverage
Occupational Employment Statistics (OES)	Department of Labor, Bureau of Labor Statistics	Through 2010	Employment status Occupation Salary Industry Employer location (national, state, metropolitan statistical area)	Employing organizations	All full-time and part-time wage and salary workers in non-farm industries. Does not cover self-employed, unincorporated firms, household workers, or unpaid family workers.
Scientists and Engineers Statistical Data System (SESTAT)—comprises Survey of Doctorate Recipients, National Survey of College Graduates, National Survey of Recent College Graduates	National Science Foundation, National Center for Science and Engineering Statistics	Through 2008	Employment status Occupation Job characteristics (work activities, technical expertise) Salary Detailed educational history Demographic characteristics	Individuals	Individuals with bachelor's degree or higher in S&E or S&E-related field, or with non-S&E bachelor's but working in S&E or S&E-related occupation.
American Community Survey (ACS)	Department of Commerce, Census Bureau	Through 2009	Employment status Occupation First bachelor's degree field Educational attainment Demographic characteristics	Households	U.S. population
Current Population Survey (CPS)	Department of Labor, Bureau of Labor Statistics	Through 2010	Employment status Occupation Educational attainment Demographic characteristics	Households	U.S. population

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Table 3-2
Classification of degree fields and occupations

Classification	Degree field	Occupation	Occupation classification: STEM	Occupation classification: S&T
S&E	Biological, agricultural, and environmental life sciences	Biological, agricultural, and environmental life scientists	X	X
	Computer and mathematical sciences	Computer and mathematical scientists	X	X
	Physical sciences	Physical scientists	X	X
	Social sciences	Social scientists	X	X
	Engineering	Engineers	X	X
		S&E postsecondary teachers	X	X
S&E-related	Health fields	Health-related occupations		
	Science and math teacher education	S&E managers	X	
	Technology and technical fields	S&E precollege teachers		
	Architecture	S&E technicians and technologists	X	X
	Actuarial science	Architects		
		Actuaries		
		S&E-related postsecondary teachers		
Non-S&E	Management and administration	Non-S&E managers		
	Education (except science and math teacher education)	Management-related occupations		
		Non-S&E precollege teachers		
	Social services and related fields	Non-S&E postsecondary teachers		
	Sales and marketing	Social services occupations		
	Arts and humanities	Sales and marketing occupations		
	Other fields	Arts and humanities occupations		
		Other occupations		

S&T = science and technology; STEM = science, technology, engineering, and mathematics

NOTES: Designations STEM and S&T refer to occupations only. For more detailed classification of occupations and degrees by S&E, S&E-related, and non-S&E, see National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT), http://sestat.nsf.gov/docs/occ03maj.html and http://sestat.nsf.gov/docs/ed03maj.html.

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Technical Expertise on the Job

The Joint Program on Survey Methodology (JPSM) provides advanced education for survey research professionals through a collaboration among the University of Maryland, the University of Michigan, and Westat, a survey research firm. As part of their training, JPSM students take a course in which they design and analyze a survey on a topic of interest to a federal statistical agency.

In 2009, JPSM's survey probed the meaning of SESTAT data indicating that many college-educated Americans who are not employed in S&E occupations say their jobs require the technical expertise of an S&E bachelor's degree. The survey asked a nationally representative group of college graduates who are members of the Knowledge Networks Internet survey panel about the knowledge and skills they use on the job and the education and experience through which they acquired them. The survey also collected various additional information about the survey respondents—the colleges they attended; their major fields of study; and the characteristics of their current and previous jobs, including respondents' occupations, salaries, job satisfaction, and employer characteristics.

Preliminary analyses suggest that asking about either "knowledge and skills" or "technical expertise" produces roughly equivalent response patterns; if anything, a higher percentage of respondents claim that "knowledge and skills" associated with a degree are required on the job than make the equivalent claim about "technical expertise." In addition, the data suggest that graduates in different major fields vary in how often they claim that their jobs require bachelor's level competency in a field. Along with education majors, people who major in natural sciences and engineering appear to more frequently view their jobs as requiring bachelor's degree level competency in some field of study. Those who major in health-related fields and social sciences rank somewhat below them. College graduates with degrees in arts, humanities, business administration, communications, and other fields outside the sciences less often report that their jobs need this kind of competency. However, these data offer numerous opportunities for further analysis of the relationships among knowledge, skills, and job activities, and such analyses might cast these preliminary findings in a different light.

Size of the S&E Workforce

In the most recent estimates, the U.S. S&E workforce (defined by occupation) totaled between 4.8 million and 6.4. million people (table 3-3). Those in S&E occupations who also had bachelor's degrees were estimated at between 4.8 million (Census Bureau 2009) and 4.9 million (NSF, National Center for Science and Engineering Statistics [NCSES], Scientists and Engineers Statistical Data System [SESTAT]).[3] SESTAT's 2008 estimates for individuals with an S&E degree at the bachelor's level or higher (17.2 million) or whose highest degree was in S&E (12.6 million) were substantially higher than the number of current workers in S&E occupations. Many of those whose highest degree is in S&E reported that their job, although not in an occupation classified as S&E, was closely (2.2 million) or somewhat (2.1 million) related to their highest degree. Counting these people, along with those in S&E occupations, as part of the S&E workforce increases the SESTAT S&E workforce estimate from 4.9 million to 9.1 million, an 84% increase.

The 2003 SESTAT surveys provide a recent estimate for a different assessment of S&E work—whether workers believe their jobs require technical expertise at the bachelor's degree level or higher in S&E fields. According to these surveys, 12.9 million bachelor's degree holders reported that their jobs required at least this level of expertise in one or more S&E fields. This contrasts with 2003 SESTAT estimates of 4.8 million workers in S&E occupations and 11.9 million whose highest degree was in an S&E field.

Growth of the S&E Workforce

However defined, the S&E workforce has for decades grown faster than the total workforce. Defined by occupation, growth in the S&E workforce can be examined over nearly seven decades using Census Bureau data. The number of workers in S&E occupations grew from about 182,000 in 1950 to 5.4 million in 2009. This represents an average annual growth rate of 5.9%, much greater than the 1.2% growth rate for the total workforce older than age 18 during this period. The somewhat broader category of S&T occupations grew from 205,000 to 6.6 million (a 6.1% growth rate) (figure 3-1).

In each decade, the growth rate of S&E occupations exceeded that of the total workforce (figure 3-2). During the 1960s, 1980s, and 1990s, the difference in growth rates was very large (about 3 times the rate for the total labor force). It was smallest during the slower growth period of the 1970s. Between 2000 and 2007, the ratio of the S&E growth rate to the overall workforce was 1.6, which was comparable to the 1970s. The economic downturn at the end of this decade resulted in almost no overall workforce growth for the decade as a whole, well below the 1.4% growth rate for the S&E workforce for the same period. While both the total and S&E employment experienced smaller growth rates in the 2000s compared to the 1990s, the trend of higher growth rates in S&E occupations relative to other jobs continues, even through the recent economic downturn. S&E occupational employment has grown from 2.6% of the workforce in 1983 to 4.8% of all employment in 2010 (figure 3-3).

Table 3-3
Measures and size of employed S&E workforce: 2003, 2008, and 2009

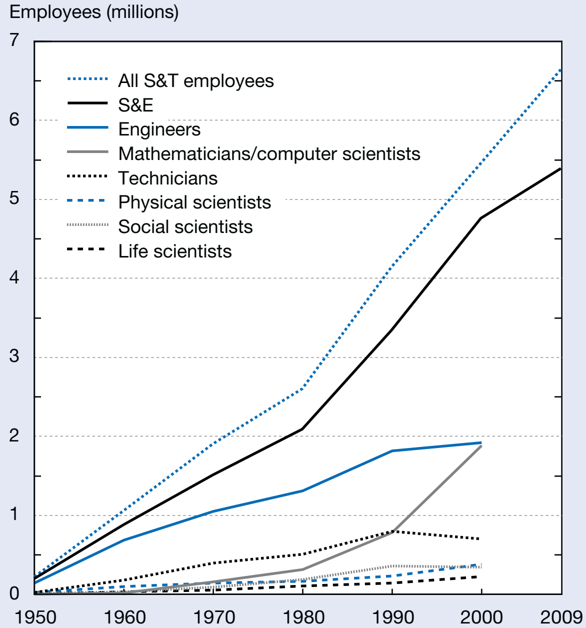
Measure	Education coverage	Data source	Workers
Occupation			
Employment in S&E occupations	All degree levels	2009 BLS OES	5,786,000
Employment in S&E occupations	Bachelor's and above	2008 NSF/NCSES SESTAT	4,874,000
Employment in S&E occupations	All degree levels	2009 Census Bureau ACS	6,416,000
Employment in S&E occupations	Bachelor's and above	2009 Census Bureau ACS	4,750,000
Education			
At least one degree in S&E field	Bachelor's and above	2008 NSF/NCSES SESTAT	17,214,000
Highest degree in S&E field	Bachelor's and above	2008 NSF/NCSES SESTAT	12,588,000
Job closely related to highest degree	Bachelor's and above	2008 NSF/NCSES SESTAT	4,802,000
S&E occupation	Bachelor's and above	2008 NSF/NCSES SESTAT	2,635,000
Other occupation	Bachelor's and above	2008 NSF/NCSES SESTAT	2,168,000
Job somewhat related to highest degree	Bachelor's and above	2008 NSF/NCSES SESTAT	3,101,000
S&E occupation	Bachelor's and above	2008 NSF/NCSES SESTAT	996,000
Other occupation	Bachelor's and above	2008 NSF/NCSES SESTAT	2,105,000
Job requires S&E technical expertise at bachelor's level			
In one or more S&E fields	Bachelor's and above	2003 NSF/NCSES SESTAT and NSCG	12,855,000
Engineering, computer science, mathematics, or natural sciences	Bachelor's and above	2003 NSF/NCSES SESTAT and NSCG	9,215,000
Social sciences	Bachelor's and above	2003 NSF/NCSES SESTAT and NSCG	5,335,000

ACS = American Community Survey; BLS = Bureau of Labor Statistics; OES = Occupational Employment Statistics Survey; NSF/NCSES = National Science Foundation, National Center for Science and Engineering Statistics; SESTAT = Scientists and Engineers Statistical Data System; NSCG = National Survey of College Graduates

SOURCES: BLS, 2009 OES; Census Bureau, 2009 ACS; NSF/NCSES, 2008 SESTAT integrated file and special analytic file comprising 2003 SESTAT integrated file and 2003 NSCG.

Science and Engineering Indicators 2012

Figure 3-1
Science and technology employment: 1950–2009



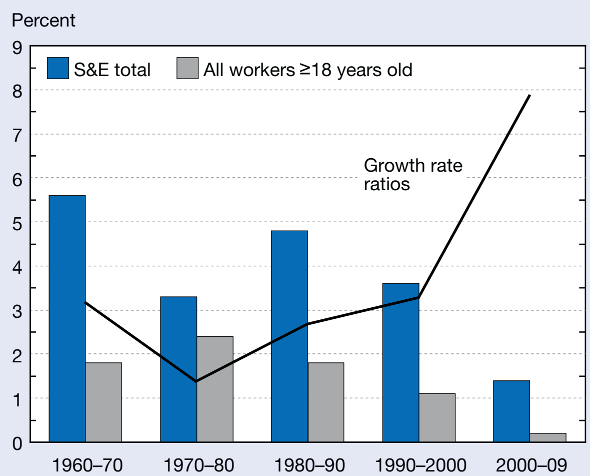
S&T = science and technology

NOTE: Data include bachelor's degrees or higher in science occupations, some college and above in engineering occupations, and any education level for technicians and computer programmers. No estimates were calculated below level of S&E and S&T from 2009 American Community Survey.

SOURCES: Adapted from Lowell BL, Regets MC, A Half-Century Snapshot of the STEM Workforce, 1950 to 2000, Commission on professionals in Science and Technology (2006); with additional estimates from the Census Bureau, American Community Survey (2009).

Science and Engineering Indicators 2012

Figure 3-2
Average annual growth rates of S&E occupations and total workforce: 1960–2009



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2011) from 1960–2000 Decennial Census, Public-Use Microdata Sample (PUMS), and American Community Survey (2009).

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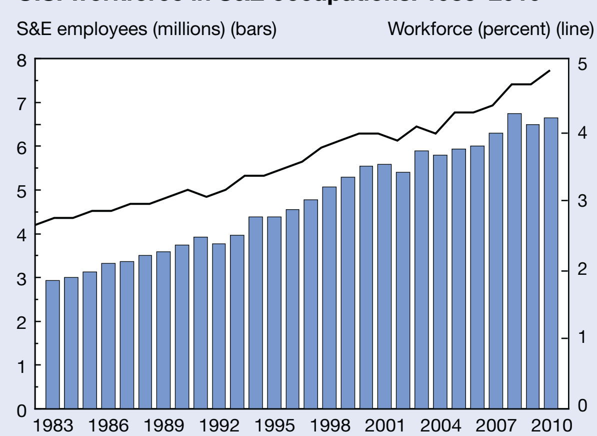
Recent OES employment estimates for workers in S&E occupations indicate that the S&E workforce has remained steady while the total workforce has declined. The OES estimate was 5.5 million in May 2010, compared to 5.6 million in May 2007. The total workforce declined from 134 million to 127 million in this time frame. The broader STEM aggregate (including technicians, S&E managers, etc.) also remained relatively steady at 7.4 million in May 2010, compared to 7.6 million in May 2007. OES projections for 2008 to 2018 are that S&E occupations will grow at a faster rate than the total workforce. (See sidebar, "Projected Growth of Employment in S&E Occupations.")

Between 1980 and 2000, although the number of S&E degree holders in the workforce grew more than the number of people working in S&E occupations, degree production in all broad categories of S&E fields rose at a slower rate than employment in S&E jobs (figure 3-4). (See chapter 2 for a fuller discussion of S&E degrees.) During this period, S&E employment grew from 2.1 million to 4.8 million (4.2% average annual growth), while annual S&E degree production increased from 526,000 to 676,000 (1.5% average annual growth). Except for mathematics, computer sciences, and the social sciences, the growth rate for advanced degrees was higher than for bachelor's degrees.

This growth in the S&E labor force was possible largely because of three factors: (1) increases in U.S. S&E degrees earned by both native and foreign-born students who entered the labor force, (2) temporary and permanent migration to the United States of those with foreign S&E educations, and (3) the relatively small proportion of scientists and engineers retiring from the S&E labor force. Many have expressed concerns about the effects of changes in any or all of these factors on the future of the U.S. S&E labor force (see NRC 2010 and NSB 2003).

Figure 3-3
U.S. workforce in S&E occupations: 1983–2010



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2011) from Bureau of Labor Statistics, Current Population Survey Monthly Outgoing Rotation files (1983–2010).

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Projected Growth of Employment in S&E Occupations

Projections of employment growth are plagued by uncertain assumptions and notoriously difficult to make. Many corporate and government spending decisions on R&D are impossible to anticipate. In addition, R&D funds increasingly cross borders in search of the best place to have particular research performed. Finally, it may be difficult to anticipate new products and industries that may be created via the innovation processes that are most closely associated with scientists and engineers.

The worldwide economic crisis and the dynamics of recovery from it compound the already difficult problem of making employment projections, because recent economic upheavals may produce long-term changes in employment patterns and trends. The reader is cautioned that the assumptions underlying projections such as those that follow, which rely on past empirical relationships, may no longer be valid.

The most recent Bureau of Labor Statistics (BLS) occupational projections, for the period 2008–18, suggest that total employment in occupations that NSF classifies as S&E will increase at more than double the overall growth rate for all occupations (figure 3-A). S&E occupations are projected to grow by 20.6% between 2008 and 2018, while employment in all occupations is projected to grow 10.1% over the same period (table 3-A, appendix table 3-1).* These projections involve only the demand for strictly defined S&E occupations and do not include the wider range of jobs in which S&E degree holders often use their training.

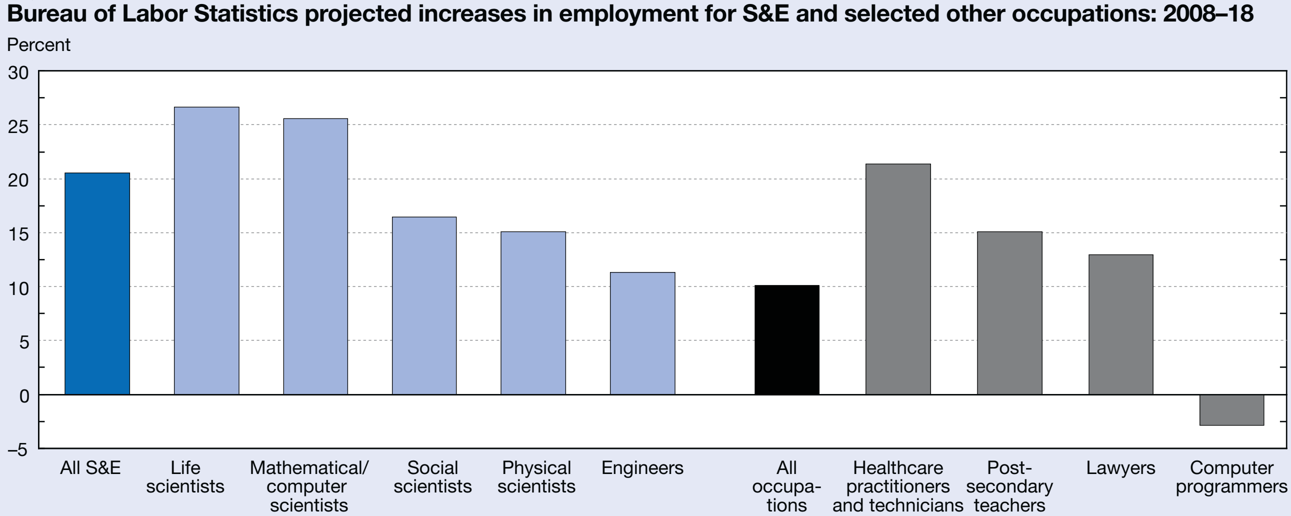
Approximately 58% of BLS's projected increase in S&E jobs is in computer and mathematical scientist occupations (table 3-A). Although life scientists account for a smaller number of job openings, they have a higher projected growth rate (26.7%) than computer and mathematical scientists (25.6%). The growth rates projected for physical scientists and social scientists are also above those for all occupations. Engineering occupations, with projected growth of 11.3%, are expected to grow at only slightly more than the rate for all jobs.

Table 3-A also shows occupations that either contain significant numbers of S&E-trained people or represent other career paths that are often chosen by S&E bachelor's degree holders who pursue graduate training. Among these, the occupation healthcare practitioners and technicians is projected to grow faster than all S&E occupations, from 7.5 million to 9.1 million workers over the decade between 2008 and 2018—an increase of 21.4%. Postsecondary teacher, which includes all fields of instruction, is projected to grow 15.1%. In contrast, BLS projects computer programmers to decrease by 2.9%.

BLS also projects that job openings in NSF-identified S&E occupations over the 2008–18 period will represent a greater proportion of current employment than openings in all other occupations—41.7% versus 33.7% (figure 3-B). Job openings include both growth in total employment and openings caused by attrition.

*Although BLS labor force projections do a reasonable job of forecasting employment in many occupations (see Alpert and Auyer 2003), the mean absolute percentage error in the 1988 forecast of employment in detailed occupations in 2000 was 23.2%.

Figure 3-A
Bureau of Labor Statistics projected increases in employment for S&E and selected other occupations: 2008–18



SOURCE: Bureau of Labor Statistics, Office of Occupational Statistics and Employment Projections, National Industry-Occupation Employment Projections 2008–18. See appendix table 3-1.

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Projected Growth of Employment in S&E Occupations—continued

Table 3-A
Bureau of Labor Statistics projections of employment and job openings in S&E and other selected occupations: 2008–18
(Thousands)

Occupation	BLS National Employment Matrix 2008 estimate	BLS projected 2018 employment	Job openings from growth and net replacements, 2008–18	10-year growth in total employment (%)	10-year job openings % of 2008 employment
All occupations	150,932	166,206	50,929	10.1	33.7
All S&E	5,571	6,717	2,321	20.6	41.7
Computer/mathematical scientists	3,101	3,895	1,353	25.6	43.6
Life scientists	279	354	144	26.7	51.4
Physical scientists	276	317	123	15.1	44.6
Social scientists/related occupations	343	400	170	16.5	49.4
Engineers	1,572	1,750	531	11.3	33.8
S&E-related occupations					
S&E managers	522	589	166	13.0	31.8
S&E technicians	855	925	298	8.2	34.9
Computer programmers	427	414	80	-2.9	18.8
Healthcare practitioners and technicians	7,491	9,091	3,139	21.4	41.9
Selected other occupations					
Postsecondary teachers	1,699	1,956	553	15.1	32.5
Lawyers	759	858	240	13.0	31.7

BLS = Bureau of Labor Statistics

NOTES: Estimates of current and projected employment for 2008–18 from BLS's National Employment Matrix. Data in matrix from Occupational Employment Statistics (OES) survey and Current Population Survey (CPS). Together, these sources cover paid workers, self-employed workers, and unpaid family workers in all industries, agriculture, and private households. Because data are derived from multiple sources, they can often differ from employment data provided by OES, CPS, or other employment surveys alone. BLS does not make projections for S&E occupations as a group; numbers in table based on sum of BLS projections in occupations that National Science Foundation considers as S&E.

SOURCE: BLS, Office of Occupational Statistics and Employment Projections, special tabulations (2011) of 2008–18 National Industry-Occupation Employment Projections.

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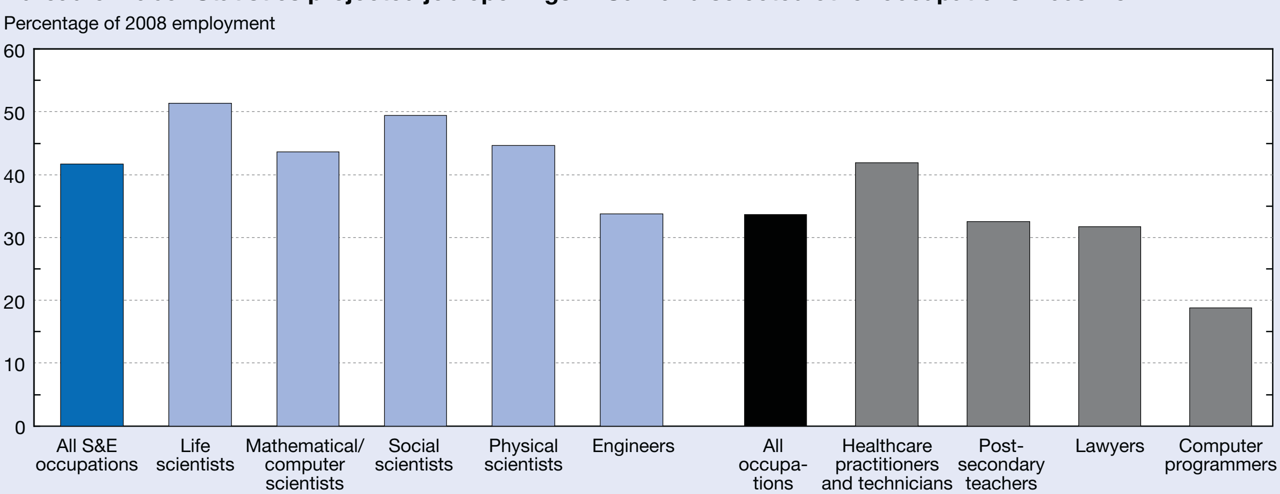
Figure 3-B
Bureau of Labor Statistics projected job openings in S&E and selected other occupations: 2008–18



SOURCE: Bureau of Labor Statistics, Office of Occupational Statistics and Employment Projections, National Industry-Occupation Employment Projections 2008–18. See appendix table 3-1.

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(table 3-4). S&E workers who have both S&E and non-S&E degrees very likely earned their first bachelor's degree in S&E, even if their highest degree was not in an S&E field. Among workers in S&E occupations, the most common degrees are in engineering (38%) and computer sciences and mathematics (22%) (figure 3-6).

Table 3-4
Educational background of workers in S&E occupations: 2008

Educational background	Workers	Percent
S&E occupations	4,874,000	100.0
At least one S&E degree	4,275,000	87.7
First bachelor's degree in S&E field	4,022,000	82.5
Highest degree in S&E field	3,881,000	79.6
All degrees in S&E fields	3,644,000	74.8
At least one degree in field		
Computer and mathematical sciences	1,056,000	21.7
Biological, agricultural, and other life sciences	591,000	12.1
Physical sciences	479,000	9.8
Social sciences	675,000	13.9
Engineering	1,839,000	37.7
No S&E degrees but at least one S&E-related degree	217,000	4.4
No S&E or S&E-related degrees	382,000	7.8

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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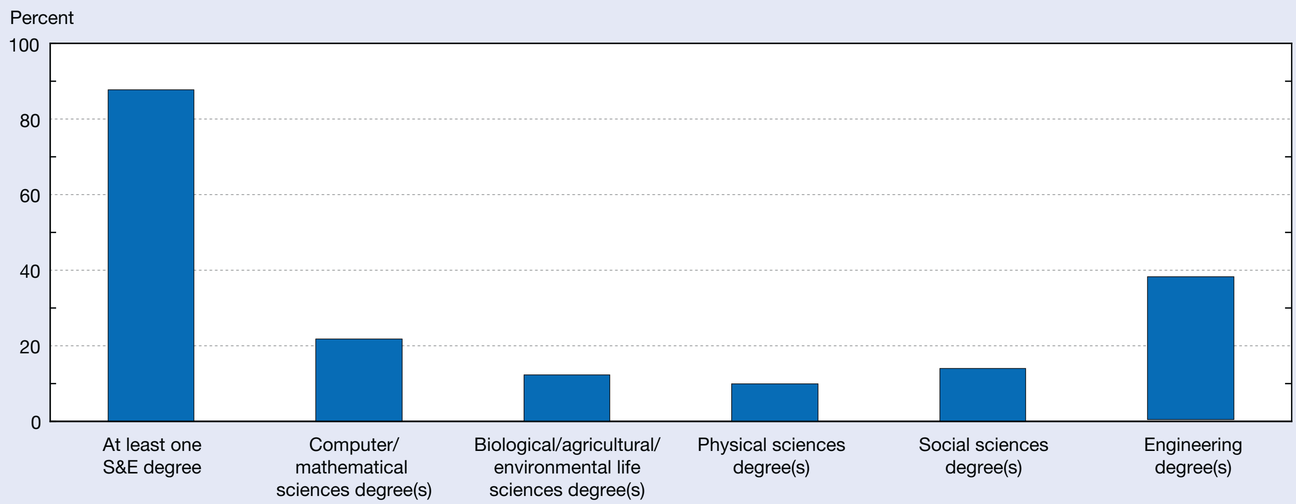
S&E Degree Holders in Non-S&E Occupations

S&E degree holders work in all manner of jobs. For example, they work in S&E-related jobs such as health occupations (1.4 million workers) or in S&E managerial positions (367,000 workers), but they also hold non-S&E jobs such as college and precollege teachers in non-S&E areas (655,000 workers) or work in social services occupations (634,000 workers) (appendix table 3-2).

In 2008, 6.3 million workers whose highest degree was in an S&E field did not work in an S&E occupation. Some 1.3 million worked in S&E-related occupations, while 5.1 million worked in non-S&E jobs. The largest category of non-S&E jobs was management and management-related occupations, with 1.5 million workers, followed by sales and marketing occupations, with 882,000 workers (appendix table 3-2).

Only about 38% of college graduates whose highest degree is in an S&E field work in S&E occupations (figure 3-7). The proportion is higher for those with more advanced degrees. The overall proportion varies substantially by field, ranging from engineering (64%) at the top, followed closely by computer sciences and mathematics (56%) and physical sciences (54%). Although a smaller percentage (31%) of biological/agricultural sciences degree holders work in S&E occupations, an additional 26% of persons with degrees in these fields work in S&E-related occupations (appendix table 3-2). Individuals with social science degrees (14%) are least likely to work in S&E occupations. This pattern of field differences generally characterizes individuals whose highest degree is either a bachelor's or a master's. At the doctoral level, the size of these field differences shrinks substantially.

Figure 3-6
S&E degree background of workers in S&E occupations: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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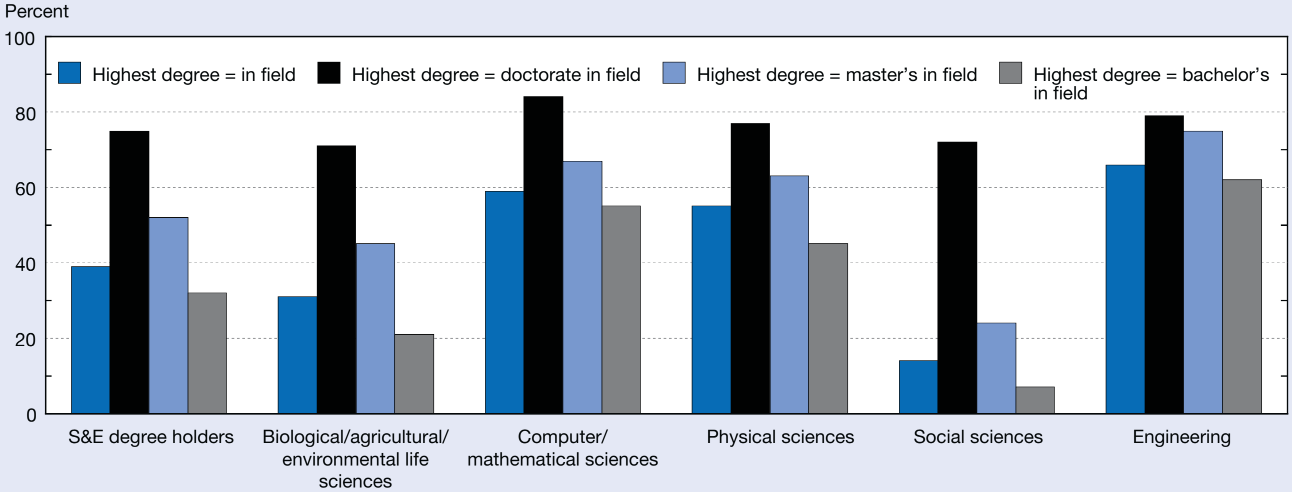
Figure 3-7
S&E degree holders working in S&E occupations, by degree field: 2008



NOTE: Individuals may have degrees in more than one S&E degree field.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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By field, holders of degrees in computer sciences and mathematics and engineering most often work in the broad occupation group in which they were trained (49% and 42%, respectively). S&E doctorate holders more often work in an S&E occupation similar to their doctoral field (55%) compared with individuals whose highest degree is an S&E bachelor's (23%) (appendix table 3-3).

Relationships Between Jobs and Degrees

Most individuals with S&E highest degrees who work in S&E-related or non-S&E occupations do not see themselves as working entirely outside their field of degree. Rather, most indicate that their jobs are either closely (34%) or somewhat (33%) related to their degree field (table 3-5). Among those in managerial and management-related occupations, for example, 33% characterize their jobs as closely related and 42% as somewhat related. More than half (52%) of workers in sales and marketing say their S&E degrees are closely or somewhat related to their jobs. Among S&E precollege teachers whose highest degree is in S&E, 72% say their jobs are closely related to their degrees.

Workers with more advanced S&E education more often do work that is at least somewhat related to their field of degree. Up to 5 years after receiving their degrees, 96% of S&E doctorate holders say that they have jobs closely or somewhat related to their degree field, compared with 92% of master's degree holders and 75% of bachelor's degree holders (figure 3-8). Even when the fit between an individual's job and degree is assessed using the stricter criterion of *closely related,* the data indicate that many S&E bachelor's degree holders who received their degree up to 5 years earlier are working in jobs that use skills developed during their college training (figure 3-9). In the natural sciences and engineering fields (i.e., S&E degree fields excluding the social sciences), half or more characterized their jobs as closely related to their field of degree: 58% in engineering, 57% in physical sciences, 60% in computer/mathematical sciences, and 46% in biological, agricultural, and environmental life sciences. The comparable figure for social science graduates (30%) was substantially lower.

Table 3-5
Relationship of highest degree to job among S&E highest degree holders not in S&E occupations, by degree level: 2008
(Percent)

Highest degree	Workers	Degree related to job: Closely	Somewhat	Not
All degree levels[a]	6,335,000	34.2	33.2	32.6
Bachelor's	5,108,000	30.8	33.6	35.6
Master's	1,027,000	49.3	30.6	20.1
Doctorate	193,000	45.1	36.9	18.0

[a]Includes professional degrees not broken out separately.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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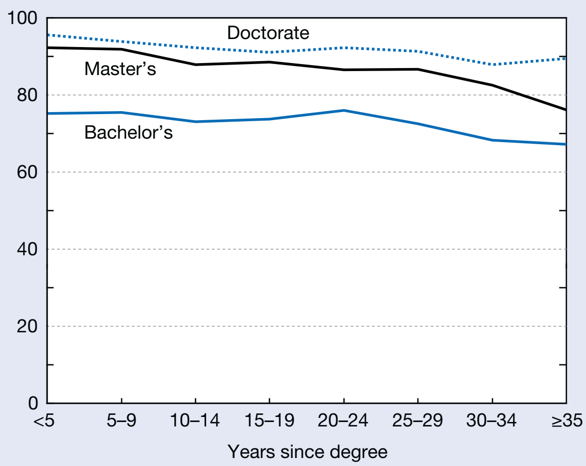
Figure 3-8
S&E degree holders employed in jobs related to highest degree, by years since highest degree: 2008



NOTE: Includes those who say their job is either closely related or somewhat related to field of their highest degree.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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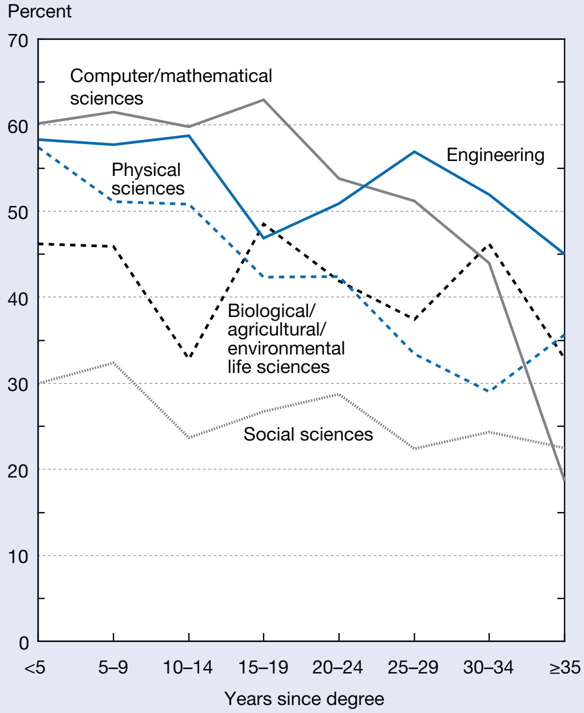
Figure 3-9
S&E bachelor's highest degree holders employed in jobs closely related to degree, by degree field and years since degree: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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The stronger relationship between S&E jobs and S&E degrees at higher degree levels holds at all career stages, as seen in comparisons among groups of bachelor's, master's, and doctoral degree holders at comparable numbers of years since receiving their degrees. However, for each group, the relationship between job and field of degree becomes weaker over time. There are many reasons for this decline: individuals may change their career interests, gain skills in different areas, take on general management responsibilities, forget some of their original college training, or even find that some of their original training has become obsolete. Against this background, the career-cycle decline in the relevance of an S&E degree appears modest.

The loose relationship among jobs, degrees, and individuals' perceptions of the expertise they need to do their work can be seen in figures 3-10 and 3-11. In figure 3-10, the intersecting area shows individuals whose highest degree is in S&E who are also working in S&E occupations. Less than one-third of SESTAT respondents fall in this area—the rest have one or the other attribute but not both. Figure 3-11 compares three groups of individuals who hold at least a bachelor's degree: those whose highest degree is in S&E and who say their job is at least somewhat related to their degree, those who say they need at least a bachelor's degree level of S&E expertise to perform their job, and those in S&E occupations. In 2008, about 13 million Americans had one or more of these characteristics.[5] Yet these three characteristics are not strongly associated with each other:

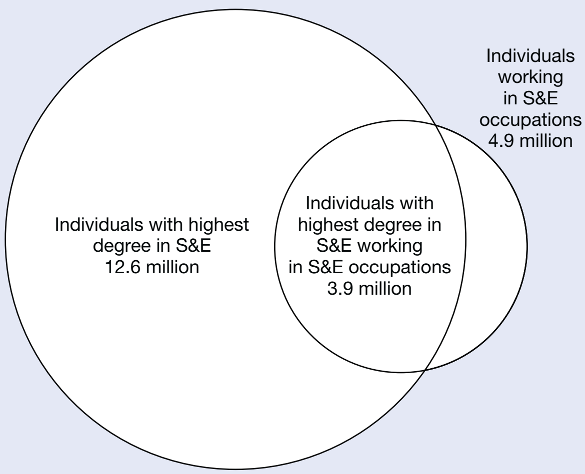
- Only 27% had all three characteristics, and 43% had only one.
- Even among those in S&E occupations, only about 71% also had S&E degrees, had jobs at least somewhat related to S&E, and believed they needed at least a bachelor's degree level of S&E expertise.
- Among the people who claimed they needed the technical expertise associated with an S&E bachelor's degree for their job, more than 40% said either that their job was unrelated to their actual degree or that their highest degree was not in S&E.

S&E Workers in the Economy

This section profiles how the S&E labor force is distributed across employment sectors in the U.S. economy. It shows that members of the S&E labor force work in all sectors, including for-profit businesses, nonprofit organizations, educational institutions, and government. The section begins with a brief description of patterns and trends in the proportions of the S&E labor force in these different employment sectors, and in the characteristics of organizations that employ S&E workers. The section looks at employment patterns in sectors and industries that have unusually high concentrations of S&E workers and variations among employers of different sizes. It then closes with a brief presentation of data on geographical areas with major concentrations of S&E workers. This includes data both on areas where workers in S&E occupations constitute a large percentage of the labor force and areas where large numbers of workers in these occupations are geographically concentrated.

The section then analyzes S&E employment in the different economic sectors. In the business/industry sector, it describes differences between for-profit and nonprofit organizations and in the proportion of S&E workers by industrial sector. The section also examines self-employed workers with S&E degrees and in S&E occupations. Throughout the section, the analysis distinguishes between employment sectors for individuals with S&E degrees and for those working in S&E occupations.

Figure 3-10
Intersection of individuals with highest degree in S&E and S&E occupation: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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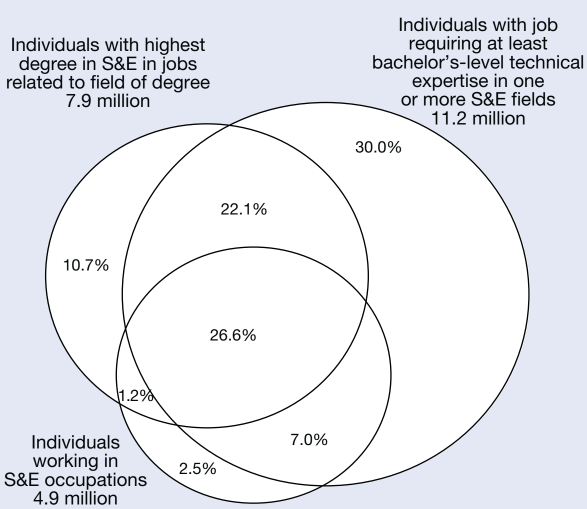
Figure 3-11
Measures of the S&E workforce: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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A brief analysis of the education sector, including all levels of education at both public and private institutions, and the government sector follows. In light of specialized scientific missions and the scope of scientific activities supported by the U.S. government, this section focuses on federal employment.

The S&E labor force is often seen as a major contributor to innovation. The section concludes, therefore, with data on various activities associated with innovation, such as performing R&D, patenting, and enhancing knowledge and skills through work-related training. This includes a description of data on job changes among S&E workers, which enable them to apply work-related learning in new contexts and may thereby spur innovation.

Characteristics of Employers of Scientists and Engineers

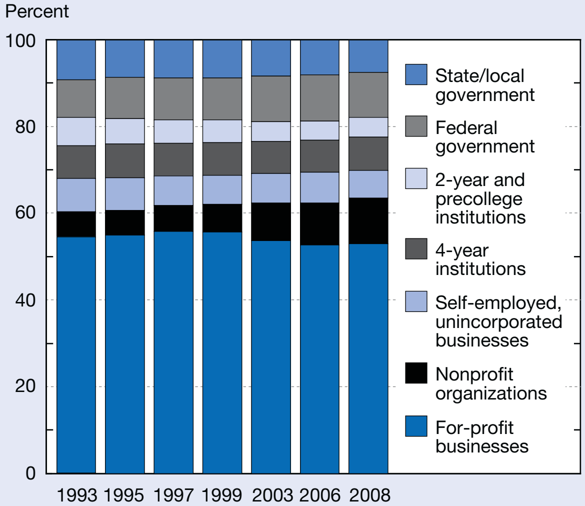
Employment Sector

In general, the labor market is divided into workers in the public sector and those in the private sector. This classification works awkwardly for analysis of the S&E labor force. Because educational institutions are significant employers of scientists and engineers in the United States, these institutions are better treated as a distinct sector, which spans public and private institutions and includes 4- and 2-year colleges and universities and precollege institutions. Employees in the business/industry sector work in for-profit businesses and nonprofit organizations, as well as being self-employed. The government sector includes local, state, and federal employees.

The S&E workforce includes both those working in S&E occupations and those trained in S&E fields. In 2008, approximately 70% of individuals trained or working in S&E worked in the business/industry sector, 12% in the government sector, and 18% in the education sector. This distribution has stayed relatively stable since the early 1990s (see figure 3-12), with some minor shifts. Although the overall percentage of scientists and engineers working in educational institutions has stayed at approximately 18% of overall employment, the relative proportion working in 4-year institutions versus other educational institutions has changed from about 50/50 in 1993 to 40/60 in 2008. Compared with 1993, a smaller proportion of scientists and engineers are working in the federal government in 2008 (6.4% versus 4.5%). The largest change has been within the nonprofit sector. In 1993, the proportion working in this sector was 5.8%; by 2008, it was 10.4%, an 80% increase.

The different sectors in which scientists and engineers are employed are shown in table 3-6. The sector distributions of scientists and engineers by highest degree in S&E versus any degree in S&E are very similar, and mirror the distributions found among all employed S&Es. Workers in different

Figure 3-12
Employed scientists and engineers, by employment sector: 1993–2008



NOTE: *Scientists and engineers* refers to all persons who work in an S&E occupation or who received a bachelor's degree or higher in an S&E degree field in 1993–99 or an S&E or S&E-related field in 2003–08.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1993–2008), http://sestat.nsf.gov.

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broad occupational categories are concentrated in different employment sectors. Four-year educational institutions, for example, employ a higher percentage of workers in S&E occupations than other institutions in the education sector. A larger proportion of S&E-related workers are employed in nonprofit organizations, compared to those in S&E or non-S&E occupations.

Employer Size

Employer size can affect the breadth and depth of S&E employment concentration. Educational institutions and government entities that employ scientists and engineers are, primarily, larger employers. A large majority of these organizations have 100 or more employees (88% in the education sector, 91% in the government sector). Scientists and engineers working in the business/industry sector are more broadly distributed across firms of many sizes.

S&E degree holders who work in for-profit businesses are distributed particularly broadly. Moreover, within the business/industry sector, workers at different degree levels are distributed similarly across firms of different sizes (figure 3-13). Companies with fewer than 100 employees, for example, employ 36% of S&E highest degree holders who work in the business/industry sector, ranging from 32% of master's degree holders to 38% of doctorate holders. S&E doctorate holders in this sector, however, are concentrated at very small and very large firms. Some 23% work at the

Table 3-6
Employment sector of employed scientists and engineers, by broad occupation and degree field: 2008
(Number and percent)

		Occupation			Education	
Employment sector	All employed scientists and engineers	S&E	S&E related	Non-S&E	Highest degree in S&E	Any degree in S&E
Total *(n)*	19,244,000	4,874,000	5,542,000	8,828,000	10,216,000	14,145,000
Business/industry (%)	69.8	70.9	69.6	69.3	71.3	69.8
For-profit businesses	53.0	63.2	45.0	52.4	58.9	55.5
Nonprofit organizations	10.4	4.4	18.4	8.6	6.9	7.8
Self-employed, unincorporated businesses	6.4	3.3	6.1	8.3	5.5	6.5
Education (%)	18.0	16.4	21.0	17.0	15.5	17.2
4-year institutions	7.5	13.3	7.1	4.5	8.3	8.0
2-year institutions	1.0	1.6	0.6	0.9	0.9	0.9
Precollege and other institutions	9.5	1.5	13.5	11.5	6.3	8.2
Government (%)	12.2	12.7	9.4	13.7	13.2	13.0
Federal	4.5	6.1	3.4	4.4	5.3	5.0
State	3.7	3.7	2.8	4.2	4.0	3.9
Local	4.0	3.0	3.2	5.1	3.9	4.2

NOTE: *Scientists and engineers* refers to all persons who have received a bachelor's degree or higher in a science or engineering (S&E) field or S&E-related field or occupation.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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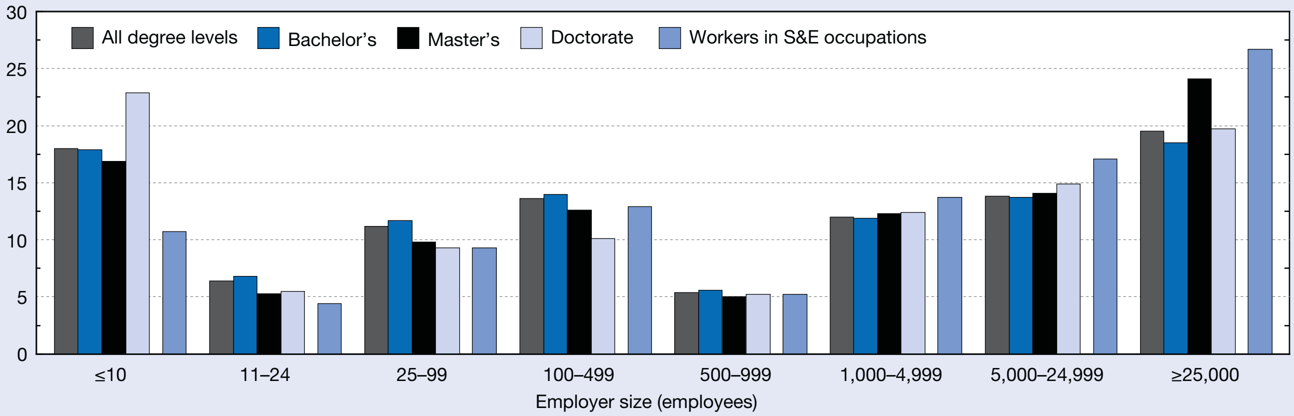
Figure 3-13
S&E highest degree holders and S&E workers employed in business/industry sector, by employer size: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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smallest firms (under 10 employees), but the proportion of them at firms with fewer than 500 employees is similar to that among S&E highest degree holders generally. At the other end of the spectrum, close to 20% of doctorate holders work at firms of 25,000 or more employees.

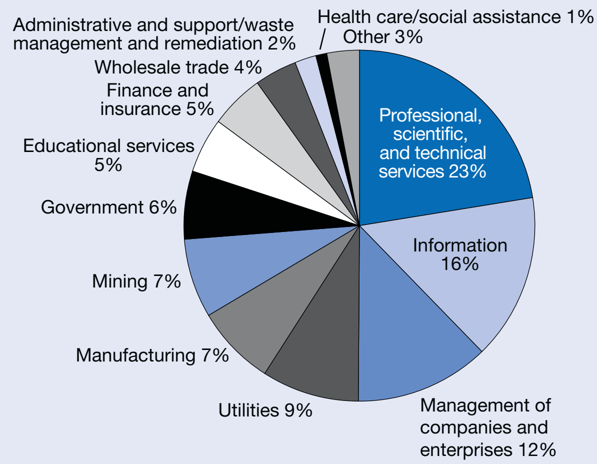
The distribution of employees in the business/industry sector in S&E occupations, however, shows a different pattern. Among this group, there is a greater concentration of employment in firms with more than 5,000 employees (44%), compared to those in smaller firms of 100 employees or fewer (25%).

S&E Occupation Density by Type of Industry

Industries vary in their proportions of S&E workers (table 3-6). The OES survey provides detailed estimates for employment by type of industry, although it excludes the self-employed and those employed in recent startups. OES classifies the government sector within the broad category "government," and educational institutions within the broad category of "educational services." In the for-profit sector, the industry with the highest percentage of S&E workers was "professional, scientific, and technical services" with 29%, followed by information with 16% (figure 3-14). The government (federal, state, and local) had 6% and the educational services sector had 5% of total employment in S&E occupations in 2010.

In 2010, slightly more than 1 million workers in S&E jobs were employed in industries whose S&E employment component was less than the national average of 4.4% (table 3-7). These industries employ 75% of all workers and 21% of all workers in S&E occupations. Examples include local government (at 3.0%, with 165,960 S&E jobs), hospitals (at 1.5%, with 77,890 S&E jobs), and plastic parts manufacturers (at 2.6%, with 13,000 S&E jobs).

Figure 3-14
Industries that employ workers in S&E occupations: May 2010



NOTE: Industries defined by North American Industry Classification System.

SOURCE: Bureau of Labor Statistics, Occupational Employment Statistics Survey (May 2010).

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Industries with higher proportions of individuals in S&E occupations tend to pay higher average salaries to both their S&E and non-S&E workers (table 3-7). The average salary of workers in non-S&E occupations employed in industries where more than 40% of workers are in S&E occupations is nearly double the average salary of workers in non-S&E occupations in industries with below-average proportions of workers in S&E occupations ($79,540 versus $29,970).

S&E Workers by Metropolitan Area

The availability of highly skilled workers can affect an area's economic competitiveness and its ability to attract business investment. The federal government uses standard definitions to describe geographical regions in the United States for comparative purposes. It designates very large metropolitan areas, sometimes dividing them into smaller metropolitan divisions that can also be substantial in size (Office of Management and Budget 2009).

Two measures indicate availability of workers in S&E occupations: (1) the number of these workers in a metropolitan area or division and (2) the proportion of the entire metropolitan workforce in S&E occupations. For both measures, estimates are affected by the geographic scope of a metropolitan area, which can vary significantly. Thus, comparisons between areas can be strongly affected by how much territory outside the urban core is included in the metropolitan area.

Table 3-8 presents the total number and proportion of workers in STEM and S&E occupations in the very large metropolitan areas with multiple metropolitan subdivisions. Metropolitan divisions with the largest estimated proportion of the workforce employed in S&E occupations are shown in table 3-9; those with the largest estimated number of workers employed in S&E occupations are listed in table 3-10. The metropolitan areas with the highest estimated

Table 3-7
Average annual salaries of workers, by industries' proportion of employment in S&E occupations: May 2010

				Average annual salary ($)		
Workers in S&E occupations (%)	All occupations	S&E occupations	Non-S&E occupations	All occupations	S&E occupations	Non-S&E occupations
All industries	127,097,160	5,549,980	121,547,180	44,410	80,170	42,770
>40.0	2,464,060	1,183,480	1,280,580	82,770	86,250	79,540
20.1–40.0	3,459,430	2,492,720	966,710	67,570	87,720	57,810
10.1–20.0	11,084,360	1,585,440	9,498,920	64,680	80,590	47,750
4.4–10.0	9,533,170	8,861,610	671,560	53,680	74,290	35,490
<4.4 (below national average)	95,119,520	1,139,620	93,979,900	40,480	70,320	29,970

SOURCE: Bureau of Labor Statistics, Occupational Employment Statistics Survey (May 2010).

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Table 3-8
Workers in S&E and STEM occupations in largest metropolitan statistical areas: May 2010

	Workers employed (*n*)			Percentage of workforce	
Metropolitan statistical area	All occupations	S&E occupations	STEM occupations	S&E occupations	STEM occupations
U.S. total	127,097,160	5,549,980	7,427,350	4.4	5.8
New York-Northern New Jersey-Long Island, NY-NJ-PA	8,101,890	S	443,200	S	5.5
Washington-Arlington-Alexandria, DC-VA-MD-WV	2,840,740	298,180	360,580	10.5	12.7
Los Angeles-Long Beach-Santa Ana, CA	5,191,880	237,430	308,090	4.6	5.9
Boston-Cambridge-Quincy, MA-NH	2,413,780	190,260	244,740	7.9	10.1
Chicago-Naperville-Joliet, IL-IN-WI	4,169,840	155,760	214,310	3.7	5.1
Dallas-Fort Worth-Arlington, TX	2,832,560	151,090	198,860	5.3	7.0
Seattle-Tacoma-Bellevue, WA	1,601,010	138,350	174,920	8.6	10.9
San Francisco-Oakland-Fremont, CA	1,900,110	138,280	177,380	7.3	9.3
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	2,619,360	129,910	168,720	5.0	6.4
Detroit-Warren-Livonia, MI	1,686,920	102,210	135,190	6.1	8.0
Miami-Fort Lauderdale-Pompano Beach, FL	2,143,470	63,060	83,940	2.9	3.9

S = suppressed for reasons of confidentiality and/or reliability

STEM = science, technology, engineering, and mathematics

NOTES: Includes only metropolitan statistical areas with multiple metropolitan divisions. Differences among employment estimates may not be statistically significant. For additional information see appendix table 3-4.

SOURCE: Bureau of Labor Statistics, Occupational Employment Statistics Survey (May 2010).

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Table 3-9
Metropolitan areas with largest proportion of workers in S&E occupations, by occupation category: May 2010

Metropolitan area	Percentage of workforce: S&E occupations	Percentage of workforce: STEM occupations	Workers employed (*n*): All occupations	Workers employed (*n*): S&E occupations	Workers employed (*n*): STEM occupations
U.S. total	4.4	5.8	127,097,160	5,549,980	7,427,350
San Jose-Sunnyvale-Santa Clara, CA	15.4	19.2	857,160	131,890	164,640
Huntsville, AL	13.7	17.5	202,410	27,780	35,500
Boulder, CO	13.6	15.9	152,100	20,640	24,220
Corvallis, OR	12.4	17.4	32,770	4,050	5,700
Durham, NC	11.8	15.1	266,990	31,590	40,260
Framingham, MA NECTA Division	11.4	14.8	154,760	17,710	22,960
Lowell-Billerica-Chelmsford, MA-NH NECTA Division	11.1	14.7	113,630	12,630	16,660
Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Division	10.6	12.7	2,289,200	243,350	291,730
Bethesda-Frederick-Gaithersburg, MD Metropolitan Division	9.9	12.5	551,550	54,820	68,860
Seattle-Bellevue-Everett, WA Metropolitan Division	9.7	12.3	1,346,300	131,130	164,980
Kennewick-Pasco-Richland, WA	9.2	12.6	96,390	8,830	12,100
Bloomington-Normal, IL	8.8	11.4	85,760	7,570	9,750
College Station-Bryan, TX	8.8	11.1	92,510	8,110	10,230
Palm Bay-Melbourne-Titusville, FL	8.6	11.3	189,730	16400	21,480
Boston-Cambridge-Quincy, MA NECTA Division	8.4	10.7	1,658,000	139,620	177,930
Olympia, WA	8.4	10.3	93,910	7,870	9,640
Kokomo, IN	8.4	10.9	37,790	3,160	4,120
Fort Collins-Loveland, CO	8.0	10.0	125,100	10,070	12,500
Austin-Round Rock, TX	8.0	10.4	759,910	60,600	79,210
Colorado Springs, CO	7.9	9.5	240,000	19,050	22,700

NECTA = New England City and Town Area; STEM = science, technology, engineering, and mathematics

NOTES: Excludes metropolitan statistical areas where S&E proportions were suppressed. Larger metropolitan areas broken into component metropolitan divisions. Differences among employment estimates may not be statistically significant. For additional details, see appendix table 3-4.

SOURCE: Bureau of Labor Statistics, Occupational Employment Statistics Survey (May 2010).

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proportion of S&E employment are mainly smaller and perhaps less economically diverse. However, some large areas, such as Washington, D.C.; Seattle; Boston; and San Jose, also appear on the list of metropolitan areas with the greatest intensity of S&E employment. Differences between estimates for different areas are not necessarily statistically significant. More detailed information on all metropolitan areas can be found in appendix table 3-4.

S&E Workers by Employment Sector

Education Sector

Overall, the education sector employs 18% of scientists and engineers and 16% of those in S&E occupations (table 3-6). Depending on the population, however, the proportion working within different parts of the education sector varies. For example, for workers with an S&E doctorate, 4-year colleges and universities are the most important employer (appendix table 3-5). However, only a minority (41%) of S&E doctorate holders work in this sector, and not all of these are tenured or tenure-track faculty. This figure also includes individuals holding postdoc and other temporary positions, working in various other S&E teaching and research jobs, performing administrative functions, and employed in a wide variety of non-S&E occupations. (See chapter 5 for additional details on academic employment of science, engineering, and health (SEH) doctorates.)

Within the education sector, the portion of the workforce in S&E occupations is concentrated in 4-year institutions (81%). In contrast, most education sector workers in S&E-related or non-S&E occupations are found in precollege or other institutions (63% and 68%, respectively). These workers are primarily teachers in these types of institutions.

Business/Industry Sector

For-profit businesses. For-profit businesses employ the greatest number of individuals with S&E degrees (figure 3-12). In 2008, they employed 59% of all individuals whose highest degree is in S&E and 35% of S&E doctorate holders (appendix table 3-5). By occupation, they employ 53% of those working in S&E occupations.

Table 3-10
Metropolitan areas with largest number of workers in S&E occupations, by occupation category: May 2010

	Workers employed (*n*)			Percentage of workforce	
Metropolitan area	All occupations	S&E occupations	STEM occupations	S&E occupations	STEM occupations
U.S. total	127,097,160	5,549,980	7,427,350	4.4	5.8
Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Division	2,289,200	243,350	291,730	10.6	12.7
New York-White Plains-Wayne, NY-NJ Metropolitan Division	4,982,650	182,350	250,050	3.7	5.0
Los Angeles-Long Beach-Glendale, CA Metropolitan Division	3,817,570	169,040	217,670	4.4	5.7
Houston-Sugar Land-Baytown, TX	2,497,880	135,170	184,640	5.4	7.4
Chicago-Naperville-Joliet, IL Metropolitan Division	3,542,180	131,980	182,380	3.7	5.1
Boston-Cambridge-Quincy, MA NECTA Division	1,658,000	139,620	177,930	8.4	10.7
Seattle-Bellevue-Everett, WA Metropolitan Division	1,346,300	131,130	164,980	9.7	12.3
San Jose-Sunnyvale-Santa Clara, CA	857,160	131,890	164,640	15.4	19.2
Dallas-Plano-Irving, TX Metropolitan Division	2,001,860	115,340	150,490	5.8	7.5
Atlanta-Sandy Springs-Marietta, GA	2,200,660	108,840	139,950	4.9	6.4
Minneapolis-St. Paul-Bloomington, MN-WI	1,678,090	99,380	132,040	5.9	7.9
Philadelphia, PA Metropolitan Division	1,804,600	93,760	120,330	5.2	6.7
San Diego-Carlsbad-San Marcos, CA	1,238,720	83,330	111,550	6.7	9.0
Denver-Aurora, CO	1,183,990	82,610	101,300	7.0	8.6
Phoenix-Mesa-Scottsdale, AZ	1,683,500	73,680	100,060	4.4	5.9
Baltimore-Towson, MD	1,238,860	72,670	93,740	5.9	7.6
San Francisco-San Mateo-Redwood City, CA Metropolitan Division	948,970	73,800	92,600	7.8	9.8
Santa Ana-Anaheim-Irvine, CA Metropolitan Division	1,374,310	68,390	90,420	5.0	6.6
Warren-Troy-Farmington Hills, MI Metropolitan Division	1,017,660	65,640	86,600	6.5	8.5
Oakland-Fremont-Hayward, CA Metropolitan Division	951,150	64,470	84,770	6.8	8.9

NECTA = New England City and Town Area; STEM = science, technology, engineering, and mathematics

NOTES: Larger metropolitan areas broken into component metropolitan divisions. Differences among employment estimates may not be statistically significant. For additional details see appendix table 3-4.

SOURCE: Bureau of Labor Statistics, Occupational Employment Statistics Survey (May 2010).

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Nonprofit organizations. Nonprofit organizations have shown substantial growth in the percentage of scientists and engineers that they employ (see figure 3-12). However, this is primarily driven by those working in S&E-related occupations (which include health-related jobs); 18.4% of the workers in S&E-related occupations work in nonprofit organizations (table 3-6). Among those in S&E occupations, the proportion is much smaller—4.4%.

Self-employment. More than 3.6 million individuals with S&E degrees or working in S&E occupations were self-employed in 2008—18.8% of all scientists and engineers in the United States (table 3-11; NSF/NCSES 2008). This SESTAT estimate of self-employment is much higher than others that have been published elsewhere because it includes those self-employed individuals who work in incorporated businesses. In contrast, most reports of federal data on self-employment are limited to individuals whose businesses are unincorporated.

Although only about one-third of all self-employed workers in the United States work in incorporated businesses (Census Bureau 2009), about two-thirds of self-employed scientists and engineers in the broad SESTAT population work in such businesses (table 3-11). The rate of incorporated self-employment is much higher for individuals with S&E degrees (12%), with S&E highest degrees (11%), or working in S&E occupations (8%) than for the U.S. workforce as a whole, where the comparable rate is 3% (Census Bureau 2009).

Scientists and engineers working in S&E-related or non-S&E occupations reported higher levels of self-employment (20% and 22%, respectively) than those working in S&E occupations. Some 16% of social scientists indicated that they are self-employed, but unlike the general pattern of higher

Table 3-11
Self-employed scientists and engineers, by education, occupation, and type of business: 2008
(Percent)

Characteristic	Total	Unincorporated business	Incorporated business
All self-employed scientists and engineers	18.8	6.4	12.4
S&E degree holders			
At least one degree in S&E field	18.7	6.5	12.2
Highest degree in S&E field	16.7	5.6	11.1
Computer and mathematical sciences	13.9	3.3	10.6
Biological, agricultural, and environmental life sciences	17.1	6.5	10.6
Physical sciences	15.1	5.7	9.4
Social sciences	18.0	7.4	10.6
Engineering	16.8	3.5	13.3
Occupation			
S&E occupation	11.1	3.3	7.8
Computer and mathematical scientists	10.3	2.4	7.9
Biological, agricultural, and environmental life scientists	5.7	1.6	4.1
Physical scientists	9.3	3.2	6.1
Social scientists	16.1	11.1	5.0
Engineers	12.3	2.4	9.9
S&E-related occupations	20.1	6.1	14.0
Non-S&E occupations	22.3	8.3	14.0

NOTE: Scientists and engineers include those with one or more S&E or S&E-related degrees at bachelor's level or higher or who have a non-S&E degree at bachelor's level or higher and were employed in an S&E or S&E-related occupation in 2008.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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incorporated self-employment exhibited among scientists and engineers in general, this group reported higher rates of unincorporated self-employment. This is largely driven by psychologists, 30% of whom are self-employed, mostly in unincorporated businesses (NSF/NCSES 2008). Many scientists and engineers who are self-employed are working in small businesses. Some 81% of self-employed individuals in unincorporated businesses and 46% of self-employed people in incorporated businesses are working in businesses with 10 or fewer employees. Some proportion of these scientists and engineers are likely to be working as independent professionals, rather than in small businesses.

The proportion of self-employed workers generally decreases by level of degree and increases with age (figure 3-15). Across all ages, 18% of S&E bachelor's degree holders are self-employed, but the proportion falls to 12% for S&E doctorate holders. However, self-employment increases with age at all degree levels. By ages 60–64, self-employment reaches about 35% for bachelor's degree, 27% for master's degree, and 21% for doctorate holders.

Government Sector

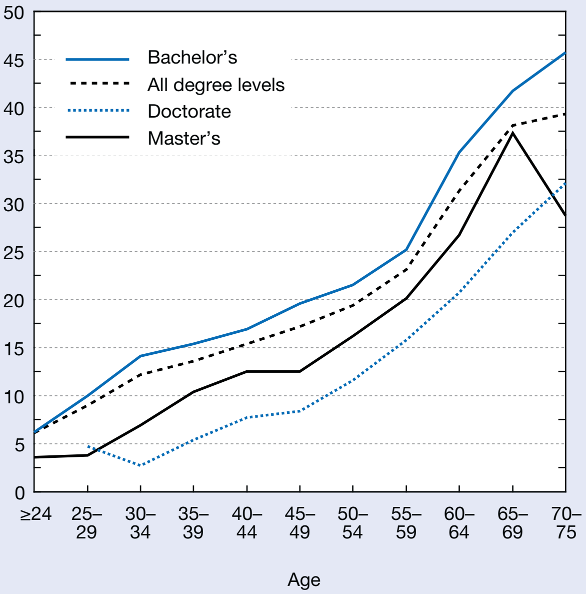
Federal government. The United States' federal government is a major employer of scientists and engineers. However, its employees are largely limited to those with U.S. citizenship.[6] According to data from the U.S. Office of Personnel Management, the federal government employed approximately 235,000 persons in S&E occupations in 2009. Many of these workers were in occupations that, nationwide, include relatively large concentrations of foreign-born persons, some of whom are not U.S. citizens, rendering them ineligible for many federal jobs. Among federal employees in S&E occupations, 60% were in science occupations and 40% were in engineering occupations.

The five federal agencies with the largest proportions of scientists and engineers among their workforce are those with strong scientific missions: the National Aeronautics and Space Administration (NASA), Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), National Science Foundation (NSF), and Department of Energy. The Department of Defense employed the largest number of scientists and engineers, with 43% of the federal S&E workforce (NSF/NCSES 2012b, forthcoming).[7]

Overall, scientists and engineers represent approximately 11.5% of the entire federal workforce. Among federal executives in the Senior Executive Service (SES),[8] 22% are scientists and engineers.

State and local government. Data from the 2010 OES survey show that there are approximately 7.89 million employees of state and local governments in the United States. In 2008, SESTAT estimated 1.48 million scientists and engineers working in this sector. Approximately 8% of

Figure 3-15
Self-employment rates of workers with highest degrees in S&E, by degree level and age: 2008



NOTE: Self-employment includes unincorporated self-employed and incorporated self-employed. All degree levels includes professional degrees not broken out separately.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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individuals with highest degrees in S&E work in this sector; 7% of those with S&E occupations also work there (appendix table 3-5). Within S&E occupations, a larger proportion of biological and physical scientists work in state and local governments (11.3% and 10.5%, respectively), relative to other S&E occupations.

Scientists and Engineers and Innovation-Related Activities

Who Performs R&D?

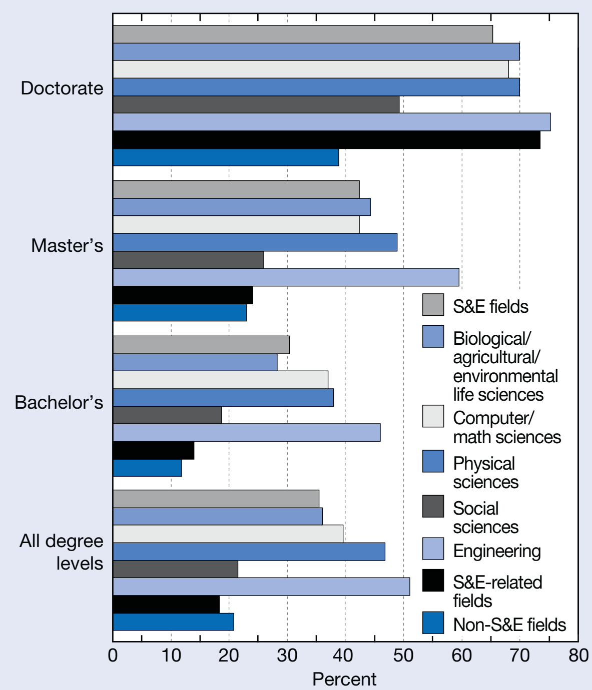
Because R&D creates new knowledge and new types of goods and services that can fuel economic growth, individuals with S&E expertise who use their knowledge in R&D attract special interest. Using SESTAT data, this section reports two broad indicators of R&D work. One involves whether performing R&D is a major work activity constituting at least 10% of the worker's job. The other is whether workers report R&D as a primary or secondary work activity—an activity ranking first or second in work hours from a list of 14 choices.

In 2008, just over 14.1 million employed individuals had one or more S&E degrees (NSF/NCSES 2008). Overall, 31% of S&E degree holders report R&D as a major work activity in their principal jobs. The majority of them have bachelor's (52%) or master's (32%) degrees, while individuals with doctorates, who constitute only 6% of all individuals with S&E degrees, represent 12% of individuals who report R&D as a major work activity.

R&D as a work activity varies among S&E degree holders depending on the field of their highest degree. Figure 3-16 shows the proportion of S&E degree holders who report R&D as their primary or secondary work activity, by their highest degree level and field (which may not be in S&E). Among S&E fields, the highest degree holders in engineering reported the highest aggregate R&D activity rate (51%), while those in the social sciences reported the lowest rate (22%).

In all fields, doctorate holders report higher R&D activity rates than those at lower levels of educational attainment. Engineering doctorate holders report the highest R&D rates, with other doctorate holders in natural and mathematical sciences fields having slightly lower rates. Social sciences and health doctorates report the lowest R&D rates (figure 3-16). This pattern of differences among fields is similar to that found among all degree holders.

Figure 3-16
R&D activity rate of employed S&E degree holders, by field and level of highest degree: 2008



NOTES: "All degree levels" includes professional degrees not broken out separately. R&D activity rate is proportion of individuals who report that basic research, applied research, design, or development is primary or secondary work activity. For classification of degrees by S&E, S&E-related, and non-S&E, see table 3-1.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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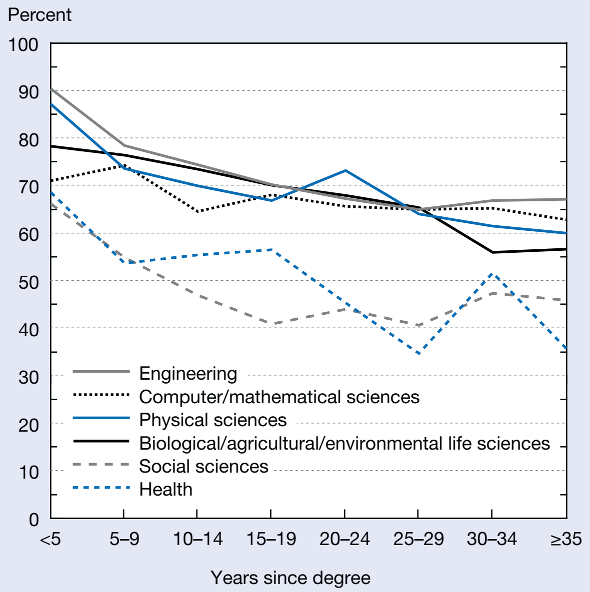
Doctorate holders in all fields engaged in declining amounts of R&D activity over the course of their careers (figure 3-17). The decline may reflect movement into management or other career interests. It may also reflect increased opportunity for more experienced scientists to perform functions involving the interpretation and use of, as opposed to the creation of, scientific knowledge.

Figure 3-17
SEH doctorate holders with R&D as major work activity, by field and years since degree: 2008



SEH = science, engineering, and health

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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Many S&E degree holders subsequently earn degrees in other fields, such as medicine, law, or business. Figure 3-16 includes individuals who have at least one S&E degree, but then may have earned other degrees in S&E-related and non-S&E fields. These individuals report substantial R&D activity rates less often than workers whose highest degrees are in S&E fields. Nonetheless, the proportions who report R&D as their primary or secondary activity—18% for those whose highest degree is in an S&E-related field and 21% for those whose degree is in a non-S&E field—are still substantial and are similar to those for people with their highest degree in the social sciences.

R&D activity spans a broad range of occupations. Table 3-12 shows the occupational distribution of S&E degree holders who spend at least 10% of their time on R&D or report R&D as a major work activity. Among the former, 39% are in non-S&E occupations (lawyers or non-S&E managers, for example). Twenty-seven percent of those for whom R&D is a major work activity are in non-S&E occupations.

R&D Employment in the Business/Industry Sector

A large proportion (78%) of scientists and engineers who work in the business/industry sector report spending at least 10% of their work hours on R&D activities; this proportion is 80% for those employed in the for-profit sector (NSF/NCSES 2008). The 2009 Business R&D and Innovation Survey, which includes only U.S.-located companies that fund or perform R&D, allows for further examination of R&D employment in this sector.

Table 3-12
Employed S&E degree holders with R&D work activities, by occupation: 2008

Occupation	Employed S&E degree holders		R&D at least 10% of work time			R&D as major work activity		
	Number	Percent	Number	Percent	R&D activity rate (%)	Number	Percent	R&D activity rate (%)
All occupations	14,145,000	100.0	7,670,000	100.0	54.2	4,403,000	100.0	31.1
S&E occupations	4,275,000	30.2	3,397,000	44.3	79.5	2,590,000	58.8	60.6
Biological, agricultural, environmental life scientists	455,000	3.2	399,000	5.2	87.8	338,000	7.7	74.3
Computer and mathematical scientists	1,577,000	11.1	1,163,000	15.2	73.7	811,000	18.4	51.4
Physical scientists	308,000	2.2	263,000	3.4	85.5	219,000	5.0	71.1
Social scientists	449,000	3.2	303,000	4.0	67.6	228,000	5.2	50.7
Engineers	1,487,000	10.5	1,268,000	16.5	85.3	994,000	22.6	66.8
S&E-related occupations	2,507,000	17.7	1,258,000	16.4	50.2	631,000	14.3	25.2
Non-S&E occupations	7,363,000	52.1	3,015,000	39.3	40.9	1,182,000	26.8	16.1

NOTE: Detail may not add to total because of rounding. R&D as major work activity includes those reporting basic research, applied research, design, or development as activities they spent the most or second-most hours engaged in during a typical work week.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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The proportion of R&D employment relative to total employment, or R&D employment intensity, is one indicator of a company's involvement in R&D activity. Companies located in the United States that performed or funded research and development domestically or overseas employed an estimated 27.1 million workers worldwide in 2009 (NSF/NCSES 2012a, forthcoming). The domestic employment of these companies totaled 17.8 million workers, including 1.4 million domestic R&D employees. Thus, domestic R&D employment accounted for 8% of companies' total domestic employment (table 3-13).

Smaller companies reported higher proportions of domestic R&D employment than did larger companies, with companies of 250 or more reporting 10% or fewer of their domestic employees as R&D employees, and small companies reporting rates higher than 10% (table 3-13). The greatest proportion of R&D employment (27.0%) is among companies of 5–24 employees, whereas the smallest proportion (5.1%) is among very large companies of 25,000 or more.

R&D employment is found in both manufacturing and nonmanufacturing industries, but at different rates. R&D employment intensity is 8.6% in manufacturing industries and 7.3% in nonmanufacturing industries (figure 3-18). Examination of this indicator across industries shows the highest R&D employment intensity rates in scientific R&D services (36%), communications equipment (30%), software publishers (28%), semiconductor and other electronics equipment (27%), and pharmaceuticals and medicines (20%).

Table 3-13
Domestic industrial and R&D employment, by company size: 2009
(Thousands of employees)

Company size	Domestic employees: All	R&D	% R&D employees
All companies	17,788	1,424	8.0
Small companies			
5–499	3,045	459	15.1
5–99	1,471	295	20.1
5–49	869	197	22.7
5–24	429	116	27.0
25–49	440	81	18.4
50–99	602	99	16.4
100–249	853	91	10.7
250–499	721	72	10.0
Medium and large companies			
500–999	795	64	8.1
1,000–4,999	2,349	204	8.7
5,000–9,999	1,603	112	7.0
10,000–24,999	2,679	212	7.9
≥25,000	7,316	374	5.1

NOTES: Data representative of companies where worldwide R&D expense plus worldwide R&D costs funded by others are greater than zero. Size based on number of domestic employees. Includes 2002 North American Industry Classification System (NAICS) codes 21–23, 31–33, and 42–81. Upper bound of "small company" classification based on U.S. Small Business Administration's definition of small business; Business R&D and Innovation Survey (BRDIS) does not include companies with fewer than 5 domestic employees. Detail may not add to total because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, BRDIS (2009 preliminary).

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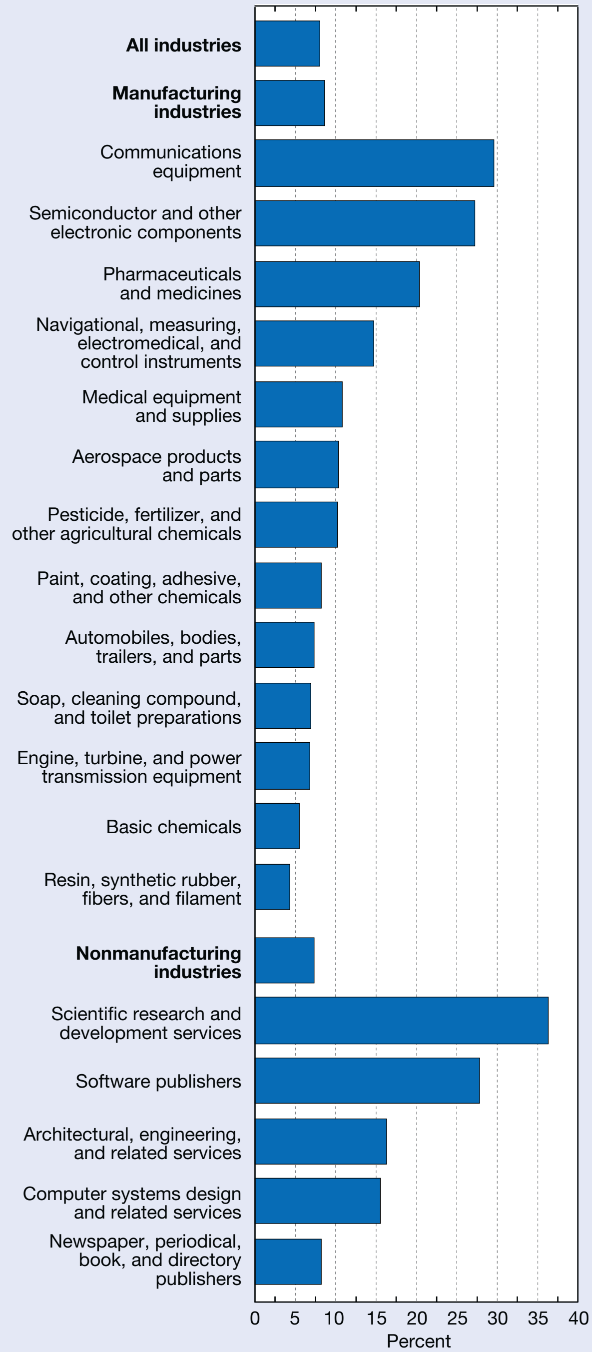
Figure 3-18
Domestic R&D employment in selected industries: 2009



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Business R&D and Innovation Survey (2009 preliminary).

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Patenting Activity of Scientists and Engineers

The U.S. Patent and Trademark Office grants patents to inventions that are new, useful, and not obvious. Patenting is a limited but useful indicator of the inventive activity of scientists and engineers.

In its 2003 SESTAT surveys of the S&E workforce, NSF asked scientists and engineers to report on their recent patenting activities. Among those who had ever worked, 2.6% reported that from fall 1998 to fall 2003 they had been named as an inventor on a U.S. patent application (NSB 2010). Patenting activity rates were highest among those employed in the business/industry sector.

The patent office does not grant all patent applications, and not all granted patents produce useful commercial products or processes. NSF estimates that in the 5-year period for which data were collected, U.S. scientists and engineers filed 1.8 million patent applications. The patent office granted some 1 million patents (although applicants may have applied for some of these at an earlier period).

Of those patents granted between 1998 and 2003, about 54% resulted in a commercialized product, process, or license during the same period. Scientists and engineers employed in the business/industry sector reported the highest commercialization success rate (58%), much higher than the education (43%) and government (13%) sectors.[9] The overall commercialization rate varies by degree level, at 60%–65% for bachelor's and master's degree holders but 38% for doctorate holders (many of whom work in education, which has a low commercialization rate relative to other sectors).

In 2003, the patent activity rate of doctorate holders was 15.7%, compared with 0.7% among those whose highest degree was at the bachelor's level.[10] However, there are far fewer doctoral-level scientists and engineers, so they accounted for only about a quarter of all survey respondents named on a U.S. patent application. Bachelor's and master's degree holders accounted for 41% and 31%, respectively, of all patenting activity reported in the survey.

More recent data from 2008 on a subset of scientists and engineers—U.S.-trained science, engineering, and health (SEH) doctorates—show that the patent activity rate of this set of employed doctorate holders from 2003 to 2008 was 16.2% (table 3-14). The highest patenting activity rates were among doctorate holders in engineering (38.6%) and physical sciences (25.0%). Doctorate holders in these two fields also report the highest average number of applications per person (5.9 in both fields) and the highest average number granted (3.6 and 3.4, respectively). Doctorate holders in engineering and computer/information sciences report the highest average number commercialized (1.5 in both fields).

Table 3-14
Patenting indicators for employed U.S.-trained SEH doctorate holders, by field of doctorate: 2003–08

Indicator	All fields	Biological sciences	Computer/ information sciences	Mathematics/ statistics	Physical sciences	Psychology	Social sciences	Engineering	Health
Employed U.S. SEH doctorates	651,168	163,981	16,152	30,035	115,376	99,157	81,596	115,994	28,878
Patent applicants	105,196	26,159	4,780	2,034	30,621	1,010	591	38,368	1,632
Patent activity rate (%)	16.2	17.2	15.1	5.4	25.0	1.0	8.0	38.6	6.7
Patent grantees	73,169	16,905	3,064	1,367	22,664	677	343	27,047	1,099
Patent commercializers	40,365	7,779	1,787	692	12,256	349	255	16,593	653
Grantee's commercialization success rate (%)	55.2	46.0	58.3	50.6	54.1	51.6	74.3	61.3	59.4
Average number									
Applications	5.18	3.63	5.08	4.89	5.87	2.35	3.56	5.91	2.82
Patents granted	2.92	1.77	2.45	2.66	3.57	1.38	1.24	3.40	1.32
Commercialized products, processes, or licenses	1.16	0.69	1.49	1.06	1.14	0.66	0.79	1.50	0.69
Number of patents									
Applied for	545,058	95,080	24,312	9,940	179,737	2,378	2,113	227,002	4,609
Granted	307,583	46,199	11,682	5,405	109,389	1,395	729	130,686	2,160
Commercialized	122,182	18,055	7,114	2,147	34,914	673	464	57,700	1,131
Patent commercialization success rate (%)	39.7	39.1	60.9	39.7	31.9	48.2	63.6	43.9	52.4

SEH = science, engineering, and health

NOTES: Patenting indicators include activities between October 2003 and October 2008. Patenting indicators defined in Morgan R, Kruytbosch C, Kannankutty N, Patenting and invention activity of U.S. scientists and engineers in the academic sector: Comparisons to industry, *Journal of Technology Transfer* 26:173–83 (2001). Biological sciences includes agricultural and environmental life sciences.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2008), http://sestat.nsf.gov.

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Work-Related Training

In addition to formal education, scientists and engineers very often engage in work-related training. Such training can contribute to innovation in the economy by enhancing skills and knowledge within the S&E labor force. According to SESTAT, about three-fifths of scientists and engineers participated in work-related training in 2008. Among those who were employed, the rate was approximately 67%; for the unemployed, it was 32% (table 3-15). Among employed scientists and engineers, those in S&E-related occupations (health-related occupations, S&E managers, S&E precollege teachers, and S&E technicians and technologists) had the highest participation rate (79%).

Most who took training did so to improve skills or knowledge in their current occupational field (53%) (appendix table 3-6). Others did so for licensure/certification in their current occupational field (24%) or because it was required or expected by their employer (14%). Relative to those who were employed or not in the labor force, those who were unemployed more often reported that they engaged in work-related training to facilitate a change to a different occupational field. Not surprisingly, those who were not in the labor force more often reported that they engaged in this activity for leisure or personal interest. Women participated in work-related training at a higher rate than men: 61% compared with 55% of men (appendix table 3-7). This difference exists regardless of labor force status or highest degree level.

Table 3-15
Scientists and engineers participating in work-related training, by employment status and occupation: 2008

Employment status and occupation	Number	Percent
All scientists and engineers	23,232,000	57.8
Employed	19,244,000	66.5
S&E occupations	4,874,000	58.1
Computer and mathematical scientists	1,970,000	54.1
Biological, agricultural, other life scientists	498,000	56.2
Physical scientists	322,000	53.1
Social scientists	502,000	62.9
Engineers	1,582,000	63.1
S&E-related occupations	5,542,000	78.5
Non-S&E occupations	8,828,000	63.6
Unemployed	604,000	31.8
S&E occupations	140,000	25.9
Computer and mathematical scientists	61,000	28.8
Biological, agricultural, other life scientists	12,000	24.7
Physical and related scientists	10,000	22.5
Social and related scientists	11,000	36.8
Engineers	45,000	20.2
S&E-related occupations	106,000	44.0
Non-S&E occupations	359,000	30.5
Not in labor force	3,383,000	13.1

NOTES: Scientists and engineers include those with one or more S&E or S&E-related degrees at bachelor's level or higher, or who have non-S&E degree at bachelor's level or higher and employed in S&E or S&E-related occupation in 2006. Unemployed individuals are those not working but who looked for job in preceding 4 weeks. For unemployed, the last job held was used for classification. Total excludes scientists and engineers who never worked. Detail may not add to total because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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S&E Labor Market Conditions

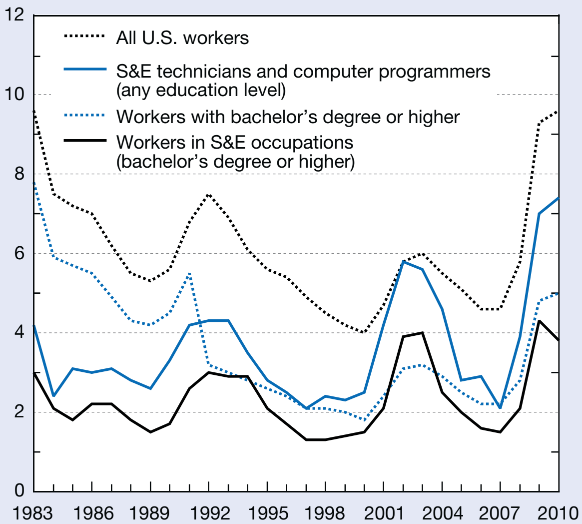
Labor market conditions for scientists and engineers affect the attractiveness of S&E fields to both students and those already in the labor force. Assessing the state of the labor market generally includes examining a variety of indicators that can include employment and unemployment conditions and earnings, and the interplay of these indicators with other economic measures. The most recent recession officially began in December 2007 and ended in June 2009.[11] These two endpoints represent the peak of a business cycle through the trough. Although there are no fixed definitions that identify peaks and troughs of business activity, factors such as the gross domestic product, aggregate employment, and national income are considered relevant. As various measures are presented in this section, it is important to note that many of these measures are lagging indicators. That is, they are economic factors that sometimes do not change until the economy has already begun to follow a particular trend. For example, unemployment rates can continue to rise or can remain the same although a recession has ended. Unemployment rates, involuntarily out-of-field rates, and earnings should all be considered in this context. This section looks at both long-term and recent trends in these indicators using NSF, Census Bureau, and BLS data ranging from before and continuing after the recession.

Unemployment in the S&E Labor Force

In general, those who hold S&E degrees or those working in S&E occupations have had lower rates of unemployment than other college graduates and much lower rates than those without a college education. However, this does not exempt them from unemployment due to overall business cycles or specific events affecting individuals with training in their fields.

Unemployment rates in S&E occupations are also generally less volatile than unemployment rates for these other groups (figure 3-19). The Bureau of Labor Statistics' Current Population Survey data for 1983–2010 indicate that the unemployment rate for all individuals in S&E occupations ranged from 1.3% to 4.3%, which contrasted favorably with rates for all U.S. workers (from 4.0% to 9.6%) and all workers with a bachelor's degree or higher (from 1.8% to 7.8%). The rate for S&E technicians and computer programmers ranged from 2.1% to 7.4%. During most of the period, computer

Figure 3-19
Unemployment rate, by occupation: 1983–2010



SOURCES: National Bureau of Economic Research, Merged Outgoing Rotation Group files (various years); Bureau of Labor Statistics, Current Population Survey (various years).

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programmers had an unemployment rate similar to that of workers in S&E occupations, but with greater volatility (from 1.2% to 6.7%). By 2010 unemployment rates for all U.S. workers were still increasing, while the unemployment rate for workers in S&E occupations had begun to go down.

The recent economic downturn that began in late 2007 generally follows the historic pattern. In 2008, workers in S&E occupations or S&E technician and computer programmer occupations had lower unemployment rates (2.1% or 3.9%, respectively) than all workers (5.8%). By 2009, when unemployment had reached much higher levels, workers in S&E occupations and S&E technicians and technologists still had lower rates (4.3% and 7.0%, respectively) than all workers in general (9.3%); a similar pattern existed for 2010.

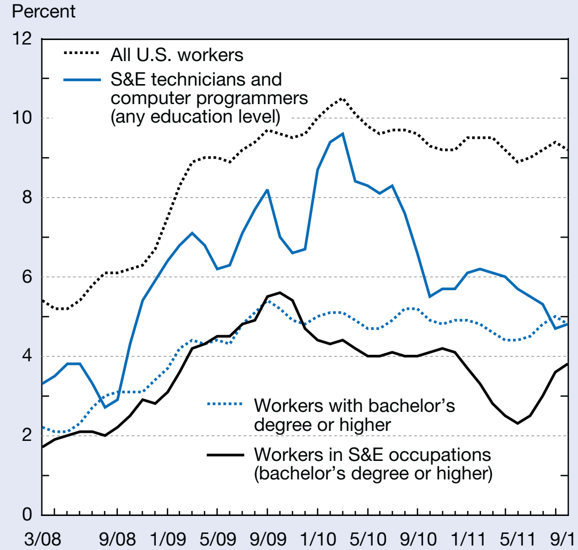
Three-month unemployment rates tell a somewhat more nuanced story. College-educated S&E workers generally have lower unemployment rates than all college graduates; this pattern was still valid in the period from 2007 to 2010. However, in the 3-month period ending in September 2009, the unemployment rate of college educated S&E workers rose to 5.5%, approximately the same rate as for all college graduates (5.4%). S&E technicians and computer programmers continued to experience a considerably lower unemployment rate (8.2%) than that of the general labor force (9.7%) (figure 3-20). These rates immediately followed the end of the official recession (June 2009). Moving forward to the 3-month period ending in September 2011, the more classic pattern emerges of college-educated S&E workers having a significantly lower unemployment rate (3.8%) than all college graduates (4.8%). It should be noted, however, that unemployment rates for college graduates have remained relatively stable since approximately April 2011, while they have risen for college-educated S&E workers.

Broader Measures of Labor Underutilization

The most commonly cited unemployment measure is the percentage of people who are not working but who have looked for work in the preceding 4 weeks. This is the standard (U3) unemployment rate. In addition to U3, the Bureau of Labor Statistics reports five other rates of labor underutilization (U1, U2, U4, U5, and U6; see table 3-16). These provide additional detail about differences in employment patterns between the S&E labor force and the general U.S. labor force (appendix table 3-8).

Trends in indicators of labor underutilization during the economic downturn that began at the end of 2007 consistently indicate that workers whose most recent job was in an S&E occupation experienced lower underutilization rates than the general labor force. Moreover, the advantages for workers in S&E occupations increased over the course of the economic downturn. Figure 3-21 shows the growing gap between these workers and the general labor force in both standard (U3) and long-term (U1) unemployment rates. The difference between their monthly standard rates ranged between 3.2 and 4.1 percentage points in 2008, between 4.0 and 4.9 percentage points in 2009, and between 5.0 and 6.1

Figure 3-20
Estimated unemployment rates over previous 3 months for workers in S&E occupations and selected other categories: March 2008–September 2011



NOTES: Estimates not seasonally adjusted. Estimates from pooled microrecords of Current Population Survey and, although similar, are not same as 3-month moving average.

SOURCE: Bureau of Labor Statistics, Current Population Survey, Public-Use Microdata Sample (PUMS), March 2008–September 2011.

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Table 3-16
Alternative measures of labor underutilization

Measure	Definition
U1	Percentage of the labor force unemployed for 15 weeks or longer
U2	Percentage of the labor force who lost jobs or completed temporary work
U3	Official unemployment rate: percentage of the labor force without jobs who have actively looked for work within the past four weeks
U4	U3 + percentage of the labor force who are discouraged workers (those who have stopped looking for work)
U5	U4 + percentage of the labor force who are marginally attached workers (those who would like to work but have not looked for work recently)
U6	U5 + percentage of the labor force who are part-time workers but want to work full time

SOURCE: Bureau of Labor Statistics, http://www.bls.gov/lau/stalt.htm.

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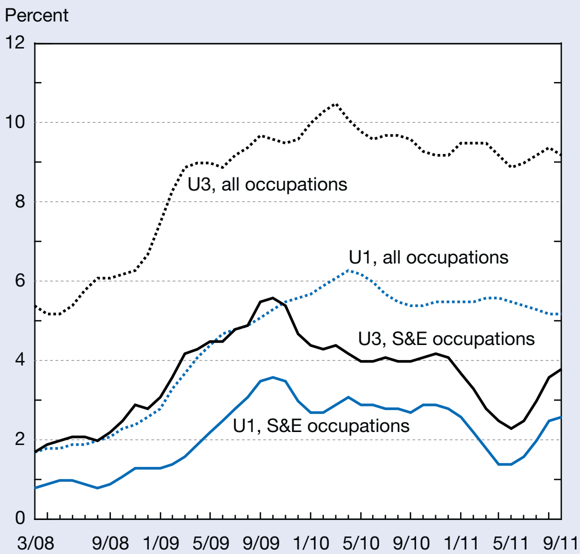
Figure 3-21
Measures of labor underutilization for S&E occupations and all occupations: March 2008–September 2011



U1 = % of labor force unemployed for 15 weeks or more; U3 = % of labor force without jobs who have looked for work in past 4 weeks (official unemployment rate)

NOTES: Estimates not seasonally adjusted. Estimates made from pooled microrecords of Current Population Survey and, although similar, are not same as 3-month moving average.

SOURCE: Bureau of Labor Statistics, Current Population Survey, Public-Use Microdata Sample (PUMS), March 2008–September 2011.

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percentage points in 2010. It remained near 6 percentage points for most of 2011. Whereas general unemployment peaked at 10.5% (March 2010), S&E unemployment rose only as high as 5.6% in October 2009.

Similarly, the difference in long-term unemployment, defined as more than 15 weeks, grew as the downturn went on. It rose from about 1 to 1.3 percentage points in 2008 to between 1.5 and 2.6 percentage points in 2009, and over 3 percentage points in the first half of 2010 before dropping later in the year. Beginning near the end of 2009, the rate of long-term unemployment in the general labor force exceeded the rate of standard unemployment for those in S&E occupations.

The most comprehensive labor underutilization indicator (U6) includes various kinds of workers who are not employed full time but would like to be. More than the U3 unemployment rate, this indicator captures the difference between workers' labor market aspirations and outcomes. During the downturn, the gap between this measure and the standard unemployment rate among workers in S&E occupations was substantially smaller than the comparable gap in the general labor force (appendix table 3-8). Thus, the proportion of underutilized workers who were unemployed in the standard sense of the term was consistently higher among S&E workers than it was in the general labor force.

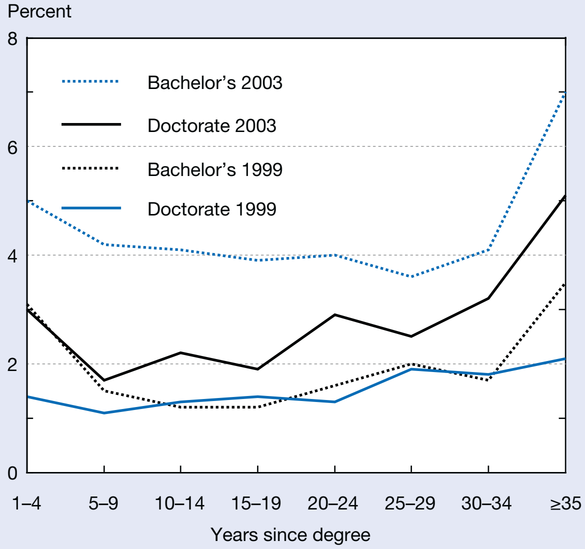
Unemployment Rates by Degree and Field

In most economic downturns, workers with advanced S&E degrees have been less vulnerable to changes in economic conditions than individuals who hold only S&E bachelor's degrees. Figure 3-22 compares unemployment rates over career cycles for persons with S&E bachelor's degrees and doctorates, regardless of their occupation, for 1999 and 2003—periods of relatively good and relatively difficult labor market conditions, respectively. The relatively difficult 2003 labor market had a greater effect on bachelor's degree holders: for individuals at various points in their careers, the unemployment rate increased by between 1.6 and 3.5 percentage points between 1999 and 2003. Labor market conditions had a smaller effect on doctorate holders, but some increases in unemployment rates affected individuals in most years-since-degree cohorts.

Similarly, among those who said they were working involuntarily outside the field of their highest degree, labor market conditions from 1999 to 2003 had a greater effect on the proportion of bachelor's degree holders than on doctorate holders (figure 3-23). These rates ranged from 7% to 12% for bachelor's degree holders in 2003 versus 2% to 5% for those with doctorates. Rates of working involuntarily out-of-field (IOF) for doctorate holders changed little between 1999 and 2003.

Although S&E qualifications may help workers weather recessions, they do not make them immune to the adverse labor market conditions that recessions bring. The estimated 4.3% unemployment rate for S&E occupations in April 2009, although low relative to other occupations, was the highest in 25 years.

Figure 3-22
Unemployment rates for individuals with S&E as highest degree, by degree level and years since degree: 1999 and 2003



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1999 and 2003), http://sestat.nsf.gov.

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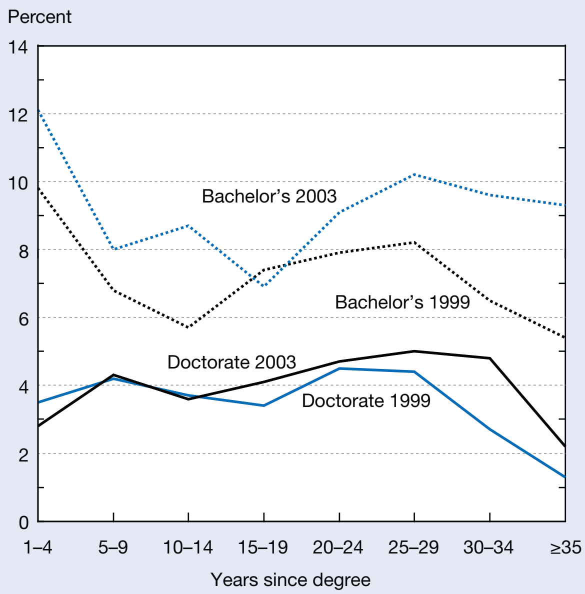
Figure 3-23
Individuals with highest degree in S&E who are involuntarily working out of field, by degree level and years since highest degree: 1999 and 2003



NOTE: Individuals involuntarily employed out of their field include those in jobs not related to field of highest degree because job in that field not available, and those employed part time because full-time work not available.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1999 and 2003), http://sestat.nsf.gov.

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Earnings

The estimated annual wages of individuals in S&E occupations, based on the OES survey, are considerably higher than the average of the total workforce. Median annual wages in 2010 (regardless of education level or field) in S&E occupations were $75,820, more than double the median ($33,840) for all U.S. workers (table 3-17). The spread in average (mean) wage was less dramatic but still quite wide, with individuals in S&E occupations again earning considerably more on average ($80,170) than workers in all occupations ($44,410). Mean S&E wages ranged from $71,860 for social science occupations to $87,980 for engineering occupations.

The 2007–10 annual growth in mean and median wages for both the S&E and STEM occupation groups were similar to those for employed U.S. workers in the OES data.

Workers with S&E degrees also have higher earnings than those with degrees in other fields. Figure 3-24 shows estimates of median salary at different points in life for individuals with a bachelor's degree as their highest degree in a variety of fields. Except in the first 4 years after earning their degrees, holders of S&E bachelor's degrees earn more than those with non-S&E degrees at every year since degree. Median salaries for S&E bachelor's degree holders in 2003 peaked at $65,000 at 15–19 years after receiving their degree, compared with $49,000 for those with non-S&E bachelor's degrees. Median salaries of individuals with bachelor's degrees in S&E-related fields (such as technology, architecture, or health) peaked at $52,000 at 25–29 years after degree, but were higher than those for non-S&E bachelor's degree holders regardless of years of experience.

Earnings at Different Degree Levels

Data on educational histories of all college graduates have been periodically collected by the National Survey of College Graduates, allowing for detailed comparisons of S&E and other college degree holders. Figure 3-25 illustrates the distribution of median salaries earned by individuals with S&E degrees at various levels. (Because the distributions are heavily skewed, the median is the preferred summary statistic.) Not surprisingly, salaries are higher for those with more advanced degrees. In 2003 (the most recent data available), 11% of S&E bachelor's degree holders had salaries higher than $100,000, compared with 28% of doctorate holders. Similarly, 22% of bachelor's degree holders earned less than $30,000, compared with 8% of doctorate holders.[12]

Figure 3-26 shows a cross-sectional profile of median 2003 salaries for S&E degree holders over the course of their career. Median earnings generally increase with time since degree, as workers add on-the-job knowledge to their formal training. For holders of bachelor's and master's degrees in S&E, average earnings adjusted for inflation begin to decline in mid to late career, a common pattern that is often attributed to "skill depreciation." In contrast, earnings for S&E doctorate holders continue to rise even late in their

Table 3-17
Annual earnings and earnings growth in science and technology and related occupations: May 2007–May 2010

Occupation	Mean			Median		
	2007 annual earnings ($)	2010 annual earnings ($)	Annual growth rate since 2007 (%)	2007 annual earnings ($)	2010 annual earnings ($)	Annual growth rate since 2007 (%)
All U.S. employment	40,690	44,410	2.2	31,410	33,840	1.9
STEM occupations	72,000	79,000	2.3	66,950	73,290	2.3
S&E occupations	74,070	80,170	2.0	70,600	75,820	1.8
Computer/mathematical scientists	71,940	77,320	1.8	68,910	73,790	1.7
Life scientists	71,700	77,850	2.1	63,170	68,740	2.1
Physical scientists	73,720	80,490	2.2	67,190	72,850	2.0
Social scientists	66,370	71,860	2.0	60,380	65,540	2.1
Engineers	81,050	87,980	2.1	77,750	83,610	1.8
Technology occupations	67,870	74,510	2.4	NA	62,180	NA
S&E managers	114,470	NA	NA	NA	NA	NA
S&E technicians/computer programmers	53,165	NA	NA	NA	NA	NA
S&E-related occupations (not included above)	66,150	72,580	2.3	50,540	71,320	9.0
Health-related occupations	66,000	72,480	2.4	55,310	59,350	1.8
Other S&E-related occupations	73,110	78,350	1.7	50,250	71,320	9.1

NA = not available

STEM = science, technology, engineering, and mathematics

NOTE: Occupational Employment Statistics (OES) employment data do not cover employment in agriculture, private household, or among self-employed and therefore do not represent total U.S. employment.

SOURCE: Bureau of Labor Statistics, OES Survey (May 2007 and May 2010).

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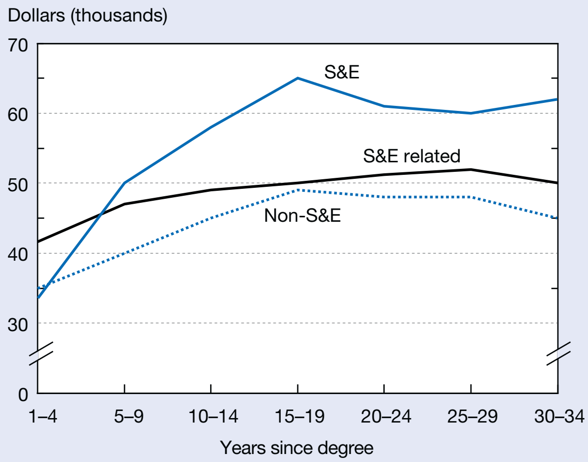
Figure 3-24
Median salaries for bachelor's degree holders, by broad field and years since degree: 2003



NOTE: See table 3-2 for definitions of S&E, S&E-related, and non-S&E degrees.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (2003).

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careers. Median salaries in 2003 peaked at $65,000 for bachelor's degree holders, $73,000 for master's degree holders, and $96,000 for doctorate holders.

Recent S&E Graduates

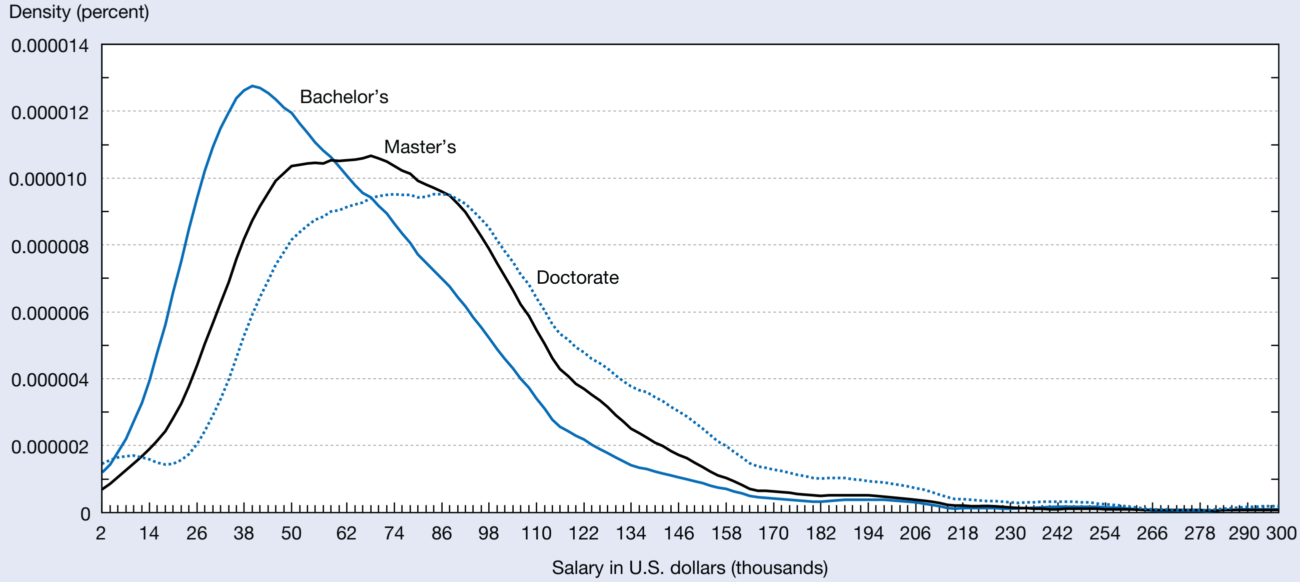
Compared with experienced S&E workers, recent S&E graduates more often bring newly acquired skills to the labor market and have relatively few work or family commitments that limit their job mobility. As a result, measures of the success of recent graduates in securing good jobs can be sensitive indicators of changes in the S&E labor market.

This section looks at a number of standard labor market indicators for recent S&E degree recipients at all degree levels and examines a number of other indicators that may apply only to recent S&E doctorate recipients.

General Labor Market Indicators for Recent Graduates

Table 3-18 summarizes some basic labor market statistics in 2008 for recent recipients of S&E degrees, with *recent* meaning up to 5 years from receiving the degree. Across all fields of S&E degrees, there was a 5.3% unemployment rate for bachelor's degree holders who received their degrees in

Figure 3-25
Salary distribution of S&E degree holders employed full time, by degree level: 2003



NOTE: Salary distribution smoothed using kernel density techniques.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2003), http://sestat.nsf.gov.

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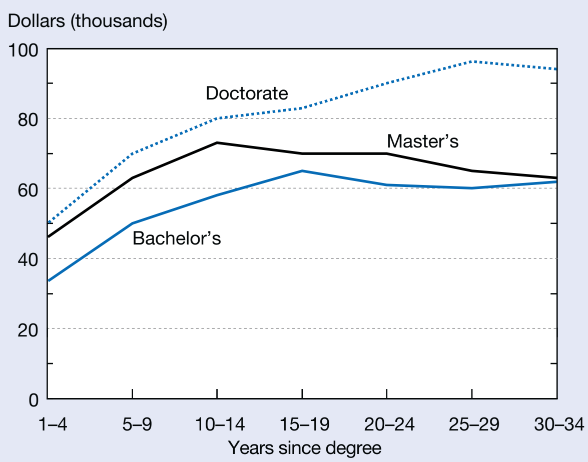
Figure 3-26
Median salaries of individuals with highest degree in S&E, by degree level and years since degree: 2003



SOURCE: National Science Foundation, Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2003), http://sestat.nsf.gov.

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the previous 5 years. This ranged from 2.1% for those with engineering degrees to 6.7% for social science degree recipients. Early in their careers, individuals tend to change jobs more often and have a higher incidence of unemployment. However, with the exception of those who earned a bachelor's degree in the social sciences, the unemployment rate for those with recent S&E degrees was less than the unemployment rate of 6.5% for the full U.S. labor force in October 2008.

A useful but more subjective indicator of labor market conditions for recent graduates is the proportion reporting that a job in their degree field was not available. This involuntarily out-of-field (IOF) rate is a measure unique to NSF's labor force surveys. At the bachelor's degree level, across all S&E fields, the IOF rate in 2008 was 7.9%, but it ranged from 2.4% for recent engineering graduates to 12.0% for recent graduates in the social sciences. In all fields of degrees, the IOF rate decreases as the level of education increases, reaching a low of 1.5% for recent doctorate recipients.

The median salary for recent S&E bachelor's degree recipients in 2008 was $39,800, ranging from $30,000 in the life sciences to $59,000 in engineering. Recent master's degree recipients had average salaries of $57,000, with recent doctorate recipients earning $65,000.

Recent Doctorate Recipients

The career rewards of highly skilled individuals in general, and doctorate holders in particular, often extend beyond salary and employment to the more personal rewards of doing the kind of work for which they have trained. No single standard measure satisfactorily reflects the state of the doctoral S&E labor market; a range of relevant labor market indicators are discussed below, including unemployment rates, IOF employment, employment in academia versus other sectors, employment in postdoc positions, and salaries. Although a doctorate opens both career and salary

Table 3-18
Labor market indicators for recent S&E degree recipients up to 5 years after receiving degree, by field: 2008

		Highest degree field				
Indicator and degree	All S&E fields	Computer/ mathematical sciences	Biological/ agricultural/ environmental life sciences	Physical sciences	Social sciences	Engineering
Unemployment rate (%)						
All degree levels	4.6	3.2	5.1	3.4	6.1	2.0
Bachelor's	5.3	3.2	6.0	3.9	6.7	2.1
Master's	2.9	3.5	2.4	2.5	3.5	2.0
Doctorate	1.5	0.3	2.1	2.5	1.2	1.0
Involuntarily out-of-field rate (%)						
All degree levels	7.9	4.0	7.6	5.6	12.0	2.4
Bachelor's	9.7	5.4	9.1	7.6	13.6	2.5
Master's	3.5	0.7	4.1	1.8	6.1	2.6
Doctorate	1.5	0.9	1.2	3.1	1.9	0.8
Median annual salary ($)						
All degree levels	42,000	55,000	34,000	40,000	36,000	63,000
Bachelor's	39,800	51,000	30,000	32,000	34,000	59,000
Master's	57,000	72,000	44,000	47,000	43,000	70,000
Doctorate	65,000	80,000	50,000	67,000	60,000	86,000

NOTES: Median annual salaries are rounded to nearest $1,000. All degree levels includes professional degrees not broken out separately. Includes degrees earned from October 2003 to October 2008. Involuntarily out-of-field rate is proportion of individuals employed in job not related to field of highest degree because job in that field was not available.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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opportunities, these opportunities come at the price of many years of lost labor market earnings. For some doctorate holders, a postdoc position further extends this period of low earnings. In addition, some doctorate holders do not obtain the jobs they desire after they complete their education.

Although the official recession began in the United States in December 2007 and overall unemployment rose precipitously after April 2008, as of October 2008, the labor market indicators for individuals who recently earned an SEH doctoral degree in the United States remained relatively positive. Their unemployment rate was only modestly higher than in April 2006; the rate of working involuntarily outside of one's field was slightly lower than in 2006; the decline in the proportion of recent doctorate holders who had secured either tenure or tenure-track faculty appointments was modest; and inflation-adjusted salaries rose considerably between 2006 and 2008.

Unemployment

As of October 2008, the 1.5% unemployment rate for SEH doctorate recipients up to 3 years after receiving their doctorates was considerably lower than the unemployment rate of the civilian labor force in general (6.5%) and the unemployment rate for recent recipients of S&E bachelor's degrees (5.3%). Among recent SEH doctoral degree recipients, the unemployment rate in each of the broad SEH degree areas was lower in 2008 than it was in 2003 with the exception of the physical sciences (table 3-19). With a 3% unemployment rate, the physical sciences had considerably higher unemployment among recent doctoral degree recipients than other SEH areas. Indeed, in all other broad SEH fields except the social sciences the unemployment rate among recent SEH doctoral degree recipients was below 2% in 2008.

Working Involuntarily Outside the Field

In addition to the 1.5% who were unemployed in 2008, another 1.3% of recent SEH doctorate recipients in the labor force reported that they took a job that was not related to the field of their doctorate because a job in their field was not available. The share of recent SEH doctoral degree recipients who have reported involuntarily working outside of their field has declined steadily from 2001, when the IOF rate was 2.8% (table 3-19).

The highest IOF rates were found for recent doctorate recipients in the physical sciences and the social sciences. However, within the physical sciences the IOF rate declined from 5.4% to 2.3% between 2001 and 2008.

Tenure-Track Positions

Many SEH doctorate recipients may aspire to tenure-track academic appointments, but most will end up working in other positions and sectors. In 2008, 16% of all those who had earned their SEH doctoral degree within the previous 3 years had a tenure or tenure-track faculty appointment, a share that has held

Table 3-19
Employment characteristics of recent SEH doctorate recipients up to 3 years after receiving doctorate, by field: 2001–08
(Number and percent)

Field	Recent doctorates (*n*)				Unemployment rate (%)				Involuntarily out-of-field rate (%)			
	2001	2003	2006	2008	2001	2003	2006	2008	2001	2003	2006	2008
All recent SEH doctorates	48,700	43,700	49,500	52,600	1.3	2.5	1.2	1.5	2.8	2.1	1.4	1.3
Biological, agricultural, and environmental life sciences	12,300	11,200	12,600	13,400	1.4	2.4	0.9	1.7	2.6	1.0	0.3	1.0
Computer/information sciences	1,600	1,400	1,500	2,400	0.3	4.1	1.9	S	S	S	2.6	1.4
Mathematics and statistics	2,200	1,600	2,000	2,400	0.2	3.4	S	S	1.4	3.4	2.2	1.1
Physical sciences	7,700	6,500	7,400	7,500	1.5	1.3	1.1	3.0	5.4	4.2	2.6	2.3
Psychology	7,200	6,300	7,000	5,800	1.5	2.7	1.2	0.8	3.0	1.5	1.4	0.8
Social sciences	5,800	6,000	6,200	5,900	1.6	3.1	1.4	2.1	3.3	3.0	2.3	3.4
Engineering	9,400	8,000	9,500	12,000	1.5	3.0	1.8	1.2	2.0	3.0	1.6	0.7
Health	2,400	2,700	3,200	3,300	0.4	0.7	0.9	1.2	S	1.1	S	S

S = suppressed for reasons of confidentiality and/or reliability

SEH = science, engineering, and health

NOTES: Involuntarily out-of-field rate is proportion of individuals employed in job not related to field of doctorate because job in that field was not available. 2001 and 2006 data include graduates from 12 to 36 months prior to survey reference date; 2003 and 2008 data include graduates from 15 to 36 months prior to survey reference date.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR), (2001–08), http://sestat.nsf.gov.

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broadly steady since 1993, with a 2003 peak approaching 19% and subsequent modest declines (table 3-20).

The share of SEH degree recipients who hold a tenure or tenure-track faculty appointment increases with increasing time since earning the doctorate. In 2008, the proportion of SEH doctorates with tenure or tenure-track appointments who were less than 3 years from completing their doctorate was 16.2%; for those who had been in the labor market for 3 to 5 years, the comparable rate was 22.9%. In computer and information sciences, 22.0% of individuals who had less than 3 years in the labor force since earning their doctoral degree had a tenure or tenure-track faculty appointment; the proportion increases by 15.8 percentage points to 37.8% for those 3 to 5 years from the doctoral degree. Psychology and the social sciences are the only areas that do not show a dramatic rise in the share of the labor force with a tenure or tenure-track appointment among those with 3 to 5 years of labor market exposure compared to those with less than 3 years of labor market exposure. (See chapter 5 for a discussion of trends in tenure-track positions as a proportion of all academic positions.)

The availability of tenure-track positions may be counterbalanced by the availability of desirable nonacademic employment opportunities. One of the quickest declines among recent doctoral degree recipients in tenure-track employment occurred in computer sciences, from 31.5% in 1993 to 18.2% in 1999 despite the high demand for computer sciences faculty (table 3-20).

Salaries for Recent SEH Doctorate Recipients

For all SEH degree fields in 2008, the median annual salary for recent doctorate recipients up to 5 years after they received their degrees was $67,000. Across various SEH fields of degree, median annual salaries ranged from a low of $50,000 in the biological sciences to a high of $88,000 in computer and information sciences (table 3-21). From 2006 to 2008, salaries for recent recipients of doctoral degrees rose considerably. After adjusting for inflation, the median salary for recent doctoral degree recipients rose by 17%.

By type of employment, salaries for recent doctorate recipients ranged from $42,000 for postdoc positions to $85,000 for those employed by private for-profit businesses (table 3-22).

Postdoc Positions

The growing number of recent doctorate recipients in postdoctoral appointments, generally known as *postdocs*,[13] has become a major concern in science policy. Neither the reasons for this growth nor its effect on the health of science are well understood. Increases in competition for tenure-track academic research jobs, collaborative research in large teams, and needs for specialized training are possible factors explaining this growth. Although individuals in postdoc positions often perform cutting-edge research, there is concern that time spent in a postdoc position is time added onto the already long time spent earning a doctorate, thereby delaying the start and advancement of independent careers. Because postdoc positions usually offer low pay, forgone earnings add significantly to the costs of a doctoral education and may discourage doctoral-level careers in S&E.

How Many Postdocs Are There?

In 2010, *Science and Engineering Indicators* (NSB 2010) included an analysis of a one-time postdoc module from the 2006 Survey of Doctorate Recipients (SDR), and compared it

Table 3-20
Employed SEH doctorate recipients holding tenure and tenure-track appointments at academic institutions, by years since degree and field: 1993–2008
(Percent)

Years since doctorate and field	1993	1995	1997	1999	2001	2003	2006	2008
<3 years								
All SEH fields	18.1	16.3	15.8	13.5	16.5	18.6	17.7	16.2
Biological, agricultural, and environmental life sciences	9.0	8.5	9.3	7.7	8.6	7.8	7.2	6.5
Computer/information sciences	31.5	36.5	23.4	18.2	20.7	32.5	31.2	22.0
Mathematics and statistics	40.9	39.8	26.9	18.9	25.2	38.4	31.6	31.3
Physical sciences	8.8	6.9	8.5	7.8	10.0	13.3	9.8	8.8
Psychology	12.8	13.6	14.7	16.0	15.6	14.6	17.0	18.1
Social sciences	43.5	35.9	37.4	35.4	38.5	44.8	39.3	45.4
Engineering	15.0	11.5	9.4	6.4	11.3	10.8	12.4	9.3
Health	33.9	34.2	30.1	28.1	32.1	30.3	36.2	27.7
3–5 years								
All SEH fields	27.0	24.6	24.2	21.0	18.5	23.8	25.9	22.9
Biological, agricultural, and environmental life sciences	17.3	17.0	18.1	16.4	14.3	15.5	13.7	14.3
Computer/information sciences	55.7	37.4	40.7	25.9	17.3	32.2	45.7	37.8
Mathematics and statistics	54.9	45.5	48.1	41.0	28.9	45.5	50.6	40.7
Physical sciences	18.8	15.5	14.5	11.9	15.8	18.3	19.7	16.5
Psychology	17.0	20.7	16.8	17.6	17.5	19.9	23.8	18.3
Social sciences	54.3	52.4	50.4	46.5	38.8	46.0	50.4	48.9
Engineering	22.7	19.3	19.4	12.6	10.8	15.9	16.3	15.5
Health	47.4	40.2	41.1	39.5	25.1	40.8	43.1	34.4

SEH = science, engineering, and health

NOTES: Proportions calculated on basis of all doctorates working in all sectors of economy. Data for 1993–1999, 2001, and 2006 includes graduates from 12 to 60 months prior to survey reference date; 2003 and 2008 data include graduates from 15 to 60 months prior to survey reference date.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (1993–2008), http://sestat.nsf.gov.

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Table 3-21
Salary of recent SEH doctorate recipients up to 5 years after receiving degree, by field and percentile: 2008
(Dollars)

Field of doctorate	25th percentile	50th percentile	75th percentile
All SEH fields	48,000	67,000	88,000
Biological, agricultural, and environmental life sciences	41,000	50,000	68,000
Computer and information sciences	72,000	88,000	107,000
Mathematics and statistics	52,000	65,000	90,000
Physical sciences	50,000	68,000	85,000
Psychology	48,000	58,000	75,000
Social sciences	50,000	62,000	82,000
Engineering	70,000	86,000	100,000
Health	60,000	76,000	95,000

SEH = science, engineering, and health

NOTES: Salaries are rounded to nearest $1,000. Includes graduates from 15 to 60 months prior to survey reference date.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2008), http://sestat.nsf.gov.

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to data collected on NSF's Survey of Graduate Students and Postdocs in Science and Engineering, in order to estimate the total number of postdocs in the United States. Similar more recent data from the SDR are not available. However, there are several point estimates from more recent years.

In October 2008, the SDR measured 27,100 individuals with SEH doctorates who were employed in postdoc positions. The SDR covers U.S. residents with research doctorates in SEH fields from U.S. universities, but not those with non-U.S. doctorates. The NSF Graduate Student Survey (GSS) gathers information on postdocs from U.S. academic graduate departments, regardless of where these individuals earned their doctorates. It does not cover people in nonacademic employment, at some university research centers, or at academic departments that lack graduate programs. The fall 2008 estimate from the GSS was 54,100 postdocs. The SDR and GSS estimates overlap in some populations (U.S.-trained doctorates and those working in academia), but differ in others (GSS covers foreign-trained doctorates, but not those in the industry or government sectors).

Postdocs by Academic Discipline

More than half of all U.S.-educated SEH doctorates in postdoctoral positions in 2008 (57%) had doctorates in biological or health sciences (figure 3-27). In these fields,

Table 3-22
Median annual salary of recent SEH doctorate recipients up to 5 years after receiving degree, by field and employment sector: 2008
(Dollars)

		Education					
		4-year institution					
Field of doctorate	All sectors	Tenured or tenure-track position	Postdoc	Other academic positions	2-year or precollege institution	Govern-ment	Business/ industry
All SEH fields	67,000	65,000	42,000	55,000	60,000	71,000	85,000
Biological, agricultural, and environmental life sciences	50,000	62,000	41,000	50,000	55,000	60,000	65,000
Computer and information sciences	88,000	80,000	46,000	80,000	80,000	90,000	100,000
Mathematics and statistics	65,000	59,000	52,000	50,000	60,000	86,000	97,000
Physical sciences	68,000	60,000	43,000	53,000	52,000	69,000	85,000
Psychology	58,000	57,000	42,000	55,000	62,000	75,000	65,000
Social sciences	62,000	60,000	50,000	52,000	56,000	87,000	85,000
Engineering	86,000	80,000	43,000	68,000	45,000	78,000	95,000
Health	76,000	75,000	43,000	68,000	69,000	82,000	85,000

SEH = science, engineering, and health

NOTES: Salaries are rounded to nearest $1,000. Includes graduates from 15 to 60 months prior to survey reference date.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2008), http://sestat.nsf.gov.

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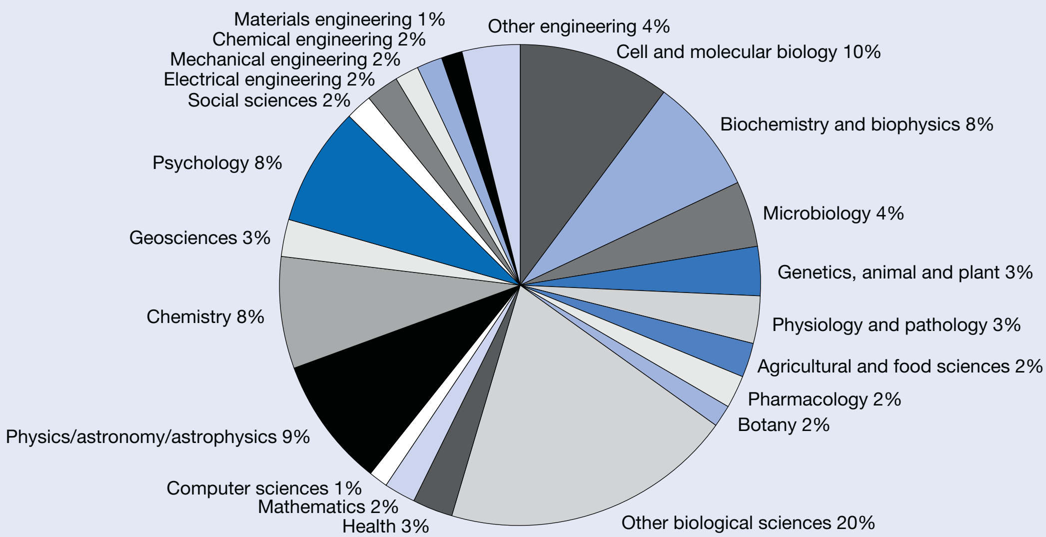
Figure 3-27
U.S.-educated SEH doctorate holders in postdoctorate positions, by doctorate field: 2008



SEH = science, engineering, and health

NOTE: Percentages do not add to 100% because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2008), http://sestat.nsf.gov.

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postdoc training has been common for a long time and individuals remain in postdoc positions longer than in other fields. Psychology, chemistry, and physics also have high rates of graduates entering postdoc positions and together make up another one-quarter of postdoc positions. The remaining quarter come from all other SEH fields, most of which do not have a strong postdoc tradition as part of their career paths.

Increase in the Likelihood and Length of Postdoc Positions

Among holders of U.S. SEH doctorates received before 1972, 31% reported having had a postdoc position earlier in their careers (NSB 2010). This proportion has risen over time to 46% among 2002–05 graduates and has increasingly involved fields in which, formerly, only a small number of doctorate recipients went on to postdoc positions. In traditionally high-postdoc fields such as the life sciences (from 46% to 60%) and the physical sciences (from 41% to 61%), most doctorate recipients now have a postdoc position as part of their career path. Similar increases were found in mathematical and computer sciences (19% to 31%), social sciences (18% to 30%), and engineering (14% to 38%). Recent engineering doctorate recipients are now almost as likely to take a postdoc position as physical sciences doctorate holders were 35 years ago.

Postdoc Pay and Benefits

Low pay and fewer benefits for postdocs are frequently raised as concerns by those worried about the effect of the increasing number of postdoc positions on the attractiveness of science careers. The median academic postdoc salary is 44% less than the median salary for nonpostdocs up to 5 years after receiving their doctorates (table 3-23). Among engineering doctorates, academic postdocs are paid half the salary of those who are not in postdoc positions up to 5 years after receiving their doctorate. Among social sciences doctorates, this gap is closer to one-quarter (24%). Nonacademic postdocs are better paid than academic postdocs, but their median salary is still 33% less than that of those who are not in postdoc positions.

The 2006 Survey of Earned Doctorates asked about employment benefits among postdocs. Across all S&E fields, 90% of postdocs reported having medical benefits and 49% reported having retirement benefits. It is not possible to know from the survey how extensive medical benefits may be or how transferable retirement benefits are. In the social sciences, medical benefits are less available, with only 75% of postdocs reporting that they had medical benefits.

Postdoc Positions as a Sign of Labor Market Distress

In 2006, former postdoc position holders reported reasons for accepting their appointment that are consistent with the traditional intent of a postdoc position as a type of apprenticeship, such as seeking “additional training in doctorate field” or “training in an area outside of doctorate field.” However, 10% of SDR respondents in a postdoc position in October 2008 reported that they took their current postdoc position because “other employment not available.” This reason was given by 9% of postdocs in the biological and agricultural sciences, 5% in the health sciences, 12% in computer sciences and mathematics, 12% in the physical sciences, 6% in the social sciences, and 16% in engineering.

Postdoc Outcomes

In 2006, most former postdocs reported that their most recent postdoc appointment had enhanced their career opportunities, and the proportions who said this were similar for different cohorts (NSB 2010). Across all S&E fields and cohorts, 53%–56% of former postdocs said that their postdoc appointment enhanced their career opportunities to a “great

Table 3-23
Median salary of U.S. SEH doctorate holders in postdoc positions: 2008

	Median salary ($)		
Field of doctorate	Academic postdocs	Nonacademic postdocs	Nonpostdocs
All SEH	42,000	50,000	75,000
Biological/agricultural/environmental life sciences	41,000	47,000	65,000
Computer/information sciences	46,000	S	90,000
Mathematical sciences	52,000	S	71,000
Physical sciences	43,000	57,000	75,000
Psychology	42,000	48,000	60,000
Social sciences	47,000	S	62,000
Engineering	43,000	57,000	90,000
Health	43,000	63,000	80,000

S = suppressed for reasons of confidentiality and/or reliability

SEH = science, engineering, and health

NOTE: Salaries are rounded to nearest $1,000.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2008), http://sestat.nsf.gov.

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extent"; an additional 33%–38% said that their postdoc appointment "somewhat" enhanced their career opportunities. The proportion of those completing postdoc positions who said that it was no help to their career opportunities ranged from only 8% for the 2002–05 graduation cohort to 12% for the 1987–91 cohort. For a more detailed look at perceived and actual outcomes from a postdoc experience, see chapter 3 in the 2008 edition of *Science and Engineering* (NSB 2008) and NSF/SRS (2008b).

Demographics of the S&E Workforce

This section describes the demographic composition of the U.S. S&E workforce by sex, race/ethnicity, foreign origin, and age. It also addresses the relationship between workforce demographics and selected indicators of labor force rewards and participation.

The section begins with a focus on differences by sex among workers in S&E occupations and among S&E degree holders. Similar comparisons will be made across race/ethnicity categories. Historically, in the United States, very high proportions of workers in S&E occupations have been male and white (non-Hispanic). Engineering and physical science occupations have had particularly low concentrations of women and of members of most underrepresented minority groups (i.e., blacks, Hispanics, American Indians, and Alaska Natives), both relative to the concentrations of these groups in other occupational areas and relative to their representation in the population in general. However, both women and minorities increasingly have been entering a wide range of S&E occupations. Asians have also been increasing their participation in S&E occupations, although with concentrations in areas different from women and underrepresented minorities. This section documents, across S&E occupations, the extent to which the numbers and the share of workers who are women, underrepresented minorities, and Asians have risen, and provides indicators of their contemporary levels of participation.

The presentation of indicators of levels of participation will be followed by an analysis of the relationship between wage differences and demographic factors. Historically, women and minorities in S&E occupations have received lower salaries than white men. This section will provide data on contemporary salary differences as well as findings regarding how various factors contribute to these differences.

This discussion of wage differences will be followed by a presentation of indicators pertaining to S&E immigration trends. Increasing global competition for S&E workers and changes in economic conditions influence levels of immigration. This section describes recent trends in immigration of S&E workers that can be compared with other factors (like economic growth). Indicators are collected from population data from the U.S. Census Bureau and visa data from the U.S. Citizenship and Immigration Service, as well as S&E workforce data from the NSF SESTAT data system. Data from the Survey of Earned Doctorates will be presented to capture stay rates: rates at which noncitizen recipients of U.S. S&E doctoral degrees remain in the United States.

The demographics section ends with a presentation of indicators of the aging of the S&E workforce as the baby-boom generation moves toward retirement age. The high concentration of workers over age 50 suggests that the S&E workforce will soon experience high levels of turnover. Thus, indicators will also be presented pertaining to levels of workforce participation and engagement of individuals at the ages near the end of their career cycle.

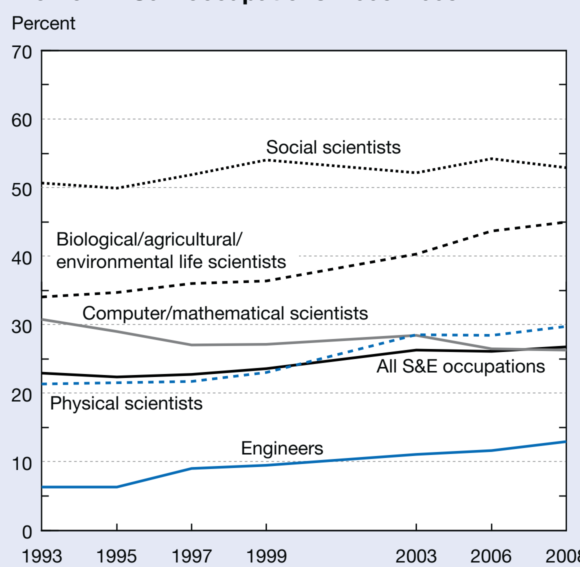
Sex Differences in the S&E Workforce

Sex Differences in S&E Occupations

Historically, men in S&E occupations have outnumbered women by wide margins. Yet the number of women in these occupations has been on the rise, increasing over the past two decades by more than half-a-million workers. These recent increases in the number of women have narrowed overall disparities by sex, but only modestly. In 2008, overall disparities remained pronounced, with women constituting 27% of workers, only a slightly higher share than in the previous decade when women made up 23% of workers (figure 3-28).

Sex disparities vary across occupations (appendix table 3-9). The most extreme disparities are within engineering, where women constituted 13% of the workforce in 2008. Among large engineering occupations, the disparity between men and women is greatest among mechanical engineers, with men outnumbering women by more than 12

Figure 3-28
Women in S&E occupations: 1993–2008



NOTE: National estimates not available from Scientists and Engineers Statistical Data System (SESTAT) in 2001.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993–2008), http://sestat.nsf.gov.

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to 1. Other large engineering occupations in which women account for as few as 9% of workers include electrical and electronics engineers and aerospace, aeronautical, and astronautical engineers.

Both computer and mathematical scientists (26% women) and physical scientists (30% women) are disproportionately male. Within physical science occupations, physicists have the largest imbalance by sex. Within computer and mathematical scientist occupations, the largest component, computer and information scientists (25% women), is the most imbalanced. Mathematical scientists (45% women) are much closer to parity.

Sex parity in participation was nearly achieved by 2008 among biological and medical scientists (51% women). With 53% of women in the field in 2008, parity in the social sciences has been long established. Occupations within social sciences, however, vary with respect to the proportion of female workers. For example, women account for slightly less than one-third of economists, but more than two-thirds of psychologists. Psychology, with about 185,000 total workers, is the only large S&E occupation with substantially more women than men.

The number of women working in each occupational area has risen since the early 1990s. Growth has been strongest in the biological and related sciences, where the number of female workers doubled between 1993 and 2008. This rate of growth has far outstripped that of men in these occupations, thus women's share of workers has also increased (from 34% in 1993 to 45% in 2008, see figure 3-28). During the same period, women have also increased their share among workers in engineering (from 9% to 13%) and in the physical sciences (from 21% to 30%). In these two occupational areas, women's increased share emerged as women's numbers in the workforce expanded (roughly by 60%) but men's numbers did not, remaining roughly similar between 1993 and 2008.

In social science occupations, the growth in women's participation has occurred at levels similar to those in engineering and the physical sciences. However, men's participation in these occupations has grown at similar levels and, therefore, the balance between men and women has changed little.

With 230,000 more female computer and mathematical scientists in 2008 than in 1993, women have added more workers in this area than in any of the other S&E occupations. The rate of growth of women in this area is also higher than in any other area, except for life scientists. However, unlike in the other four areas, men's rate of growth in this occupational area is higher than women's. Thus, women's share of this occupation has been declining. From 1993 to 2008 women's share of computer and mathematical scientists dropped from 31% to 26%, making the sex disparity here even greater than in physical science occupations. The declining share of women in the computer and mathematical science occupations reflects increasing disparities in participation among those whose highest degree is at the bachelor's degree level. Among those with a doctoral degree, women's share of workers in computer science occupations increased from 13% to 18% over this period.

Sex Differences in Age and Racial/Ethnic Groups

With the recent, greater growth among women than among men in S&E occupations, women in the field tend to be somewhat younger than the men (table 3-24). Age disparities are greatest among life scientists, physical scientists, and engineers, where women's participation levels have been increasing relative to men's. Age disparities are small among computer and mathematical scientists, where women have lost ground relative to men in levels of participation. Overall, in 2008 28% of men working in S&E occupations were over age 50 compared with 22% of women. Only 13% of men were younger than 30, but 17% of women were. The median age of women in S&E occupations was 41 years compared with 43 years among men.

Women in S&E occupations were more likely than men to be classified as an American Indian/Alaska Native, black, Hispanic, Native Hawaiian/Pacific Islander or of two or more races. In 2008, 14% of women in S&E occupations identified themselves within one of these groups compared with 10% of men (appendix table 3-10). Neither occupational area nor age explains the increased likelihood for women to be from a minority group, and less likely to be white. Women are more likely to be minorities within all five broad occupational areas whether or not age is controlled.

Sex Differences Among S&E Degree Holders

Sex disparities among the general U.S. workforce with S&E degrees are somewhat smaller than disparities within S&E occupations. In 2008, among individuals with their highest degree in an S&E field, women constituted 38% of those who were employed, up from 31% in 1993. Over the

Table 3-24
Age distribution of workers in S&E occupations, by sex and race/ethnicity: 2008
(Percent)

	Age (years)		
Sex and race/ethnicity	<30	30–50	>50
All S&E occupations	14.1	59.3	26.7
Sex			
Male	12.9	58.6	28.4
Female	17.2	61.0	21.9
Race/ethnicity			
Asian	17.8	67.7	14.5
American Indian/Alaska Native	8.7	70.5	20.8
Black	12.5	65.8	21.8
Hispanic	18.2	65.1	16.7
White	12.6	56.6	30.8
Native Hawaiian/Other Pacific Islander	24.8	65.3	9.9
Two or more races	29.8	53.6	16.6

NOTE: All single-race categories include non-Hispanics only.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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same period, the share of women among unemployed workers with an S&E degree rose more dramatically, from 34% to 45%. Among those out of the labor market, the share of women rose from 46% to 50%.

At every age, women with their highest degree in an S&E field are more likely than men to be out of the labor market (figure 3-29). However, at typical ages for career entry and exit (before age 30 and after age 60) these differences are modest. The sex disparity in the likelihood of being out of the labor market is particularly pronounced in the middle years of the career cycle. Between ages 30 and 55, 16.1% of women were out of the labor market compared with 2.2% of men.

Many women between ages 30 and 55 with S&E degrees who were not in the labor market identified family reasons as an important factor: 69% of women reported that family was a factor compared with 25% of men. Within this age range, women were also much more likely than men to report that they did not need to work or did not want to work (46% of women and 26% of men).

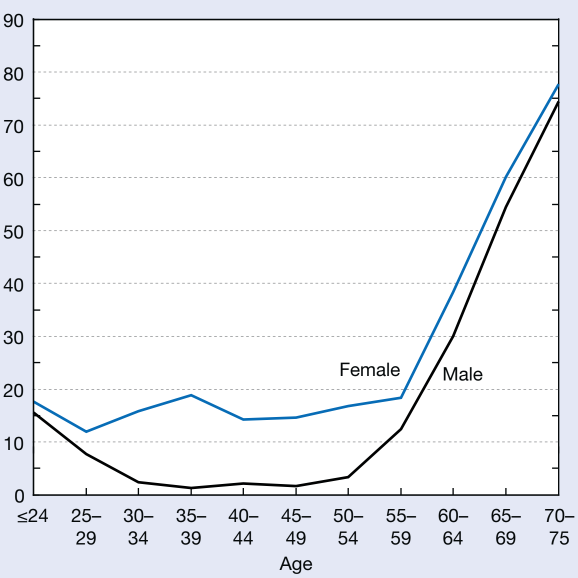
Sex Differences in Degree Fields and Degree Levels

With respect to the proportion of men and women among S&E highest degree holders, the pattern of variation among degree fields echoes the pattern of variation among occupations associated with those fields (see appendix table 3-11). In 2008, more than half (54%) of degree holders in the social science fields were women, as were nearly half (46%) of those with a degree in the biological and related sciences. Men outnumbered women among computer sciences and mathematics degree holders (31% women) and among physical science degree holders (28% women). Disparities, however, were greatest among those with a degree in engineering, where only 13% of degree holders were women. In all fields except computer and mathematical sciences, the share of women with degrees in the workforce has been increasing over the past two decades. In computer science and mathematics this share has remained flat.

Sex differences are not limited to the field of degree, but also to the level of the S&E degree. Men in the workforce are more likely to have a more advanced S&E degree. For example, women accounted for 38% of those whose highest degree in S&E is at the bachelor's level but 29% of workers whose highest degree in S&E is at the doctoral level (figure 3-30). At the doctoral degree level, however, women's share has been steadily increasing. Women's share of S&E bachelor's degree holders in the workforce has also been rising since the early 1990s, but in 2008 this share was not larger than it had been in 2006.

Working men and women with S&E degrees also differ in the extent to which they are employed in the same field as their S&E degree. However, this disparity is largely the result of women having a high concentration in the two degree areas—social sciences and life sciences—where degree holders most often work outside of S&E occupations.

Figure 3-29
Highest degree holders in S&E not in the labor force, by sex and age: 2008



NOTE: Not in labor force includes those not working nor looking for work in the 4 weeks prior to October 2008.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System, SESTAT (2008), http://sestat.nsf.gov.

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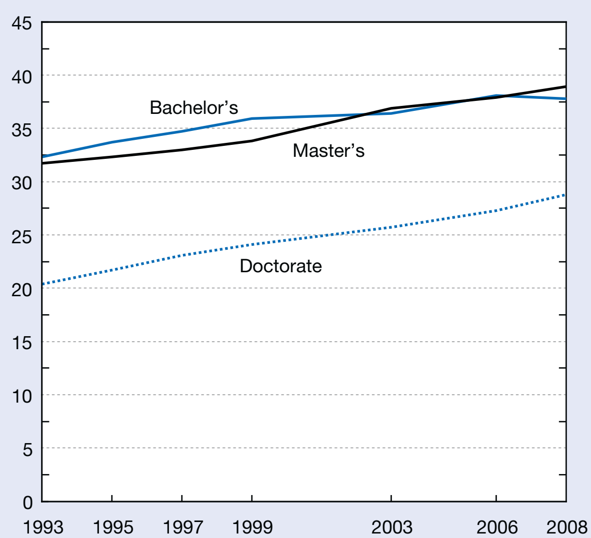
Figure 3-30
Employed women with highest degree in S&E, by degree level: 1993–2008



NOTE: National estimates not available from Scientists and Engineers Statistical Data System (SESTAT) in 2001.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993–2008), http://sestat.nsf.gov.

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In 2008, across all degree areas, 21% of women with a highest degree in S&E compared with 35% of men were employed in the field in which they earned their degree (appendix table 3-12). About 26% of women were working in an S&E occupation compared with 45% of men. However, within most degree areas, a similar proportion of men and women work in an occupation that matches their degree field, and similar proportions work in non-S&E jobs. Computer and mathematical science fields are exceptions, where men are more likely to work in an occupation that matches their degree field.

Racial/Ethnic Differences in the S&E Workforce

This section addresses the level of diversity in science and engineering by describing the cross-cutting social categories of race and Hispanic status. Like the preceding section, this section draws on data from the NSF science and engineering labor force surveys to report on levels of participation in science and engineering: first, across occupations, and next, across the overall workforce with science and engineering degrees.

Whether defined by occupation, S&E degree, or the combined criteria used in SESTAT, the majority of scientists and engineers in the United States are non-Hispanic white. The next largest group of scientists and engineers are Asians, who have been increasing their share in the S&E field since the early 1980s. On the other hand, several minority groups, including blacks, Hispanics, and Native Americans, have low levels of participation in science and engineering occupations both compared with other groups and compared with their proportion of the general working-age population (table 3-25). Both blacks and Hispanics also have low levels of participation in S&E relative to their proportion in the general population with a college degree. The composition of the S&E workforce across these groups has been a concern of policymakers who are interested in the development and utilization of human capital to maintain the United States' global competitiveness in science and engineering.

In 2008, with 3.5 million workers in S&E occupations, whites made up over 70% of the country's scientists and engineers. Whites accounted for more than 50% of workers within each of the S&E occupations (see appendix table 3-13). Whites are particularly highly concentrated in areas that focus on macrophysical systems. For example, whites were a strong majority of forestry and conservation scientists (91%); earth, atmospheric, and ocean scientists (86%); and agricultural and food scientists (82%).

Asians, with 824,000 workers in S&E occupations, accounted for 17% of scientists and engineers. They are strongly concentrated in computer engineering fields, constituting 40% of computer hardware engineers, 30% of computer software engineers, and 23% of the related occupations of electrical and electronics engineering. On the other hand, Asians participate in social science occupations at much lower rates than whites. For example, Asians account for 4% of psychologists and just 3% of sociologists and anthropologists.

The social sciences are the one occupation within S&E in which the underrepresented minorities (American Indian/Alaska Natives, blacks, Hispanics, and Native Hawaiians/Pacific Islanders) outnumber Asians. Collectively, these groups account for 17% of sociologists and anthropologists, and 12% of psychologists. These minorities also account for a comparatively high share of computer support specialists (16%) and statisticians (14%). On the other hand, underrepresented minorities account for relatively few physicists and astronomers (6%). Moreover, among these minority physicists and astronomers, only one-third were born in the United States compared with the more than two-thirds of underrepresented minorities who are in other S&E occupations and were born in the United States. U.S.-born underrepresented minorities accounted for less than 2% of physicists and astronomers.

Table 3-25
Racial/ethnic distribution of individuals in S&E occupations, S&E degree holders, college graduates, and U.S. residents: 2008
(Percent)

Race/ethnicity	S&E occupations	S&E degree holders	College degree holders	Total U.S. residential population
S&E occupations				
Asian	16.9	11.2	8.5	4.7
American Indian/Alaska Native	0.3	0.4	0.3	0.7
Black	3.9	5.5	7.2	11.7
Hispanic	4.9	5.6	6.2	13.9
White	71.8	75.2	76.5	67.6
Native Hawaiian/Other Pacific Islander	0.4	0.4	0.1	0.1
Two or more races	1.7	1.7	1.1	1.2

SOURCES: Census Bureau, American Community Survey (2008); National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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Race/Ethnicity Trends in S&E Occupations

Over the past two decades, the U.S. workforce in S&E occupations has been becoming more diverse with increasing numbers of minorities and Asians and a decreasing share of whites. In 1993, 84% of workers in S&E occupations reported their race as white. By 2008, this proportion declined to 72%. Some of this decline reflects changes to the NCSES workforce surveys that collect information on race in the S&E workforce. After 2000, respondents were able to report two or more races rather than just one. Some of those who self-reported as white in the 1990s may have instead reported a multiracial identity after 2000 if they had the option, which would have decreased the estimated numbers of whites. However, because less than 2% of S&E workers self-reported two or more races in years when the option was available, it is unlikely that this change contributed to much of the decline in the share of whites between 1993 and 2008. Most of the decline in whites was offset by growth among Asians during this period and some by growth in other groups, particularly Hispanics (table 3-26).

Age Differences Among Racial/Ethnic Groups

The age structure of different demographic groups (see table 3-24) reflects the fact that members of the different groups entered the S&E workforce in different numbers at different times. The largest demographic group, whites, is also the oldest, with a median age of 44. Almost one-third of whites were older than 50 and only 13% were age 30 or younger. Blacks (median age of 42) and Hispanics (median age of 39) are somewhat younger. Asians are even younger, with a median age of 38. The comparative youthfulness of Asians reflects the age distribution of Asians working in S&E who were born in the United States. Native-born Asians were dramatically younger than other demographic groups, including foreign-born Asians. The median age among U.S. native-born Asians working in S&E occupations was 30, and only 9% were older than 50.

Racial/Ethnic Differences Among S&E Degree Holders

Most patterns across demographic groups among workers in S&E occupations also hold for members of the workforce with a highest degree in an S&E field. Additionally, outcomes that vary by race among S&E degree holders deal with unemployment rates and level of degree attainment.

In 2008, among those whose highest degree was in an S&E field, Hispanics and blacks had the highest unemployment rate (5.2% and 5.1%, respectively), which was roughly two percentage points higher than the unemployment rate for whites (3.2%). Although whites had the lowest unemployment rate, they also had the highest labor force nonparticipation rate (17%). Because of the large numbers of whites who are out of the labor force, whites have the lowest rates of employment among S&E highest degree holders.

Among those who are employed and whose highest degree is in an S&E field, race/ethnicity groups have concentrations in different degree fields. Differences in degree fields resemble those among S&E occupations. Both blacks and Hispanics are more concentrated in the social sciences, and Asians are more concentrated in engineering and in computer and mathematical sciences. In 2008, among blacks, more than half had their highest S&E degree in the social sciences, while 46% of Hispanics did (table 3-27). For both of these groups, close to one-third had their highest S&E degrees in engineering or in the computer and mathematical sciences. Asians, on the other hand, are heavily concentrated in the computer and mathematical sciences and in engineering, with 59% having their highest degree in one of these two fields and 20% having their highest degree in the social sciences. The distribution of degree fields for whites more closely resembles that for non-Asian groups. (See appendix table 3-14 for more detailed data on S&E degrees by race and Hispanic status.) On the whole, the field differences among S&E degree holders are more pronounced than are the corresponding differences among workers in S&E occupations.

Table 3-26
Distribution of workers in S&E occupations, by race/ethnicity and year: 1993–2008
(Percent)

Race/ethnicity	1993	1995	1997	1999	2003	2006	2008
Asian	9.1	9.6	10.4	11.0	14.2	16.1	16.9
American Indian/Alaska Native	0.2	0.3	0.3	0.3	0.3	0.4	0.3
Black	3.6	3.4	3.4	3.4	4.3	3.9	3.9
Hispanic	2.9	2.8	3.1	3.4	4.4	4.6	4.9
White	84.1	83.9	82.9	81.8	75.2	73.2	71.8
Native Hawaiian/Other Pacific Islander	NA	NA	NA	NA	0.3	0.5	0.4
Two or more races	NA	NA	NA	NA	1.4	1.4	1.7

NA = not available

NOTES: Before 2003, respondents could not classify themselves in more than one racial/ethnic category. Before 2003, Asian included Native Hawaiians and other Pacific Islanders.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1993–2008), http://sestat.nsf.gov.

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Table 3-27
Field of highest degree among workers with highest degree in S&E, by race/ethnicity: 2008
(Percent)

Race/ethnicity	All S&E fields	Computer/ mathematical sciences	Biological/ agricultural/ environmental life sciences	Physical sciences	Social sciences	Engineering
Employed with highest degree in S&E	12,588,000	15.3	15.6	6.7	39.3	23.2
Asian	1,545,000	24.7	13.8	7.4	20.2	33.9
American Indian/Alaska Native	46,000	19.9	17.3	6.3	41.3	15.1
Black	638,000	17.0	12.3	3.5	54.0	13.1
Hispanic	722,000	11.7	14.7	5.1	45.8	22.7
White	9,348,000	14.0	16.1	7.0	40.6	22.3
Native Hawaiian/Other Pacific Islander	53,000	14.1	14.9	3.6	40.2	27.2
Two or more races	236,000	11.1	14.7	5.5	50.3	18.5

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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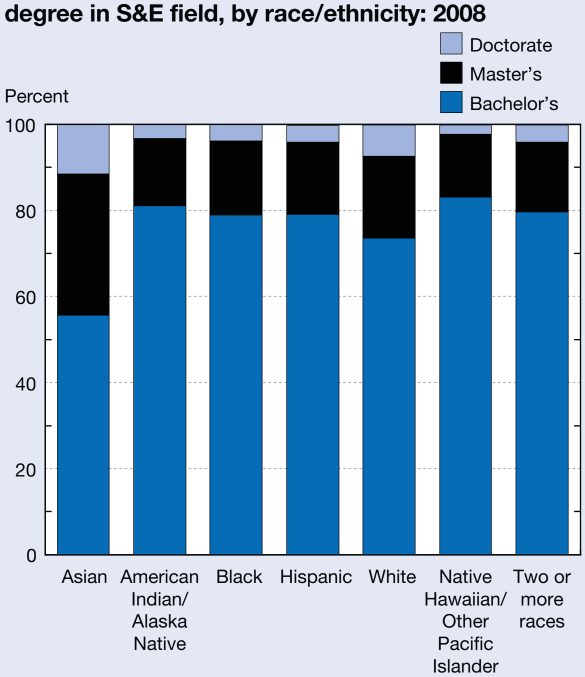
In addition to having concentrations in different fields, the demographic groups differ in the level of their highest degree. For example, among Asians with a highest degree in an S&E field, 56% have their highest degree at the bachelor's level and 12% have a doctoral degree (figure 3-31). In comparison, among both blacks and Hispanics 79% have their highest degree at the bachelor's level and 4% have a doctoral degree.

Figure 3-31
Level of S&E degree among workers with highest degree in S&E field, by race/ethnicity: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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Asians whose highest degree is in an S&E field are more likely than are others to work in an S&E occupation and are more likely than are others to work in the area in which they earned their degree (see appendix table 3-12). Among blacks, only one-quarter work in an S&E occupation; among Hispanics and American Indians/Alaska Natives nearly one-third work in an S&E occupation. By comparison, more than half of Asians work in these occupations.

Race/ethnicity matters even for those with similar credentials. Some, but not all, of the high concentration of black S&E degree holders working outside of science and engineering, and the high concentration of Asian S&E degree holders working within S&E, can be explained by their different degree levels or fields. But Asians with an S&E degree have a higher propensity to work in S&E occupations than others even among individuals with similar degree levels and fields. Thus differences between Asians and blacks in the propensity among degree holders to work in S&E occupations remain even among those with the same degrees.

Salary Differentials for Women and Minorities

Women and minority groups generally receive less pay than their male and white counterparts. The median salary in 2008 among women with a highest degree in an S&E field and working full time was one-third lower than the median salary among similar men (appendix table 3-15). Salary differences between men and women are much greater among those who are not working in S&E occupations. Among those working full time in S&E occupations, women's salaries were 18% lower than men's.

Racial/ethnic salary differences were somewhat smaller than salary differences between men and women (appendix table 3-16). American Indians/Alaska Natives with a highest degree in an S&E field and working full time earned 19% less than whites; blacks earned 16% less than whites; and Hispanics earned 14% less than whites. These salary differences were generally more modest among those who worked in S&E occupations.

Overall, both salary differences between men and women and race/ethnicity salary differences remained largely unchanged in the 15-year period between 1993 and 2008.

Differences in average age, work experience, field of degree, sector of employment, and other characteristics can make direct comparison of salary and earnings statistics misleading. Statistical models can estimate the size of the wage difference between men and women, as well as the wage difference between minorities and whites when various salary-related factors are taken into account. Estimates of these differences vary somewhat depending on the assumptions that underlie the statistical model used. The remainder of this section presents estimates of the expected size of the wage difference between men and women among individuals who are similar in age, work experience, field of degree, and other relevant characteristics; data bearing on wage differences between non-Asian minorities and whites are also included. These estimates are substantively consistent with many of the other published analyses on these topics (see, for example, Xie and Shauman 2003). Without accounting for any factors except level of degree, women working full time whose highest degree is a bachelor's in an S&E field were paid salaries that were 38% lower than those of men (figure 3-32).[14] This salary difference is substantial, but it is smaller at both the master's level (28%) and at the doctoral level (24%). The salary differences for minorities relative to whites are narrower (figure 3-33). Minority salary levels are 10% lower than those of whites at the bachelor's level, 16% lower at the master's level, and 4% lower at the doctoral level. All estimated baseline differences are statistically significant.

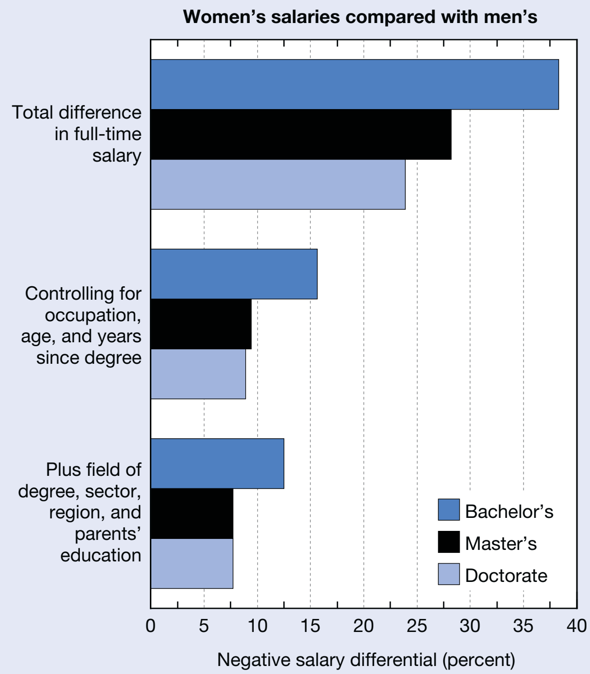
Effects of Occupation and Experience on Salary Differences

Salaries differ across occupations. For example, in the three S&E occupations with the lowest concentrations of women—aerospace, aeronautical, or astronautical engineers; mechanical engineers; and electrical and electronics engineers—the combined median salary among men is $90,000, and among women it is $81,000. These figures are substantially higher than the combined sex-specific median salary ($65,750 for men and $54,000 for women) in the three large S&E occupations with the highest concentrations of women—psychologists; medical scientists, except practitioners; and biological scientists (see appendix table 3-15). Salary also varies by indicators of experience, including both age and years since completing education. Estimates of salary differences are made by applying controls for occupation, age, and years since completing the highest degree.[15] After controlling for these factors, the estimated wage difference between men and women narrows. However, among men and women in similar jobs and with similar levels of experience, women are still paid 16% less than men (among individuals whose highest degree is at the bachelor's level) and 9% less than men (among individuals whose highest degree is at the master's and doctoral level). Minorities with their highest degree at the bachelor's level also earn somewhat less (6%) than whites, after controlling for occupation and experience. Among those with a doctoral degree, the wage difference between minorities and whites is mostly attenuated (3%) and at the master's degree level, the difference is fully attenuated after controlling for occupation and experience. This illustrates that at higher degree levels, minorities and white degree holders in similar S&E occupations and with similar experiences receive about the same salaries.

Effects of Other Factors: Sector, Field of Degree, and Region

Salaries vary by other work-related factors beyond occupation and experience. For example, salaries differ across sector. Academic and nonprofit employers typically pay less for the same skills than employers pay in the private sector, and government compensation falls somewhere between the two groups. These differences are salient for understanding salary variations by sex and race/ethnicity because whites and males are more highly concentrated in the

Figure 3-32
Estimated differences in full-time salary between women and men with highest degree in S&E, controlling for selected employment and other characteristics, by degree level: 2008



NOTES: Salary differentials represent estimated percentage differential of women's full-time salary relative to men's full-time salary. Coefficients are estimated in a mixed-effects regression model using natural log of full-time annual salary as dependent variable.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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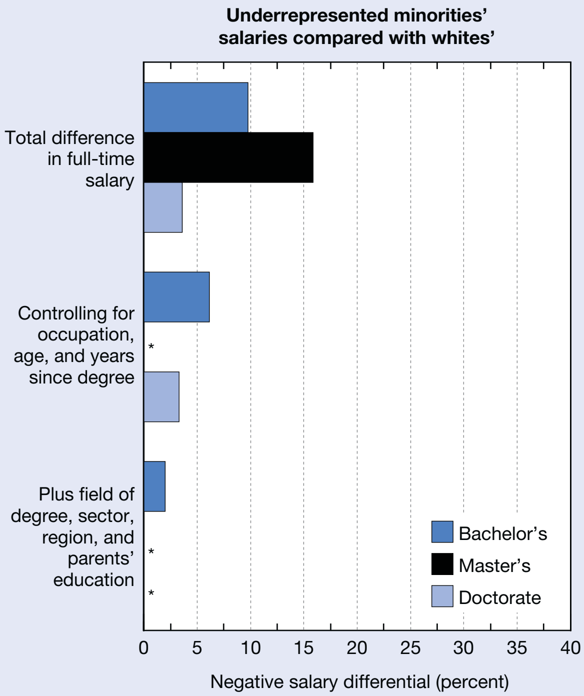
Figure 3-33
Estimated differences in full-time salary between underrepresented minorities and whites with highest degree in S&E, controlling for selected employment and other characteristics, by degree level: 2008



* Differences not significant at $p < .05$.

NOTES: Salary differentials represent estimated percentage differential of underrepresented minorities' full-time salary relative to whites' full-time salary. Coefficients estimated in a mixed-effects regression model using natural log of full-time annual salary as dependent variable. Asians and multiracial individuals, representing 15% of employed highest S&E degree holders, are not included in regression. Underrepresented minorities include American Indian/Alaska Natives, blacks, Hispanics, and Native Hawaiian/Other Pacific Islanders.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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private for-profit sector. Salaries also differ across regions. For example, at $86,000, the Pacific census division had the highest median salaries for scientists and engineers among the nine U.S. census divisions and the west-north-central, at $75,000, had the lowest. Almost one-quarter (23%) of U.S.-born underrepresented minorities worked in the Pacific division compared with 15% of whites, whereas whites had a higher concentration in the west-north-central (9%) than underrepresented minorities (4%).

Salaries also vary by degree field. Salaries among those with degrees in engineering, the physical sciences, and in computer and mathematical sciences are higher than salaries among those with degrees in the environmental and life sciences, and among those with degrees in the social sciences. Degree areas with lower salaries also have higher concentrations of women and minorities.

However, taking these factors into account[16] in addition to occupation and experience results in only marginal changes in the estimated salary differences between men and women compared with estimates generated accounting for occupation and experience alone. Women who are similar to men along all seven of these factors receive salaries that are 13% (among bachelor's degree holders) to 8% (among master's degree and doctoral degree holders) lower than their male counterparts. The salary difference between minorities and whites fully attenuates when all seven factors are simultaneously controlled.

Effects of Family on Salary Differences

The family roles of wife and mother are associated with lower salaries for women. In contrast, the roles of husband and father are associated with higher salaries among men. To evaluate the effects of family status on wage differences between men and women, these differences are estimated separately for the set of workers in science and engineering occupations who are unmarried and without young children, who are married and without young children, and who are married and with young children. Each estimate is made accounting for occupation, age, time since degree, employment sector, field of degree, region, and parents' educational attainment, as described above. The analysis presented in figure 3-34 considers a household to include young children if a child age 12 or younger was present.[17]

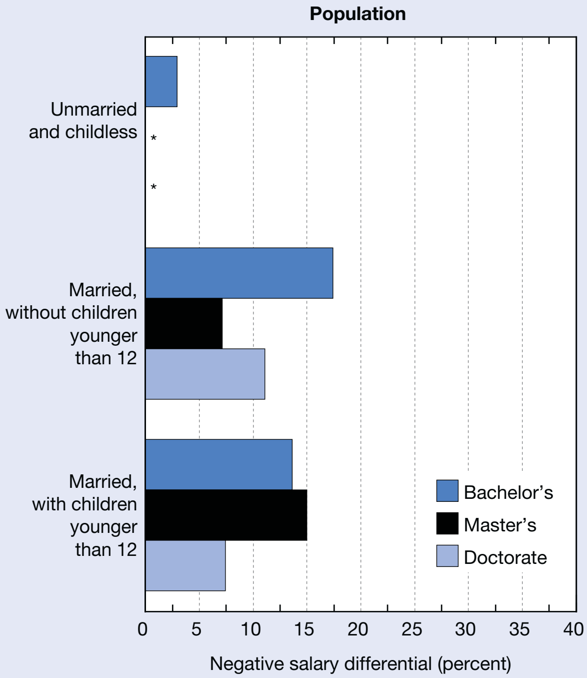
Among full-time workers with a highest degree in an S&E field who are both unmarried and childless, men and women tend to be paid similar salaries. At the bachelor's level, the estimated salary difference is 3% among men and women who are similar in occupation, age, experience, work sector, degree field, region, and parents' education (figure 3-34). At the master's and doctoral levels, estimated salary differences between men and women among the unmarried and childless are statistically insignificant. The presence or absence of children under age 12 does not consistently affect the size of salary differences between men and women beyond what would be expected considering other factors.[18]

S&E Immigrants

The foreign born constitute a considerable proportion of workers in science and engineering occupations, and both the number and share of foreign-born workers have been increasing. However, immigration of scientists and engineers to the United States has declined during the recent economic downturn. Most indicators presented in this section apply to all foreign born, despite the fact that *the foreign born* is a broad category comprising long-term U.S. residents with strong roots in the United States as well as recent immigrants who compete in global job markets or whose main social ties are in their countries of origin.

Several sources yield broadly consistent estimates of U.S. reliance on foreign-born scientists and engineers. Table 3-28

Figure 3-34
Estimated differences in full-time salary between men and women with highest degree in S&E, controlling for selected employment and other characteristics, by marital and parental status and degree level: 2008



* Not significantly different than zero at $p = .05$.

NOTES: Salary differentials represent estimated percentage differential of women's full-time salary relative to men's full-time salary when controlling for occupation, age, years of experience, field of degree, employment sector, region, and parents' education. Coefficients estimated in a mixed-effects regression model using natural log of full-time annual salary as dependent variable.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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shows upward trends in the percentage of foreign-born individuals in U.S. S&E occupations over the first decade of the century. The share of nonacademic scientists and engineers who are foreign born rose from 22% in 2000 to 25% in 2009, although some evidence suggests that the rate of growth slowed in the last years of the decade.

The similarity in the estimates from SESTAT and the U.S. Census Bureau American Community Survey (ACS) is noteworthy because the two surveys differ methodologically. SESTAT surveys include only individuals who were counted in the most recent Decennial Censuses or who received a U.S. S&E degree, thereby excluding recently arrived foreign-born and foreign-educated scientists and engineers. The potential for an undercount of the foreign born is smallest in the earliest portion of the decade—the closer in time to the Decennial Census—and increases over the course of the decade.[19] The ACS, on the other hand, draws a new sample of the U.S. residential population every year. However, ACS occupation coding is less precise, and the ACS does not distinguish postsecondary teachers in science and engineering fields from other postsecondary teachers. The similarity in the estimates from these surveys, despite their contrasting limitations, suggests that the overall picture the surveys provide is broadly accurate.

Characteristics of the Foreign Born

The foreign born in S&E occupations tend to have higher levels of education than the U.S. native born. In most S&E occupations, the higher the degree level, the greater the proportion of the workforce who are foreign born (appendix table 3-17). This relationship is weakest among social scientists and strongest among computer and mathematical scientists and engineers. In 2003, at the bachelor's degree level, the proportion of foreign-born individuals within occupational areas ranged between 10% (social scientists) and 19% (computer and mathematical scientists). However, at the doctoral degree level, about half of the workers in computer and mathematical sciences and in engineering were foreign born.

In 2003, more than half (55%) of foreign born in the United States with a highest degree in an S&E field came from Asian countries. Just over one-fifth were born in Europe. North America (Canada), Central America, the Caribbean, South America, and Africa each supply roughly equal numbers (each accounting for from 4% to 5% of the foreign born). The leading country of origin among immigrant S&E workers in the United States is India, which accounted for 16% of the foreign born. China (with 11%) is the second leading country. Source countries for the 276,000 foreign-born holders of S&E doctorates are somewhat more concentrated, with China providing 22% and India 14% (figure 3-35 and appendix table 3-18).

Source of Education

The majority of foreign-born scientists and engineers in the United States came to the United States before completing their higher education, but a substantial number came to the United States after receiving their university training abroad. Although almost half of the foreign-born, university-educated individuals working in the United States have a degree from a foreign university, two-thirds earned their highest degree from a U.S. educational institution. Among the foreign born with a doctoral degree, just over two-thirds received this degree from a U.S. institution, although nearly 80% have at least one degree from a foreign institution.

New Foreign-Born Workers

The number and share of foreign-born S&E workers have been rising, but the volume of new foreign workers entering U.S. S&E occupations has shown signs of decline during the recent economic downturn. One indicator of new foreign-born S&E workers joining the U.S. workforce is the number of temporary work visas issued by the U.S. government in visa classes for high-skilled workers. A second indicator is

Table 3-28
Foreign-born workers in S&E occupations, by education level: Selected years, 2000–09
(Percent)

Education	2000 Decennial census	2003 SESTAT	2003 ACS	2006 SESTAT	2006 ACS	2008 SESTAT	2008 ACS	2009 ACS
All college educated[a]	22.4	22.6	24.2	24.0	25.3	24.8	24.9	25.2
Bachelor's	16.5	16.4	17.7	17.5	18.1	17.2	18.4	18.3
Master's	29.0	30.3	32.0	32.8	33.5	33.9	32.7	33.4
Doctorate	37.6	40.5	37.8	40.9	41.8	41.4	40.9	41.6

ACS = American Community Survey; SESTAT = Scientists and Engineers Statistical Data System

[a]Includes professional degrees not broken out separately.

NOTES: Includes all S&E occupations except postsecondary teachers because these occupations not separately reported in 2000 Census or ACS data files. SESTAT 2006 and 2008 data do not include foreign workers who arrived in the United States after 2000 Decennial Census and also did not earn S&E degree in United States.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (2003–08), http://sestat.nsf.gov; Census Bureau, 2000 Decennial Census Public Use Microdata Sample (PUMS) and ACS (2003, 2006, 2008, 2009).

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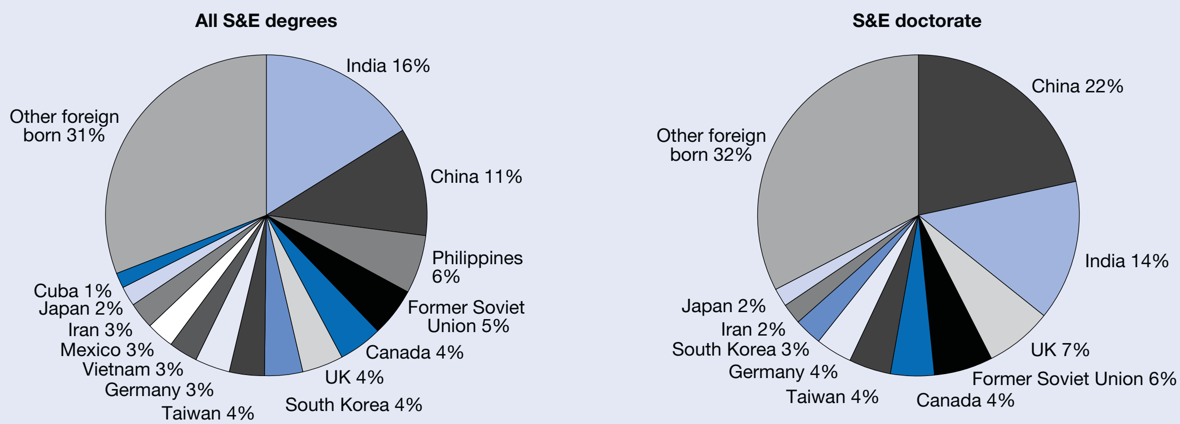
Figure 3-35
Foreign-born individuals with highest degree in S&E living in the United States, by place of birth: 2003



UK = United Kingdom

NOTE: Percents may not add to 100% because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2003), http://sestat.nsf.gov. See appendix table 3-18.

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the rate at which foreign-born recipients of U.S. doctoral degrees remain in the United States after earning their degree ('stay-rates').

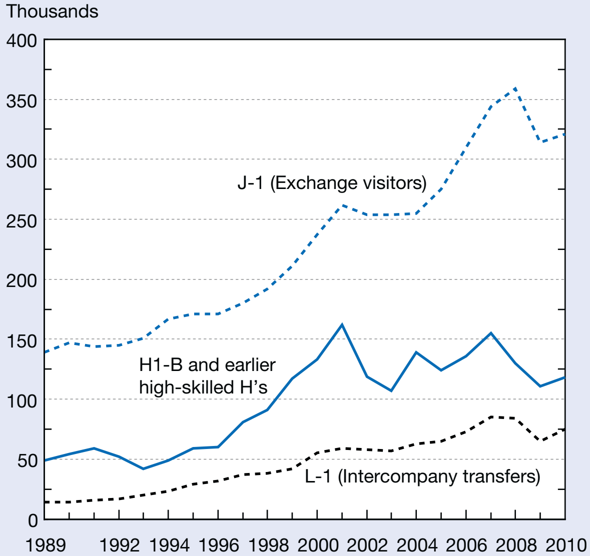
Temporary Visas

The number of temporary work visas issued for high-skill workers provides an indication of the volume of immigration of these workers. However, for all types of temporary work visas, the actual number of individuals using them is less than the number issued. For example, some individuals may have job offers from employers in more than one country and may choose not to foreclose any options until a visa is certain.

The largest classes of these temporary visas declined during the recent economic downturn, after several years of growth (figure 3-36). Data for 2010, however, suggest that this period of decline may be short-lived. The previous period of decline in the use of these visas occurred during the more mild recession in the earlier part of the decade, and these declines were unevenly experienced across visa categories.

H-1B temporary work visas account for a larger number of high-skill workers than other visa classes. This visa is issued to individuals who seek temporary entry into the United States in a specialty occupation that requires the skills of a professional. It is issued for up to 3 years with the possibility of an extension to 6 years. In 2010, the United States issued

Figure 3-36
Temporary work visas issued in categories with many high-skilled workers: FY 1989–2009



NOTE: J-1 exchange visitor visa used for many different skill levels.

SOURCE: U.S. Department of State, Nonimmigrant Visa Issuances by Visa Class and by Nationality, http://www.travel.state.gov/visa/statistics/nivstats/nivstats_4582.html (accessed May 4, 2011).

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more than 118,000 H-1B visas, down almost 25% from the nearly 155,000 issued in 2007.

Similarly, many fewer J-1 exchange visas—visas issued for limited periods of study, research, or teaching—were issued in 2010 than in 2007. For L-1 visas, which support intercompany transfers, the number was 12% lower in 2010 than in 2007. The smaller, more specialized visa programs for high-skilled workers also fell slightly in 2010. These visa classes include O-1 (a person of outstanding ability), O-2 (an assistant to an O-1, sometimes a postdoc), TN (college-degreed citizens of Canada and Mexico), and E-3 (college-degreed citizens of Australia).

Characteristics of H-1B Visa Recipients

The H-1B visa, which is the most common visa for new foreign entrants into the U.S. S&E workforce, is not issued exclusively for scientists and engineers. Other professional workers who use an H-1B visa include those in administrative occupations, legal occupations, and cultural occupations (such as artists and entertainers). However, because the U.S. Citizenship and Immigration Services do not classify occupations with the same taxonomy used by the National Science Foundation, precise counts of H-1B visas issued to scientists and engineers cannot be obtained. Nevertheless, it is safe to say that the bulk of H-1B visa recipients work in S&E or S&E-related occupations (appendix table 3-19). In 2009, workers in computer-related occupations were the most common recipients of H-1B visas, accounting for 35% of H-1B visas issued. The total number of newly initiated H-1B visas for workers in computer-related fields declined by nearly half from 2008 to 2009 while the share of total recipients who worked in these fields declined from 50% to 35%. Despite this drop, the proportion of H-1B recipients who worked in computer sciences was considerably higher than it was early in the decade. For example, in 2002, only 25% of these visa recipients worked in computer-related fields.

H-1B visa recipients tend to possess advanced degrees. In FY 2009, 58% of new H-1B visa recipients had an advanced degree, including 40% with master's degrees, 6% with professional degrees, and 13% with doctorates. This degree distribution differs by occupation, with 83% of mathematical and physical scientists holding advanced degrees (44% with doctorates). Among life scientists, 87% hold advanced degrees (61% with doctorates).

Almost half of recent H-1B visa recipients were from India (39%) or China (10%). Among doctorate holders, 29% were from China and another 16% from India (figure 3-37). Altogether, Asian citizens made up nearly two-thirds of all H-1B visa recipients with a doctoral degree.[20]

Table 3-29 shows salaries paid to new recipients of H-1B temporary work visas by occupation group and level of degree. These starting salaries, taken from final visa application forms sent to U.S. Citizenship and Immigration Services, are different from—and generally higher than—H-1B salaries that firms report on their applications to the Department of Labor, which are filed much earlier in the H-1B process. The relatively low average salaries for doctorate holders in the life sciences may reflect the common use of H-1B visas to hire individuals for relatively low-paying postdoc fellowships.

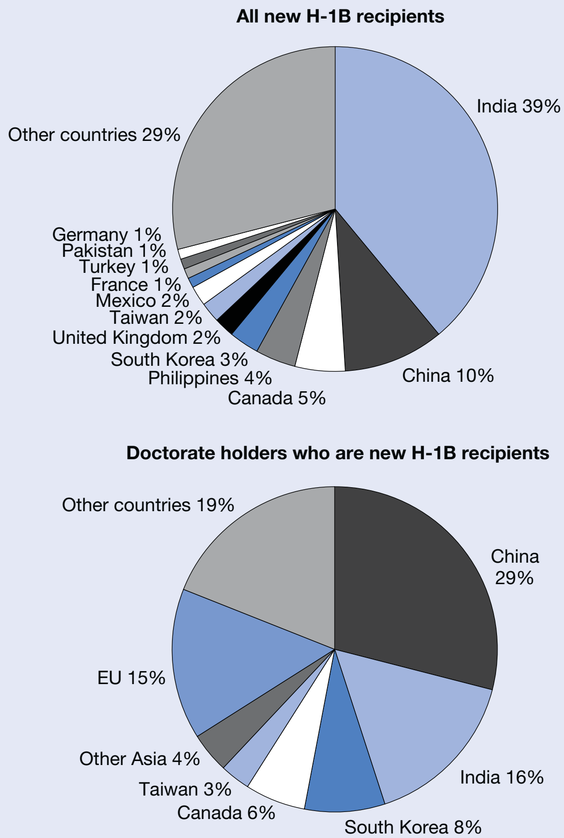
Short-Term Stay Rates for U.S. Doctorate Recipients

Among doctoral recipients, the period immediately after earning the doctoral degree is a pivotal point at which long-term career trajectories may be set. Foreign doctoral recipients who remain in the United States may set themselves on a pathway toward long-term residency.

At time of award, foreign students who receive doctoral degrees from U.S. universities report whether they intend to stay in the United States and whether they have a firm offer (either a postdoc or employment opportunity) to stay in the United States.[21] These responses provide estimates of short-term stay rates.

Most foreign U.S. doctorate recipients plan to stay in the United States after graduation. At the time of doctorate receipt, three-quarters of foreign recipients of U.S. S&E doctorates, including those on both temporary and permanent visas, plan to stay in the United States, and about half have either accepted an offer of postdoc study or employment or are continuing employment in the United States (figure 3-38).[22] Through the 1980s, about half of foreign students who earned S&E degrees at U.S. universities reported that they planned to stay in the United States after graduation, and about one-third said they had firm offers for postdoc study or employment (NSB 1998). In the 1990s, however, these percentages increased substantially. Thus, the proportion

Figure 3-37
Citizenship of new recipients of U.S. H-1B temporary work visas: FY 2009



EU = European Union

NOTE: Other Asia includes Hong Kong, Japan, Malaysia, Singapore, and Thailand.

SOURCE: Department of Homeland Security (DHS), U.S. Citizenship and Immigration Services; National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2011) of DHS administrative records.

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of foreign S&E doctoral degree recipients reporting plans to stay in the United States rose to 72% in the 1998–2001 period and to 77% in the 2006–09 period (appendix table 3-20). In 2009, both the percentage who reported plans to stay in the United States and those with firm offers to stay declined modestly from 2008. The number of foreign doctoral degree recipients also declined in 2009, making the drop from 2008 to 2009 in numbers of foreign-born doctoral recipients with plans to stay in the United States somewhat more pronounced, with 6% fewer foreign-born doctoral recipients reporting plans to stay in the United States.

Overall S&E short-term stay rates reflect the high short-term stay rates in computer and mathematical sciences, the biological and related sciences, the physical sciences, and engineering. Between 2006 and 2009, the short-term stay rate in each of these four fields was about 80%, as measured by reports of intentions to stay in the United States. However, the short-term stay rate for foreign doctoral recipients in the social sciences and in health fields was considerably lower.

Stay rates vary by place of origin. In the period 2006–09, 89% of U.S. S&E doctoral recipients from China and from India reported plans to stay in the United States, and close to 60% reported accepting firm offers for employment or postdoc research in the United States. Doctorate recipients from Japan, South Korea, and Taiwan were less likely than those from China and India to stay in the United States (figure 3-39). Close to half of U.S. S&E doctoral degree recipients from Europe had firm plans to stay after graduation. In North America, the percentage of 2006–09 doctoral degree students who had definite plans to stay in the United States was higher for those from Canada than those from Mexico (see appendix table 3-20).

Between 2002–05 and 2006–09, the percentage of U.S. S&E doctoral degree recipients from the two top countries of origin (China and India) who were reporting definite plans to stay in the United States declined. Other countries, however, experienced sharp increases in short-term stay rates among S&E doctoral degree recipients in the United States, including Indonesia, New Zealand, Mexico, and Colombia.

Long-Term Stay Rates

The rate at which foreign recipients of U.S. doctoral degrees who stayed in the United States immediately after they received their degree continue to remain in the United States over longer durations can also be observed.[23] Recent trends in long-term stay rates show that within cohorts, long-term stay rates are similar to short-term rates. This similarity is particularly evident for the cohort of foreign S&E doctoral recipients who earned their degrees in 1993 (figure 3-40). Two years after receiving the doctoral degree, 53% of these foreign doctorates who were temporary residents when they earned their degree remained in the United States. By 2009, 52% remained, with little variation along the way. More recent cohorts have had higher short-term stay rates, but these stay rates have declined over time. The cohort of degree recipients who earned their doctorates in 1999 had a stay rate after 2 years of 68%. After 10 years, this rate declined by 7 percentage points, but the rate of decline gradually attenuated. The cohort of foreign S&E doctoral degree recipients of 2004 had a 2-year stay rate of 66%, which declined to 62% by 2009 (figure 3-40; Finn 2012, forthcoming).

The stability of stay rates over time applies whether or not these rates are calculated for foreign doctoral recipients from U.S. institutions who received their doctoral degree while on a temporary visa status or for those who held either a temporary or permanent visa. Temporary visa holders make up the largest share of foreign S&E doctoral degree recipients. They also have lower stay rates than do permanent residents. For example, among foreign S&E doctoral degree recipients from the 1993 cohort, those who were permanent residents at the time they earned their degree had stay rates that were 24 percentage points higher than those with temporary visas. This difference persisted through 2009. Among more recent cohorts, the difference in stay rates between permanent and

Table 3-29
Average annual salary of new H-1B visa recipients, by occupation and education level: FY 2009
(Dollars)

Occupation	All degree levels	Bachelor's	Master's	Professional	Doctorate
Administrative specializations	57,700	56,000	59,000	77,000	89,000
Architecture/engineering/surveying	71,300	71,000	68,000	77,000	82,000
Art	47,800	47,000	50,000	na	na
Computer-related occupations	66,300	65,000	66,000	73,000	94,000
Education	53,200	40,000	48,000	78,000	57,000
Entertainment/recreation	36,600	37,000	36,000	na	na
Law/jurisprudence	108,200	83,000	74,000	137,000	na
Life sciences	53,300	47,000	52,000	54,000	55,000
Managers/officials nec	87,200	83,000	89,000	132,000	138,000
Mathematics/physical sciences	69,800	70,000	68,000	84,000	71,000
Medicine/health	76,500	55,000	58,000	100,000	64,000
Miscellaneous professional/technical/managerial	75,300	72,000	76,000	91,000	101,000
Museum/library/archival sciences	49,900	na	46,000	na	na
Religion/theology	37,800	41,000	36,000	na	na
Social sciences	67,400	60,000	70,000	na	95,000
Writing	44,600	44,000	43,000	na	na

na = not applicable; nec = not elsewhere classified

SOURCE: Department of Homeland Security (DHS), U.S. Citizenship and Immigration Services; National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2011) of DHS administrative records.

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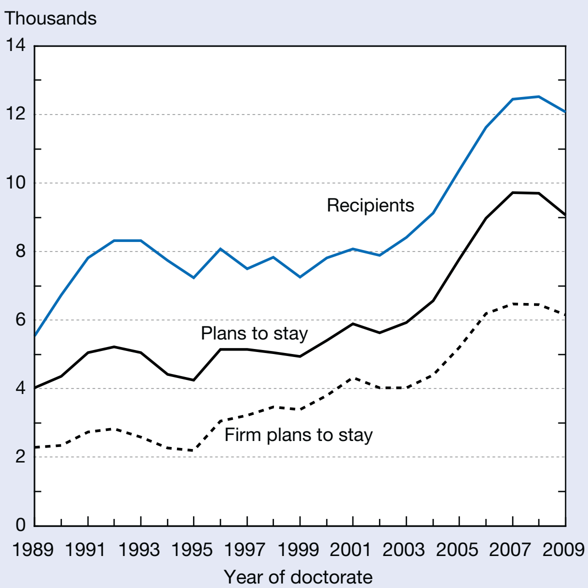
Figure 3-38
Plans of U.S. S&E doctorate recipients with temporary visas at graduation to stay in United States, by year of doctorate: 1989–2009



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2011) of Survey of Earned Doctorates.

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temporary residents was initially much smaller, but increased rapidly over the 5 years after receipt of the doctorate.

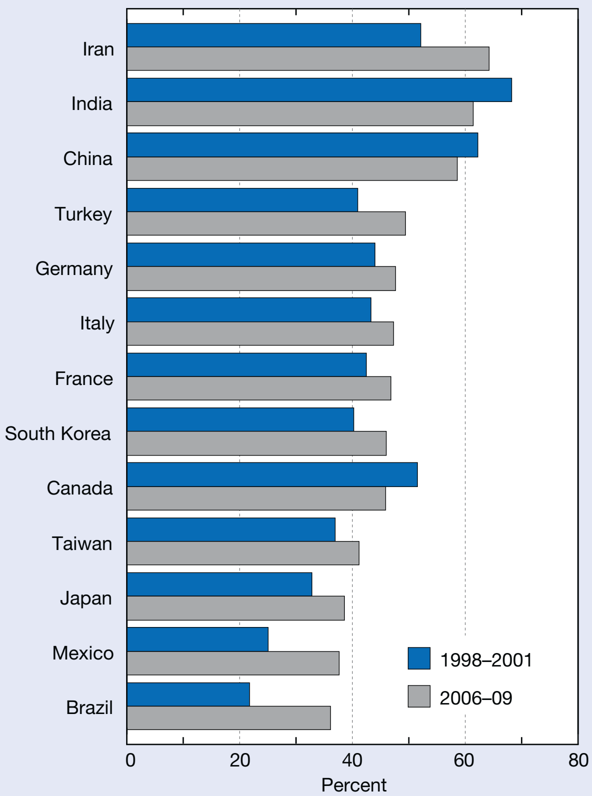
Because of the persistence of stay rates over time, factors that are associated with the level of short-term stay rates are similarly associated with the level of longer-term stay rates. For example, countries with the highest levels of short-term stay rates (e.g., China and India) are among the countries with the highest long-term stay rates. Similarly, academic fields that have the highest short-term stay rates (e.g., the physical sciences) also have the highest long-term stay rates, and the field with the lowest short-term stay rates, the social sciences, has the lowest long-term stay rates.

Some evidence suggests that stay rates may vary for doctorate recipients from graduate programs of different quality based on ratings of faculty by the publication *U.S. News and World Report* and on separate ratings by the National Research Council (Finn 2009). Doctorate recipients from the graduate programs designated among the top 25 were somewhat less likely to remain in the United States than were graduates of other programs (see table 3-30). The difference in 1-year stay rates was 2 percentage points: 69% of those from the top-rated programs and 71% of other doctorate recipients remained in the United States 1 year after receiving their degrees. By 5 years after receiving their degree, the two groups showed differences that rose to 5 percentage points, with stay rates of 59% and 64%, respectively.

Age and Retirement

The baby boom generation—the unusually large cohort born between 1946 and 1964 (with birth rates in the United States peaking in 1957)—affected the age structure of the S&E labor force in much the same way it affected the general labor force. Thus, in the early 1990s, this bulge produced a relatively large concentration of S&E workers in their late 20s to mid-40s contributing to a comparatively

Figure 3-39
Plans of U.S. S&E doctorate recipients with temporary visas at graduation to stay in the United States, by place of origin and year of doctorate: 1998–2001 and 2006–09



NOTE: Rates are proportions of each group reporting firm commitment to postgraduation employment in United States.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2011) of Survey of Earned Doctorates.

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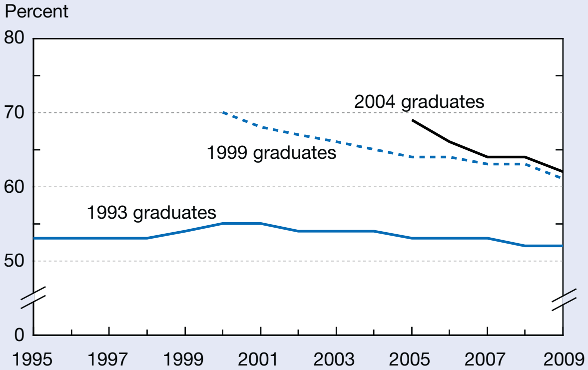
Figure 3-40
Stay rates for U.S. S&E doctorate recipients with temporary visas at graduation, by selected year of doctorate: 1995–2009



SOURCE: Finn M, Stay rates of foreign doctorate recipients from U.S. universities: 2012, Oak Ridge Institute for Science and Education (forthcoming).

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youthful S&E workforce. By 2008, these cohorts had aged into their early 40s to early 60s, with the oldest nearing traditional retirement ages. One indicator of the aging of the S&E workforce is the increasing percentage of individuals in this workforce above age 50 (as seen in figure 3-41). In 2008, 27% of individuals with S&E degrees and in S&E occupations were in that age group, whereas 15 years earlier just 18% were in that age group.

Another indication of the aging of the S&E labor force is the increase over time of the median age of individuals working in S&E occupations. From 1993 to 2008, the median age rose by 4 years, from 37 to 41 years of age. The median age of workers with a highest degree at the bachelor's level rose by 5 years (from 35 to 40), at the master's level by 3 years (from 39 to 42), and at the doctoral level by 3 years (from 44 to 47).

The increasing average age of S&E workers may mean increased experience and greater productivity among them. However, it could also reduce opportunities for younger researchers to make productive contributions by working independently. In many scientific fields, folklore and empirical evidence indicate that the most creative research comes from younger people (Stephan and Levin 1992).

Age Differences Among Occupations

Individuals with S&E degrees who work in S&E occupations are younger than individuals with S&E degrees who work in S&E-related occupations. They also are younger than those whose jobs are not in, nor related to, S&E. Figure 3-42 shows, for 2008, age distributions for S&E-degree holders by highest degree level and broad occupational area. Age differences across broad occupational areas are more pronounced at higher degree levels. Among those whose highest S&E degree is at the master's level, the median age of workers in S&E occupations was 42; for workers in S&E-related occupations it was 47; for workers in jobs not in nor related to S&E occupations it was 49. Among those whose highest S&E degree is at the doctoral level, the median age of workers in S&E occupations was 47 compared with 50 for workers in S&E-related occupations and 53 for workers in jobs not in nor related to S&E. The flow of workers out of S&E occupations into other occupations compared with the reverse flow from other occupations to S&E occupations contributes to much of the differences in age distributions across broad occupational areas. For example, among workers in S&E occupations who were observed in 2003, 16% were no longer in such occupations in 2006. On the other hand, only 5% of those workers in other occupations in 2003 were in S&E occupations in 2006. Among the S&E workers who moved into other occupations, one-third (approximately 200,000 workers) went into management positions, many of which involve supervising S&E workers.

Age Differences Among S&E Degree Fields

In 2008, the median age among those in the labor force with any degree in S&E was 43. Degree holders in different areas varied in their ages. Degree holders in the physical sciences were comparatively old with a median age of 47 and 38% of the field's workers over age 50 (figure 3-43). Degree holders in computer and mathematical sciences were relatively young, with a median age of 42 and only 22% over age 50. Within degree areas, specific fields differed considerably in the ages of their workers. For example, within engineering the youngest degree holders were in bioengineering and biomedical engineering, with a median age of 34 and with 39% younger than age 30 (see appendix table 3-21). On the other hand, more than 40% of the workers in metallurgical engineering and mining and mineral engineering were older than 50.

Leaving the Labor Force and Retirement

The increasing share of the S&E labor force over age 50 makes retirement patterns among S&E workers more important in terms of how they will affect the supply of these workers. Recent patterns of labor force exit and work reduction among the older members of the workforce suggest that by age 55 rates of participation in the S&E workforce begin to decline and are markedly reduced by the time workers reach

Table 3-30
Temporary U.S. residents who received S&E doctorates in 2002, by program rating and year: 2003–07
(Percent)

Program rating	Foreign doctorate recipients (*n*)	2003	2004	2005	2006	2007
All programs	7,850	70	67	65	63	63
Top-rated programs	2,611	69	65	62	60	59
All other programs	5,239	71	69	67	65	64

NOTE: Characterization of programs as "top-rated" by Finn, using ratings of faculty reputation in research from *U.S. News and World Report* and National Research Council.

SOURCE: Finn M, Stay rates of foreign doctorate recipients from U.S. universities: 2012, Oak Ridge Institute for Science and Education (forthcoming).

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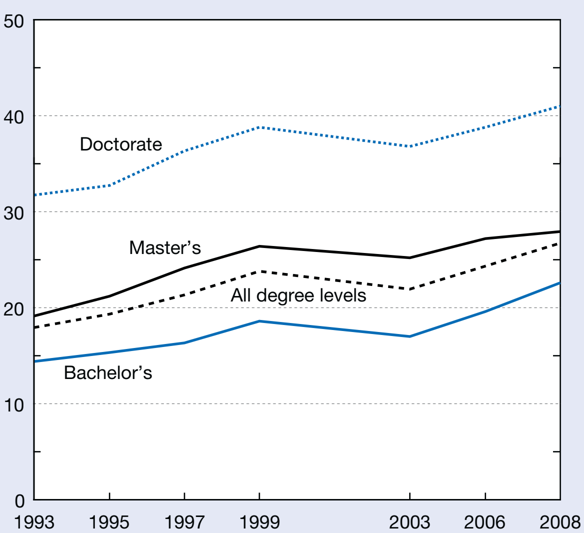
Figure 3-41
Workers older than age 50 in S&E occupations, by highest degree level and year: 1993–2008



NOTES: Total includes professional degrees not broken out separately. National estimates not available from Scientists and Engineers Statistical Data System (SESTAT) in 2001.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993–2008), http://sestat.nsf.gov.

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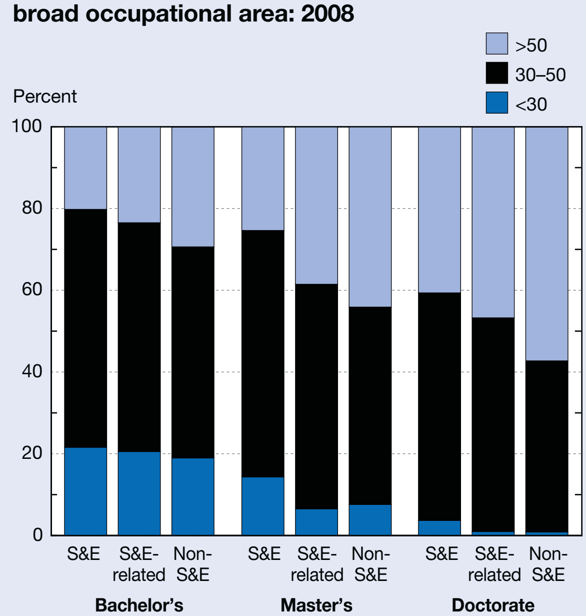
Figure 3-42
Age distribution of employed individuals with highest degree in S&E, by degree level and broad occupational area: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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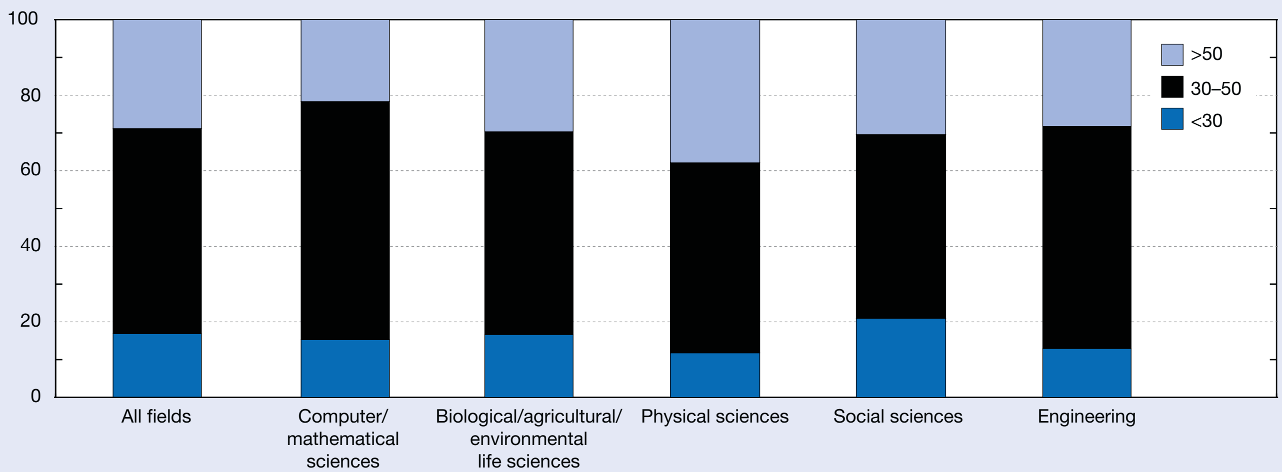
Figure 3-43
Age distribution among employed individuals with highest degree in S&E, by degree field: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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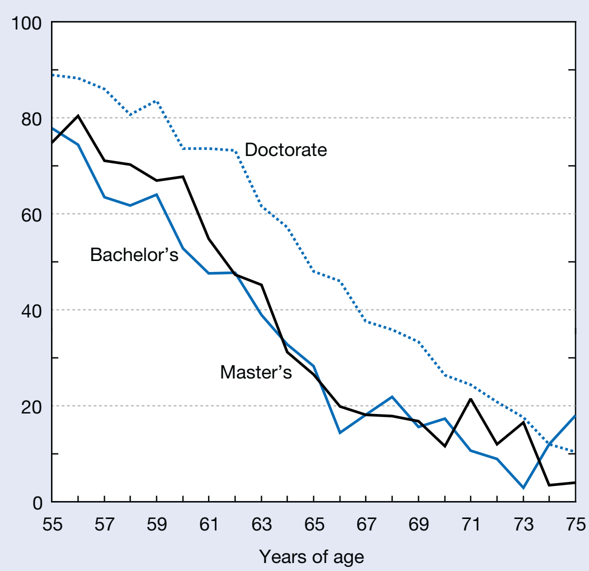
their mid-60s. One indication of the relationship between age and the level of labor force participation is illustrated by figure 3-44, which shows full-time work rates among older S&E degree holders by highest level of education. In 2008, at age 55, 78% of those whose highest degree was at the bachelor's level, 75% of those whose highest degree was at the master's level, and 89% of those whose highest degree was at the doctoral level worked full time. However, at all degree levels, full-time labor force participation rates decline quickly as S&E workers age into their late 50s. By age 61, more than half of S&E bachelor's degree holders are not working full time. Among those whose highest degree is at the master's level, this milestone is reached at age 62. For S&E doctoral degree holders, half are not working full time by age 64. After age 65, no more than one-quarter of the workforce with a highest degree at the master's or bachelor's level worked full time. Among those with a doctoral degree, this proportion is reached at age 71.

Another indicator of the relationship between age and labor force participation is the proportion of S&E degree holders who reported that they were out of the labor market. In 2008, at age 55, 12% of those whose highest degree is at the bachelor's level, 7% of those whose highest degree is at the master's level, and 5% of those whose highest degree was at the doctoral level were out of the labor force. By the early 60s, the proportion of people who are out of the labor force takes a sharp turn upwards, and by age 65 about half of those whose highest degree is at the master's level and half of those whose highest degree is at the bachelor's level report that they are neither working nor looking for work. Among those with a doctoral degree, more than half report neither working nor looking for work at age 68.

Table 3-31 shows the rates at which holders of U.S. S&E doctorates left full-time employment, by sector of employment, between April 2006 and October 2008. Rates of leaving full-time employment for S&E doctorate holders were higher for those working in the private sector than those

Figure 3-44
Older individuals with highest degree in S&E who work full time, by age and degree level: 2008



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2008), http://sestat.nsf.gov.

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Table 3-31
Employed S&E doctorate holders who left full-time employment after April 2006, by employment sector and age: October 2008
(Percent)

Age (years)	April 2006 employment sector: All sectors	Education	Government	Business/ industry
50–55......	4.7	3.3	2.5	6.9
56–62......	9.7	7.9	10.2	11.7
63–70......	27.6	26.3	28.0	29.3

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2006, 2008), http://sestat.nsf.gov.

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employed in education or government, although in the oldest group this sector difference largely disappears.

Between 1993 and 2008, increasing percentages of SESTAT respondents in their 60s reported that they were still in the labor force. Whereas 59% of S&E degree holders between the ages of 60 and 64 were employed in 1993, the comparable percentage rose to 66% in 2006. For S&E degree holders between ages 65 and 69, the increase was larger, rising from 32% in 1993 to 44% in 2006. After peaking in 2006, rates of employment among workers in their 60s declined slightly in 2008, but remained above rates prior to 2006. Other indicators, including full-time employment rates and retirement rates, show similar patterns, as do comparisons restricted to workers with similar highest degree levels and degrees in similar fields. In recent years, labor force participation has also risen slightly among S&E degree holders in their early 70s, but has not changed among those in their late 50s.

Global S&E Labor Force

Work that involves science and engineering occurs throughout the world. Such work is concentrated in developed nations, where most R&D also takes place. The availability of a suitable labor force is an important determinant of where businesses choose to locate S&E work (Davis and Hart 2010), and concentrations of existing S&E work, in turn, spawn new employment opportunities for workers with relevant S&E knowledge and skills. As a result, governments in many countries have made increased investments in S&E-related postsecondary education a high priority. At the same time, high-skill workers, such as those in S&E occupations, are increasingly mobile, and the number who leave their native countries to pursue education and career goals is growing. In recent years many nations, recognizing the value of high-skill workers for the economy as a whole, have changed their laws to make it easier for such workers to immigrate. These changes indicate an accelerating competition for globally mobile talent (Shachar 2006).

Ideally, data on the global S&E labor force would include statistics on its overall size and growth, enable detailed comparisons of S&E labor force characteristics in different countries, and track flows of S&E workers across national boundaries. Unfortunately, the internationally comparable data that exist are limited to establishment surveys that provide only basic information about workers in S&E occupations or with training in S&E disciplines. The U.S. SESTAT system, for example, includes far more data on members of the U.S. S&E labor force than is available in other national statistical systems. In addition, although surveys that collect workforce data are conducted in many member countries of the Organisation for Economic Co-operation and Development (OECD), they do not cover several countries—including Brazil, India, and Israel—that have been making concerted efforts to build knowledge economies in which S&E play a central role, and they do not provide fully comparable data for China.

This section begins with information about the size and growth of workforce segments whose jobs involve S&E in nations for which relevant data exist. It then reports limited data on high-skill migration trends. Data on the role of immigrants in the U.S. S&E labor force are reported earlier in this chapter (see "Demographics in the S&E Labor Force"). The section closes with data on international employment by U.S. multinational companies and international engagement by members of the U.S. S&E workforce.

Size and Growth of Global S&E Labor Force

Although comprehensive data on the worldwide S&E workforce do not exist, OECD data covering significant, internationally comparable segments of the S&E workforce provide strong evidence of widespread, though uneven, growth in the world's developed nations.

OECD countries, which include most of the world's highly developed nations, compile data on researchers from establishment surveys in member and selected non-member countries. These surveys mostly use a standardized occupational classification that defines researchers as "professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned" (OECD 2002, p. 93). Because this definition can be applied differently when different nations conduct surveys, international comparisons should be made with caution. The OECD also reports data on personnel employed directly in R&D. These data include clerical and administrative staff employed in R&D organizations as well as professionals whose skills and career paths are more closely connected to R&D.

OECD reports an estimated increase in researchers in its member countries from 2.8 million in 1995 to 4.2 million in 2007. OECD also publishes estimates for eight non-member economies, including China and Russia; adding these to the OECD member total for 2007 yields a worldwide estimate of 6.3 million. Numerous uncertainties affect this estimate, however:

- Some non-member countries that engage in large and growing amounts of research (e.g., India, Brazil) are omitted entirely from these totals.
- China's data for 2009, collected in accordance with OECD definitions and standards, yield an estimate of about 440,000 fewer researchers than China's data for the preceding year.
- For some countries and regions, including the United States and the European Union, OECD estimates are derived from multiple national data sources and not from a uniform or standardized data collection procedure.

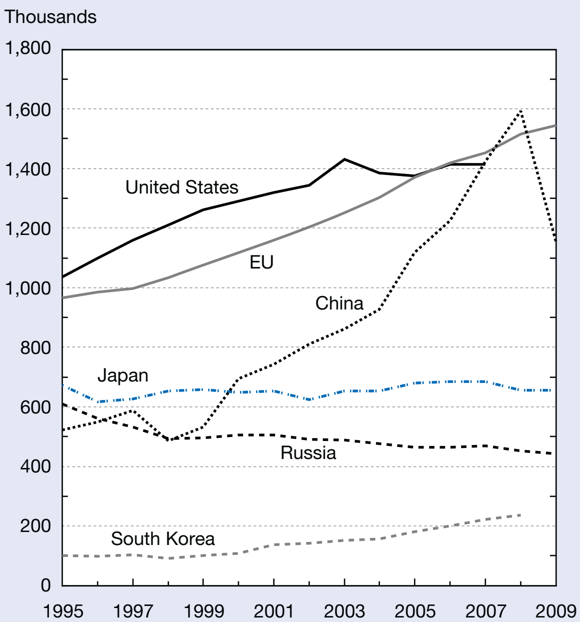
Despite these limitations for making worldwide estimates of the number of researchers, the OECD data are a reasonable starting point for estimating the rate of worldwide growth.

For most economies with large numbers of researchers, growth since the mid-1990s has been substantial (figure 3-45). China, whose pre-2009 data did not entirely correspond to the OECD definition, reported about triple the number of researchers in 2008 compared with 1995. South Korea doubled its number of researchers between 1995 and 2006 and continued to grow strongly between 2007 and 2008. The United States and the European Union experienced steady growth but at a lower rate between 1995 and 2007, both starting the period at about 1 million researchers and increasing to almost 1.5 million. Japan (little change) and Russia (decline, especially early in the period; see also Gokhberg and Nekipelova 2002) were exceptions to the overall worldwide trend. Trends in full-time equivalent R&D personnel were generally parallel to those for researchers in those cases for which both kinds of data are available (appendix table 3-22).

OECD also estimates the proportion of researchers in the workforce in different economies. In OECD's most recent estimates, small economies in Scandinavia (Denmark, Finland, Iceland, Norway, Sweden) and East Asia (Singapore, Taiwan) report that at least 1% of their workforce are researchers (appendix table 3-23).[24] Among economies with more than 200,000 researchers, OECD's latest estimates are that researchers make up the highest proportions of the workforce in Japan (1.04%), South Korea (1.00%), and the United States (0.95%). Although China reports a large number of researchers, they are a much smaller percentage of its workforce (0.15%) than in OECD member countries.

Several Asian economies have shown marked and continuous increases since 1995 in the percentage of their workforce employed as researchers. These include China, South Korea, Singapore, and Taiwan. In the United States and Japan, where growth occurred at all, it took place mostly between 1995 and 2003 (figure 3-46). Patterns and trends in the proportion of the workforce classified as R&D personnel are generally similar to those for researchers.

Figure 3-45
Estimated number of researchers in selected countries/regions: 1995–2009



EU = European Union

NOTES: Researchers are full-time equivalents. Before 2009, counts for China were not consistent with Organisation for Economic Co-operation and Development (OECD) standards.

SOURCE: OECD, Main Science and Technology Indicators (2010/1 and earlier years).

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High-Skill Migration

Worldwide or internationally comparable data on migration of workers in S&E occupations or with college-level S&E degrees do not exist. Docquier, Lowell, and Marfouk (2009; see also Docquier and Marfouk 2006) compiled and analyzed data on migrants to OECD countries in 1990 and 2000. Their data come from almost 200 source locations, all but a handful of them independent nations. They report several characteristic patterns in high-skill migrations, defined as emigration of people with some postsecondary education from the country of their birth:

- Between 1990 and 2000, the overall number of immigrants to OECD countries increased from about 42 million to about 58 million.
- Rates of legal emigration were much greater among high-skill persons than among persons with less education.
- In countries the World Bank classifies as low income, the gap in emigration rates between high- and low-skill groups (6.1% compared with a total emigration rate of 0.5%) was especially large.
- The proportion of women among high-skill migrants rose, partly but not entirely because of the worldwide increase in the proportion of people with some postsecondary education who are women.
- Countries estimated to have the largest number of high-skill emigrants living in OECD countries in 2000 were the United Kingdom (1.5 million), the Philippines (1.1

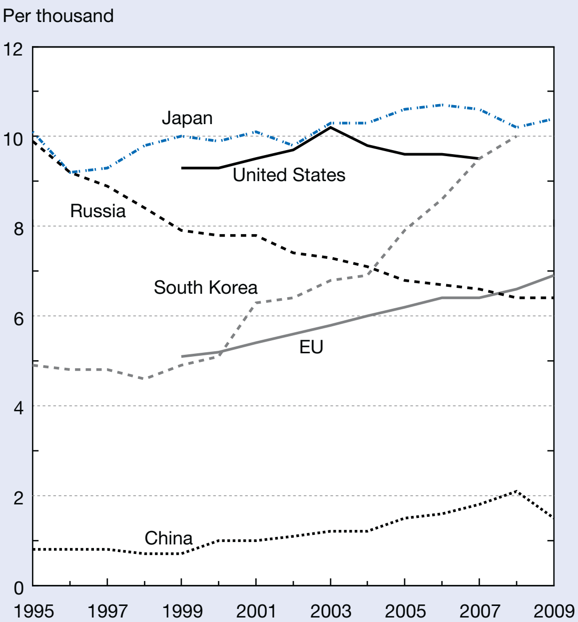
million), India (1.0 million), Mexico (0.9 million), and Germany (0.9 million) (figure 3-47).

♦ In both 1990 and 2000, about half of the immigrants with tertiary education living in OECD countries were in the United States.

In a more limited study covering six major destination countries, Defoort (2008) concluded that worldwide emigration rates for high-skill persons were stable between 1975 and 2000; Docquier and Marfouk (2006) calculate an increase in the migration rate for these persons from 5.0% to 5.4% between 1990 and 2000. Nonetheless, because worldwide education levels are rising, the proportion of high-skill persons among those who immigrated to OECD countries rose between 1990 and 2000 (Docquier and Marfouk 2006).

Insofar as S&E workers, especially those in natural science and engineering fields, are less dependent on language- and culture-specific skills than highly educated workers trained in other fields, they may be more internationally mobile than other high-skill workers. Thus, in the United States high-skill immigrants are disproportionately found in S&E occupations and disproportionately have degrees in the natural sciences and engineering. However, current international data do not enable researchers to assess whether and how migration rates vary among different categories of high-skill workers.

Figure 3-46
Researchers as a share of total employment in selected countries/regions: 1995–2009



EU = European Union

NOTES: Researchers are full-time equivalents per thousand total employment. Before 2009, counts for China were not consistent with Organisation for Economic Co-operation and Development (OECD) standards.

SOURCE: OECD, Main Science and Technology Indicators (2010/1 and earlier years).

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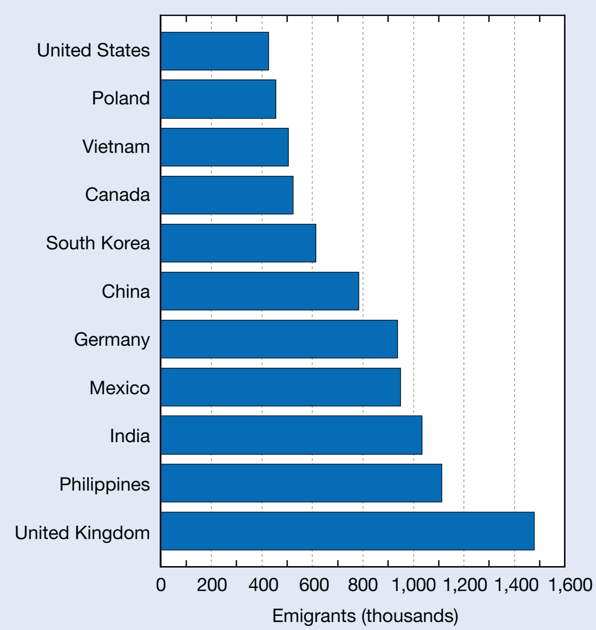
R&D Employment Abroad by U.S. Companies

R&D jobs located abroad in U.S.-owned companies are an indicator of global engagement in the world's S&E workforce. Data from the 2009 Business R&D and Innovation Survey provide an overview of R&D employment in the business sector and enable comparisons between domestic and foreign R&D employment in companies located in the United States (both U.S.- and foreign-owned) that have R&D activity (table 3-32). These data identify employment as either domestic or foreign on the basis of the job's location and not on the basis of the company's ownership, the employee's citizenship, or the employee's place of birth.

Among firms with five or more employees, R&D employment is disproportionately domestic. About one-third of all employees are located abroad, compared with about one-quarter of R&D employees. There is a large disparity between the overall proportion of manufacturing employment that is foreign (41%) and the proportion of manufacturing R&D employment that is foreign (25%). In contrast, the proportions in nonmanufacturing industries are similar: 24% for overall employment and 23% for R&D employment.

Larger companies locate more of their R&D employment outside the country than small ones. In firms with 1,000 or more employees, 30% of R&D employment is foreign-based, whereas only 11% is foreign-based in firms with

Figure 3-47
Top countries of origin of foreign-born persons having at least a tertiary education and residing in an OECD country: 2000



OECD = Organisation for Economic Co-operation and Development

SOURCE: Docquier F, Lowell BL, Marfouk A. A Gendered Assessment of Highly Skilled Emigration (2009), http://perso.uclouvain.be/frederic.docquier/filePDF/DLM_PDR09.pdf.

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Table 3-32
Domestic and foreign business-sector employment, by company characteristics: 2009

	Company size				Industry type			
	5–999		≥1,000		Manufacturing		Nonmanufacturing	
Education	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total employment								
Worldwide	4,915	100	22,177	100	16,679	100	10,415	100
Domestic	3,840	78	13,947	63	9,882	59	7,906	76
Foreign	1,075	22	8,321	37	6,798	41	2,509	24
R&D employment								
Worldwide	587	100	1,290	100	1,137	100	742	100
Domestic	523	89	902	70	850	75	574	77
Foreign	65	11	391	30	287	25	167	23

NOTES: Data are representative of companies where worldwide R&D expense plus worldwide R&D costs funded by others are greater than zero. Includes 2002 North American Industry Classification System (NAICS) codes 21–23, 31–33, and 42–81. Detail may not add to total because of rounding. Industry classification based on dominant business code for domestic R&D performance, where available. For companies not reporting business codes, classification used for sampling was assigned.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Business R&D and Innovation Survey (2009 preliminary).

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fewer than 1,000 employees. In both cases, comparable percentages are higher for overall employment (37% and 22%, respectively).

The domestic and foreign R&D workforces of U.S.-located businesses have similar occupational and demographic profiles. Data on broad occupational categories, levels of educational attainment, and sex distributions for businesses in different sectors and of different sizes are in appendix table 3-24.

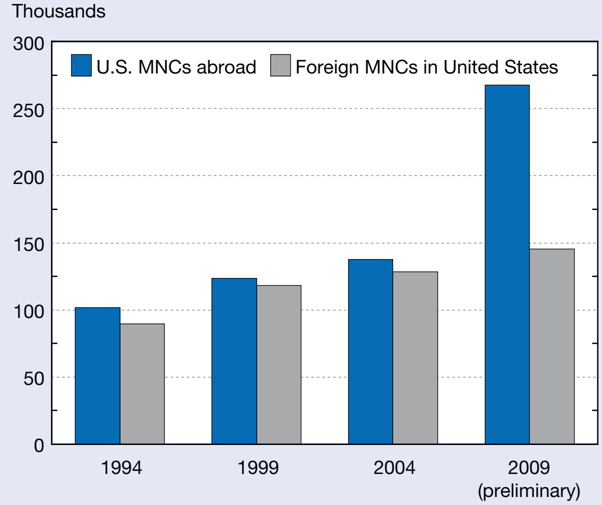
Multinational companies (MNCs) perform a substantial proportion of R&D through foreign direct investment (FDI) (see chapter 4). Data on MNC R&D employment count managers, scientists, engineers, and other professional and technical employees engaged in R&D. The Survey of U.S. Direct Investment Abroad, conducted by the Bureau of Economic Analysis (BEA), provides data on R&D employment of parent companies of U.S. MNCs and their overseas affiliates every 5 years. Preliminary data for this indicator are available for 2009. Separately, BEA's Survey of Foreign Direct Investment in the United States includes data on U.S. R&D employment by foreign-based MNCs.[25]

Between 1994 and 2004, R&D employment in the United States by foreign firms grew slightly faster than R&D employment abroad by U.S. firms. During this period, R&D employment in the United States by majority-owned affiliates[26] of foreign firms rose from 89,800 to 128,500, a 43% increase (figure 3-48). Over the same 10 years, R&D employment by U.S. firms at their majority-owned foreign affiliates grew 35%, from 102,000 in 1994 to 137,800 in 2004. Adding U.S. parent company R&D employment of 716,400 workers, U.S. MNCs employed 854,200 R&D workers globally (figure 3-49) in 2004.

The average annual growth in R&D employment abroad by U.S. firms from 1994 to 2004 was 3%. This shifted their proportion of overseas employment slightly, increasing it from 14% to 16% of total employment.

The 2009 data on MNC R&D employment abroad show a markedly different trend after 2004 from the trend in the preceding decade. About 85% of MNC R&D employment growth occurred abroad. Whereas employment abroad nearly doubled, domestic employment during the same period

Figure 3-48
R&D employment of U.S. multinational corporations at their foreign affiliates, and foreign MNCs at their U.S. affiliates: 1994, 1999, 2004, and 2009



MNC = multinational corporation

NOTE: Includes only employment at majority-owned affiliates.

SOURCE: Bureau of Economic Analysis, Survey of Foreign Direct Investment in the United States and Survey of U.S. Direct Investment Abroad (various years).

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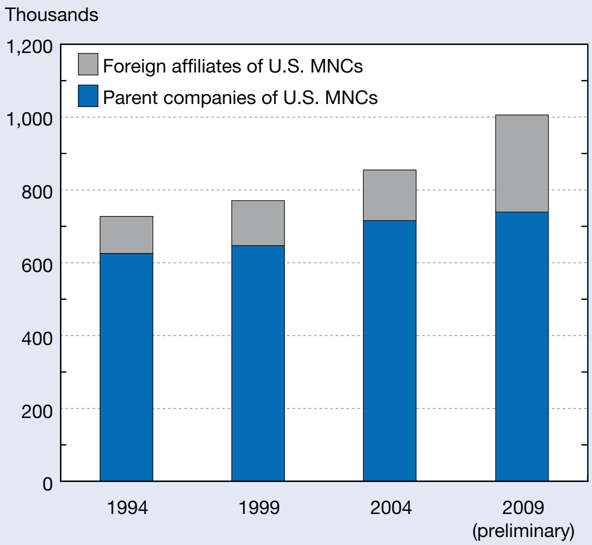
Figure 3-49
R&D employment of U.S. multinational corporations' parent companies in the United States and their foreign affiliates: 1994, 1999, 2004, and 2009



MNC = multinational corporation

NOTE: Includes only employment at majority-owned affiliates.

SOURCE: Bureau of Economic Analysis, Survey of U.S. Direct Investment Abroad (various years).

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grew by less than 5%. As a result, the proportion of MNC R&D employment located outside the United States went from 16% to 27%.

The unprecedented increase in U.S. MNC R&D employment abroad contrasts with the continuation of modest growth in R&D employment by foreign firms in the United States. Because of this, unlike in 2004 and prior years, the amount of R&D employment attributed to U.S. MNCs abroad is much larger than the comparable figure for foreign firms in the United States (figure 3-48).

The data in figures 3-48 and 3-49 are consistent with two trends discussed in this chapter: growth in S&T employment in the United States coinciding with a general expansion throughout the world of the capacity to do S&T work.

International Engagement by the Domestic S&E Workforce

Working with people in foreign countries is an indicator of how globally engaged the S&E workforce is. In 2006, SESTAT asked survey respondents whether they had worked "with individuals located in other countries" during a particular week. Seventeen percent of respondents reported that they had.

The proportion of the workforce that reported this kind of international engagement varied depending on differences in their work roles and demographic characteristics (table 3-33; appendix table 3-25) (NSF/NCSES 2012c, forthcoming). The following patterns were found among SESTAT respondents:

- Workers in for-profit organizations (24%) had the highest rates of international work, more often reporting such work than those in government, education, self-employment, or nonprofit organizations. Federal government workers had higher rates than state or local employees, and those in 4-year higher educational institutions had higher rates than persons teaching at institutions serving less advanced students.
- Workers in S&E occupations had much higher rates of international engagement (28%) than those in non-S&E (16%) or S&E-related (8%) occupations.
- Among those in S&E occupations, computer and mathematical scientists and engineers had the highest rates of international engagement and social scientists had the lowest rates. However, within employment sectors field differences did not consistently follow this pattern.
- Doctorate holders had substantially higher rates of international engagement than individuals whose highest degrees were at the master's or bachelor's level. Professional degree holders had the lowest rates of all.
- Men (21%) reported international engagement more often than women (11%).
- Foreign-born survey respondents (24%) reported international engagement more often than U.S.-born individuals (15%).
- SESTAT respondents who earned degrees both in the United States and abroad had the highest rates of international engagement (31%). The comparable figure for those who earned their degrees abroad was 23%, and for those with only U.S. degrees it was 16%.

SESTAT respondents showed substantial variation in international engagement depending on their work activities. For persons reporting either computer applications, programming, and systems or R&D as a primary or secondary work activity, the rate of international engagement was high—about one-quarter reported an international interaction. Rates for teaching (6%) and for professional services (7%) were substantially lower than for other activities.

Data on another indicator of international engagement, international coauthorship of S&E journal articles, are reported in chapter 5.

Table 3-33

Scientists and engineers reporting international engagement, by demographic characteristics, education, employment sector, occupation, and salary: 2006

Characteristic	Total employment	Reporting international engagement	
		Number	Percent
All employed scientists and engineers	18,927,000	3,157,000	16.7
Sex			
Male	10,683,000	2,293,000	21.5
Female	8,244,000	865,000	10.5
Place of birth			
U.S. born	15,714,000	2,397,000	15.3
Not U.S. born	3,213,000	761,000	23.7
Age group (years)			
≤24	619,000	86,000	13.9
25–34	3,951,000	679,000	17.2
35–44	5,169,000	1,006,000	19.5
45–54	5,381,000	886,000	16.5
55–64	3,165,000	425,000	13.4
≥65	641,000	75,000	11.8
Place of postsecondary education			
All degrees earned in United States	17,031,000	2,675,000	15.7
Degrees earned abroad and in United States	730,000	229,000	31.4
All degrees earned abroad	114,000	254,000	22.8
Highest degree			
Bachelor's	10,886,000	1,761,000	16.2
Master's	5,384,000	970,000	18.0
Professional	1,774,000	171,000	9.7
Doctorate	883,000	254,000	28.8
Employment sector			
Business/industry	13,137,000	2,653,000	20.2
For-profit	7,682,000	2,048,000	26.7
Self-employed[a]	3,624,000	478,000	13.2
Non-profit	1,830,000	127,000	6.9
Government	2,228,000	216,000	9.7
Federal	824,000	146,000	17.8
State/local	1,405,000	69,000	4.9
Education	3,562,000	289,000	8.1
4-year educational institutions[b]	1,549,000	229,000	14.8
Other educational institutions[c]	2,014,000	60,000	3.0
Occupation			
S&E occupations	5,024,000	1,416,000	28.2
Computer/mathematical scientists	2,112,000	667,000	31.6
Biological/agricultural/other life scientists	487,000	116,000	23.9
Physical scientists	334,000	80,000	23.9
Social scientists	47,000	70,000	14.8
Engineers	1,621,000	483,000	29.8
S&E-related occupations	5,246,000	394,000	7.5
Non-S&E occupations	8,657,000	1,348,000	15.6
Salary			
<$30,000	2,923,000	190,000	6.5
$30,000–49,999	4,127,000	362,000	8.8
$50,000–69,999	3,872,000	522,000	13.5
$70,000–89,999	2,986,000	636,000	21.3
$90,000–109,999	2,068,000	551,000	26.6
≥$110,000	2,950,000	897,000	30.4

[a]Includes self-employed or business owners in incorporated or unincorporated businesses, professional practices, or farms.
[b]4-year educational institutions include 4-year colleges or universities, medical schools (including university-affiliated hospitals or medical centers), and university-affiliated research institutions.
[c]Other educational institutions include 2-year colleges, community colleges, or technical institutes and other precollege institutions.

NOTES: International engagement defined as working with individuals located in other countries during survey reference week. *Scientists and engineers* refers to all persons who have received a bachelor's degree or higher in an S&E or S&E-related field, plus persons holding a non-S&E bachelor's or higher degree who were employed in an S&E or S&E-related occupation in 2003. Numbers rounded to nearest 1,000. Detail may not add to total because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering, Scientists and Engineers Statistical Data System (SESTAT) (2006), http://sestat.nsf.gov.

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Conclusion

The S&E labor force may be defined in a variety of ways. At its core are individuals in S&E occupations, with S&E degrees, using knowledge and skills closely related to their S&E training, and working in jobs that make use of this expertise. But in a modern knowledge-based economy many workers have one or two of these attributes rather than all of them. Nonetheless, by any plausible definition, the S&E labor force experienced strong growth in the United States and the world throughout the second half of the twentieth century.

Policymakers with otherwise divergent perspectives agree that jobs involving S&E are good for workers and good for the economy as a whole. These jobs pay more, even when compared to jobs requiring similar amounts of education and experience. Workers with S&E training or in S&E occupations are less likely to be unemployed. Industries with higher proportions of workers in S&E occupations tend to offer higher pay even to their employees who are in other lines of work.

Worldwide, growing numbers of workers are engaged in research. Growth has been especially marked in rapidly developing economies, such as South Korea and China, that have either recently joined the ranks of the world's developed economies or are poised to do so. Mature developed economies in North America and Europe have maintained slower growth, while the number of researchers in the struggling Japanese economy has been stagnant.

The United States has shown some recent signs of slower growth: little change in the number of trained workers in S&E occupations, an aging S&E workforce that is drawing nearer to retirement (though showing signs of delaying retirement to somewhat later ages), and a modest drop during the most recent recession in the proportion of foreign recipients of U.S. advanced S&E degrees who join the U.S. labor force. At the same time, members of historically underrepresented groups (e.g., women, blacks) have played an increasing role in the U.S. S&E labor force, although more so in some fields (e.g., biological and social sciences) than in others (e.g., mathematical and physical sciences and engineering). In addition, the United States has remained an attractive destination for foreign workers with advanced S&E training.

Numerous factors beyond the availability of workers equipped to use S&E knowledge and skills on the job will affect the kinds of jobs that the U.S. economy generates in the future. As a result, data on current labor force trends do not necessarily portend future patterns that will emerge in a dynamic world economy recovering from the shocks produced by a prolonged economic downturn.

Notes

1. The standard definition of the term *labor force* includes the population that is employed or not working but seeking work (unemployed); other individuals are not considered in the labor force. When data refer only to employed persons, the term *workforce* is used. For data on unemployment rates by occupation, calculations assume that unemployed individuals are seeking further employment in their most recent occupation.

2. Despite the limitations of this subjective measure, variations among occupations in the proportions of workers who say they need this level of S&E technical expertise accord with common sense. For example, among doctoral level postsecondary teachers of physics, 99.7% said they needed at least a bachelor's degree level of knowledge in engineering, computer sciences, mathematics, or the natural sciences, compared with 5% among doctoral level postsecondary teachers of English. Likewise, among the small numbers of S&E bachelor's degree holders whose occupation is *secretary/receptionist/typist,* fewer than one in six reported that their job needed bachelor's level S&E expertise of any kind.

3. Estimates of the size of the S&E workforce vary across the example surveys because of differences in the scope of the data collection (SESTAT surveys collect data from individuals with bachelor's degrees and above only); because of the survey respondent (SESTAT surveys collect data from individuals, OES collects data from establishments, and ACS collects data from households); or because of the level of detail collected on an occupation, which aids in coding. All of these differences can affect the estimates.

4. Many comparisons using Census Bureau data on occupations are limited to looking at all S&E occupations except postsecondary teachers because the Census Bureau aggregates all postsecondary teachers into one occupation code. Only NSF surveys of scientists and engineers and some BLS surveys collect data on postsecondary teachers by field.

5. SESTAT/National Survey of College Graduates (NSCG) 2003 and 2008 estimates for the data displayed in figure 3-11 are not comparable. The 2003 estimates include a full complement of respondents to the 2003 NSCG, many of whom report that their jobs require S&E expertise, even though they lack degrees in S&E fields. SESTAT 2008 continues to gather data from S&E degree holders identified in the NSCG, but does not include individuals who are not either in S&E occupations or holders of S&E degrees. Thus, SESTAT 2003 data, although less current, are in some ways better suited for analyzing the relationships among occupations, degrees, and subjective assessments of job requirements. Relevant 2003 data were reported in *Science and Engineering Indicators 2010*. Because of the limitations of the 2008 SESTAT data, table 3-3 uses 2003 estimates.

6. Only U.S. citizens and nationals may be appointed in the competitive civil service; however, federal agencies may employ certain noncitizens who meet specific employability requirements in the excepted service or the Senior Executive Service.

7. This list does not include the National Institutes of Health, which is a part of the Department of Health and Human Services (DHHS). The proportion of all federal scientists and engineers working at DHHS is 5%.

8. SES includes occupations of senior managerial, supervisory, and policy positions in the executive branch of the federal government who generally serve as the link between political appointees and the rest of the federal workforce.

9. The commercialization success rate is the ratio of patents commercialized to patents granted.

10. The patent activity rate is the proportion who report having been named as an inventor on a patent application in the previous 5 years.

11. The Business Cycle Dating Committee of the National Bureau of Economic Research is generally the source for determining the beginning and end of recessions or expansions in the U.S. economy. See http://www.nber.org/cycles/recessions.html for additional information.

12. Many doctorate holders with salaries at this level are postdocs in temporary training positions.

13. Although the formal job title is often postdoc fellowship or research associate, titles vary among organizations. This chapter generally uses the shorter, more commonly used, and best understood name, *postdoc*. A postdoc is traditionally defined as a temporary position that individuals take primarily for additional training—a period of advanced professional apprenticeship—after completion of a doctorate.

14. This estimate differs slightly from the observed median difference in salary by sex because the former addresses mean differences and the latter addresses median differences. The former is influenced by extreme cases and outliers, and the latter is not.

15. Occupation, age, and years since completion of education are each controlled for as a random effect. SESTAT respondents working in science and engineering have been classified into 62 distinct occupations. Age is observed in one of eleven 5-year brackets. Years of experience are observed in one of twelve 5-year brackets.

16. Occupational sector, region, field of degree, and parents' education are each controlled for as a random effect. *Employers* are classified into one of seven sectors: 4-year colleges and universities, 2-year colleges, for-profit private sector, nonprofit private sector, self-employment, federal government, and state and local government. *Regions* are classified into the nine U.S. census divisions. *Field of degree* is observed in 1 of 142 distinct degree fields among individuals whose highest degree is at the bachelor's level, and within 123 distinct degree fields among individuals whose highest degree is at the doctoral level. *Parents' education* measures the highest level of education completed by either parent and is observed in one of eight categories.

17. The analysis was repeated with different age cut-points defining young children. Results did not change substantially when this age limit was adjusted (from ages 0–18 to ages 0–6), indicating that the finding in the text is not substantively sensitive to where this cut-point is set.

18. Among married workers with children younger than age 12, the estimated salary differences between men and women are generally similar in magnitude to the estimates for all scientists and engineers. For example, among workers whose highest degree is a bachelor's in an S&E field, the estimated salary difference by sex is 13% among all workers and is also 13% among workers who are married and with children younger than age 12. At the doctoral level, the estimated 8% salary difference by sex applies to all workers and to workers who are married with children. Only at the master's degree level is the estimated salary difference between men and women among the married with children larger (at 15%) than the difference among all workers (7%).

19. In the future, however, the largest component of SESTAT, the National Survey of College Graduates, will be refreshed on a biennial basis using respondents from the ACS, and so the undercount of recent foreign arrivals will be minimized.

20. This includes East Asians, South Asians, and Southeast Asians, but excludes individuals from countries in the Middle East and from the former Soviet Republics.

21. This question is part of the Survey of Earned Doctorates, which is administered to all recipients of U.S. doctoral degrees.

22. The growth in the number of doctoral students from China accounts for much of the rapid increase in foreign recipients of doctoral degrees from the early 1980s through 1996. During this period, the annual count of Chinese recipients of doctoral degrees rose from fewer than 10 to more than 3,000 (from 0.1% to 27.4% of all foreign doctoral degree recipients). The decline in foreign doctoral degree awards following 1996 also is partially, but not fully, accounted for by changes in the numbers of Chinese doctoral degree recipients. One contributing factor to the decline in 1996 was the Chinese Student Protection Act of 1992.

23. Long-term stay rates are observed by annually calculating the ratio of the number of noncitizen Survey of Earned Doctorate respondents who made Social Security contributions to the number of noncitizen Survey of Earned Doctorate respondents.

24. OECD's 2009 estimates for Norway and Singapore exceeded 1%, although the 2008 estimates reported in appendix table 3-23 did not. Iceland, which is not included in appendix table 3-23, was also above 1% in both years. OECD's estimate for Japan reported in the text is also more recent than that in the appendix table.

25. Although R&D employment by subsidiaries is an important indicator of international R&D activity, it has a significant limitation in that it does not include various external arrangements for performing R&D, ranging from R&D contracting to consulting work and strategic collaborations.

26. An *affiliate* is a company or business enterprise located in one country but owned or controlled by a parent company in another country. Majority-owned affiliates are those in which the ownership stake of parent companies is more than 50%.

Glossary

Career path job: A job that helps graduates fulfill their future career plans.

European Union (EU): A union of 27 member states on the continent of Europe, including Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

Federally funded research and development center (FFRDC): An organization that performs research and development and is exclusively or substantially financed by the federal government either to meet a particular research and development objective or, in some instances, to provide major facilities at universities for research and associated training purposes.

Involuntarily out-of-field (IOF) employment: Employment in a job not related to the field of one's highest degree because a job in that field was not available.

Labor force: A subset of the population that includes both those who are employed and those who are not working but seeking work (unemployed); other individuals are not considered to be in the labor force.

Organisation for Economic Co-operation and Development (OECD): An international organization of 30 countries headquartered in Paris, France. The member countries are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States. Among its many activities, the OECD compiles social, economic, and science and technology statistics for all member and selected non-member countries.

Postdoc: A temporary position awarded in academia, industry, government, or a nonprofit organization, primarily for gaining additional education and training in research after completion of a doctorate.

SESTAT: Scientists and Engineers Statistical Data System, a system of three surveys conducted by the National Science Foundation that measure the educational, occupational, and demographic characteristics of the science and engineering workforce. The three surveys are the National Survey of College Graduates (NSCG), the Survey of Doctorate Recipients (SDR), and the National Survey of Recent College Graduates (NSRCG).

Stay rate: The proportion of students on temporary visas who stay in the United States 1–10 years after receiving a doctorate.

Tertiary education: Roughly equivalent in U.S. terms to individuals who have earned at least technical school or associate's degrees and includes all degrees up to the doctorate.

Workforce: A subset of the labor force that includes only employed individuals.

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Errata

The following errors were discovered after publication of the print and PDF versions of *Science and Engineering Indicators 2012* and *Science and Engineering Indicators Digest 2012.* These errors have been corrected in the online version of the volume and in the interactive *Digest.*

Updated 12 February 2013

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Chapter 3

Page 3-15. The field of study "biological/agricultural/environmental life sciences" was incorrectly reported as "biological/agricultural sciences" and the percentage of degree holders in this field working in S&E occupations was incorrectly calculated. The correct percentage is 30%.

Page 3-16. The percentages of degree holders in computer sciences and mathematics and those in engineering who work in the broad occupation group in which they were trained were incorrectly calculated. The correct value for computer sciences/mathematics is 53%, and for engineering, 50%.

Figure 3-7: The percentages of S&E degree holders working in S&E occupations were incorrectly calculated. The correct percentages for highest degree being in the field (f), doctorate in field (d), master's in field (m), and bachelor's in field (b), respectively, are as follows. All S&E degree holders: 38% (f), 74% (d), 51% (m), 31% (b). Biological/agricultural/environmental life sciences: 30% (f), 68% (d), 46% (m), no change (b). Computer/mathematical sciences: 56% (f), no change (d), 65% (m), 52% (b). Physical sciences: 54% (f), 78% (d), 60% (m), 44% (b). Social sciences: no change (f), 70% (d), 23% (m), 8% (b). Engineering: 64% (f), 80% (d), 73% (m), 60% (b).

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Chapter 3

Page 3-45. Salary differentials were incorrectly calculated for minorities. The correct percentages are as follows: American Indians/Alaska Natives earned 22% less than whites, blacks earned 22% less, and Hispanics 15% less.

Figure 3-12. The top four segments of the stacked bars are mislabeled. The correct labels, in order from top to bottom, are 4-year institutions, 2-year and precollege institutions, Federal government, and State/local government.

Appendix table 3-16. The table title corrected from "workers with highest degree in S&E field" to "scientists and engineers employed full time."