Chapter 3
Science and Engineering Labor Force

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Highlights

U.S. S&E Workforce: Definition, Size, and Growth

The S&E workforce can be defined in several ways: by workers in S&E occupations, by holders of S&E degrees, and by the use of S&E technical expertise on the job. The estimated size of the S&E workforce varies depending on the criteria chosen.

- In 2010, estimates of the size of the U.S. S&E workforce ranged from approximately 5 million to more than 19 million depending on the definition used.
- In 2010, there were about 5.4 million college graduates employed in S&E occupations in the United States. Occupations in the computer and mathematical sciences (2.4 million) and engineering (1.6 million) were the largest categories of S&E occupations. Occupations in the life sciences (597,000), social sciences (518,000), and physical sciences (320,000) each employed a smaller number of S&E workers.
- In 2010, about 19.5 million college graduates in the United States had a bachelor's or higher level degree in an S&E field of study. Almost three-fourths (74%) of these college graduates (14.5 million) held their highest level of degree (bachelor's, master's, professional, or doctorate) in an S&E field. Overall, the most common fields of S&E highest degrees were social sciences (40%) and engineering (23%). Computer and mathematical sciences, life sciences, and physical sciences together accounted for slightly more than one-third (38%) of individuals with S&E highest degrees.
- The application of S&E knowledge and skills is widespread across the U.S. economy and not just limited to S&E occupations. The number of college-educated individuals reporting that their jobs require at least a bachelor's degree level of technical expertise in one or more S&E fields (16.5 million) is significantly higher than the number in occupations with formal S&E titles (5.4 million).

The S&E workforce has grown steadily over time.

- Between 1960 and 2011, the number of workers in S&E occupations grew at an average annual rate of 3.3%, greater than the 1.5% growth rate for the total workforce.
- Data from more recent years indicate that trends in S&E employment compared favorably to overall employment trends during and after the 2007–09 economic downturn. Between 2006 and 2012, the number of workers employed in S&E occupations rose slightly, whereas the total workforce shrank.

S&E Workers in the Economy

Scientists and engineers work for all types of employers.

- By far the largest employer of scientists and engineers (individuals with an S&E degree or employed in an S&E occupation) is the business sector (70%), followed by the education sector (19%) and the government sector (11%). Within the business sector, for-profit businesses employ the largest number of scientists and engineers.
- Scientists and engineers with S&E doctorates are more evenly distributed between the business sector (46%) and the education sector (45%). Within the education sector, over 90% are found in 4-year academic institutions, including those in postdoctoral and other temporary positions.
- Small firms are important employers of those with S&E highest degrees (individuals who attained their highest level of degree in an S&E field of study). Firms with fewer than 100 persons employ 37% of such individuals in the business sector.
- Within the business sector, the industry with the largest number of workers in S&E occupations is the professional, scientific, and technical services industry.
- Employment in S&E occupations is geographically concentrated in the United States. The 20 metropolitan areas with the largest proportion of the workforce employed in S&E occupations accounted for 18% of nationwide S&E employment, compared to 8% of all employment.

S&E Labor Market Conditions

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

- Half of the workers in S&E occupations earned $78,270 or more in 2012, more than double the median earnings ($34,750) of the total U.S. workforce.
- Employed college graduates with a highest degree in S&E earn more than those with non-S&E degrees. Moreover, within each broad degree field (S&E and non-S&E), those employed in S&E occupations earn more than those in non-S&E occupations.

Individuals 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 graduates and much lower than those for the overall labor force. In October 2010, an estimated 4.3% of scientists and engineers and 5.1% of all college-educated individuals in the labor force were unemployed. At the same time, the official unemployment rate for the entire U.S. labor force was 9.0%.
- Unemployment rates for S&E doctorate holders are generally lower than for those at other degree levels.

Demographics of the S&E Workforce

The U.S. S&E labor force is aging. However, in 2010, a larger proportion of older scientists and engineers reported being in the labor force than in 1993.

- The proportion of scientists and engineers in the U.S. labor force over age 50 increased from 20% in 1993 to 33% in 2010. The median age of such individuals was 44 years in 2010, compared to 41 years in 1993.
- Between 1993 and 2010, increasing percentages of scientists and engineers in their 60s reported that they were still in the labor force. Whereas 54% of scientists and engineers between the ages of 60 and 69 were employed in 1993, the comparable percentage rose to 63% in 2010.

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

- Despite accounting for half of the college-educated workforce, in 2010 women constituted 37% of employed individuals with a highest degree in an S&E field and 28% of employed individuals in S&E occupations.
- From 1993 to 2010, growth occurred in both the proportion of workers with a highest degree in an S&E field who are women (increasing from 31% to 37%) and the proportion of women in S&E occupations (increasing from 23% to 28%).
- Women employed in S&E occupations are concentrated in different occupational categories than are men, with relatively high proportions of women in the social sciences (58%) and life sciences (48%) and relatively low proportions in engineering (13%) and computer and mathematical sciences (25%).

Historically underrepresented racial and ethnic groups, particularly blacks and Hispanics, continue to display lower S&E participation rates relative to their presence in the U.S. population. Conversely, Asians and foreign-born individuals display higher S&E participation rates relative to their overall presence in the U.S. population.

- Hispanics, blacks, and American Indians or Alaska Natives together make up 26% of the U.S. population age 21 and older but a much smaller proportion of the S&E workforce: 10% of workers in S&E occupations and 13% of S&E highest degree holders.
- Asians work in S&E occupations at higher rates (19%) than their representation in the U.S. population age 21 and older (5%). Asians have a large presence in engineering and computer sciences occupations, particularly among computer software and hardware engineers, software developers, and postsecondary teachers in engineering.
- About 70% of workers in S&E occupations are non-Hispanic whites, which is comparable to their overall representation in the U.S. population age 21 and older (68%).
- Foreign-born individuals account for slightly more than one-fourth of all workers in S&E occupations, which is higher than their representation in the entire college-educated workforce (15%). Foreign-born workers employed in S&E occupations tend to have higher levels of education than their U.S. native-born counterparts.

A variety of indicators point to a decline in the immigration of scientists and engineers during the 2007–09 economic downturn. However, data since the downturn suggest that this decline may be temporary.

- After several years of growth, the number of temporary work visas issued to high-skill workers fell during the 2007–09 economic downturn. It has rebounded since then, although data for 2012 indicate that the issuance of temporary work visas has not yet reached the recent highs seen in 2007 and 2008.
- After rising for most of the decade 2000–09, the number of foreign recipients of U.S. S&E doctoral degrees declined in 2009 and 2010. It has risen slightly in 2011 but remains below the recent highs seen in 2007 and 2008.
- Among foreign-born U.S. S&E doctorate recipients with temporary visas at graduation, the proportion that remained in the United States 5 years after receiving their degrees rose during the first half of the decade of the 2000s, reaching 67% in 2005. The proportion declined during the economic downturn but rose to 66% in 2011.

Global S&E Labor Force

Worldwide, the number of workers engaged in research has been growing.

- Among countries with large numbers of researchers—defined as workers engaged in the creation and development of new knowledge, products, and processes—growth has been most rapid since the mid-1990s in China and South Korea.
- The United States and the European Union experienced steady growth but at a lower rate than in China or South Korea.
- Japan and Russia were exceptions to the worldwide trend. Between 1995 and 2011, the number of researchers in Japan remained largely unchanged, and in Russia the number declined.

Introduction

Chapter Overview

Policymakers and scholars consistently emphasize innovation based on S&E research and development as a vehicle for a nation's economic growth and global competitiveness. Workers with S&E expertise are an integral part of a nation's innovative capacity because of their high skill level, their creative ideas, and their ability not only to advance basic scientific knowledge but also to transform advances in fundamental knowledge into tangible products and services. As a result, these workers make important contributions to improving living standards and accelerating the pace of a nation's economic and productivity growth.

Chapter Organization

The U.S. workforce includes both individuals employed in S&E occupations and individuals educated in S&E fields but employed in a variety of non-S&E occupations. Many more individuals have S&E degrees than work in S&E occupations. Indicative of a knowledge-based economy, many individuals in non-S&E occupations report that their work nevertheless requires a bachelor's degree level of S&E expertise. Therefore, the first section in this chapter, "U.S. S&E Workforce: Definition, Size, and Growth," discusses the U.S. S&E workforce based on three measures: workers in S&E occupations, holders of S&E degrees, and use of S&E technical expertise on the job. This section also discusses the interplay between educational background and occupational choice as well as the growth in the U.S. S&E workforce over time.

The second section in this chapter, "S&E Workers in the Economy," examines the distribution of S&E workers across employment sectors. It describes the distribution of S&E workers across sectors (e.g., business, education, government) as well as within particular sectors (e.g., local, state, and federal government). This section also presents data on geographic distribution of S&E employment in the United States. Data on R&D activity and work-related training by S&E workers are also discussed.

The third section, "S&E Labor Market Conditions," looks at labor market outcomes for S&E workers. Data in this section focus on earnings and unemployment. Data on recent S&E graduates are also discussed, as are broader measures of labor underutilization that go beyond the conventional unemployment rate.

The next three sections cover labor force demographics. "Age and Retirement of the S&E Workforce" presents data on the age distribution and retirement patterns of S&E workers. "Women and Minorities in the S&E Workforce" focuses on S&E participation by women and by racial and ethnic minorities; this section also presents data on salary differences by sex and by race and ethnicity. "Immigration and the S&E Workforce" presents data on S&E participation by foreign-born individuals in the United States as well as the worldwide migration patterns of high-skill workers.

The final section in this chapter is "Global S&E Labor Force." Although there are indications that the global S&E labor force has grown, international data on the characteristics of this broader labor force are particularly limited and are not always comparable with data for the United States. In this final section, data from the Organisation for Economic Co-operation and Development (OECD) are used to present indicators of worldwide R&D employment.

This chapter uses a variety of data sources, including, but not limited to, the National Science Foundation's (NSF's) Scientists and Engineers Statistical Data System (SESTAT), the Census Bureau's American Community Survey (ACS), the Occupational Employment Statistics (OES) survey administered by the Bureau of Labor Statistics (BLS), and the Current Population Survey (CPS) sponsored jointly by the Census Bureau and BLS. Different sources cover different segments of the population and different levels of detail on different topics. (See table 3-1 and sidebar, "NSF's Scientists and Engineers Statistical Data System.") Although data collection methods and definitions can differ across surveys in ways that affect estimates, combining data from different sources facilitates an accurate and comprehensive picture of the very specialized S&E workforce. A particular measure or categorization of the workforce may be better suited for addressing some questions than others, and a particular data source may not include information in every category. Analyses of long-term trends, international trends, and comparison of S&E and non-S&E workers are discussed whenever data are available.

U.S. S&E Workforce: Definition, Size, and Growth

Definition of the S&E Workforce

Because there is no standard definition of S&E workers, this section uses multiple categorizations to measure the U.S. S&E workforce. In general, this section defines the S&E workforce to include people who either work in S&E occupations or hold S&E degrees.[1] The application of S&E knowledge and skills is not limited to jobs with formal S&E titles; the number of college graduates reporting that their jobs require at least a bachelor's degree level of knowledge in one or more S&E fields exceeds the number of workers employed in S&E occupations in the economy. Therefore, this section also presents data on the use of S&E technical expertise on the job to provide an estimate of the U.S. S&E workforce. The estimated number of scientists and engineers varies based on the criteria applied to define the S&E workforce.

U.S. federal occupation data classify workers by the activities or tasks they primarily perform in their jobs. The NSF and Census Bureau occupational data in this chapter come from federal statistical surveys in which individuals or household members provide information about job titles and work activities. This information is used to classify jobs

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 2012	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—see sidebar "NSF's Scientists and Engineers Statistical Data System"	National Science Foundation, National Center for Science and Engineering Statistics	Through 2010	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 2011	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 2013	Employment status Occupation Educational attainment Demographic characteristics	Households	Civilian noninstitutional population age 16 and over

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into standard occupational categories based on the Standard Occupational Classification (SOC) system.[2] In contrast, the BLS-administered OES survey relies on employers to classify their workers using SOC definitions. Differences between employer- and individual-provided information can affect the content of occupational data.

NSF has developed a widely used set of SOC categories that it calls *S&E occupations*. Very broadly, these occupations include life scientists, computer and mathematical scientists, physical scientists, social scientists, and engineers. NSF also includes postsecondary teachers of these fields in S&E occupations. A second category of occupations, *S&E-related occupations*, includes health-related occupations, S&E managers, S&E technicians and technologists, architects, actuaries, S&E precollege teachers, and postsecondary teachers in S&E-related fields. The S&E occupations are generally assumed to require at least a bachelor's degree level of education in an S&E field. The vast majority of S&E-related occupations also require S&E knowledge or training, but an S&E bachelor's degree may not be a required credential for employment in some of these occupations. Examples include health technicians and computer network managers. Other occupations, although classified as *non-S&E occupations,* may include individuals who use 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 along with the NSF educational classification of S&E, S&E-related, and non-S&E degree fields.

Other general terms, including science, technology, engineering, and 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.

The number of individuals who have S&E training or who reported applying S&E technical expertise in their jobs exceeds the number of individuals employed in S&E

NSF's Scientists and Engineers Statistical Data System

NSF's Scientists and Engineers Statistical Data System (SESTAT) provides detailed employment, education, and demographic data for scientists and engineers under age 76 residing in the United States. The 2010 SESTAT defines scientists and engineers as individuals who have college degrees in S&E or S&E-related fields or who are working in S&E or S&E-related occupations.* (See table 3-2 for definitions of S&E and S&E-related occupations.) Unless otherwise noted, the term "scientists and engineers" as used in this chapter refers to this broad SESTAT population. Data available through SESTAT are collected by three large demographic and workforce surveys of individuals conducted by NSF: the National Survey of College Graduates (NSCG), the National Survey of Recent College Graduates (NSRCG), and the Survey of Doctorate Recipients (SDR). SESTAT integrates the data from the three surveys, and together the data provide a comprehensive picture of scientists and engineers in the United States.

The NSCG is the central component of SESTAT, providing data that detail the characteristics of the entire college-educated population in the United States (regardless of their S&E background). Its population of college graduates includes individuals trained as scientists and engineers who hold at least a bachelor's degree. Because it covers the entire college graduate population residing in the United States, the NSCG provides information on individuals educated or employed in S&E fields as well as those employed or educated in non-S&E fields. The data presented in this chapter for all college graduates (regardless of S&E background) are based on the NSCG.

Whereas NSCG data cover the general college-educated population, the NSRCG supplements SESTAT by adding recent college graduates at the bachelor's and master's degree level. The 2010 NSRCG data represent almost 1.5 million recent bachelor's and master's graduates in science, engineering, and health (SEH) fields from academic years 2008 and 2009.

The SDR supplements SESTAT by adding doctoral scientists and engineers who earned their SEH doctorates from U.S. academic institutions. Data from the 2010 SDR were collected from doctoral graduates who received SEH research degrees from a U.S. academic institution before 1 July 2009.

*For details on the 2010 SESTAT see http://www.nsf.gov/statistics/sestat/ and http://www.nsf.gov/statistics/infbrief/nsf13311/.

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		
	Social services and related fields	Non-S&E precollege teachers		
	Sales and marketing	Non-S&E postsecondary teachers		
	Arts and humanities	Social services occupations		
	Other fields	Sales and marketing occupations		
		Arts and humanities occupations		
		Other occupations		

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

NOTES: The 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.

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occupations. A relatively narrow definition of the S&E workforce consists of workers in occupations that NSF designates as S&E occupations. A much broader definition of an S&E worker, defined by SESTAT, includes any individual with at least a bachelor's (or higher) degree in an S&E or S&E-related field of study or a college graduate in any field employed in an S&E or S&E-related occupation. The S&E workforce may also be defined by the technical expertise or training required to perform a job. Unlike information on occupational categories or educational credentials, information on the use of technical knowledge, skills, or expertise in a person's job reflects that individual's subjective opinion about the content and characteristics of the job.[3] The next section provides estimates of the size of the S&E workforce using all three definitions.

Size of the S&E Workforce

Defined by occupation, the U.S. S&E workforce totals between 5.8 million and 6.0 million people according to the most recent estimates (table 3-3). Those in S&E occupations who had at least a bachelor's degree are estimated at between 4.3 million and 5.4 million (table 3-3).[4] By far the largest categories of S&E occupations are in computer and mathematical sciences and engineering, which together account for between three-fourths and four-fifths of all employed workers in S&E occupations (figure 3-1). Occupations in the life sciences, social sciences, and physical sciences each employ a smaller proportion of S&E workers.

As noted earlier, S&E degree holders greatly outnumber those currently employed in S&E occupations. In 2010, about 19.5 million college graduates in the United States had a bachelor's or higher level degree in an S&E field of study (table 3-3). Almost three-fourths of these college graduates (14.5 million) attained their highest degree in an S&E field (in this chapter, these individuals are referred to as S&E highest degree holders). An individual's highest degree is often an accurate representation of the skills and credentials that one employs in the labor market, which is why the data presented in this chapter by educational attainment are often provided for highest degree. Overall, social sciences and engineering were the most common degree fields among individuals with S&E highest degrees (figure 3-2). Of the 14.5 million S&E highest degree holders, slightly more than one-fourth attained a master's degree (3 million) or doctorate (979,000) as their highest degree.[5]

The majority of individuals with a highest degree in S&E reported that their job was either closely or somewhat related to their field of highest degree (table 3-3). This is despite

Table 3-3
Measures and size of U.S. S&E workforce: 2010, 2011, and 2012

Measure	Education coverage	Data source	Workers
Occupation			
Employed in S&E occupations	All education levels	2012 BLS OES	5,968,000
Employed in S&E occupations	Bachelor's and above	2010 NSF/NCSES SESTAT	5,398,000
Employed in S&E occupations	All education levels	2011 Census Bureau ACS	5,756,000
Employed in S&E occupations	Bachelor's and above	2011 Census Bureau ACS	4,279,000
Education			
At least one degree in S&E field	Bachelor's and above	2010 NSF/NCSES SESTAT	19,493,000
Highest degree in S&E field	Bachelor's and above	2010 NSF/NCSES SESTAT	14,457,000
Job closely related to highest degree	Bachelor's and above	2010 NSF/NCSES SESTAT	5,396,000
S&E occupation	Bachelor's and above	2010 NSF/NCSES SESTAT	2,796,000
Other occupation	Bachelor's and above	2010 NSF/NCSES SESTAT	2,600,000
Job somewhat related to highest degree	Bachelor's and above	2010 NSF/NCSES SESTAT	3,358,000
S&E occupation	Bachelor's and above	2010 NSF/NCSES SESTAT	966,000
Other occupation	Bachelor's and above	2010 NSF/NCSES SESTAT	2,392,000
Job requires S&E technical expertise at bachelor's level			
In one or more S&E fields	Bachelor's and above	2010 NSF/NCSES SESTAT NSCG	16,456,000
Engineering, computer science, mathematics, or natural sciences	Bachelor's and above	2010 NSF/NCSES SESTAT NSCG	11,710,000
Social sciences	Bachelor's and above	2010 NSF/NCSES SESTAT NSCG	7,443,000

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

NOTES: Estimates 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 classifying a reported occupation into a standard occupational category. All of these differences can affect the estimates. For example, the SESTAT estimate of the number of workers in S&E occupations includes postsecondary teachers of S&E fields; however, postsecondary teachers in ACS are grouped under a single occupation code regardless of field and are therefore not included in the ACS estimate of the number of workers in S&E occupations.

SOURCES: BLS, 2012 OES; Census Bureau, 2011 ACS; NSF/NCSES, 2010 NSCG, and 2010 SESTAT integrated file.

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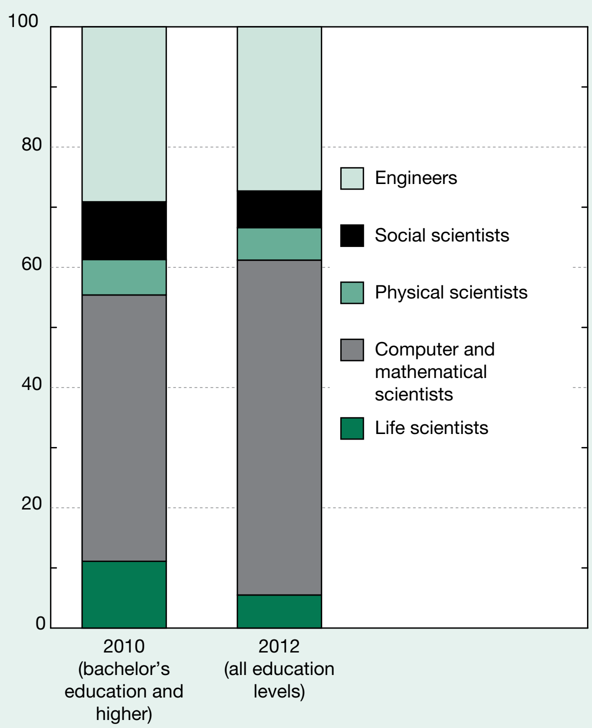
the fact that many of these individuals were employed in occupations not categorized as S&E. This suggests that the application of S&E knowledge and skills is widespread across the U.S. economy and not just limited to S&E occupations.

The extensive use of S&E expertise in the workplace is also evident from the number of college graduates who indicate that their jobs require technical expertise at the bachelor's degree level in S&E fields. According to the 2010 National Survey of College Graduates (NSCG), 16.5 million college graduates reported that their jobs require at least this level of technical expertise in one or more S&E fields (table 3-3). This figure is much higher than the estimated number of college graduates employed in S&E occupations (5.4 million).

Growth of the S&E Workforce

The S&E workforce has grown faster over time than the overall workforce. According to Census Bureau data, employment in S&E occupations grew from about 1.1 million in 1960 to about 5.8 million in 2011.[6] This represents an average annual growth rate of 3.3%, compared to the 1.5% growth in total employment during this period. As a proportion of all employment, S&E occupational employment grew from 1.6% in 1960 to 4.1% in 2011.

Figure 3-1
Employment in S&E occupations, by broad occupational category: 2010 and 2012



SOURCES: Bureau of Labor Statistics, Occupational Employment Statistics Survey, 2012; National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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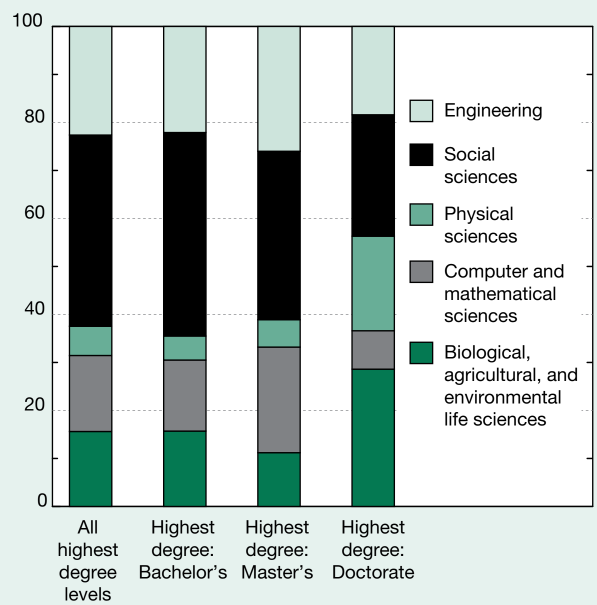
Data from more recent years indicate that trends in S&E employment compared favorably to overall employment trends during and after the 2007–09 economic downturn. OES employment estimates from BLS indicate that the size of the S&E workforce rose slightly from 5.4 million in May 2006 to 5.8 million in May 2009 and then remained relatively steady through May 2012, reaching a level of 6 million. In contrast, the total workforce during this period declined from 133 million in May 2006 to 131 million in May 2009 and then to 130 million in May 2012. The broader STEM aggregate (including S&E technicians, S&E managers, etc.) remained relatively steady at 7.9 million in May 2012, compared with 7.8 million in May 2009 and 7.4 million in May 2006. BLS projects that between 2010 and 2020 S&E occupations—particularly computer and mathematical sciences, life sciences, and social sciences-related occupations—will grow at a faster rate than the total workforce. (See sidebar, "Projected Growth of Employment in S&E Occupations.")

The growth in the number of individuals with S&E degrees in recent years can be examined using data from NSF's SESTAT. The number of S&E highest degree holders employed in the United States grew from 9.6 million to 11.4 million between 2003 and 2010, with most broad fields exhibiting growth (figure 3-3). Similarly, employment in S&E occupations among college degree holders rose from 4.8 million to 5.4 million during this timeframe. Although individuals with advanced degrees beyond the bachelor's level

Figure 3-2
S&E degrees among college graduates, by field and level of highest degree: 2010



NOTE: All degree levels include professional degrees not shown separately.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Projected Growth of Employment in S&E Occupations

The most recent Bureau of Labor Statistics (BLS) occupational projections, for the period 2010–20, suggest that total employment in occupations that NSF classifies as S&E will increase at a faster rate (18.7%) than employment in all occupations (14.3%) (figure 3-A; table 3-A). These projections are based only on the demand for narrowly defined S&E occupations and do not include the wider range of occupations in which S&E degree holders often use their training.

BLS also projects that, for the period 2010–20, job openings in NSF-identified S&E occupations will represent a slightly larger proportion of current employment than openings in all other occupations: 39.6% versus 38.3% (figure 3-B). Job openings include both growth in total employment and openings caused by attrition.

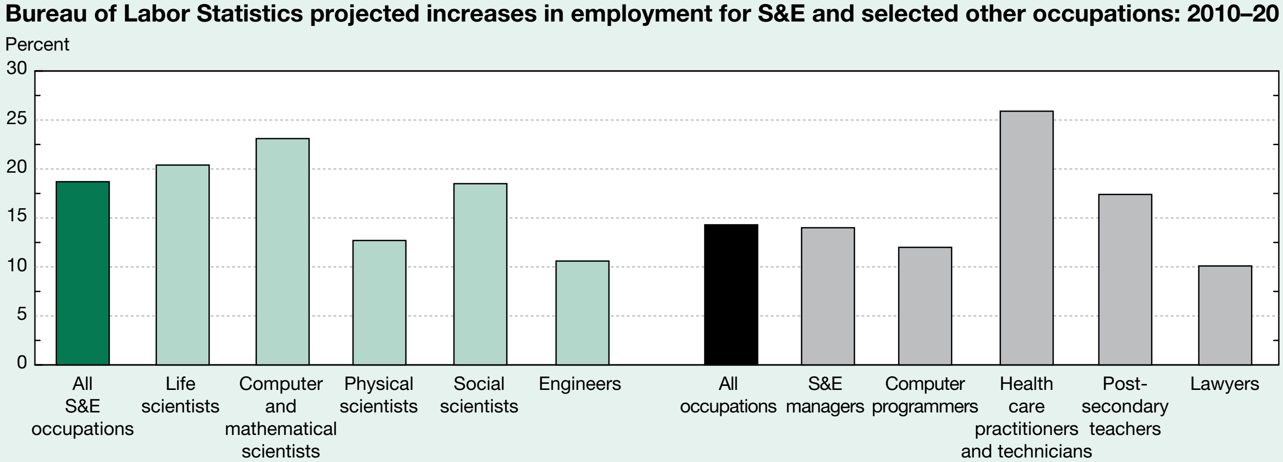
Of the BLS-projected job openings in NSF-identified S&E occupations, 59% are in computer and mathematical scientist occupations, the largest sub-category of S&E occupations (table 3-A). These occupations also have the largest growth rate (23.1%). Life sciences and social sciences occupations, which account for a much smaller proportion of S&E occupations, have the next highest projected growth rates: 20.4% and 18.5%, respectively. Job openings in the social sciences are projected to be particularly high, representing half of the current employment in that field. Physical scientists and engineering occupations are projected to grow at rates slightly lower than the rate for all occupations. Total job openings in physical sciences, however, are expected to represent a larger share of current employment than openings in all occupations.

In addition to S&E occupations, table 3-A also shows selected other occupations that contain significant numbers of S&E-trained workers. Among these, the health care practitioners and technicians occupation, which employs more workers than all S&E occupations combined, is projected to grow at 25.9%, nearly double the rate of growth in all occupations. The postsecondary teachers occupation, which includes all fields of instruction, and the S&E managers occupation are projected to grow 17.4% and 14.0%, respectively, both of which are lower than the projected growth rate in S&E occupations but close to (S&E managers) or higher than (postsecondary teachers) the projected growth rate in all occupations. In contrast, BLS projects that computer programmers and S&E technicians will grow more slowly than all occupations as well as all S&E occupations.

Employment projections are uncertain.* Many industry and government decisions that affect hiring are closely linked to national and global fluctuations in aggregate economic activity, which are difficult to forecast long in advance. In addition, technological and other innovations will influence demand for workers in specific occupations. The assumptions underlying projections are sensitive to fundamental empirical relationships, and, as a result, may become less accurate as overall economic conditions change.

* Although BLS does a reasonable job of projecting employment in many occupations, the mean absolute percentage error in the 1996 forecast of employment in detailed occupations in 2006 was 17.6% (Wyatt 2010). The inaccuracies in the 1996 projection of 2006 employment were primarily driven by not projecting the housing bubble and increases in oil prices (Wyatt 2010).

Figure 3-A
Bureau of Labor Statistics projected increases in employment for S&E and selected other occupations: 2010–20



SOURCE: Bureau of Labor Statistics, Employment Projections program, 2010–20, special tabulations (2013) of 2010–20 Employment Projections. See appendix table 3-2.

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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: 2010–20
(Thousands)

Occupation	BLS National Employment Matrix 2010 estimate	BLS projected 2020 employment	Job openings from growth and net replacements, 2010–20	10-year growth in total employment (%)	10-year job openings as percentage of 2010 employment
All occupations	143,068	163,537	54,787	14.3	38.3
All S&E	5,546	6,585	2,197	18.7	39.6
Computer and mathematical scientists	3,157	3,886	1,290	23.1	40.9
Life scientists	286	344	106	20.4	37.1
Physical scientists	282	318	122	12.7	43.2
Social scientists and related occupations	302	358	152	18.5	50.4
Engineers	1,519	1,679	526	10.6	34.6
S&E-related occupations					
S&E managers	534	609	186	14.0	34.8
S&E technicians	808	873	275	8.0	34.1
Computer programmers	363	407	128	12.0	35.3
Health care practitioners and technicians	7,799	9,819	3,591	25.9	46.0
Selected other occupations					
Postsecondary teachers	1,756	2,062	586	17.4	33.4
Lawyers	728	802	212	10.1	29.1

BLS = Bureau of Labor Statistics.

NOTES: Estimates of current and projected employment for 2010–20 are from BLS's National Employment Matrix; data in the matrix are from the Occupational Employment Statistics (OES) survey and the 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 the table are based on the sum of BLS projections for occupations that the National Science Foundation considers as S&E. See appendix table 3-2.

SOURCE: BLS, Employment Projections program, 2010–20, special tabulations (2013) of 2010–20 Employment Projections.

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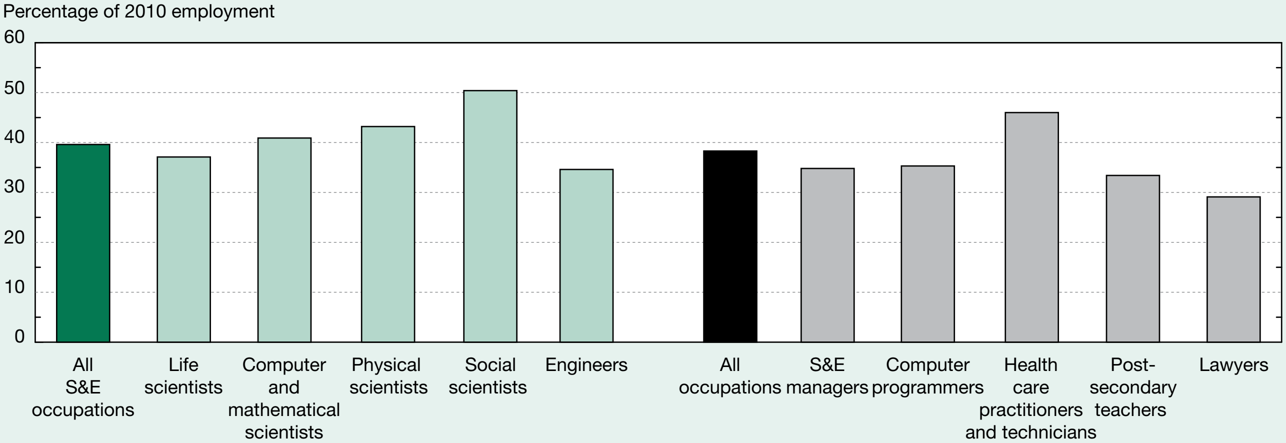
Figure 3-B
Bureau of Labor Statistics projected job openings in S&E and selected other occupations: 2010–20



SOURCE: Bureau of Labor Statistics, Employment Projections program, 2010–20, special tabulations (2013) of 2010–20 Employment Projections. See appendix table 3-2.

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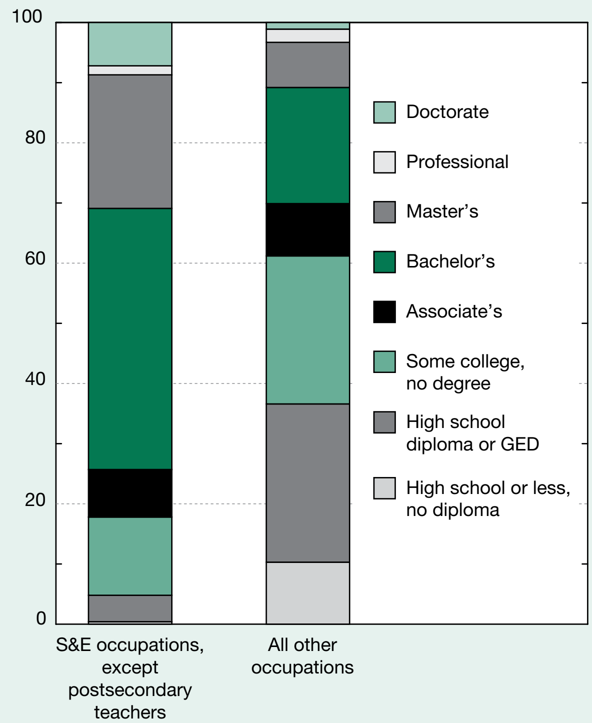
account for a minority of the college graduate population, between 2003 and 2010 the growth in S&E degree holders with advanced degrees generally outpaced the growth in individuals with bachelor's degrees in most broad fields (with the exception of social sciences) (figure 3-3). (See chapter 2 for a fuller discussion of S&E degrees.)

A number of factors likely contributed to the growth in the U.S. S&E labor force over time: the rising demand for S&E skills in a global and highly technological economic landscape; increases in U.S. S&E degrees earned by women, by racial and ethnic minority groups, and by foreign-born individuals; temporary and permanent migration to the United States of those with foreign S&E educations; and the relatively small proportion of scientists and engineers retiring from the S&E labor force. The demographic sections of this chapter provide data on aging and retirement patterns of scientists and engineers as well as on S&E participation by women, by racial and ethnic minorities, and by foreign-born individuals.

Educational Distribution of Workers in S&E Occupations

Workers in S&E occupations have undergone more formal education than the general workforce (figure 3-4). Data from the 2011 ACS indicate that a larger proportion of workers in nonacademic S&E occupations (74%) hold a bachelor's or higher degree than workers in all other occupations (30%).[7] The proportion of workers with advanced degrees beyond the bachelor's level is 31% in S&E occupations, compared to 11% in all other occupations. About 7% of all S&E workers (except postsecondary teachers) have doctorates.

Figure 3-4
Educational attainment, by type of occupation: 2011



GED = General Equivalency Diploma.

SOURCE: Census Bureau, American Community Survey (2011).

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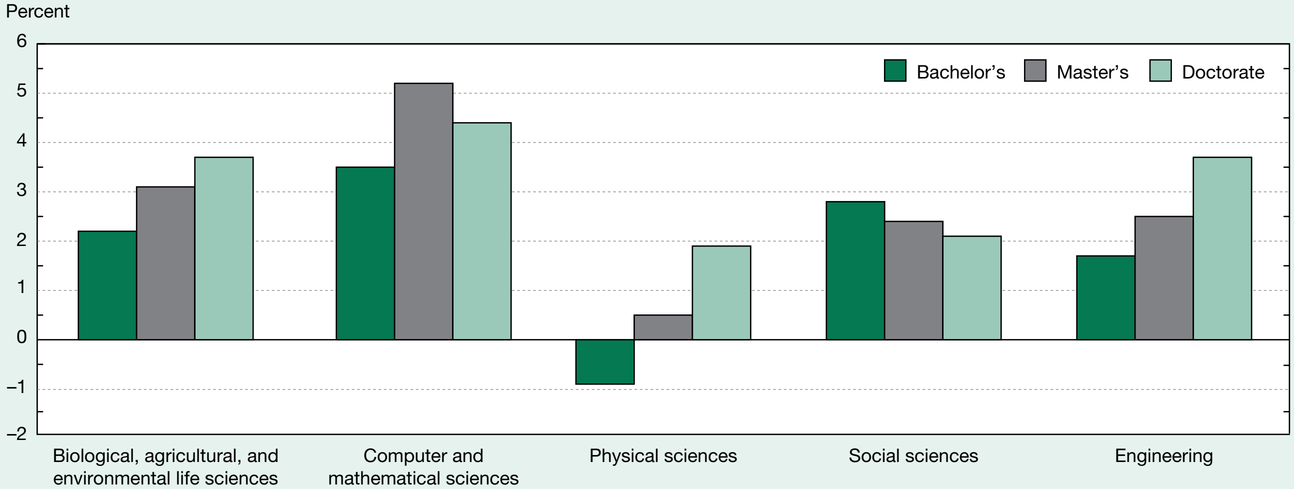
Figure 3-3
Average annual growth in the number of employed individuals whose highest degree is in S&E, by field and level of highest degree: 2003–10



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Science and Engineering Statistical Data System (SESTAT) (2003 and 2010), http://sestat.nsf.gov.

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Compared with the rest of the workforce, a very small minority of those employed in S&E occupations have only a high school degree. Many individuals enter the S&E workforce with marketable technical skills from technical or vocational schools (with or without an earned associate's degree) or college courses, and many acquire these skills through workforce experience or on-the-job training. In information technology, and to some extent in other occupations, employers frequently use certification exams, not formal degrees, to judge skills. (See sidebar, "The U.S. S&E Workforce Without a Bachelor's Degree" and the discussion in chapter 2.)

According to the 2010 SESTAT data, the vast majority (81%) of college graduates employed in S&E occupations have at least one S&E degree (table 3-4), suggesting that formal S&E training is the usual pathway for obtaining employment in these occupations. However, the importance of formal S&E training in the same broad field as one's S&E occupation varies across occupational categories. Among computer and mathematical scientists, for example, less than half (44%) have a bachelor's or higher level degree in the field of computer and mathematical sciences. The proportion is significantly higher in other broad S&E occupational categories: 73% of life scientists, 72% of physical scientists, 77% of social scientists, and 81% of engineers have a bachelor's or higher level degree in their respective broad field. Slightly more than one-fourth (28%) of computer and mathematical scientists do not have any S&E degree. The next section presents data on the proportion of S&E degree holders who obtain employment in S&E and non-S&E occupational categories.

The U.S. S&E Workforce Without a Bachelor's Degree

Although the Scientists and Engineers Statistical Data System (SESTAT) provides detailed information on college graduate scientists and engineers, it lacks similar data on individuals who do not have a bachelor's degree. The Census Bureau's American Community Survey (ACS) provides nationally representative occupational data for workers at all levels of education.* In 2011, about one-fourth of S&E workers age 25 and older did not have a bachelor's degree. This sidebar looks at the demographic, educational, and employment characteristics of these S&E workers without a bachelor's degree.†

Relative to college graduate workers employed in S&E occupations, a disproportionate number of those without a bachelor's degree employed in S&E occupations were black or Hispanic and native U.S. born. In 2011, about 9% of S&E workers without a bachelor's degree were black, and another 9% were Hispanic. In contrast, 6% of college-educated S&E workers were black and 5% were Hispanic. Asians represented only 3% of S&E workers without a bachelor's degree, compared to 19% of S&E workers with a bachelor's degree. In 2011, only 8% of S&E workers without a college degree were foreign born, compared to about one-fourth of college-educated S&E workers.

S&E workers without a bachelor's degree were mostly concentrated in computer occupations, with 69% employed in the field. In comparison, 44% of the college-educated S&E workers held computer jobs. Among computer occupations, computer support specialists, network and computer systems administrators, and other computer occupations together represented about half of the S&E workers without a bachelor's degree employed in computer occupations. Unlike the computer field, life sciences, physical sciences, and social sciences occupations had much smaller proportions of workers without a bachelor's degree. About 3% of the S&E workforce without a bachelor's degree were employed in these areas combined, compared to about one-fifth of the college-educated S&E workforce.

Relative to other occupations, S&E occupations provide stable employment with good earnings for workers without a college degree. In 2011, the median earnings among workers 25 years of age and older, without a bachelor's degree, and employed in S&E occupations ($60,000) was twice as high as the median earnings among comparable workers employed in other occupations ($30,000). The unemployment rate among these workers in S&E occupations was 6%, about half the rate in other occupations (11%).

Workers employed in S&E occupations had more formal training (even if they did not have a bachelor's degree) than those employed in other occupations, so it is not surprising that salaries were higher in S&E jobs. About one-third of the workers without a bachelor's degree employed in S&E occupations had an associate's degree, compared to 14% of those employed in other occupations.

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* For methodological reasons, estimates from ACS and SESTAT differ slightly even for the college graduate population, which both surveys cover. For example, the two surveys vary in the level of detail collected on work activities, which affects how workers are coded into standard occupational categories. In addition, ACS collects data from households, whereas SESTAT collects data from individuals. Finally, the analysis using ACS data counts postsecondary teachers of S&E as working in non-S&E occupations because the Census Bureau data do not identify them by field.

† This sidebar defines the S&E workforce by workers in S&E occupations (except postsecondary teachers in S&E fields). The ACS data do not allow for separate identification of postsecondary teachers by fields. See appendix table 3-1 for a list of S&E occupations in the 2011 ACS.

Occupational Distribution of S&E Degree Holders and Relationship between Jobs and Degrees

NSF's SESTAT provides information on the degree and occupational choices of scientists and engineers in the United States, thus enabling a comparison of the interplay between degree and occupation for members of the S&E workforce with and without a highest degree in an S&E discipline. Although an S&E degree is often necessary to obtain S&E employment, the data indicate that many individuals with S&E degrees pursue careers outside of S&E. The majority of workers with S&E training who work in non-S&E jobs reported that their work is nonetheless related to their S&E training, suggesting that the application of S&E skills and expertise extends well beyond the jobs NSF classifies as S&E. (The next section, "S&E Workers in the Economy," provides data on R&D activity of scientists and engineers employed in S&E and non-S&E occupations.)

Only about half of S&E highest degree holders are employed in an S&E (35%) or S&E-related (14%) occupation; the rest are employed in non-S&E occupations. Figure 3-5 shows the occupational distribution of the S&E workforce with S&E, S&E-related, and non-S&E highest degrees. The largest category of non-S&E jobs for S&E highest degree holders is management and management-related occupations (2.1 million workers), followed by sales and marketing occupations (995,000 workers) (appendix table 3-3). Other non-S&E occupations with a large number of S&E-trained workers include social services occupations (400,000) and

Figure 3-5
Occupational distribution of scientists and engineers, by broad field of highest degree: 2010

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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Table 3-4
Educational background of college graduates employed in S&E occupations, by broad S&E occupational category: 2010
(Percent)

Educational background	All S&E occupations	Biological, agricultural, and environmental life scientists	Computer and mathematical scientists	Physical scientists	Social scientists	Engineers
Total (*n*)	5,398,000	597,000	2,394,000	320,000	518,000	1,569,000
At least one S&E degree	81.1	86.3	72.1	96.9	81.9	89.5
At least one S&E degree in field	81.1	73.2	44.2	72.2	76.8	81.0
Highest degree in field	74.1	66.3	40.1	66.3	67.4	73.4
All degrees in S&E	69.3	71.4	61.8	88.1	56.2	80.5
No S&E degrees but at least one S&E-related degree	4.7	7.4	4.6	2.5	2.1	5.1
No S&E or S&E-related degree but at least one non-S&E degree	14.2	6.5	23.4	0.6	16.0	5.3

NOTES: At least one S&E degree in field is the proportion of workers in a particular S&E occupational category with at least one degree in the same broad field. Highest degree in field is the proportion of workers in a particular S&E occupational category with highest degree in the same broad field. For example, among computer and mathematical scientists, these data refer to the proportion with at least one college-level or higher degree in the broad field of computer and mathematical sciences and the proportion with highest degree in the broad field of computer and mathematical sciences, respectively. 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) (2010), http://sestat.nsf.gov.

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college and precollege teaching in non-S&E areas (358,000). S&E highest degree holders also work in S&E-related jobs (14%) such as health occupations (532,000), S&E managerial positions (417,000), S&E technicians or technologists positions (405,000), and precollege teaching in S&E areas (196,000).

Most individuals who have S&E highest degrees but are not working in S&E occupations do not see their field of highest degree as entirely irrelevant to their work. Rather, most indicate that their jobs are either closely (35%) or somewhat (32%) related to their highest degree field (table 3-5). Among S&E highest degree holders in non-S&E managerial and management-related occupations, for example, 33% indicate that their jobs are closely related, and another 40% say that their jobs are somewhat related, to their S&E degree. Among those in social services and related occupations, 73% say that their jobs are closely related, and another 21% say that their jobs are somewhat related, to their S&E degree. Among workers in sales and marketing, 50% characterize their jobs as closely or somewhat related to their S&E degree.

Unlike members of the S&E workforce with an S&E highest degree, half or more of the S&E workforce with S&E-related or non-S&E highest degrees obtain employment in their respective broad occupational category (figure 3-5). For those with an S&E-related highest degree, the largest category of jobs is health occupations (3.2 million); for those with a non-S&E highest degree, the largest category of jobs is management and management-related occupations (862,000) (appendix table 3-3). Significant numbers of the S&E workforce with a non-S&E highest degree also work in health occupations (604,000), in precollege teaching in S&E areas (536,000), or as lawyers or judges (571,000).

The pattern of significant proportions of S&E highest degree holders obtaining employment in areas other than S&E occupations has been robust over time. SESTAT data from 1993 indicate that 36% of all scientists and engineers with S&E highest degrees were employed in S&E occupations, and the rest held positions in areas other than S&E.

The proportion of S&E highest degree holders who go on to work in S&E occupations varies substantially by S&E degree fields and levels. Individuals with social sciences highest degrees are the least likely to work in S&E occupations; these individuals primarily obtain non-S&E employment (figure 3-6). Only about 13% of social sciences highest degree holders work in S&E occupations, whereas 80% work in non-S&E occupations. Similar proportions of life sciences highest degree holders work in S&E occupations (30%) and in S&E-related occupations (26%) such as health occupations, and less than half (44%) work in non-S&E occupations. In contrast, individuals with computer and mathematical sciences (54%), physical sciences (51%), or engineering (58%) highest degrees are much more likely to work in S&E occupations. Computer and mathematical sciences highest degree holders are the most likely to obtain employment in the broad S&E field in which they were trained (51%), whereas social sciences highest degree holders are the least likely to do so (8%).

This pattern of field differences generally characterizes individuals whose highest degree is at either a bachelor's or master's degree level. At the doctoral level, the size of these field differences shrinks substantially (figure 3-7). S&E doctorate holders most often work in an S&E occupation similar to their doctoral field.

Whereas figure 3-7 shows the proportion of S&E degree holders employed in S&E occupations, figure 3-8 shows the proportion of S&E degree holders (regardless of occupational categories) who reported that their work is related to their S&E degree. Workers with more advanced S&E training are more likely than those with only bachelor's level degrees to work in a job that is related to their field of highest degree. Up to 5 years after receiving their degrees, 97% 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 73% of bachelor's degree holders (figure 3-8). In general, higher proportions of employed individuals with natural sciences and engineering highest degrees compared with those with social sciences highest degrees

Table 3-5
Relationship of highest degree to job among S&E highest degree holders not in S&E occupations, by degree level: 2010

		Degree related to job (%)		
Highest degree	Workers (*n*)	Closely	Somewhat	Not
All degree levels[a]	7,386,000	35.2	32.4	32.4
Bachelor's	5,902,000	31.1	33.1	35.8
Master's	1,242,000	51.8	28.7	19.5
Doctorate	236,000	49.6	34.3	16.1

[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) (2010), http://sestat.nsf.gov.

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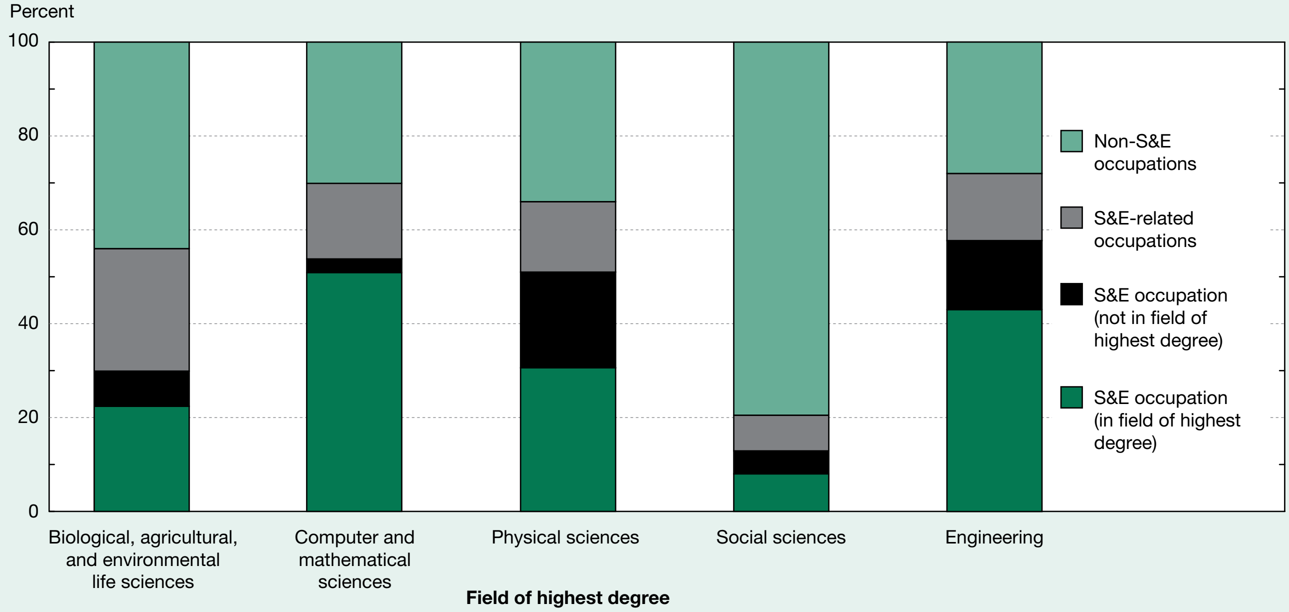
Figure 3-6
Occupational distribution of S&E highest degree holders, by field of highest degree: 2010



NOTES: Detail may not add to total because of rounding. For each broad S&E highest degree field, S&E occupation (in field of highest degree) includes individuals who report being employed in an occupation in the same broad category. For example, for highest degree holders in computer and mathematical sciences, S&E occupation (in field of highest degree) includes those who report computer or mathematical sciences as their occupation, and S&E occupation (not in field of highest degree) includes those who report an S&E occupation other than computer or mathematical sciences occupations.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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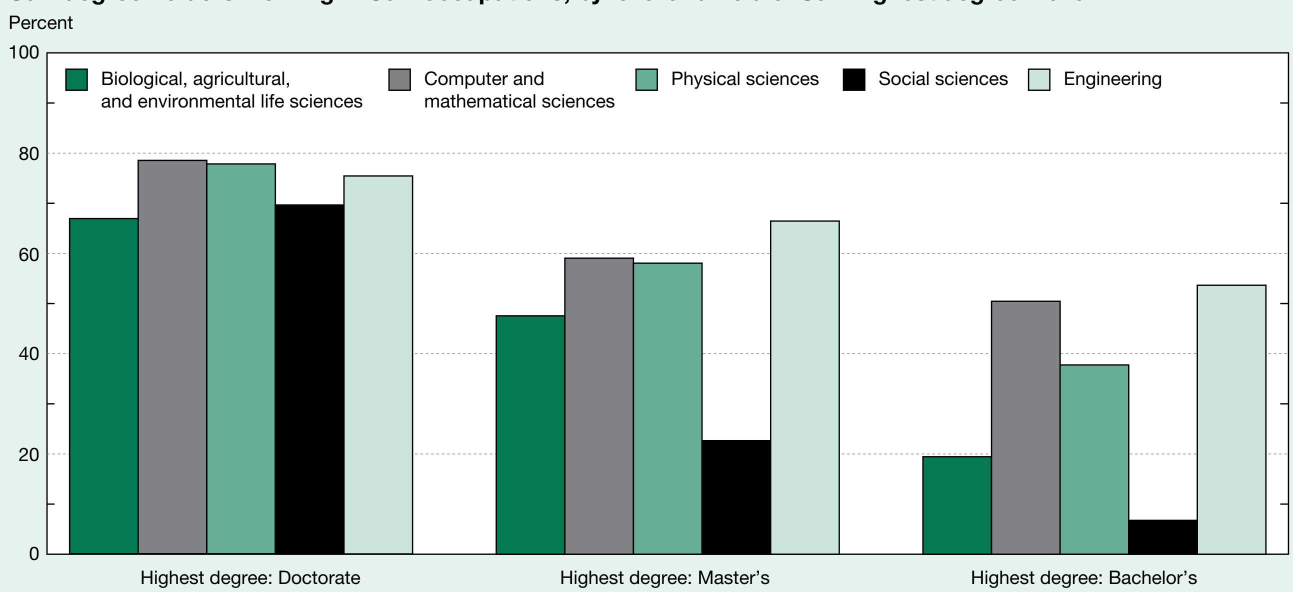
Figure 3-7
S&E degree holders working in S&E occupations, by level and field of S&E highest degree: 2010



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) (2010), http://sestat.nsf.gov.

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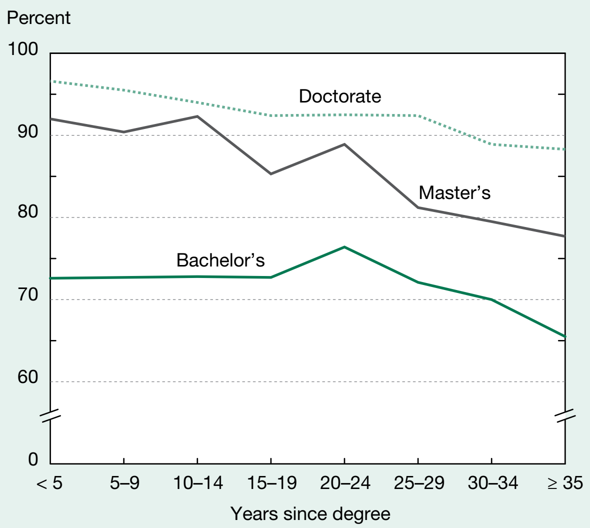
indicate that their jobs are related to their field of highest degree. Thus, among the SESTAT population of scientists and engineers in 2010, 75% of life sciences highest degree holders, 77% of physical sciences highest degree holders, 87% of computer and mathematical sciences highest degree holders, and 88% of engineering highest degree holders reported that their jobs were either closely or somewhat related to their highest degree field compared with 66% of social sciences highest degree holders. This is not surprising given that individuals trained in the social sciences most often obtain employment in non-S&E occupations.

The pattern of a stronger relationship between S&E jobs and S&E degrees at higher degree levels is robust across 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 (figure 3-8). For each group, the relationship between job and field of highest degree becomes weaker over time. Possible reasons for this decline include changes in career interests, development of skills in different areas, promotion to general management positions, or realization that some of the original training has become obsolete. Despite these potential factors, the career-cycle decline in the relevance of an S&E degree appears modest.

Figure 3-8
S&E degree holders employed in jobs related to highest degree, by level of and years since highest degree: 2010



NOTE: Data include those who report their job is either closely related or somewhat related to the field of their highest degree.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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S&E Workers in the Economy

To understand the economic and scientific contributions of scientists and engineers, it is important to know how they are distributed across the economy and what kind of work they perform. This section examines the characteristics of organizations that employ scientists and engineers, including sector and size of employing organizations. This section also describes the distribution of S&E workers within particular sectors. The data indicate that individuals trained in S&E fields or working in S&E occupations are found in all sectors, including for-profit businesses; non-profit organizations; public and private educational institutions; and local, state, and federal government. This section also examines self-employed scientists and engineers, as well as the concentration of S&E workers by industry sectors and by geography.

The S&E labor force is often seen as a major contributor to innovation. Work such as patenting activity, R&D activity, and work-related training are indicators of worker skill level, productivity, and innovative capacity. In addition to collecting information on formal education and employment, SESTAT gathers data on the degree to which workers engage in such activities. This section concludes with data on these activities.

Throughout this section, data are provided for the broad SESTAT population of scientists and engineers, including those employed in S&E or S&E-related occupations as well as those with S&E or S&E-related bachelor's or higher level degrees. Whenever possible, the data distinguish between individuals with S&E degrees and those working in S&E occupations.

Employment Sectors

The business sector is by far the largest employer of the broad S&E workforce covered by SESTAT, employing about 70% of individuals trained or working in S&E in 2010 (table 3-6). The education sector, including private and public institutions, employs 19% of the SESTAT population of scientists and engineers, and the government sector, including federal, state, and local government, employs another 11%. Within the business sector, for-profit businesses account for a larger number of scientists and engineers than non-profit organizations or the self-employed; within the education sector, 2-year and precollege institutions employ a larger number of scientists and engineers than 4-year institutions.

The relative distribution in the business, education, and government sectors has remained relatively stable since the early 1990s (figure 3-9). Nonetheless, some minor shifts occurred between 1993 and 2010:

- ♦ The proportion of scientists and engineers working in 4-year educational institutions dropped slightly (from 9.3% to 7.9%).

Table 3-6
Employment sector of scientists and engineers, by broad occupational category and degree field: 2010

Employment sector	All employed scientists and engineers	Highest degree in S&E	S&E occupations	S&E-related occupations	Non-S&E occupations
Total (*n*)	21,903,000	11,385,000	5,398,000	6,957,000	9,549,000
Business/industry (%)	69.8	71.8	70.3	68.3	70.7
For-profit businesses	52.5	58.6	62.1	45.3	52.3
Nonprofit organizations	10.7	7.0	4.6	17.6	9.1
Self-employed, unincorporated businesses	6.6	6.2	3.6	5.4	9.3
Education (%)	19.0	15.5	17.6	23.0	16.9
4-year institutions	7.9	8.6	14.3	7.4	4.7
2-year and precollege institutions	11.1	6.9	3.3	15.7	12.2
Government (%)	11.2	12.6	12.2	8.7	12.4
Federal	4.5	5.4	6.3	3.7	4.2
State/local	6.6	7.3	5.9	5.0	8.2

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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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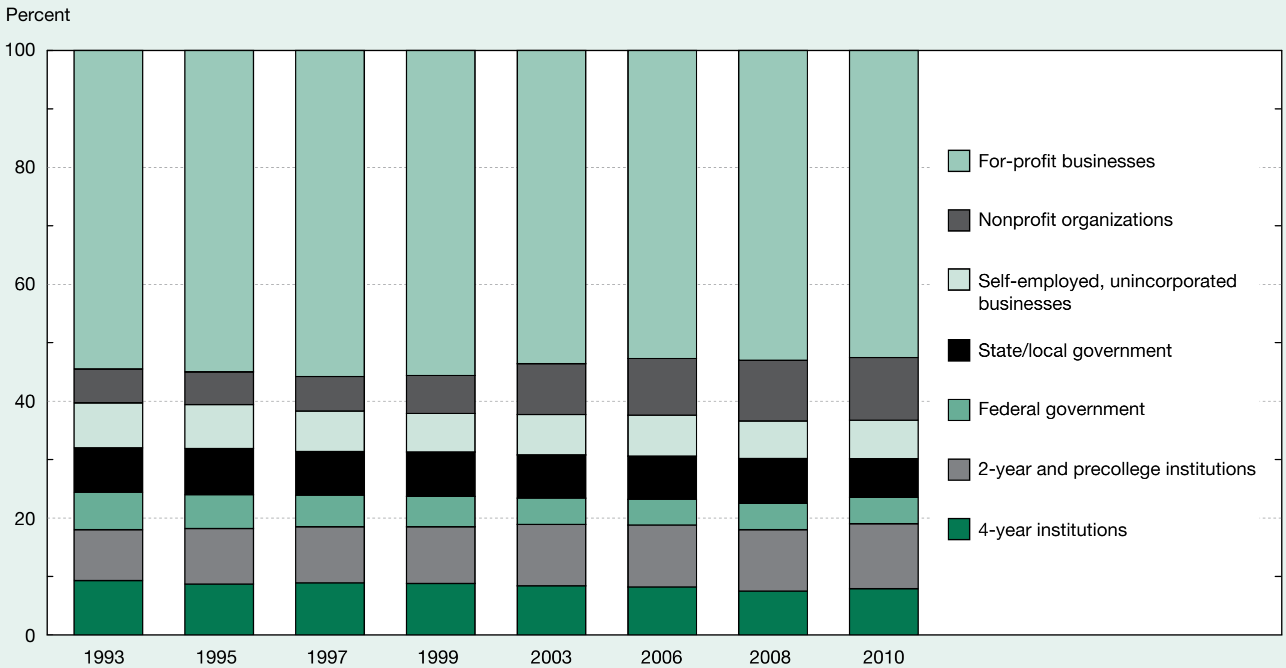
Figure 3-9
Employed scientists and engineers, by employment sector: 1993–2010



NOTES: During 1993–99, scientists and engineers include those with one or more S&E degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E occupation. During 2003–10, scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1993–2010), http://sestat.nsf.gov.

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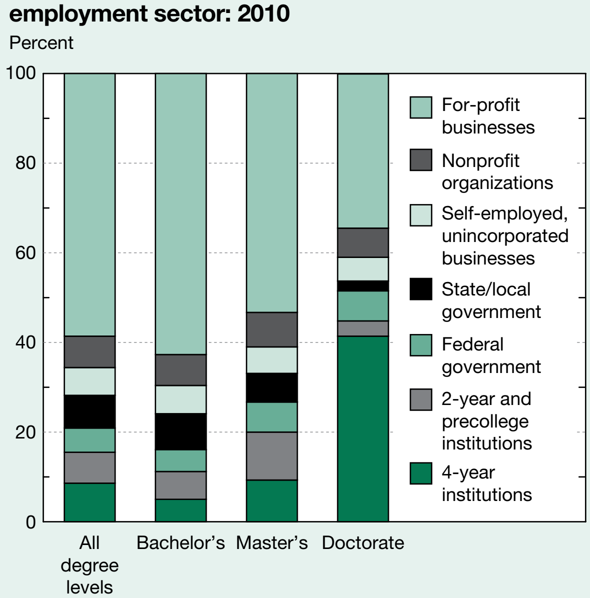
- The proportion of scientists and engineers working in the federal government declined by almost one-third (from 6.4% to 4.5%).
- The proportion of scientists and engineers working in the non-profit sector nearly doubled (from 5.8% to 10.7%).

Some differences exist in the concentration of particular groups of S&E workers across employment sectors. For example, academic institutions are the largest employer of the SESTAT population with doctorates, even though the business sector is the largest employer of the overall SESTAT population. Whereas individuals employed in engineering occupations and computer and mathematical sciences occupations are largely concentrated in the business sector, those employed as life scientists and social scientists are more evenly distributed between the business and education sectors. The following discussion provides a deeper analysis of the economic sectors in which scientists and engineers work.

Education Sector

Overall, the education sector employs nearly one-fifth of the broad S&E workforce covered by SESTAT (table 3-6). Depending on the population, however, the proportion working within different parts of the education sector varies. For example, within the education sector, the vast majority of S&E highest degree holders whose highest degree is at the doctoral level work in 4-year institutions, but the majority of those whose highest degree is at the bachelor's level work in 2-year and precollege institutions (figure 3-10; appendix table 3-4). In addition to tenure or tenure-track faculty, the doctorate population in the education sector includes individuals who hold postdoctoral appointments and other temporary positions, work in various other S&E teaching and research jobs, perform administrative functions, and are 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.)

Figure 3-10
S&E highest degree holders, by degree level and employment sector: 2010



NOTE: All degree levels include professional degrees not reported separately.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Of scientists and engineers who are employed in S&E occupations, 18% work in the education sector (table 3-6). Within the education sector, the majority of those employed in S&E occupations are concentrated in 4-year institutions (81%). In comparison, the great majority of workers in S&E-related or non-S&E occupations in the education sector are found in 2-year and precollege institutions (68% and 72%, respectively). These workers in these types of institutions are primarily teachers. Within S&E occupations, larger proportions of life, physical, and social scientists work in the education sector than engineers or computer and mathematical scientists (figure 3-11).

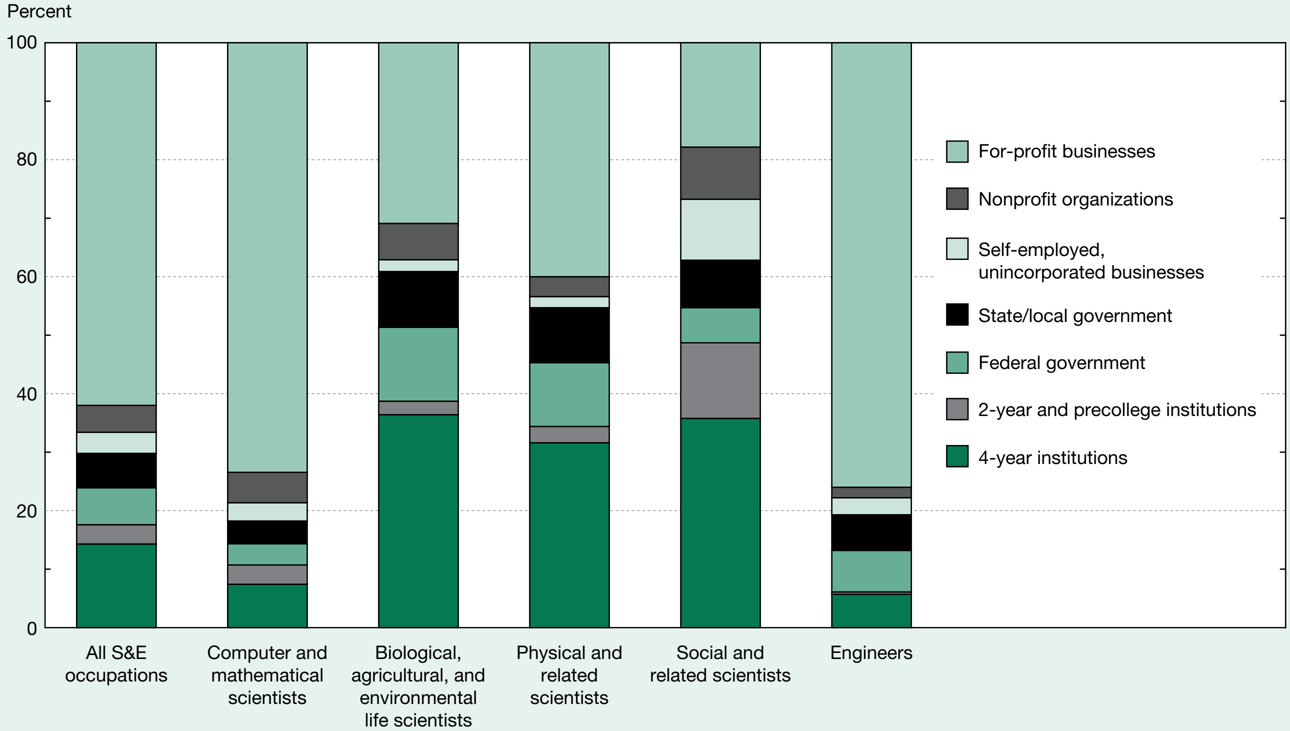
Business Sector

For-profit businesses. For-profit businesses employ the largest proportion of scientists and engineers (table 3-6). For the broad SESTAT population with doctorates, however, for-profit businesses are second to 4-year educational institutions (figure 3-10; appendix table 3-4). Approximately three-fourths of scientists and engineers working in computer and mathematical sciences occupations (73%) and in engineering occupations (76%) are employed by for-profit businesses. The proportions are much lower for those in other S&E occupations, ranging from 18% for social scientists to 40% for physical scientists (figure 3-11).

Non-profit organizations. Non-profit organizations have shown substantial growth in the percentage of scientists and engineers that they employ (figure 3-9). This growth is driven primarily by those working in S&E-related occupations, which include health-related jobs. Among all scientists and engineers employed in S&E-related occupations, 18% work in non-profit organizations (table 3-6). Among those in S&E occupations, the proportion working in non-profit organizations is much smaller (5%), although the proportion varies significantly across S&E occupational categories: from 2% of engineers to 9% of social scientists are employed by these organizations (figure 3-11).

Self-employment. In 2010, almost 4.2 million scientists and engineers (19%) reported being self-employed in either an unincorporated or incorporated business, professional practice, or farm (table 3-7).[8] Scientists and engineers working in S&E-related or non-S&E occupations reported higher levels of self-employment (18% and 24%, respectively) than those working in S&E occupations (12%). Among S&E highest degree holders, those with professional degrees

Figure 3-11
Broad S&E occupational categories, by employment sector: 2010



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010) http://sestat.nsf.gov.

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Table 3-7
Self-employed scientists and engineers, by education, occupation, and type of business: 2010
(Percent)

Characteristic	Total	Unincorporated business	Incorporated business
All self-employed scientists and engineers	19.0	6.6	12.4
Highest degree in S&E field	17.9	6.2	11.7
Biological, agricultural, and environmental life sciences	17.8	6.3	11.5
Computer and mathematical sciences	14.8	4.5	10.3
Physical sciences	17.3	5.9	11.4
Social sciences	18.9	7.8	11.1
Engineering	18.7	4.7	14.0
S&E highest degree level			
Bachelor's	19.4	6.3	13.1
Master's	14.7	5.9	8.8
Doctorate	11.7	5.3	6.4
Professional	47.8	39.1	8.7
Occupation			
S&E occupation	12.0	3.6	8.4
Biological, agricultural, and environmental life scientists	6.2	2.0	4.2
Computer and mathematical scientists	11.7	3.1	8.6
Physical scientists	7.5	1.9	5.6
Social scientists	16.4	10.4	6.0
Engineers	14.1	2.9	11.2
S&E-related occupations	18.4	5.4	13.0
Non-S&E occupations	23.5	9.3	14.2

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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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reported significantly higher rates of self-employment (48%) than those with a bachelor's degree (19%), master's degree (15%), or doctorate (12%) as their highest degree.

Incorporated businesses account for the majority of self-employed scientists and engineers, with the exception of those with a highest degree at the professional level or those in social sciences occupations, who primarily work in unincorporated businesses (table 3-7). The higher levels of unincorporated self-employment among social scientists and professional degree holders are largely driven by psychologists. About one-third of those working as psychologists (32%) are self-employed, mostly in unincorporated businesses. Nearly half of those whose highest degree at the professional level is in a field of psychology (48%) are self-employed, again primarily in unincorporated businesses.

Government Sector

Federal government. The U.S. federal government is a major employer of scientists and engineers. According to data from the U.S. Office of Personnel Management, in 2012 the federal government employed approximately 325,000 persons in S&E occupations, which represents about 15% of the federal civilian workforce. Federal workers in S&E jobs are almost evenly distributed among computer and mathematical sciences occupations (33%); engineering occupations (32%); and life sciences, physical sciences, and social sciences occupations (36%).[9] The vast majority (80%) of the federal workers in S&E occupations have a bachelor's or higher level degree.

The five federal agencies with the largest proportions of scientists and engineers in their workforce are those with strong scientific missions: the National Aeronautics and Space Administration (NASA) (65%), the Nuclear Regulatory Commission (NRC) (62%), the Environmental Protection Agency (EPA) (60%), NSF (40%), and the Department of Energy (33%). The Department of Defense employs the largest number of scientists and engineers (150,000), accounting for 46% of the federal S&E workforce.[10]

Among federal workers hired in 2012, about 9% were in S&E occupations. Nearly one-third of these newly hired workers were in occupations related to information technology.

State and local government. In 2010, SESTAT estimated that almost 1.5 million scientists and engineers (7%) were working in state and local governments in the United States (table 3-6). Public educational institutions, which are included in the education sector, are not included in this statistic. The state and local government sector hires a larger proportion of scientists and engineers with bachelor's or master's degrees than of those with doctorates (figure 3-10). Approximately 6% of scientists and engineers employed in S&E occupations are employed by state and local governments (table 3-6). Within S&E occupations, larger proportions of life scientists, physical scientists, social scientists, and engineers work in state and local governments relative to computer and mathematical scientists (figure 3-11).

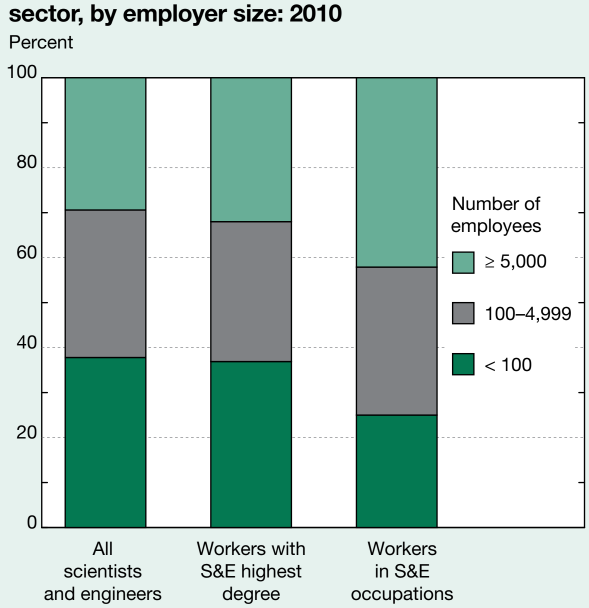
Employer Size

The vast majority of educational institutions and government entities that employ individuals trained in S&E fields or working in S&E occupations are larger employers (i.e., having 100 or more employees). These large organizations employ 88% of scientists and engineers in the education sector and 92% of those in the government sector. In contrast, scientists and engineers working in the business sector are more broadly distributed across firms of many sizes (figure 3-12; appendix table 3-5).

Workers employed in the business sector in S&E occupations are more densely concentrated in larger firms than the broad SESTAT population or even than all those with S&E highest degrees (figure 3-12; appendix table 3-5). The largest firms (those with 5,000 or more employees) employ 42% of college-educated workers in S&E occupations, compared to 30% of the broad SESTAT population. The proportion in firms with 100 or more employees is 75% for S&E occupations compared with 62% for all scientists and engineers. Within the business sector, workers at different degree levels are distributed similarly across firms of different sizes (figure 3-13).

Many scientists and engineers who are self-employed work in businesses with 10 or fewer employees. In all, 82% of self-employed individuals in unincorporated businesses and 41% of self-employed individuals in incorporated businesses

Figure 3-12
Scientists and engineers employed in the business sector, by employer size: 2010



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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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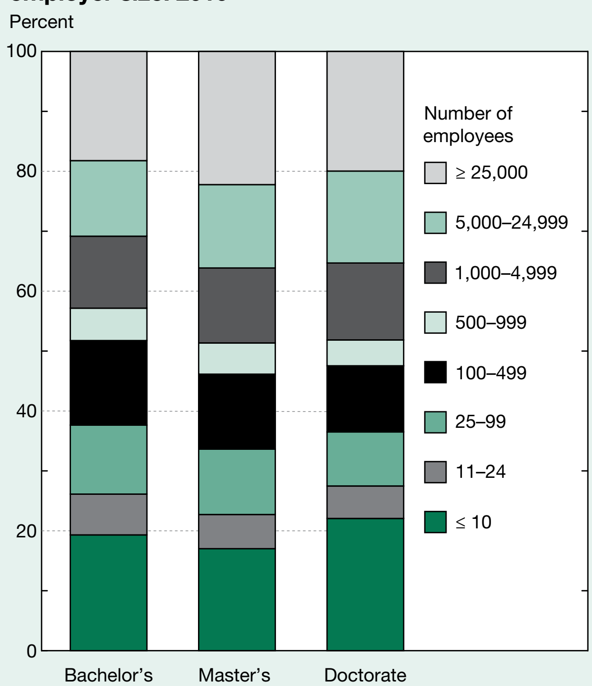
work in businesses with 10 or fewer employees. In contrast, only 5% of all other scientists and engineers work in businesses with 10 or fewer employees. Many of these scientists and engineers likely think of themselves as independent professionals rather than small business owners.

Industry Employment

The OES survey provides detailed estimates for employment in S&E occupations by type of industry; however, it excludes the self-employed and those employed in agriculture and in recent startups. Industries vary in their proportions of S&E workers (table 3-8). In 2012, the industry group with the largest S&E employment was professional, scientific, and technical services, which employed about 1.8 million (31%) S&E workers, followed by manufacturing, which employed 887,000 (15%) S&E workers (table 3-8). The government, which includes federal, state, and local government, employed 636,000 (11%) S&E workers; educational services, which includes private and public educational institutions, employed another 684,000 (12%) S&E workers. These four industry groups—professional, scientific, and technical services; manufacturing; government; and educational services—had a disproportionate concentration of S&E jobs. Together, these industry groups employed about two-thirds of all workers in S&E occupations (68%), compared with one-third of workers in all occupations (32%).

Figure 3-13
S&E highest degree holders employed in the business sector, by highest degree level and employer size: 2010



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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S&E employment intensity, defined by an industry's S&E employment as a proportion of its total employment, was highest in professional, scientific, and technical services (24%) followed by information (17%) and management of companies and enterprises (13%) (table 3-8). The broad industry groups with S&E employment intensity below the national average (4.6%) together employed 59% of all workers in 2012 but only 14% of workers in S&E occupations. These groups with S&E employment intensity below the national average include large employers such as health care and social assistance, retail trade, and accommodation and food services.

Employment by Metropolitan Area

The availability of a skilled workforce is an important predictor of a region's population, productivity, and technological growth (Carlino, Chatterjee, and Hunt 2001; Glaeser and Saiz 2003). 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).

This section presents the following indicators of the availability of S&E workers in a metropolitan area: (1) the number of S&E workers in the metropolitan area or division, (2) the proportion of the entire metropolitan area workforce in S&E occupations, and (3) the proportion of the nationwide S&E workforce in the metropolitan area. Data on the metropolitan areas with the largest proportion of workers in S&E occupations appear in table 3-9. These estimates are affected by the geographic scope of each metropolitan area, which can vary significantly. In particular, comparisons between areas can be strongly affected by how much territory outside the urban core is included in the metropolitan area.

S&E employment in the United States is geographically concentrated; that is, a small number of geographic areas account for a significant proportion of S&E jobs. For example, the 20 metropolitan areas listed in table 3-9 account for 18% of nationwide employment in S&E jobs, compared to about 8% of employment in all occupations.

Scientists and Engineers and Innovation-Related Activities

Who Performs R&D?

Because R&D creates new types of goods and services that can fuel economic and productivity growth and enhance living standards, individuals with S&E expertise who use their knowledge in R&D attract special interest. This section uses SESTAT data to examine the R&D activity of scientists and engineers. In this section, R&D activity is defined as the proportion of workers who reported basic research, applied research, design, or development as a primary or secondary work activity in their principal job (i.e., activities

Table 3-8
Employment in S&E occupations, by major industry sector: May 2012

Industry sector	Workers employed (*n*)		U.S. total S&E employment in industry (%)	Industry workforce in S&E occupations (%)
	All occupations	S&E occupations		
U.S. total—all industries	130,287,700	5,968,240	100	4.6
Agriculture, forestry, fishing, and hunting	393,840	1,110	0.0	0.3
Mining	783,110	62,260	1.0	8.0
Utilities	552,750	49,160	0.8	8.9
Construction	5,611,950	53,070	0.9	0.9
Manufacturing	11,866,540	887,060	14.9	7.5
Wholesale trade	5,623,510	235,120	3.9	4.2
Retail trade	14,982,710	50,970	0.9	0.3
Transportation and warehousing	5,014,660	41,070	0.7	0.8
Information	2,688,380	446,310	7.5	16.6
Finance and insurance	5,535,000	299,180	5.0	5.4
Real estate, rental, and leasing	1,928,950	12,110	0.2	0.6
Professional, scientific, and technical services	7,768,610	1,831,940	30.7	23.6
Management of companies and enterprises	2,003,680	259,200	4.3	12.9
Administrative and support and waste management and remediation	7,991,260	180,950	3.0	2.3
Educational services	12,683,810	683,510	11.5	5.4
Health care and social assistance	17,720,090	187,780	3.1	1.1
Arts, entertainment, and recreation	1,937,910	9,050	0.2	0.5
Accommodation and food services	11,675,540	2,570	0.0	0.0
Other services (except federal, state, and local government)	3,809,410	40,030	0.7	1.1
Federal, state, and local government (OES designation)	9,716,010	635,760	10.7	6.5

OES = Occupational Employment Statistics.

NOTES: Industries are defined by the North American Industry Classification System (NAICS). The OES Survey does not cover employment among self-employed workers and employment in the following industries: crop production (NAICS 111); animal production (NAICS 112); fishing, hunting, and trapping (NAICS 114); and private households (NAICS 814). As a result, the data do not represent total U.S. employment. Differences between any two industry sectors may not be statistically significant.

SOURCE: Bureau of Labor Statistics, OES Survey (May 2012).

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that rank first or second in total work hours from a list of 14 activities).[11]

The SESTAT data from 2010 indicate that 27% of employed scientists and engineers reported R&D as a primary or secondary work activity. However, the proportion who do so varies substantially across occupations and degrees (figure 3-14). In general, SESTAT respondents employed in S&E occupations are the most likely to perform R&D as a primary or secondary work activity (57%), but a considerable proportion of those in S&E-related (21%) or non-S&E occupations (16%) also reported R&D as a primary or secondary activity. This indicates that R&D activity spans a broad range of occupations.

Nearly half of the scientists and engineers who have a highest degree in a non-S&E field but are employed in an S&E job reported R&D activity (47%), although they did so less often than those who have a highest degree in an S&E field and are employed in an S&E job (60%). Many S&E degree holders subsequently earn degrees in other fields, such as medicine, law, or business. The SESTAT data from 2010 indicate that the majority of scientists and engineers (67%) with a highest degree in a non-S&E field also obtained other degrees in S&E or S&E-related fields.

Those with doctorates account for a disproportionate segment of R&D performers. These individuals constitute only 5% of all SESTAT respondents but 11% of SESTAT respondents who reported R&D as a major work activity. However, the majority of R&D performers in the S&E workforce have bachelor's (53%) or master's (32%) degrees.

Among the SESTAT population employed in S&E occupations, life scientists (75%) reported the highest rates of R&D activity, whereas social scientists (49%) and computer and mathematical scientists (46%) reported the lowest rates (table 3-10). In most occupations, those with doctorates indicated higher rates of R&D activity than those with a bachelor's or master's degree as their highest degree (table 3-10).[12]

SEH doctorate holders in later career stages reported lower rates of R&D activity than those in earlier career stages (figure 3-15). Thus, 55% of those who received their SEH doctorate in 1990 or earlier reported R&D activity in 2010, compared to 67% of those who received their doctorates between 1991 and 2009. The decline in R&D activity over the course of individuals' careers may reflect movement into management, growth of other career interests, or possession of scientific knowledge and skills that are no longer in demand. It may also reflect increased opportunity for more experienced scientists to perform functions involving the interpretation and use of, as opposed to the creation and development of, scientific knowledge.

For the most part, scientists and engineers performing R&D activity are distributed similarly across broad employment sectors as scientists and engineers who do not perform R&D as a primary or secondary work activity. About 70% of scientists and engineers in each group are employed in the business sector (68% and 71%, respectively), about 20% are employed in the education sector (21% and 18%, respectively), and 11% are employed in the government sector. However, within the education sector, 4-year institutions employ 66% of SESTAT respondents who perform R&D as a primary or secondary work activity, compared to 31% of those who do not.

Patenting Activity

The U.S. Patent and Trademark Office (USPTO) 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. Not all patent applications received by the USPTO are granted, not all granted patents result in commercial products, and not all R&D leads to patents because inventors often protect commercially useful discoveries in other ways such as copyrights and trade secrets. NSF data indicate that, among U.S.-trained SEH doctorates, 16% reported patenting activity during the period from 2003 to 2008 (National Science Board [NSB] 2012).[13] Patenting activity varied significantly across disciplines, with doctorate holders in engineering and physical sciences reporting the highest rates and those in mathematics, statistics, and psychology reporting the lowest rates. Doctorate holders in engineering and physical sciences also reported the highest average number of patent applications per person and the highest average number of patents granted. For an in-depth analysis of the relevant data, see the NSB *Science and Engineering Indicators 2012* (NSB 2012).

Work-Related Training

In addition to formal education, workers very often engage in work-related training. Such training can contribute to innovation and productivity growth by enhancing skills, efficiency, and knowledge. In 2010, 55% of scientists and engineers in the labor force reported participating in work-related training within the past 12 months of being surveyed (table 3-11). Among those who were employed, workers in S&E-related jobs (health-related occupations, S&E managers, S&E precollege teachers, and S&E technicians and technologists) exhibited higher rates of participation (73%) than workers in S&E (55%) or non-S&E jobs (61%). In general, employed scientists and engineers reported higher rates of

Table 3-9
Metropolitan areas with largest proportion of workers in S&E occupations: May 2012

Metropolitan area	Workers employed (*n*): All occupations	Workers employed (*n*): S&E occupations	Metropolitan area workforce in S&E occupations (%)	U.S. total S&E employment in metropolitan area (%)
U.S. total	130,287,700	5,968,240	4.6	100.0
San Jose–Sunnyvale–Santa Clara, CA	898,610	142,430	15.9	2.4
Boulder, CO	159,440	21,160	13.3	0.4
Huntsville, AL	203,400	26,590	13.1	0.4
Corvallis, OR	33,310	4,170	12.5	0.1
Framingham, MA, NECTA Division	157,290	19,550	12.4	0.3
Durham–Chapel Hill, NC	272,250	32,690	12.0	0.5
Washington-Arlington-Alexandria, DC-VA-MD-WV, Metropolitan Division	2,343,510	265,370	11.3	4.4
Lowell-Billerica-Chelmsford, MA-NH, NECTA Division	116,620	12,830	11.0	0.2
Seattle-Bellevue-Everett, WA, Metropolitan Division	1,409,500	148,670	10.5	2.5
Bethesda-Rockville-Frederick, MD, Metropolitan Division	560,000	54,380	9.7	0.9
Bloomington-Normal, IL	86,920	8,280	9.5	0.1
Kennewick-Pasco-Richland, WA	97,300	8,850	9.1	0.1
Boston-Cambridge-Quincy, MA, NECTA Division	1,711,350	154,470	9.0	2.6
San Francisco–San Mateo–Redwood City, CA, Metropolitan Division	1,000,430	89,480	8.9	1.5
Ann Arbor, MI	193,760	16,870	8.7	0.3
Fort Collins–Loveland, CO	132,630	11,060	8.3	0.2
Ames, IA	40,270	3,280	8.1	0.1
Olympia, WA	93,850	7,520	8.0	0.1
Austin–Round Rock–San Marcos, TX	812,600	64,780	8.0	1.1
College Station–Bryan, TX	92,990	7,370	7.9	0.1

NECTA = New England City and Town Area.

NOTES: The data exclude metropolitan statistical areas where S&E proportions were suppressed. Larger metropolitan areas are broken into component metropolitan divisions. Differences between any two areas may not be statistically significant.

SOURCE: Bureau of Labor Statistics, Occupational Employment Statistics Survey (May 2012).

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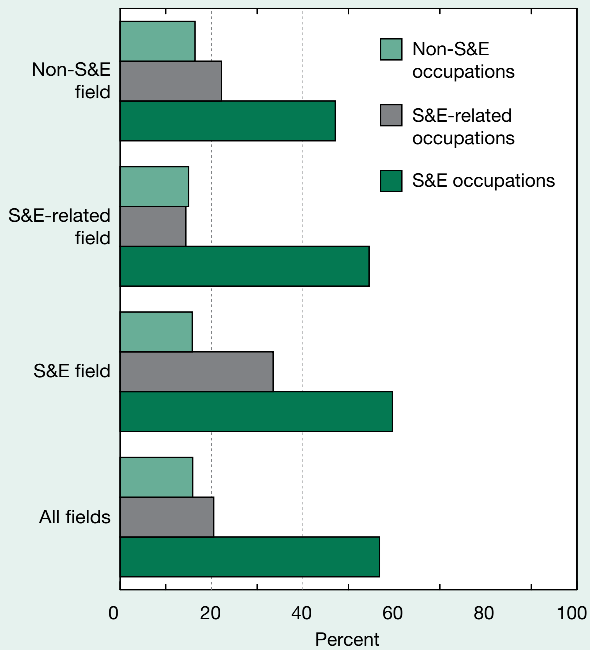
Figure 3-14
Employed scientists and engineers with R&D activity, by broad field of highest degree and broad occupational category: 2010



NOTES: Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation. R&D activity here refers to the share of workers reporting basic research, applied research, design, or development as a primary or secondary work activity in their principal job—activities ranking first or second in work hours.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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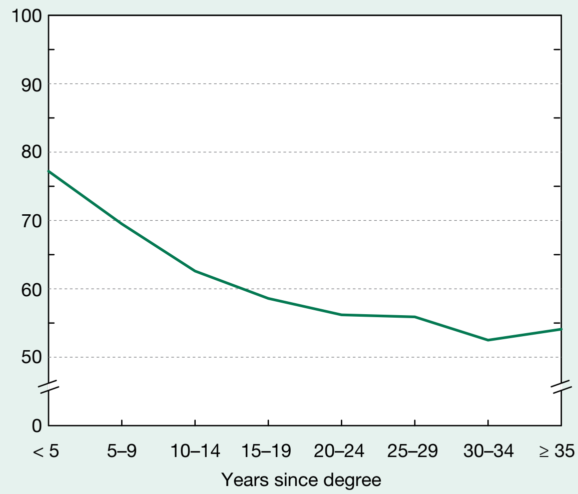
participation (63%) than unemployed scientists and engineers (30%). Women participated in work-related training at a higher rate than men: 58% of women compared with 52% of men (appendix table 3-6). This difference exists among most groups defined by labor force status or highest degree level.

Figure 3-15
Employed SEH doctorate holders with R&D activity, by years since doctoral degree: 2010



SEH = science, engineering, and health.

NOTE: R&D activity here refers to the share of workers reporting basic research, applied research, design, or development as a primary or secondary work activity in their principal job—activities ranking first or second in work hours.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2010), http://sestat.nsf.gov.

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Table 3-10
R&D activity rate of scientists and engineers employed in S&E occupations, by broad occupational category and level of highest degree: 2010
(Percent)

Highest degree level	Biological, agricultural, and environmental life scientists	Computer and mathematical scientists	Physical scientists	Social scientists	Engineers
All degree levels	75.2	45.5	70.3	49.4	66.5
Bachelor's	66.9	44.0	65.6	47.6	62.9
Master's	74.5	46.3	65.5	46.8	70.0
Doctorate	86.8	64.1	80.0	54.2	83.9

NOTES: All degree levels include professional degrees not broken out separately. R&D activity rate is the proportion of workers who report that basic research, applied research, design, or development is a primary or secondary work activity in their principal job—activities ranking first or second in work hours.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Among scientists and engineers who participated in work-related training within the 12 months before being surveyed, most did so to improve skills or knowledge in their current occupational field (52%) (appendix table 3-7).[14] Others did so for licensure/certification in their current occupational field (24%) or because it was required or expected by their employer (15%). 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 than those who were in the labor force.

Table 3-11
Scientists and engineers participating in work-related training, by labor force status and occupation: 2010

Labor force status and occupation	Number	Percent
All scientists and engineers	14,688,000	54.6
Employed	13,894,000	63.4
S&E occupations	2,950,000	54.6
Biological, agric ultural, and environmental life scientists	351,000	58.8
Computer and mathematical scientists	1,154,000	48.2
Physical scientists	166,000	51.9
Social scientists	343,000	66.2
Engineers	937,000	59.7
S&E-related occupations	5,085,000	73.1
Non-S&E occupations	5,859,000	61.4
Unemployed	297,000	29.9
S&E occupations	54,000	25.0
Biological, agricultural, and environmental life scientists	5,000	21.7
Computer and mathematical scientists	20,000	21.5
Physical and related scientists	4,000	36.4
Social and related scientists	4,000	33.3
Engineers	21,000	27.6
S&E-related occupations	72,000	39.6
Non-S&E occupations	171,000	30.1
Not in labor force	497,000	12.5

NOTES: Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation in 2010. Unemployed individuals are those not working but who looked for a job in the preceding 4 weeks. For unemployed, the last job held was used for classification. 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) (2010), http://sestat.nsf.gov.

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S&E Labor Market Conditions

This section looks at a variety of labor market indicators to assess the overall health of the labor market for scientists and engineers. Indicators of labor market participation (such as rates of unemployment and involuntarily working out of one's degree field) and earnings provide meaningful information on economic rewards and the overall attractiveness of careers in S&E fields. Many labor market indicators are lagging indicators, which change some time after other indicators show that the economy has begun to follow a particular trend. For example, although the most recent recession officially began in December 2007 and ended in June 2009, unemployment rates continued to rise after the recession had officially ended.[15] Rates of unemployment, rates of working involuntarily out of one's field of highest degree, and earnings should all be considered in this context.

Unemployment

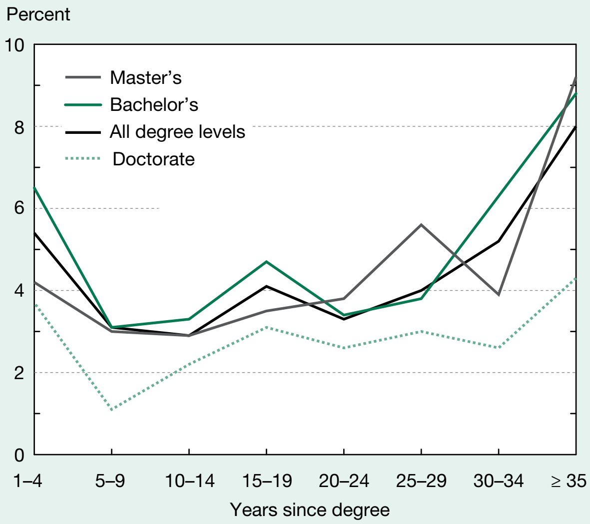
In general, those who hold S&E degrees or work in S&E occupations have had lower rates of unemployment than the broader labor force. However, the S&E workforce is not exempt from unemployment due to overall business cycles or to specific events affecting individuals in their fields. In October 2010, an estimated 4.3% of the broad SESTAT population were unemployed (appendix table 3-8). At the same time, the official unemployment rate reported by BLS for the entire U.S. labor force was about twice as high, 9.0%.[16] According to the NSCG, the unemployment rate for all college graduates was 5.1% in the same period. Thus, joblessness among scientists and engineers compares favorably with the rates for the labor force as a whole and the college-educated labor force.

In 2010, scientists and engineers employed in non-S&E occupations generally had a higher unemployment rate (5.6%) than those employed in S&E occupations (unemployment rates ranged from 2.3% among social scientists to 4.6% among engineers) (appendix table 3-8). Advanced degree holders are less vulnerable to unemployment than those with only bachelor's degrees (appendix table 3-8). Nonetheless, a comparison of SESTAT data from 2006, before the onset of the economic downturn, and from 2010, after the downturn ended, shows clear evidence that the SESTAT population of scientists and engineers were affected by the broader economic conditions: unemployment rates for comparable groups were generally higher in 2010 than in 2006.[17] For example, between 2006 and 2010, the unemployment rate among scientists and engineers with a highest degree at the bachelor's level rose from 2.9% to 4.9%; among those with a doctorate, the rate rose from 1.6% to 2.6%. During the same period, unemployment rates nearly doubled among engineers (from 2.4% in 2006 to 4.6% in 2010) and among scientists and engineers employed in non-S&E occupations (from 3.0% in 2006 to 5.6% in 2010).

The extent of unemployment also varies by career stages. Scientists and engineers in the early- to mid-stages of their career cycles (about 5 to 30 years after obtaining their highest degree) are less likely to be jobless than those at earlier points in their careers (figure 3-16). As workers strengthen their skills by acquiring labor market experience and adding on-the-job knowledge to their formal training, their work situations become more secure. However, among scientists and engineers in the later stages of their careers (about 35 or more years after obtaining their highest degree), the unemployment rates are higher than for those who are in the early- to mid-career stages. This suggests that over time scientists and engineers either become more selective about the work they are willing to do or find their skills becoming obsolete, which results in higher unemployment toward the later stages of their careers.

CPS data allow for analysis of unemployment rates over the past three decades.[18] CPS data indicate that workers employed in S&E occupations have historically experienced lower unemployment rates than the overall labor market (figure 3-17). CPS data for the period 1983–2012 indicate that the unemployment rate for college-educated individuals in S&E occupations ranged from a low of 1.3% to a high of 4.3%, which contrasted favorably with rates for the entire college-educated labor force (ranging from 1.8% to 7.8%). The unemployment rate for S&E technicians and computer programmers ranged from 2.1% to 7.4%; in comparison, the unemployment rate for the entire labor force ranged from 4.0% to 9.6%.

Figure 3-16
Unemployment rates of scientists and engineers, by level of and years since highest degree: 2010



NOTES: All degree levels include professional degrees not shown separately. Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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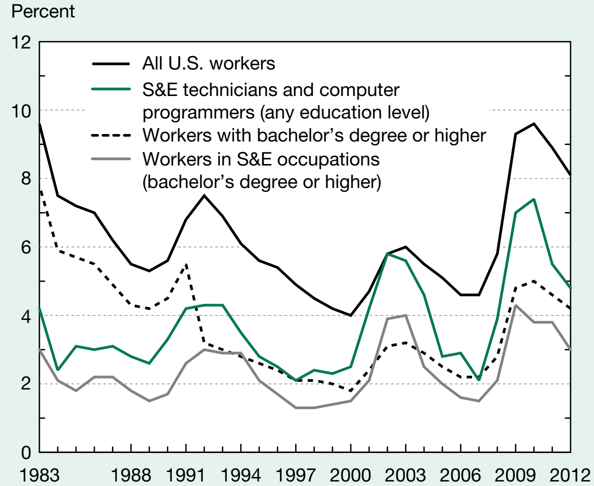
Figure 3-17
Unemployment rate, by occupation: 1983–2012



SOURCES: National Bureau of Economic Research, Merged Outgoing Rotation Group files (1983–2012); Bureau of Labor Statistics, Current Population Survey (1983–2012).

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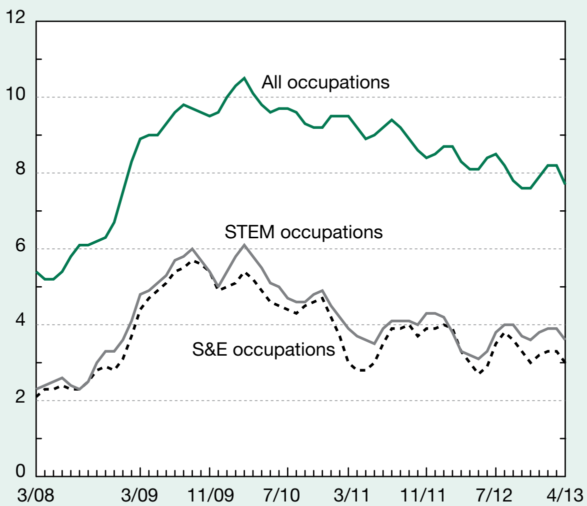
During the economic downturn that began in late 2007, unemployment rates among workers employed in S&E occupations generally followed the historic pattern (figure 3-18). Unemployment peaked at 5.7% in S&E occupations and 6.1% in the broader STEM occupations, which include S&E occupations as well as computer programmers, technicians, and S&E managers. In comparison, peak unemployment in all occupations was considerably higher (10.5%). In addition to lower rates, unemployment in S&E occupations began declining earlier than in all occupations. As of early 2013, however, unemployment rates among all workers (7.7%) as well as S&E workers (3.0%) were still higher than in the beginning of 2008 (5.4% and 2.1%, respectively).

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 official unemployment rate (U3). In addition to U3, BLS reports five other measures (table 3-12), which provide narrower (U1 and U2) or broader (U4–U6) measures of unemployment than the standard measure (U3). These additional measures, called "alternative measures of labor underutilization," provide additional detail about differences in employment patterns between the S&E labor force and the overall labor force (appendix table 3-9).

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 (figure 3-19). In addition to lower U3, workers in S&E occupations experienced lower long-term unemployment (U1), defined as unemployment

Figure 3-18
Unemployment rates for workers in S&E, STEM, and all occupations: March 2008–April 2013



STEM = science, technology, engineering, and mathematics.

NOTES: Data for S&E, STEM, and all occupations include people at all education levels. Estimates are not seasonally adjusted. Estimates are made from pooled microrecords of the Current Population Survey (CPS) and, although similar, are not the same as the 3-month moving average.

SOURCE: Bureau of Labor Statistics, CPS, Public-Use Microdata Sample (PUMS), January 2008–April 2013.

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Table 3-12
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 4 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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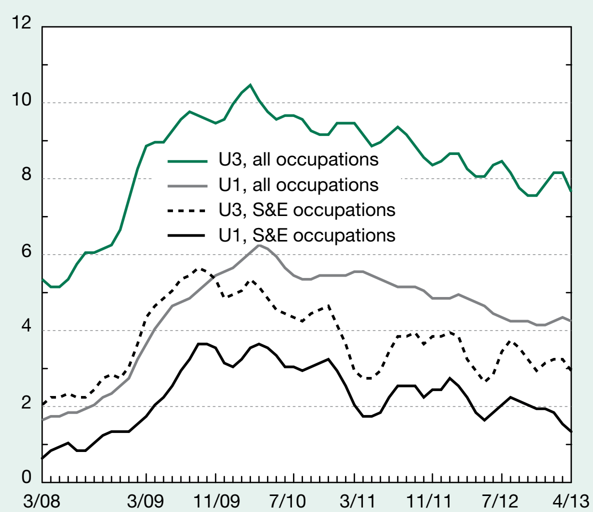
lasting 15 weeks or longer, throughout the economic downturn. Although U1 in S&E occupations stabilized and began gradually declining in the latter part of 2009, U1 in all occupations continued to rise until the beginning of 2010. Beginning around the end of 2009, the rate of long-term unemployment in 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 standard unemployment rate, this indicator captures the difference between workers' labor market aspirations and outcomes. The gap between this measure and the standard unemployment rate among workers in S&E occupations is substantially smaller than the comparable gap in the general labor force (appendix table 3-9). This suggests that underutilized workers—that is, those who work part time but would like to obtain full-time employment or those who would like to work but have stopped looking for employment—are a more significant factor among the general labor force than among those in S&E occupations.

Figure 3-19
Measures of labor underutilization for workers in S&E and all occupations: March 2008–April 2013



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

NOTES: Data for S&E and all occupations include workers at all education levels. Estimates are not seasonally adjusted. Estimates are made from the pooled microrecords of the Current Population Survey and, although similar, are not the same as the 3-month moving average.

SOURCE: Bureau of Labor Statistics, Current Population Survey, Public-Use Microdata Sample (PUMS), January 2008–April 2013.

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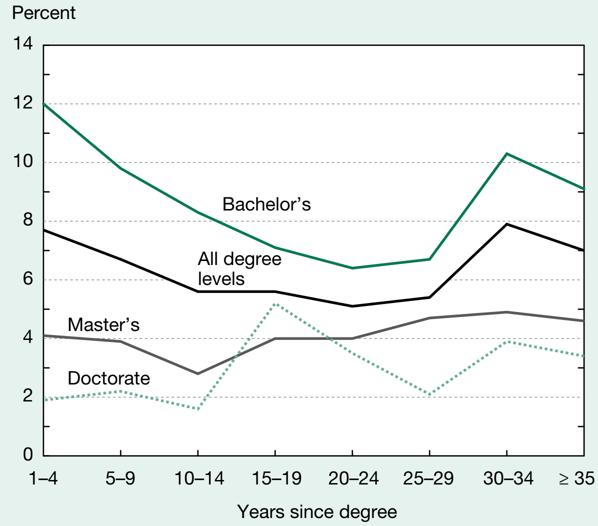
Involuntarily Working Out of One's Field of Highest Degree

SESTAT data provide information on the relevance of individuals' educational background for their principal job. SESTAT also provides data on why individuals obtain employment outside of their field of highest degree. The SESTAT population of scientists and engineers who reported that a lack of suitable jobs in their field of highest degree was the reason for their working out of field are identified as those who are working involuntarily out of field (IOF). The size of this group as a proportion of all employed scientists and engineers is considered the IOF rate.

Of the nearly 22 million employed scientists and engineers in 2010, almost 1.4 million reported working out of the field of their highest degree because of a lack of suitable jobs in their degree field, indicating an IOF rate of 6.4%. SESTAT respondents were allowed to report more than one reason for working out of field. Other reasons included pay and promotion opportunities (reported by 2.1 million individuals), change in career or professional interests (1.8 million), working conditions (2.1 million), family-related reasons (1 million), job location (1.9 million), and other reasons (400,000). When asked about the single most important reason for working in a job not related to their field of highest degree, pay and promotion opportunities were cited by most, followed by change in career interests and lack of a suitable job in their field of highest degree.

IOF rates vary by degree fields and levels. Scientists and engineers with a highest degree in engineering and computer and mathematical sciences display lower IOF rates than those with physical, life, or social sciences degrees (table 3-13). Advanced degree holders are less likely to work involuntarily out of field than those with bachelor's degrees only: in 2010, the IOF rate was 2.9% for the SESTAT population with doctorates, 4.0% for those with master's degrees, and 8.8% for those with bachelor's degrees only. However, among bachelor's degree holders, IOF rates gradually decline across career stages up to mid- to late career points, and then gradually rise (figure 3-20). In comparison, among holders of master's degrees and doctorates, IOF rates remain stable over the long term.

Figure 3-20
Scientists and engineers who are working involuntarily out of field, by level of and years since highest degree: 2010



NOTES: Involuntarily out-of-field rate is the proportion of all employed individuals who reported working in a job not related to their field of highest degree because a job in that field was not available. Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Table 3-13
Scientists and engineers who are working involuntarily out of field, by S&E degree field: 1993–2010
(Percent)

S&E degree field	1993	1995	1997	1999	2003	2006	2008	2010
All scientists and engineers	7.8	7.7	7.3	5.4	5.9	6.2	5.3	6.4
Highest degree in S&E field	9.2	8.9	8.5	6.3	7.8	8.1	7.1	8.4
Biological, agricultural, and environmental life sciences	10.3	10.2	10.0	8.3	10.1	9.7	10.1	10.1
Computer and mathematical sciences	5.3	4.1	4.0	2.9	4.9	5.7	4.5	5.1
Physical sciences	9.7	10.2	10.0	7.6	8.8	8.6	7.1	8.2
Social sciences	13.3	12.7	12.1	8.7	10.1	10.6	9.2	11.3
Engineering	4.4	4.4	3.9	2.7	4.2	4.5	3.6	4.9

NOTES: During 1993–99, scientists and engineers include those with one or more S&E degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E occupation. During 2003–10, scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation. The involuntarily out-of-field rate is the proportion of all employed individuals who report that their job is not related to their field of highest degree because a job in their highest degree field was not available.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1993–2010), http://sestat.nsf.gov.

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Earnings

Based on the OES survey, the estimated annual earnings of individuals in S&E occupations are considerably higher than those of the total workforce. Median annual earnings in 2012 in S&E occupations (regardless of education level or field) was $78,270, which is more than double the median for all U.S. workers ($34,750) (table 3-14). This is not surprising given the level of formal education and overall technical skills associated with S&E occupations. The difference in average (mean) earnings was less dramatic but still quite wide, with individuals in S&E occupations earning considerably more on average ($82,930) than workers in all occupations ($45,790). Median S&E earnings ranged from $67,660 among social scientists to $86,500 among engineers. The 2009–12 annual growth in mean and median earnings for S&E occupations were generally similar to those for all employed U.S. workers in the OES data.

According to SESTAT, the annual median salary for individuals trained or employed in S&E ($65,000) is higher than that for all college-educated individuals ($56,000). The 2010 NSCG data indicate that the annual median salary for college-educated workers with a highest degree in S&E ($65,000) or S&E-related fields ($68,000) is more than for those with non-S&E degrees ($50,000) (table 3-15). Within each broad degree field, however, those employed in S&E occupations earn more than those in non-S&E occupations. For example, among individuals with a highest degree in a non-S&E field, the annual median salary for those employed

Table 3-14
Annual earnings and earnings growth in science, technology, and related occupations: May 2009–May 2012

Occupation	Mean: 2009 annual earnings ($)	Mean: 2012 annual earnings ($)	Mean: Annual growth rate 2009–12 (%)	Median: 2009 annual earnings ($)	Median: 2012 annual earnings ($)	Median: Annual growth rate 2009–12 (%)
All U.S. employment	43,460	45,790	1.8	33,190	34,750	1.5
STEM occupations	76,600	82,160	2.4	71,080	75,840	2.2
S&E occupations	78,480	82,930	1.9	74,380	78,270	1.7
Computer and mathematical scientists	76,280	80,080	1.6	72,930	76,170	1.5
Life scientists	77,400	79,430	0.9	68,240	69,980	0.8
Physical scientists	78,880	83,750	2.0	71,670	74,880	1.5
Social scientists	69,140	73,230	1.9	63,130	67,660	2.3
Engineers	86,140	91,450	2.0	82,130	86,500	1.7
Technology occupations	72,500	78,740	2.8	60,650	65,300	2.5
S&E-related occupations (not listed above)	70,980	74,840	1.8	58,910	61,540	1.5
Health-related occupations	70,840	74,740	1.8	58,670	61,320	1.5
Other S&E-related occupations	77,930	80,380	1.0	71,020	72,950	0.9

STEM = science, technology, engineering, and mathematics.

NOTES: See table 3-2 for definitions of S&E, S&E-related, and STEM occupations. 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 2009 and May 2012).

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Table 3-15
Median salaries for employed college-educated individuals, by broad field of highest degree and broad occupational category: 2010
(Median annual salary, dollars)

Highest degree field	All occupations	S&E occupations	S&E-related occupations	Non-S&E occupations
All degrees	56,000	75,000	65,000	50,000
S&E	65,000	78,000	65,000	50,000
S&E-related	68,000	72,000	70,000	50,000
Non-S&E	50,000	70,000	53,000	50,000

NOTES: See table 3-2 for definitions of S&E, S&E-related, and non-S&E degrees and occupations. Salaries are rounded to the nearest $1,000.

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

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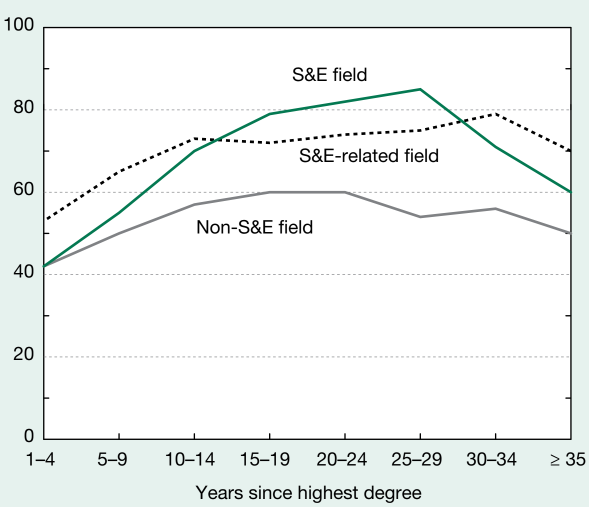
in an S&E occupation ($70,000) is more than for those employed in a non-S&E occupation ($50,000); among individuals with a highest degree in an S&E or S&E-related field, those employed in an S&E or S&E-related occupation earn more than those employed in a non-S&E occupation.

The earnings premium enjoyed by college-educated individuals with an S&E or S&E-related degree is present at all career stages. Figure 3-21 presents data on median salaries for groups with S&E, S&E-related, or non-S&E highest degrees at comparable numbers of years since receiving their highest degrees. Although median salaries are similar in the beginning for S&E and non-S&E degree holders, both of which are lower than that for S&E-related degree holders, the rise in earnings associated with career progression is much steeper among individuals with S&E degrees.

Earnings vary by degree levels. In 2010, the annual median salaries among scientists and engineers with bachelor's or master's as highest degree levels were $57,000 and $68,000, respectively. Those with doctorates ($85,000) or professional degrees ($116,000) earned significantly more. The pattern by degree level holds across career stages (figure 3-22).

S&E highest degree holders earn more than non-S&E highest degree holders at the master's degree and doctoral levels (figure 3-23). Among professional degree holders, in contrast, non-S&E degree holders earn more than S&E degree holders.

Figure 3-21
Median salaries for employed college-educated individuals, by broad field of highest degree and years since highest degree: 2010



NOTE: See table 3-2 for classification of S&E, S&E-related, and non-S&E degree fields.

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

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Among employed individuals without a bachelor's degree, S&E occupations provide stable jobs with competitive salaries relative to those workers in non-S&E occupations. (See sidebar, "The U.S. S&E Workforce Without a Bachelor's Degree.")

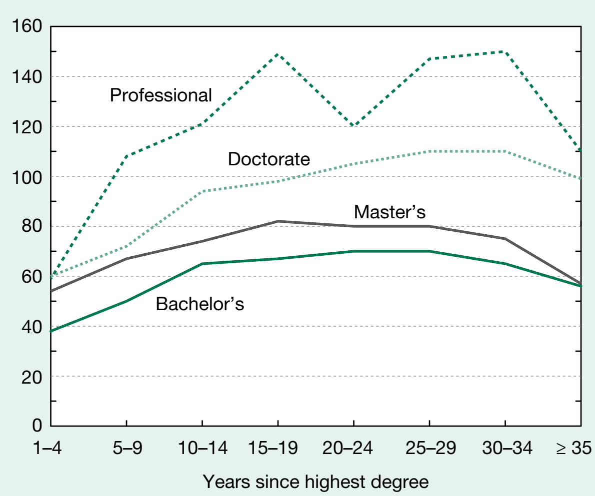
Recent S&E Graduates

In today's knowledge-based and globally integrated economy marked by rapid information flow and development of new knowledge, products, and processes, demand for certain skills and abilities may change fast. The employment outcomes of recent graduates are an important indicator of current changes in labor market conditions. Compared with experienced S&E workers, recent S&E graduates more often bring new ideas and newly acquired skills to the labor market. This section examines the employment outcomes of recent recipients of S&E bachelor's, master's, and doctoral degrees.

General Labor Market Indicators for Recent Graduates

Table 3-16 summarizes some basic labor market statistics in 2010 for recent recipients of S&E degrees; *recent* here is defined as between 1 and 5 years since receiving the degree.

Figure 3-22
Median salaries for employed scientists and engineers, by level of and years since highest degree: 2010



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

SOURCE: National Science Foundation, Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Among the nearly 22 million employed SESTAT respondents in October 2010, about 1.8 million are *recent* S&E degree recipients. Overall, the unemployment rate among these recent graduates was 6.6%, higher than the 4.3% unemployment rate seen among the entire SESTAT population of scientists and engineers. However, none of the recent graduating groups by S&E degree field or level exceeded the unemployment rate of 9.0% for the entire U.S. labor force.

Among recent bachelor's degree holders, the unemployment rate averaged 7.7%, ranging from 5.2% for those with physical sciences degrees to 8.8% for those with social sciences degrees. Overall, unemployment was generally lower for those with doctorates than for those with less advanced degrees. Early in their careers, as individuals gather labor market experience and on-the-job skills, they tend to have a higher incidence of job change and unemployment, which may partially explain some of the higher unemployment rates seen among those with a bachelor's degree as their highest level degree.

A useful but more subjective indicator of labor market conditions for recent graduates is the proportion who report that their job is unrelated to their highest degree field because a job in their degree field was not available (working involuntarily out of field or IOF rate). Of the 1.8 million employed scientists and engineers who received their highest degree in an S&E field in the previous 5 years, 10.8% indicated working involuntarily out of field (table 3-16).

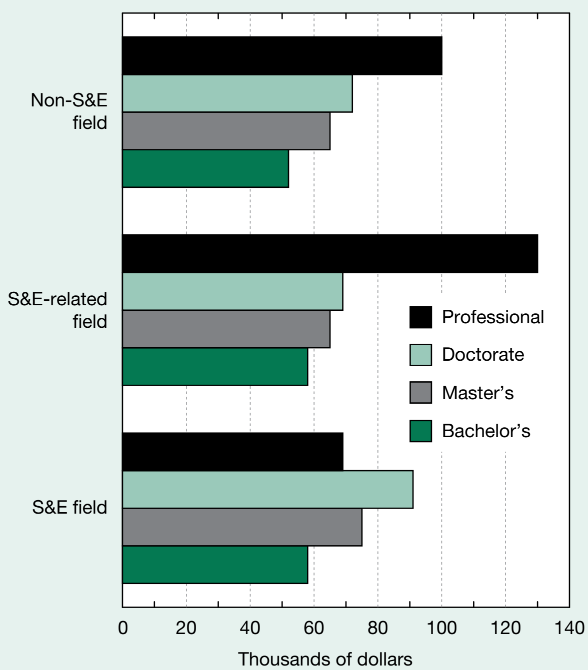
A larger proportion of recent S&E degree recipients reported working out of field because a suitable job was not available (10.8%) compared to the overall SESTAT population of scientists and engineers (6.4%). When asked about the single most important reason for working out of field, the most frequently cited reason by recent S&E degree recipients was lack of a suitable job in their degree field (cited by 29% of recent S&E degree recipients working out of field), followed by pay and promotion opportunities (20%) and change in career or professional interests (13%). The responses provided by the entire SESTAT population working out of field (regardless of graduation year) were similar, but the factors were ranked differently: the most commonly cited reason was pay and promotion opportunities (cited by 26% of all SESTAT respondents working out of field), followed by change in career or professional interests (21%) and lack of a suitable job in their degree field (19%).

Among recent bachelor's degree holders, the IOF rate in 2010 averaged 13.5%, but it ranged from 4.1% for recent engineering graduates to 18.0% for recent graduates in the social sciences (table 3-16). In all degree fields for which reliable estimates are available, the IOF rate was lower for advanced degree (master's) holders than for those with bachelor's degrees only.

The median salary for recent S&E bachelor's degree recipients in 2010 was $35,000, ranging from $30,000 in life sciences and physical sciences to $57,000 in engineering (table 3-16). Recent master's degree recipients had a median salary of $55,000, and recent doctorate recipients had a median salary of $60,000.

In 2010, among recent S&E degree recipients, those who received their degrees in 2008 or 2009, after the economic downturn began, had higher unemployment rates and IOF rates (7.4% and 12.6%, respectively) than those who received their degrees between 2005 and 2007 (6.0% and 9.5%, respectively) (appendix table 3-10). In particular, among recent master's degree holders, the unemployment rate was higher for the group receiving degrees between 2008 and 2009 than the group receiving degrees between 2005 and 2007; among recent bachelor's degree holders, the IOF rate was higher for the group receiving degrees between 2008 and 2009 than the group receiving degrees between 2005 and 2007. The doctorate population in these two groups reported similar unemployment rates and IOF rates in 2010.

Figure 3-23
Median salaries for employed scientists and engineers, by broad field and level of highest degree: 2010



NOTES: See table 3-2 for definitions of S&E, S&E-related, and non-S&E degrees. Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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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. This section discusses a range of relevant labor market indicators, including unemployment rates, IOF employment, employment in academia compared with other sectors, employment in postdoctoral positions, and salaries. Although a doctorate opens both career and salary opportunities, these opportunities may come at the price of many years of lost labor market earnings. For some doctorate holders, an ensuing postdoctoral position can further extend this period of low earnings.

Unemployment. As of October 2010, the 2.3% unemployment rate (table 3-17) for SEH doctorate recipients up to 3 years after receiving their doctorates was almost identical to the unemployment rate for all SEH doctorates (2.4%); it was considerably lower than the unemployment rate of the civilian labor force in general (9.0%) and the unemployment rate for the entire SESTAT population regardless of level or year of award of highest degree (4.3%).

Working involuntarily out of field. About 1.8% of the employed recent SEH doctorate recipients reported that they took a job that was not related to the field of their doctorate because a suitable job in their field was not available (table 3-17). This compared favorably with the IOF rate for the entire SESTAT population (6.4%).

Tenure-track positions. Although many science doctorate recipients aspire to tenure-track academic appointments (Sauermann and Roach 2012), most end up working in other positions and sectors. In 2010, about 15% of those who had earned their SEH doctorate within the previous 3 years had a tenure or tenure-track faculty appointment, a proportion that has held broadly steady since 1993 (table 3-18). Across the broad SEH fields, this proportion varied significantly, from about 7% to 8% among recent doctorates in life sciences, physical sciences, and engineering to about 41% among those in the social sciences.

The proportion of SEH doctorates who hold a tenure or tenure-track faculty appointment increases the more time has passed since earning their doctorate. In 2010, the proportion of SEH doctorates with tenure or tenure-track appointments who had been in the labor market for 3 to 5 years was higher (20%) than the rate among those who had completed their doctorate within 3 years (15%) (table 3-18). The extent of the increase varies across the broad areas of training. In the social sciences, for example, a relatively large percentage of individuals get into a tenure or tenure-track position within 3 years of obtaining their doctorate, and the increase associated with 3 to 5 years of labor market exposure is not as dramatic as in some other fields, such as physical sciences or mathematics and statistics. (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. Although the proportion of individuals who obtain tenure or tenure-track employment within 3 years of completing their doctorates has remained

Table 3-16
Labor market indicators for recent S&E degree recipients up to 5 years after receiving degree, by level and field of highest degree: 2010

Indicator and highest degree level	All S&E fields	Biological, agricultural, and environmental life sciences	Computer and mathematical sciences	Physical sciences	Social sciences	Engineering
Unemployment rate (%)						
All degree levels	6.6	6.1	6.7	4.2	8.0	4.4
Bachelor's	7.7	7.3	8.2	5.2	8.8	5.6
Master's	4.0	2.3	2.6	5.3	5.9	2.9
Doctorate	1.6	2.8	S	S	S	3.6
Involuntarily out-of-field (IOF) rate (%)						
All degree levels	10.8	10.2	7.5	9.9	15.6	3.7
Bachelor's	13.5	12.4	10.6	10.9	18.0	4.1
Master's	4.7	4.8	1.4	S	6.3	3.0
Doctorate	1.7	S	S	S	S	S
Median annual salary ($)						
All degree levels	40,000	35,000	55,000	36,000	33,000	60,000
Bachelor's	35,000	30,000	50,000	30,000	31,000	57,000
Master's	55,000	48,000	68,000	32,000	39,000	73,000
Doctorate	60,000	47,000	85,000	55,000	62,000	85,000

S = suppressed for reasons of confidentiality and/or reliability.

NOTES: Median annual salaries are rounded to the nearest $1,000. All degree levels includes professional degrees not broken out separately. Data include degrees earned from October 2005 to October 2009. The IOF rate is the proportion of all employed individuals who report that their job is not related to their field of highest degree because a job in their highest degree field was not available.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Table 3-17
Employment characteristics of recent SEH doctorate recipients up to 3 years after receiving doctorate, by field of degree: 2001–10

Field of doctorate	Recent doctorates (n)					Unemployment rate (%)					Involuntarily out-of-field rate (%)				
	2001	2003	2006	2008	2010	2001	2003	2006	2008	2010	2001	2003	2006	2008	2010
All recent SEH doctorates	48,700	43,700	49,500	52,600	52,700	1.3	2.5	1.2	1.5	2.3	2.8	2.1	1.4	1.3	1.8
Biological, agricultural, and environmental life sciences	12,300	11,200	12,600	13,400	14,100	1.4	2.4	0.9	1.7	1.5	2.6	1.0	0.3	1.0	1.5
Computer and information sciences	1,600	1,400	1,500	2,400	2,500	0.3	4.1	1.9	S	S	S	S	2.6	1.4	S
Mathematics and statistics	2,200	1,600	2,000	2,400	2,400	0.2	3.4	S	S	S	1.4	3.4	2.2	1.1	S
Physical sciences	7,700	6,500	7,400	7,500	7,700	1.5	1.3	1.1	3.0	2.6	5.4	4.2	2.6	2.3	1.4
Psychology	7,200	6,300	7,000	5,800	5,400	1.5	2.7	1.2	0.8	3.8	3.0	1.5	1.4	0.8	2.0
Social sciences	5,800	6,000	6,200	5,900	6,000	1.6	3.1	1.4	2.1	3.4	3.3	3.0	2.3	3.4	3.5
Engineering	9,400	8,000	9,500	12,000	11,300	1.5	3.0	1.8	1.2	2.7	2.0	3.0	1.6	0.7	1.9
Health	2,400	2,700	3,200	3,300	3,400	0.4	0.7	0.9	1.2	S	S	1.1	S	S	S

S = suppressed for reasons of confidentiality and/or reliability.

SEH = science, engineering, and health.

NOTES: Involuntarily out-of-field rate is the proportion of all employed individuals who report working in a job not related to their field of doctorate because a job in that field was not available. Data for 2001 and 2006 include graduates from 12 months to 36 months prior to the survey reference date; data for 2003, 2008, and 2010 include graduates from 15 months to 36 months prior to the survey reference date. Detail may not add to total because of rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2001–10), http://sestat.nsf.gov.

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Table 3-18
Employed SEH doctorate recipients holding tenure and tenure-track appointments at academic institutions, by field of and years since degree: 1993–2010
(Percent)

Years since doctorate and field	1993	1995	1997	1999	2001	2003	2006	2008	2010
< 3 years									
All SEH fields	18.1	16.3	15.8	13.5	16.5	18.6	17.7	16.2	14.7
Biological, agricultural, and environmental life sciences	9.0	8.5	9.3	7.7	8.6	7.8	7.2	6.5	7.6
Computer and information sciences	31.5	36.5	23.4	18.2	20.7	32.5	31.2	22.0	20.8
Mathematics and statistics	40.9	39.8	26.9	18.9	25.2	38.4	31.6	31.3	26.1
Physical sciences	8.8	6.9	8.5	7.8	10.0	13.3	9.8	8.8	6.8
Psychology	12.8	13.6	14.7	16.0	15.6	14.6	17.0	18.1	16.0
Social sciences	43.5	35.9	37.4	35.4	38.5	44.8	39.3	45.4	41.1
Engineering	15.0	11.5	9.4	6.4	11.3	10.8	12.4	9.3	7.5
Health	33.9	34.2	30.1	28.1	32.1	30.3	36.2	27.7	24.2
3–5 years									
All SEH fields	27.0	24.6	24.2	21.0	18.5	23.8	25.9	22.9	19.7
Biological, agricultural, and environmental life sciences	17.3	17.0	18.1	16.4	14.3	15.5	13.7	14.3	10.6
Computer and information sciences	55.7	37.4	40.7	25.9	17.3	32.2	45.7	37.8	22.2
Mathematics and statistics	54.9	45.5	48.1	41.0	28.9	45.5	50.6	40.7	41.7
Physical sciences	18.8	15.5	14.5	11.9	15.8	18.3	19.7	16.5	14.7
Psychology	17.0	20.7	16.8	17.6	17.5	19.9	23.8	18.3	19.1
Social sciences	54.3	52.4	50.4	46.5	38.8	46.0	50.4	48.9	46.7
Engineering	22.7	19.3	19.4	12.6	10.8	15.9	16.3	15.5	13.0
Health	47.4	40.2	41.1	39.5	25.1	40.8	43.1	34.4	33.3

SEH = science, engineering, and health.

NOTES: Proportions are calculated on the basis of all doctorates working in all sectors of the economy. Data for 1993–99, 2001, and 2006 include graduates from 12 months to 60 months prior to the survey reference date; data for 2003, 2008, and 2010 include graduates from 15 months to 60 months prior to the survey reference date.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (1993–2010), http://sestat.nsf.gov.

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broadly stable since 1993, the proportion of graduates with tenure or tenure-track positions within 3 to 5 years of receiving their doctorates has declined since 1993 in most broad areas of SEH training (table 3-18). One of the steepest declines occurred in computer sciences despite the high demand for computer sciences faculty.

Salaries for recent SEH doctorate recipients. For all SEH degree fields in 2010, the median annual salary for recent doctorate recipients within 5 years after receiving their degrees was $66,000. Across various SEH degree fields, median annual salaries ranged from a low of $50,000 in biological sciences to a high of $94,000 in computer and information sciences (table 3-19). Between 2008 and 2010, a period marked by the economic downturn and its immediate aftermath, median salaries for recent recipients of doctoral degrees in most SEH areas either stayed the same or declined slightly (the median salary for recent SEH doctorate recipients in 2008 was $67,000).

By type of employment, salaries for recent doctorate recipients ranged from $42,000 for postdoctoral positions in 4-year institutions to $90,000 for those employed in the business sector (table 3-20). Each sector, however, exhibited substantial variation depending on SEH fields of training.

Postdoctoral Positions

A significant number of new S&E doctorate recipients take a postdoctoral appointment (generally known as a postdoc) as their first position after receiving their doctorate.

Table 3-19
Salaries for recent SEH doctorate recipients up to 5 years after receiving degree at selected percentiles, by field of degree: 2010
(Dollars)

Field of doctorate	25th percentile	50th percentile	75th percentile
All SEH fields	47,000	66,000	90,000
Biological, agricultural, and environmental life sciences	42,000	50,000	71,000
Computer and information sciences	75,000	94,000	120,000
Mathematics and statistics	51,000	64,000	95,000
Physical sciences	45,000	60,000	84,000
Psychology	47,000	60,000	77,000
Social sciences	50,000	63,000	84,000
Engineering	67,000	87,000	101,000
Health	57,000	75,000	92,000

SEH = science, engineering, and health.

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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2010), http://sestat.nsf.gov.

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Table 3-20
Median salaries for recent SEH doctorate recipients up to 5 years after receiving degree, by field of degree and employment sector: 2010
(Dollars)

Field of doctorate	All sectors	Education: 4-year institutions: All positions	Education: 4-year institutions: Tenured or tenure-track position	Education: 4-year institutions: Postdoc	Education: 2-year or precollege institutions	Government	Business/ industry
All SEH fields	66,000	52,000	65,000	42,000	52,000	76,000	90,000
Biological, agricultural, and environmental life sciences	50,000	45,000	60,000	42,000	45,000	65,000	73,000
Computer and information sciences	94,000	70,000	74,000	47,000	S	99,000	111,000
Mathematics and statistics	64,000	56,000	62,000	51,000	58,000	S	95,000
Physical sciences	60,000	47,000	60,000	42,000	51,000	71,000	86,000
Psychology	60,000	55,000	57,000	42,000	59,000	78,000	65,000
Social sciences	63,000	58,000	63,000	44,000	57,000	85,000	98,000
Engineering	87,000	59,000	80,000	42,000	S	86,000	95,000
Health	75,000	69,000	72,000	41,000	51,000	85,000	93,000

S = suppressed for reasons of confidentiality and/or reliability.

SEH = science, engineering, and health.

NOTES: Salaries are rounded to the nearest $1,000. Data include graduates from 15 months to 60 months prior to the survey reference date. The 2-year or precollege institutions include 2-year colleges and community colleges or technical institutes and also preschool, elementary, middle, or secondary schools. The 4-year institutions include 4-year colleges or universities, medical schools, and university-affiliated research institutes.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2010), http://sestat.nsf.gov.

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Postdoc positions are defined as temporary, short-term positions, primarily for acquiring additional training in an academic, government, industry, or non-profit setting.[19] This section looks at employment characteristics of postdocs.

The incidence of SEH doctorate holders taking postdoc positions during their careers has risen over time. Among U.S. SEH doctorate holders who received their doctorate before 1972, 31% reported having had a postdoc position earlier in their careers; this proportion rose to 46% among 2002–05 graduates (NSB 2010). Although individuals in postdoc positions often perform cutting-edge research, these positions generally offer lower salaries than permanent positions, which essentially adds to the costs of doctoral studies and has the unintended consequence of making science careers less desirable to potential graduate students. The growing number of postdoc positions, as well as the rise in average postdoc tenure, has received much attention in science policy in recent years (e.g., NIH 2012). Neither the reasons for this growth nor its effects on the state of scientific research are well understood. However, possible contributing factors include increases in competition for tenure-track academic research jobs, the need for collaborative research in large teams, the influx of graduate students in SEH areas with strong postdoc traditions, and the need for additional specialized training. (See sidebar, "Employment of Biomedical Sciences Doctorates.")

Number of postdocs. In October 2010, NSF's Survey of Doctorate Recipients (SDR) estimated that 30,800 U.S. SEH doctorate recipients were employed in postdoc positions. The vast majority of these postdoc positions were in 4-year academic institutions (75%), with the remainder in industry (16%) and government (10%). The fall 2010 and fall 2011 estimates from NSF's Survey of Graduate Students and Postdoctorates in Science and Engineering, which covers academic postdocs, were 63,400 and 62,900, respectively (NSF/NCSES 2013a and 2013b). These estimates cover different segments of the postdoc population. The Survey of Graduate Students and Postdoctorates in Science and Engineering gathers information on postdocs from U.S. academic graduate departments, regardless of where these individuals earned their doctorates. It does not cover individuals in nonacademic employment, at some university research centers, or at academic departments that lack graduate programs. In contrast, the SDR covers U.S. residents with research doctorates in SEH fields from U.S. universities, but not those with doctorates from non-U.S. universities. As a result, the SDR omits a large number of postdocs who are foreign trained. The two survey estimates overlap in some populations (U.S.-trained doctorates and those working in academia), but differ in others (the Survey of Graduate Students and Postdoctorates in Science and Engineering covers foreign-trained doctorates, but not those in the industry or government sectors). In addition, the titles of postdoc researchers vary across organizations and often change as individuals advance through their postdoc appointment; both of these factors further complicate the data collection process (NIH 2012).[20]

Postdocs by academic discipline. Although postdocs are increasingly common in SEH fields, the extent to which a postdoc appointment is part of an individual's career path varies greatly across SEH fields. In the field of life sciences, for example, postdocs have historically been more common than in other SEH fields. According to NSF's Survey of Earned Doctorates (SED), the proportion of new doctorate recipients in 2011 indicating that they would take a postdoc appointment after graduation ranged from nearly 70% in life sciences (including agricultural sciences/natural resources, biological/biomedical sciences, and health sciences) to 37% in the social sciences (appendix table 3-11). SDR data indicate that in 2010 about half of those who had received their doctorates in the previous 3 years in biological/agricultural/environmental life sciences (53%) or physical sciences (47%) were employed in postdoc positions, compared to only 11% in the social sciences (figure 3-24). Within physical sciences, chemistry and physics have particularly strong postdoc traditions.

Postdoc compensation. Low compensation for postdocs is frequently raised as a concern by those who are worried about the effect of the increasing number and length of postdoc positions on the attractiveness of science careers. In 2010, the median salary for postdocs who had received their doctorate within the past 5 years was just over half (57%) the median salary paid to non-postdocs (table 3-21). This proportion ranged from about half among individuals with doctorates in engineering (48%) and computer and information sciences (50%) to about three-quarters among those with doctorates in social sciences (69%) and mathematics and statistics (76%).

Among recent graduates, similar proportions of postdocs and non-postdocs have access to certain employer-provided benefits, such as health insurance (95% of postdocs and 92% of non-postdocs) and paid vacation, sick, or personal days (87% of postdocs and 86% of non-postdocs). However, a much smaller proportion of recent graduates in postdoc positions have access to employer-provided pensions or retirement plans (56% of postdocs and 84% of non-postdocs). Information on the quality of these benefits—for example, the coverage and premium of health insurance plans, number of personal days offered by employer, and type of retirement benefits—is not available.

Reasons for taking postdoc positions. The 2010 SDR asked individuals in postdoc positions to report their reason for accepting these appointments. When asked about the primary reason, most responses were consistent with the traditional objective of a postdoc position as a type of advanced apprenticeship for career progression, such as "postdoc generally expected in field," "additional training in PhD field," "additional training in an area outside of PhD

Employment of Biomedical Sciences Doctorates

Employment patterns in the biomedical sciences have changed in the past two decades. The growth in the number of doctorates trained in the field has far surpassed the growth in academic positions, contributing to lengthy postdoc appointments, stiff competition for academic jobs, and an increasing proportion of doctorates going into positions that are not research-intensive (National Institutes of Health [NIH] 2012). According to the Survey of Doctorate Recipients (SDR), between 1993 and 2010, the number of U.S.-educated doctorate holders in the biomedical sciences substantially rose (from about 105,000 to nearly 180,000).[*] Over this same time, the proportion employed in academia declined (58% to 51%) as did the proportion employed in tenure or tenure-track positions (35% to 26%) despite the fact that both increased in absolute number. The proportion of U.S.-educated doctorate holders who reported research (basic or applied) as their primary or secondary work activity also declined in the education sector (from 75% to 70%). In contrast, the proportion of biomedical sciences doctorates employed in the business sector rose (from 31% to 39%). The majority of the increase in the business sector was driven by those whose jobs did not involve research as their primary or secondary work activity. The proportion of biomedical sciences doctorates reporting that they are employed in jobs closely related to their doctoral degree has declined over this same time (from 68% to 60%), whereas the proportion employed in jobs "somewhat" related to their doctorate has increased (from 24% to 32%). The available data cover the U.S.-educated doctorate holders; the data on foreign-trained doctorates in the field, a segment of the workforce that has grown significantly (NIH 2012), are not comprehensive. The information on postdoc researchers is also not comprehensive.

Despite the persistence of generally favorable employment indicators for biomedical sciences doctorates (the unemployment rate was around 2% in 1993 and 2010, and the rate of working involuntarily out of field was around 3% in both periods), the changes in the employment patterns have generated significant concerns in the profession. Concerns center on the rising number of research doctorates unable to find tenure-track academic research positions, the increasing number and length of postdoc appointments, the influx of foreign-trained doctorates seeking academic positions, and the rising number of early career doctorates taking positions that are not research-intensive and for which current graduate programs may not provide appropriate preparation. In addition, the overall training period, including PhD and postdoc research, is longer in the biomedical sciences than in other comparable disciplines, such as chemistry, physics, and mathematics (NIH 2012). Furthermore, average starting salaries are lower among doctorates in the biomedical sciences than in other fields, such as chemistry, clinical and health fields, and economics (NIH 2012).

In light of the changes in the profession and the resulting concern in the science community, NIH convened a working group consisting of biomedical educators and other experts on the biomedical workforce to develop a set of policy recommendations to support a robust and viable workforce.[†] The working group recently presented specific recommendations targeted at enhancing graduate training, postdoc research experience, and data collection and dissemination regarding the biomedical workforce. The following is a summary of the main recommendations of this working group:

- To prepare early career scientists for a wide range of career options, encourage graduate programs to undertake innovative approaches. These may include offering alternative degree programs, such as master's programs, and providing training in areas that are generally not covered in a research-oriented doctoral program, such as project management, business entrepreneurship skills, working in small businesses, and teaching in academic institutions that are not research-intensive.
- To shorten the length of training in the field, limit the number of years that a graduate student may be supported by NIH funds (any combination of training grants, fellowships, and research project grants).
- To improve the quality of training and mentoring received by graduate students and postdoc researchers, increase the proportion of trainees supported by NIH training grants and fellowships relative to the proportion supported by NIH research project grants without increasing the total number of graduate student and postdoc researcher positions.
- Improve postdoc compensation and benefits, and facilitate the prompt transitions of postdocs and doctoral students into permanent positions by developing individual career development opportunities.
- Encourage institutions receiving NIH funds to gather and share comprehensive information on career outcomes of their PhD trainees and postdoc researchers, such as completion rates, time to degree, time in postdoc training, and post-training career outcome. This will help prospective graduate students and postdocs contemplating careers in the biomedical sciences to make informed decisions in a changing biomedical labor market.
- Encourage NIH, through collaboration with other federal agencies, to undertake initiatives to enhance the collection, analysis, and dissemination of information on biomedical sciences doctorates and postdocs.

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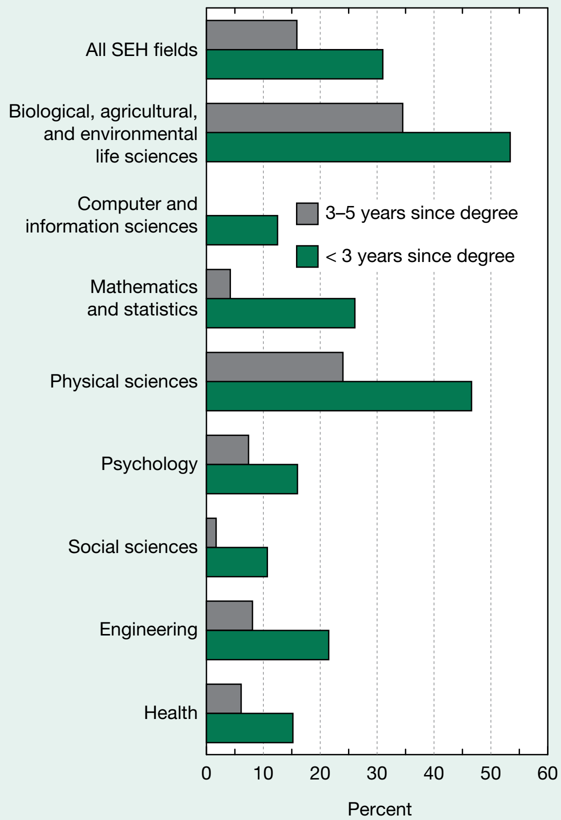
* See NIH (2012) for a discussion on the fields of science considered as biomedical sciences. Based on the report, the following degree categories from the SDR are included in the data presented in this sidebar: biochemistry and biophysics, bioengineering and biomedical engineering, cell and molecular biology, microbiological sciences and immunology, zoology, biology (general), botany, ecology, genetics (animal and plant), nutritional science, pharmacology (human and animal), physiology and pathology (human and animal), and other biological sciences.

† For detailed information, see the NIH report available at http://acd.od.nih.gov/Biomedical_research_wgreport.pdf (accessed 16 November 2013).

Figure 3-24
Recent U.S. SEH doctorate recipients in postdoc positions, by field of and years since doctorate: 2010



SEH = science, engineering, and health.

NOTES: Proportions are calculated on the basis of all doctorates working in all sectors of the economy. Data include graduates from 15 months to 60 months prior to the survey reference date (October 2010). The 3–5 year estimate for Computer and information sciences is suppressed for reasons of confidentiality and/or reliability.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2010), http://sestat.nsf.gov.

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field," or "work with a specific person or place." However, 13% of those in postdoc appointments reported lack of other employment as the primary reason for accepting these positions. In life sciences and physical sciences, the two broad fields with relatively high levels of postdoc appointments, the proportions of those reporting lack of other employment as the primary reason for accepting a postdoc position were low (11% and 17%, respectively) compared with the proportion of those in the social sciences (30%), an area where postdocs are typically not as common.

Table 3-21
Median salaries for recent U.S. SEH doctorate recipients in postdoc and non-postdoc positions up to 5 years after receiving degree: 2010
(Dollars)

Field of doctorate	All positions	Postdocs	Non-postdocs
All SEH fields	66,000	43,000	76,000
Biological, agricultural, and environmental life sciences	50,000	42,000	65,000
Computer and information sciences	94,000	48,000	97,000
Mathematics and statistics	64,000	53,000	70,000
Physical sciences	60,000	44,000	76,000
Psychology	60,000	43,000	64,000
Social sciences	63,000	44,000	64,000
Engineering	87,000	44,000	91,000
Health	75,000	47,000	77,000

SEH = science, engineering, and health.

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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (2010), http://sestat.nsf.gov.

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Age and Retirement of the S&E Workforce

This section focuses on indicators of the aging of the S&E workforce, for example, the retirement patterns of S&E workers and workforce participation levels among older individuals. The high concentration of S&E workers over age 50 suggests that the S&E workforce will soon experience high levels of turnover. The age distribution and retirement patterns of S&E workers have important implications for the supply of S&E expertise in the economy. An aging S&E labor force may translate into rising output and productivity as S&E workers acquire additional skills, gain experience, and improve their judgment. Consequently, the retirement of experienced workers could mean loss of valuable S&E expertise and knowledge. However, the retirement of older workers also makes room for newly trained S&E workers who may bring updated skills and new approaches to solving problems (Stephan and Levin 1992).

The aging of the S&E labor force is reflected in rising median ages. In 2010, the median age of scientists and engineers in the labor force was 44 years, compared to 41 years in 1993. Another indicator of the aging of the S&E labor force is the increasing percentage of individuals in this labor force over age 50 (between the ages of 51 and 75) (figure 3-25). In 1993, about 1 in every 5 scientists and engineers in the labor force was in that age group (20%), whereas by 2010 the proportion rose to 1 out of 3 (33%).

Between 1993 and 2010, the proportion of scientists and engineers in the labor force over 50 years of age rose for both men and women; however, the female labor force continues to be younger relative to their male counterparts (figure 3-25). In 2010, 30% of female scientists and engineers in the labor force were between 51 and 75 years of age, compared to 36% of male scientists and engineers in the labor force. In 2010, the median ages in the SESTAT population were 42 years for women and 45 years for men, whereas in 1993 the median ages were 38 and 42, respectively.

Age Differences among Occupations

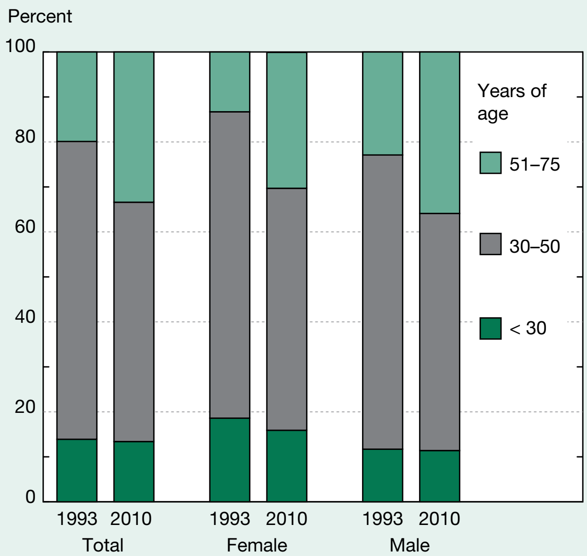
SESTAT respondents working in S&E occupations are younger than those in S&E-related or non-S&E occupations (figure 3-26). In 2010, 26% of those in S&E occupations were between 51 and 75 years of age compared with 34% of those in S&E-related occupations and 36% of those in non-S&E occupations. The median age of the SESTAT population employed in S&E occupations was 42 years, compared to 44 years among those employed in S&E-related occupations and 45 years among those employed in non-S&E occupations.

The age differences across S&E and non-S&E occupations were more pronounced for men than for women. Among male scientists and engineers, 27% of those employed in S&E occupations were between the ages of 51 and 75 compared with 41% of those employed in non-S&E occupations. Among female scientists and engineers, 24% of those employed in S&E occupations were between the ages of 51 and 75 compared with 30% of those employed in non-S&E occupations.

Age Differences among Degree Fields

Similar to the trend seen across broad occupational categories, S&E highest degree holders are generally younger than those holding highest degrees in S&E-related or non-S&E fields (figure 3-26). In 2010, 30% of S&E highest degree holders were between 51 and 75 years of age compared with 36% of those with highest degrees in S&E-related or non-S&E fields. However, degree holders in different S&E fields varied in their ages. S&E highest degree holders in the physical sciences, particularly the men in this group, were older than those in other S&E fields (appendix table 3-12). S&E highest degree holders in computer and mathematical

Figure 3-25
Age distribution of scientists and engineers in the labor force, by sex: 1993 and 2010



NOTES: For 1993 data, scientists and engineers include those with one or more S&E degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E occupation. For 2010 data, scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation. The Scientists and Engineers Statistical Data System (SESTAT) does not cover scientists and engineers over age 75.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993, 2010), http://sestat.nsf.gov.

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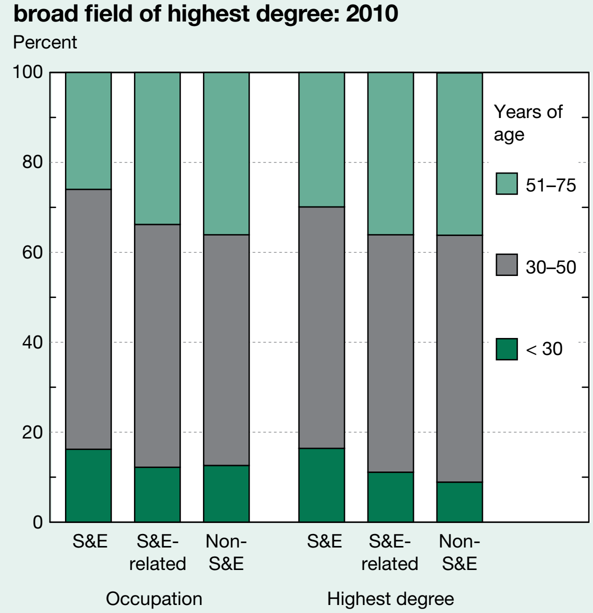
Figure 3-26
Age distribution of employed scientists and engineers, by broad occupational category and broad field of highest degree: 2010



NOTES: Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation. The Scientists and Engineers Statistical Data System (SESTAT) does not cover scientists and engineers over age 75.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (2010), http://sestat.nsf.gov.

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sciences, in social sciences, and in engineering were relatively young.

Within broad degree areas, the age profile of different degree fields varies (appendix table 3-12). For example, within computer and mathematical sciences degree fields, 16% of highest degree holders in computer and information sciences were between 51 and 75 years of age compared with 39% of highest degree holders in mathematics and statistics. In all broad S&E fields of highest degree except computer and mathematical sciences, women were younger than their male counterparts (appendix table 3-12).

Retirement

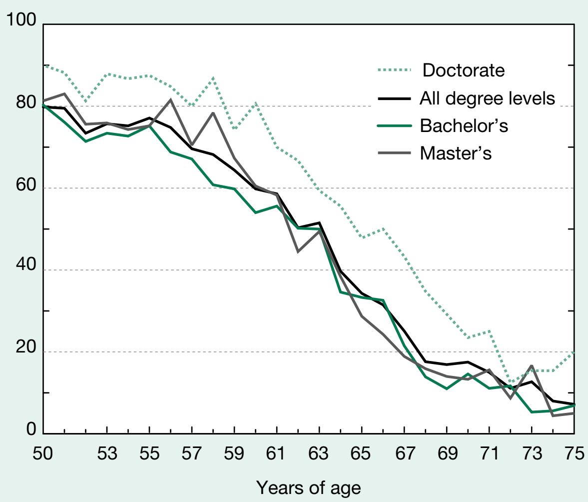
The increasing proportion of the SESTAT labor force over 50 years of age raises the issue of how impending retirement will affect the supply of S&E workers. Patterns of labor force participation among older individuals provide useful information about potential retirement ages and how retirement ages may have changed over time.

Recent patterns of leaving the labor force and shifting to part-time work among older members of the workforce suggest that after age 55 the labor force participation rate among scientists and engineers begins to decline and is markedly reduced by the time workers reach their late 60s. One indication of the relationship between age and the level of labor force participation is illustrated by figure 3-27, which shows the proportions of older scientists and engineers working full time. In 2010, at age 50, 80% of scientists and engineers worked full time (35 hours or more per week) in their principal job. Among individuals in their mid- to late-50s, this proportion dropped steeply. Among those in their mid-60s, for example, only about one-third worked full time. The overall pattern of declining full-time participation starting in individuals' mid- to late-50s held at all degree levels, although doctorate holders generally worked full time at higher rates than bachelor's degree holders (figure 3-27).

Between 1993 and 2010, increasing proportions of SESTAT respondents in their 60s reported still being in the labor force. Whereas 69% of SESTAT respondents between the ages of 60 and 64 were in the labor force in 1993, this proportion rose to 74% in 2010. For those between the ages of 65 and 69, the proportion rose from 39% in 1993 to 47% in 2010.

Reasons provided by SESTAT respondents for labor force nonparticipation or part-time work status also shed light on the relationship between age and retirement. In 2010, about 2.5 million scientists and engineers reported that they were out of the labor force because of retirement. The vast majority (87%) of retired individuals were 60–75 years of age, and half of the retired individuals (51%) were between the ages of 67 and 75. Individuals with doctorates reported lower rates of retirement than those without doctorates (figure 3-28).

Figure 3-27
Older scientists and engineers who work full time, by age and highest degree level: 2010



NOTES: All degree levels include professional degrees not reported separately. Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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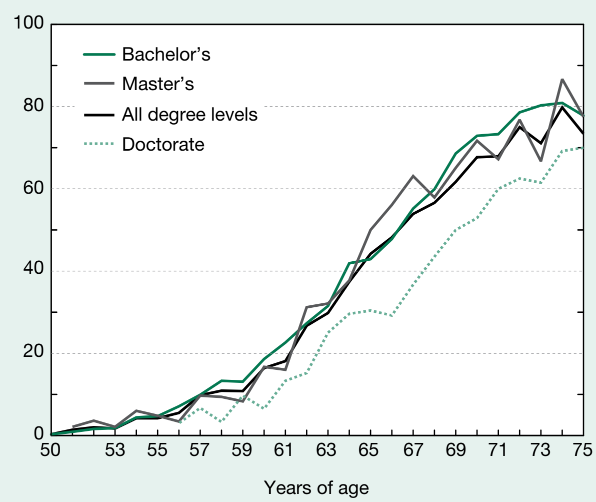
Figure 3-28
Older scientists and engineers who report not working because of retirement, by age: 2010



NOTES: All degree levels include professional degrees not reported separately. The missing data points are suppressed for reasons of confidentiality and/or reliability. Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Retirement, however, does not always mean that workers permanently leave the labor force. After nominally retiring from their jobs, some workers continue to work part time, work in a different capacity, or decide to return to the labor market at a later time. About 1.4 million scientists and engineers employed in 2010 reported that they had previously retired from a job. A total of 653,000 scientists and engineers working part time in 2010 reported their reason for working part time as having "previously retired or semi-retired." Individuals who chose to stay in or return to the labor market following an occurrence of retirement were younger (median age 62) than those who were out of the labor force following retirement (median age 67).

Compared to all employed scientists and engineers included in SESTAT, the 1.4 million SESTAT respondents who stayed in or returned to the workforce after having retired from a previous position were less likely to hold S&E jobs (18% versus 25% for all employed SESTAT respondents) or to work in areas closely related to their highest degree (46% versus 58% for all employed SESTAT respondents) and more likely to be self-employed in unincorporated businesses (17% versus 7% for all employed SESTAT respondents).

Women and Minorities in the S&E Workforce

As researchers and policymakers increasingly emphasize the need for expanding S&E capabilities in the United States, many view demographic groups with lower rates of S&E participation as an underutilized source of human capital for S&E work. Historically, in the United States, S&E fields have had particularly low concentrations of women and members of many racial and ethnic minority groups (i.e., blacks, Hispanics, American Indians or Alaska Natives), both relative to the concentrations of these groups in other occupational or degree areas and relative to their representation in the general population. However, women and racial and ethnic minorities increasingly have been choosing a wider range of degrees and occupations over time. This section presents data on S&E participation by women and by racial and ethnic minorities. It also presents data on earnings differentials by sex and by race and ethnicity.

Women in the S&E Workforce

Historically, men have outnumbered women by wide margins with regards to both S&E employment and S&E training. Although the number of women in S&E occupations or with S&E degrees nearly doubled over the past two decades, the disparity has narrowed only modestly. The imbalance is still particularly pronounced in S&E occupations. In 2010, women constituted only 28% of workers in these occupations, even though they accounted for nearly half of the college-educated workforce. Among S&E degree holders, the disparity was smaller but nonetheless significant, with women representing 37% of employed individuals with a highest degree in S&E (figure 3-29).

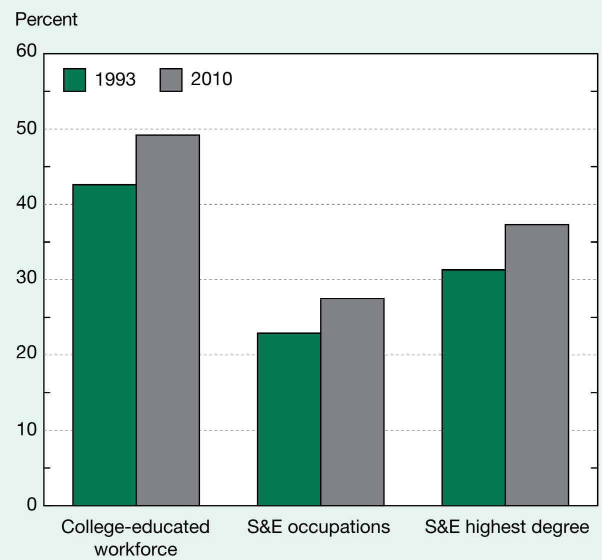
Women in S&E Occupations

Although women represented only 28% of individuals in S&E occupations in 2010, women's presence varies widely across S&E occupational fields (appendix table 3-13). The percentage of female S&E workers is lowest in engineering, where women constituted 13% of the workforce in 2010. Among engineering occupations with large numbers of workers, the disparity between men and women is greatest among mechanical engineers, with women accounting for only 7% of the workforce. Other large engineering occupations in which women account for about 11% to 12% of the workforce include electrical and computer hardware engineers and aerospace, aeronautical, and astronautical engineers.

Other disproportionately male S&E occupations include physical scientists (30% women) and computer and mathematical scientists (25% women). Within the physical sciences occupations, physicists and astronomers have the largest imbalance (18% women). Within the computer and mathematical sciences occupations, the largest component, computer and information scientists, has the smallest proportion of women (23%). The mathematical scientists component is much closer to parity (46% women).

In 2010, sex parity in S&E occupations was close among life scientists (48% women). Within the life sciences occupations, biological and medical scientists, the largest component, had reached gender parity (52% women). The field of social sciences was majority female (58%). Occupations within the social sciences, however, varied with respect to the proportion of female workers. Thus, women accounted for slightly more than one-third of economists (37%) but

Figure 3-29
Women in the workforce and in S&E: 1993 and 2010



SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) and National Survey of College Graduates (NSCG) (1993 and 2010), http://sestat.nsf.gov.

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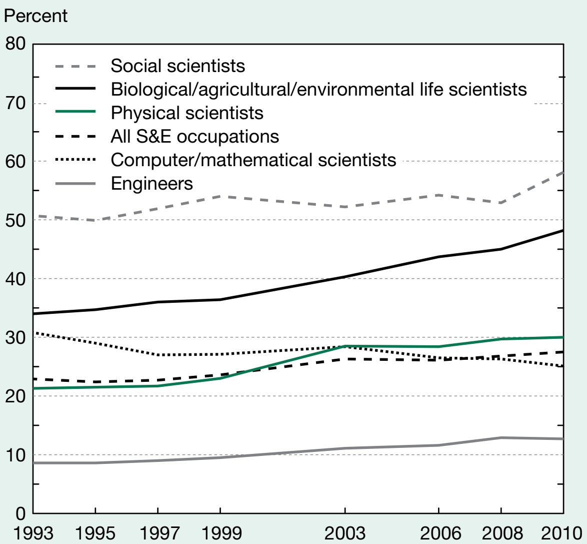
more than two-thirds of psychologists (70%). Psychologists, estimated at about 171,000 total workers in SESTAT (appendix table 3-13), was an example of a large S&E occupation with substantially more women than men.

In contrast to jobs in S&E occupations, a majority of jobs in S&E-related occupations (56%) are held by women (appendix table 3-13). The largest component, health-related occupations, employed a large number of women (68% women), primarily as nurse practitioners, pharmacists, registered nurses, dietitians, therapists, physician assistants, and health technologists and technicians.

Since the early 1990s, the number of women working in each broad S&E occupational category has risen significantly. The rate of growth has been strongest among life scientists, computer and mathematical scientists, and social scientists. These three broad S&E fields together employed 80% of women in S&E occupations in 2010, compared with 59% of men in S&E occupations. Between 1993 and 2010, the number of women more than doubled among life scientists (an increase of 162%) and nearly doubled among social scientists (an increase of 87%). The number of men also grew, but the rate of growth for women was greater than that for men, resulting in an increase in the proportion of female life scientists and female social scientists (figure 3-30).

During the same period, the number of women in computer and mathematical sciences occupations nearly doubled (an increase of 97%). However, unlike the other broad S&E occupational categories, the rate of growth in male participation was larger (161%) than that of women, resulting in an overall decline in the proportion of women from 31% to 25%. These trends made the gender disparity among computer and mathematical scientists second only to engineers. The declining proportion of women in the computer and mathematical sciences occupations reflects increasing disparities in participation among those whose highest degree is at the bachelor's degree level. Among computer and mathematical scientists with a doctoral degree, the proportion of women increased, from 16% in 1993 to 20% in 2010.

Figure 3-30
Women in S&E occupations: 1993–2010



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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993–2010), http://sestat.nsf.gov.

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During the past two decades, women have also increased their proportion among workers in engineering (from 9% to 13%) and in the physical sciences (from 21% to 30%). In these two occupational categories, this increase was led by an expansion of women's numbers in the workforce (by 67% in engineering and 60% in physical sciences) while men's numbers barely changed between 1993 and 2010.

Women among S&E Highest Degree Holders

The sex disparity among employed S&E highest degree holders is less than the disparity among those in S&E occupations. In 2010, among individuals with a highest degree in an S&E field, women constituted 37% of those who were employed, up from 31% in 1993. The pattern of variation in the proportion of men and women among degree fields echoes the pattern of variation among occupations associated with those fields (appendix table 3-14). In 2010, 54% of S&E highest degree holders in the social sciences fields were women, as were 48% of those with a highest degree in the biological and related sciences. Men outnumbered women among computer sciences and mathematics highest degree holders (28% women) and among physical sciences highest degree holders (27% women). Disparities, however, were greatest among those with a highest degree in engineering (only 14% women). In all fields except computer and mathematical sciences, the proportion of women in the workforce with associated highest degrees has been increasing over the past two decades. In computer and mathematical sciences, this proportion has declined even as the number of women with a highest degree in the field has risen.

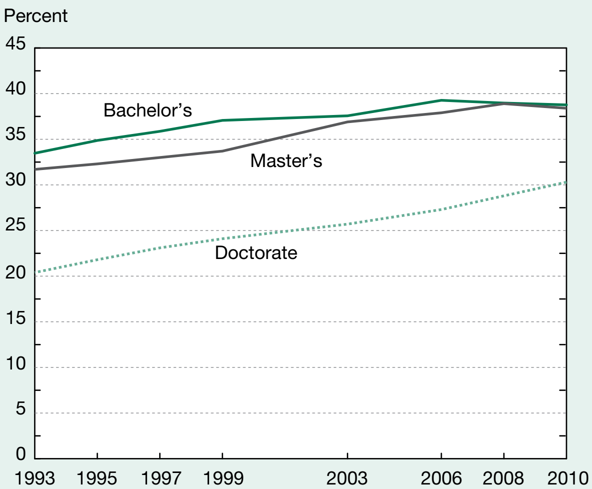
Sex differences are not limited to the field of degree, but also extend to the level of S&E degree. Men outnumber women among S&E highest degree holders at the bachelor's, master's, and doctoral levels. Moreover, the sex disparity is higher among S&E doctorate holders than among S&E bachelor's or master's degree holders. For example, in 2010 women accounted for 38% of those whose highest degree in S&E was at the bachelor's or master's level but 30% of those whose highest degree in S&E was at the doctoral level (figure 3-31). At the doctoral level, however, the proportion of women has been steadily increasing. The trend at the bachelor's and master's levels has been somewhat different: although the proportion of women in the workforce rose from 1993 to 2003, it remained mostly steady from 2003 to 2010 (figure 3-31).

Working men and women with S&E highest degrees also differ in the extent to which they are employed in the same field as their S&E highest 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 in non-S&E occupations. In 2010, these two broad fields accounted for three-fourths of all employed women with S&E highest degrees, compared with 41% of all employed men with S&E highest degrees (appendix table 3-14). (See sidebar, "S&E Credentials and the Male-Female Gap in S&E Employment.")

Across all S&E degree areas, 19% of women with an S&E highest degree are employed in the S&E field in which they earned their degree compared with 32% of men (appendix table 3-15). However, within the majority of degree areas (life sciences, social sciences, and engineering), similar proportions of men and women are employed in the S&E field in which they earned their degree. Computer and mathematical sciences fields are exceptions, where a larger proportion of men (54%) than women (43%) work in an occupation that matches their degree field and a larger proportion of women (38%) than men (27%) work in non-S&E occupations. Among those with life sciences degrees, although a similar proportion of men (23%) and women (22%) work in their degree field, a larger proportion of women (35%) than men (18%) are employed in S&E-related occupations. These sex differences in the degree fields of life sciences and computer and mathematical sciences are primarily driven by those whose highest degrees are at the bachelor's or master's levels.

Men and women with a highest degree in an S&E field also differ in their labor force nonparticipation rates. Compared with men, women were more likely to be out of the labor force (22% versus 14% for men). The difference in nonparticipation was particularly pronounced between the ages of 30 and 65 (figure 3-32). In 2010, 19% of the women in this age group with an S&E highest degree were out of the labor force compared with 7% of the men. Many women in this group identified family reasons as an important factor: 48% of women reported that family was a factor for their labor force nonparticipation compared with 9% 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 (41% of women versus 26% of men). Men, on the other hand, were much more likely than women to cite retirement as a reason for not working (28% of women versus 71% of men).

Figure 3-31
Employed women with highest degree in S&E, by degree level: 1993–2010



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

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993–2010), http://sestat.nsf.gov.

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Minorities in the S&E Workforce

The participation of underrepresented racial and ethnic minorities in the S&E workforce has been a concern of policymakers who are interested in the development and employment of diverse human capital to maintain the United States' global competitiveness in S&E. This section addresses the level of diversity in S&E by race and Hispanic ethnicity.[21] Like the preceding section, this section draws on data from NSF's SESTAT surveys to report on levels of S&E participation: first across occupations and then across the overall workforce with S&E 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 whites. The next largest group of scientists and engineers are Asians. On the other hand, several racial and ethnic minority groups, including blacks, Hispanics, and American Indians or Alaska Natives, have low levels of participation in S&E fields both compared with other groups and compared with their proportion in the population (table 3-22).

Race and Ethnicity Trends in S&E Occupations

In 2010, among the 5.4 million workers employed in S&E occupations, 70% were white, which is similar to the proportion (68%) in the U.S. population age 21 and older (table 3-22). However, S&E participation by whites varied across the broad S&E occupational categories, from 65% of computer and mathematical scientists to 81% of social scientists (appendix table 3-16). The concentration of whites in some occupations was more pronounced: they accounted for approximately 90% of workers among forestry and conservation scientists, geologists and earth scientists, and political scientists.

Asians, with nearly a million workers in S&E occupations, accounted for 19% of S&E employment. Among the overall population age 21 and older, their proportion was much smaller (5%). Asians had a large presence in computer and engineering fields, constituting 33% of computer software engineers, 30% of software developers, 40% of computer hardware engineers, 27% of bioengineers or biomedical engineers, and 35% of postsecondary teachers in engineering (appendix table 3-16). On the other hand, the proportion of Asians in social sciences occupations was much lower both compared with their participation in other S&E fields and compared with whites. For example, Asians accounted for just 6% of workers in social sciences occupations.

The social sciences are the one S&E occupational category in which the proportions of blacks (5%) and Hispanics (6%) are similar to that of Asians (6%) (appendix table 3-16). As a result, underrepresented racial and ethnic minorities (blacks, Hispanics, and American Indians or Alaska Natives) collectively outnumber Asians among social scientists. In the other broad S&E occupational categories, Asians represent a larger segment than all underrepresented racial and ethnic minorities combined.

In general, the proportions of Hispanics across the broad S&E occupational categories were roughly similar (between 5% and 6%), whereas blacks had higher rates of participation among computer and mathematical scientists (6%) relative to life scientists (3%), physical scientists (3%), and engineers (4%) (appendix table 3-16). Hispanics had a particularly large presence among sociologists (13%); psychologists (7%); aeronautical, aerospace, and astronautical engineers (9%); and civil engineers (8%). Blacks had relatively high participation rates among computer support specialists (16%), information security analysts (14%), and sociologists (13%).

Over the past two decades, the U.S. workforce in S&E occupations has been becoming more diverse with increasing proportions of Asians, blacks, and Hispanics and a decreasing proportion of whites (table 3-23). In 1993, 84% of

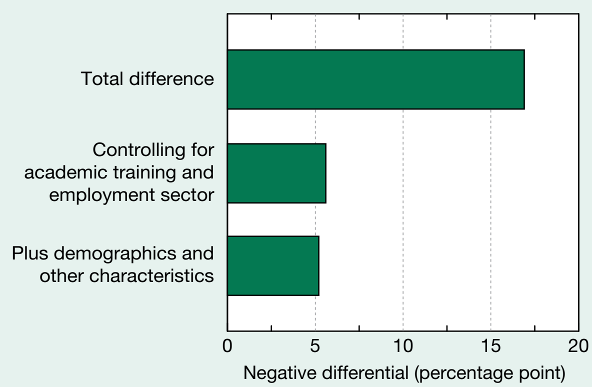
S&E Credentials and the Male-Female Gap in S&E Employment

Among college-educated individuals, a significantly higher proportion of men than women are employed in S&E occupations. For example, among S&E highest degree holders working full time, 26% of women, compared to 43% of men, hold positions with formal S&E jobs. This gender gap in S&E employment is found in all racial and ethnic groups. For example, among S&E highest degree holders working full time, S&E jobs are held by 43% of Asian women compared to 58% of Asian men, 22% of black women compared to 32% of black men, 19% of Hispanic women compared to 37% of Hispanic men, and 24% of white women compared to 41% of white men. The participation gap exists despite the trend that increasing proportions of women in all racial and ethnic groups are graduating from college. In most racial and ethnic groups, for example, a higher percentage of women than men have college degrees.

Field of degree, level of highest degree, employment sector, and other characteristics that are typically believed to be associated with occupational fields vary between men and women. As a result, it can be misleading to directly compare S&E employment rates by sex. Compared with men, women tend to have many characteristics—such as degrees in the life and social sciences, highest degrees at the bachelor's level, and employment in 2-year academic institutions and in the non-profit sector—that are associated with working outside S&E occupations. Statistical models can estimate the size of the male-female participation gap in S&E occupations when various occupation-related factors are taken into account. However, estimates of these differences vary somewhat depending on the assumptions that underlie the statistical model used.

After accounting for differences between men and women in field of degree, level of highest degree, and employment sector, the participation gap in S&E occupations declines significantly (from 17 to 6 percentage points) but does not attenuate completely (figure 3-C). Adding measures of personal and family characteristics that may affect S&E participation to academic and employment information further reduces the estimated participation gap marginally (from 6 to 5 percentage points). This suggests that although measurable differences between men and women explain a significant portion of the male-female participation gap in S&E occupations, they do not entirely explain the differing propensity of men and women to obtain S&E employment. As such, boosting college attendance alone is unlikely to equalize male-female participation in S&E employment as long as men and women study different fields and attain degrees at different levels.

Figure 3-C
Estimated differences in the proportions of women and of men with S&E highest degree employed in S&E occupations, controlling for selected characteristics: 2010



NOTE: Coefficients are estimated in a probit regression model using a binary (0–1) variable indicating employment in S&E occupations as the dependent variable.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (2010), http://sestat.nsf.gov.

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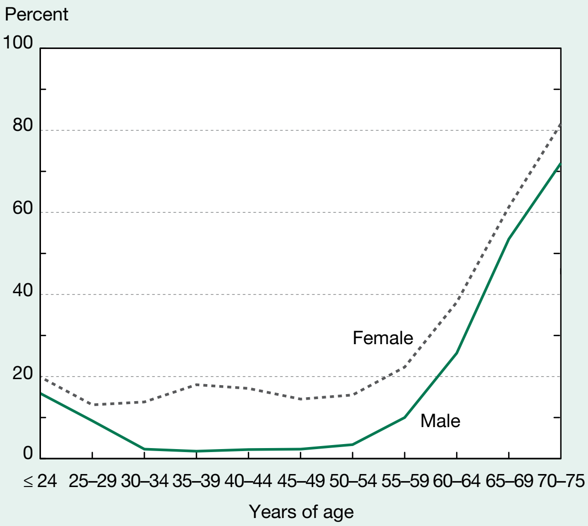
workers in S&E occupations reported their race as white. By 2010, this proportion declined to 70%. Most of the decline in the proportion of whites during this period was offset by an increase in the proportion of Asians and, to a lesser degree, by an increase in the proportion of some other groups, particularly Hispanics.

Figure 3-32
Highest degree holders in S&E not in the labor force, by sex and age: 2010



NOTE: Not in the labor force includes those not working nor looking for work in the 4 weeks prior to October 2010.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov

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Some of the changes by race may reflect changes to the way NSF workforce surveys collect information on this topic. 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 once they were given the option, which would decrease the estimated numbers of whites. However, because less than 2% of S&E workers reported a multiracial identity in years when that option was available, it is unlikely that this change contributed much to the decline in the proportion of whites between 1993 and 2010.

Racial and Ethnic Differences among S&E Degree Holders

Among employed S&E highest degree holders, racial and ethnic groups vary with respect to their proportions in different degree fields (table 3-24; appendix table 3-17). Differences in highest degree fields largely resemble the differences among S&E occupations. Asians have higher participation rates among engineering highest degree holders and among computer and mathematical sciences highest degree holders relative to other broad S&E degree fields. Blacks have higher participation rates in computer and mathematical sciences and in the social sciences. Hispanics have higher participation rates in engineering and in the social sciences. Whites represent a larger segment of life, physical, and social sciences highest degree holders than engineering or computer and mathematical sciences highest degree holders.

The demographic groups also differ in the level of their highest degree (table 3-25). For example, Asians account for a larger proportion of those whose highest degree is at the master's or doctoral level compared with those whose highest

Table 3-22
Racial and ethnic distribution of employed individuals in S&E occupations, and of S&E degree holders, college graduates, and U.S. residents: 2010
(Percent)

Race and ethnicity	S&E occupations	S&E highest degree holders	College degree holders	U.S. residential population[a]
Total (*n*)	5,398,000	11,385,000	40,623,000	221,319,000
American Indian or Alaska Native	0.2	0.2	0.3	0.6
Asian	18.5	13.9	7.9	4.9
Black	4.6	5.7	6.8	11.5
Hispanic	5.2	6.8	7.1	13.9
Native Hawaiian or Other Pacific Islander	0.2	0.3	0.3	0.1
White	69.9	71.5	76.2	67.5
More than one race	1.4	1.5	1.4	1.5

[a] Age 21 and over.

NOTES: Hispanic may be any race. American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or Other Pacific Islander, white, and more than one race refer to individuals who are not of Hispanic origin.

SOURCES: Census Bureau, American Community Survey (2010); National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT), and National Survey of College Graduates (NSCG) (2010), http://sestat.nsf.gov.

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Table 3-23
Distribution of workers in S&E occupations, by race and ethnicity: 1993–2010
(Percent)

Race and ethnicity	1993	1995	1997	1999	2003	2006	2008	2010
American Indian or Alaska Native	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.2
Asian	9.1	9.6	10.4	11.0	14.2	16.1	16.9	18.5
Black	3.6	3.4	3.4	3.4	4.3	3.9	3.9	4.6
Hispanic	2.9	2.8	3.1	3.4	4.4	4.6	4.9	5.2
Native Hawaiian or Other Pacific Islander	NA	NA	NA	NA	0.3	0.5	0.4	0.2
White	84.1	83.9	82.9	81.8	75.2	73.2	71.8	69.9
More than one race	NA	NA	NA	NA	1.4	1.4	1.7	1.4

NA = not available.

NOTES: Before 2003, respondents could not classify themselves in more than one racial and ethnic category. Before 2003, Asian included Native Hawaiian and Other Pacific Islander. Hispanic may be any race. American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or Other Pacific Islander, white, and more than one race refer to individuals who are not of Hispanic origin.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1993–2010), http://sestat.nsf.gov.

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Table 3-24
Racial and ethnic distribution of employed individuals with S&E highest degree, by field of highest degree: 2010
(Percent)

Race and ethnicity	All S&E fields	Biological, agricultural, and environmental life sciences	Computer and mathematical sciences	Physical sciences	Social sciences	Engineering
Employed with highest degree in S&E (*n*)	11,385,000	1,764,000	1,886,000	693,000	4,363,000	2,679,000
American Indian or Alaska Native	0.2	0.3	0.2	0.3	0.3	0.2
Asian	13.9	12.0	22.7	15.2	6.5	20.6
Black	5.7	3.6	7.7	3.6	7.6	3.2
Hispanic	6.8	6.2	5.5	4.5	7.7	7.4
Native Hawaiian or Other Pacific Islander	0.3	S	0.2	0.1	0.3	0.4
White	71.5	75.7	62.6	75.3	75.8	66.9
More than one race	1.5	1.4	1.1	1.2	1.9	1.3

S = suppressed for reasons of confidentiality and/or reliability.

NOTES: Hispanic may be any race. American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or Other Pacific Islander, white, and more than one race refer to individuals who are not of Hispanic origin.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Table 3-25
Racial and ethnic distribution of employed individuals with S&E highest degree, by level of highest degree: 2010
(Percent)

Race and ethnicity	Bachelor's	Master's	Doctorate
Employed with highest degree in S&E (*n*)	8,160,000	2,356,000	847,000
American Indian or Alaska Native	0.3	0.2	0.1
Asian	11.0	20.6	23.0
Black	6.1	5.6	2.8
Hispanic	7.5	5.7	3.8
Native Hawaiian or Other Pacific Islander	0.4	0.2	0.1
White	73.1	66.3	69.1
More than one race	1.6	1.4	1.1

NOTES: Hispanic may be any race. American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or Other Pacific Islander, white, and more than one race refer to individuals who are not of Hispanic origin.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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degree is at the bachelor's level. Conversely, non-Asians represent a larger proportion of those whose highest degree is at the bachelor's and master's degree level compared with those whose highest degree is at the doctoral level.

Asian S&E highest degree holders are more likely than those in other racial and ethnic groups to work in S&E occupations and to work in the area in which they earned their degree (appendix table 3-15). Among blacks, Hispanics, and whites, about one-quarter or less of S&E highest degree holders work in their same broad field of highest degree. By comparison, nearly 40% of Asians work in the same broad field in which they received their highest degree.

Salary Differences for Women and Racial and Ethnic Minorities

Women and racial and ethnic minority groups generally receive less pay than their male and white counterparts (table 3-26). In 2010, among full-time workers with a highest degree in an S&E field, the median salary for women ($53,000) was about one-third lower than that for men ($80,000). Among S&E highest degree holders who work full-time in S&E occupations, the difference in median salary between men ($85,000) and women ($69,000) was smaller (19% less) (appendix table 3-18).

Table 3-26
Median annual salary among S&E highest degree holders working full time, by sex, race, and ethnicity: 1995, 2003, 2010
(Dollars)

Characteristic	1995	2003	2010
All	44,000	60,000	70,000
Sex			
Female	34,000	45,000	53,000
Male	49,000	68,000	80,000
Race and ethnicity			
American Indian or Alaska Native	S	48,000	59,000
Asian	45,000	64,000	75,000
Black	35,000	48,000	56,000
Hispanic	38,000	50,000	60,000
Native Hawaiian or Other Pacific Islander	NA	56,000	56,000
White	45,000	60,000	72,000
More than one race	NA	50,000	60,000

NA = not available; S = suppressed for reasons of confidentiality and/or reliability.

NOTES: Salaries are rounded to the nearest $1,000. Data for 1995 include some individuals with multiple races in each category. Hispanic may be any race. American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or Other Pacific Islander, white, and more than one race refer to individuals who are not of Hispanic origin.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1995, 2003, 2010), http://sestat.nsf.gov.

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Salary differences among racial and ethnic groups were somewhat smaller than salary differences between men and women (table 3-26; appendix table 3-19). Among S&E highest degree holders working full time, American Indians or Alaska Natives earned 18% less than whites, blacks earned 22% less than whites, and Hispanics earned 17% less than whites. Relative to Asians, American Indians or Alaska Natives earned 21% less, blacks earned 25% less, and Hispanics earned 20% less. These salary differences were generally more modest among those who worked in S&E occupations (appendix table 3-19).

Overall, salary differences between men and women and among racial and ethnic groups remained largely unchanged between 1995 and 2010 (table 3-26).

Differences in average age, work experience, academic training, sector and occupation of employment, and other characteristics can make direct comparison of salary statistics misleading. Statistical models can estimate the size of the salary difference between men and women, or the salary difference between racial and ethnic groups, 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 estimated salary differences between men and women among individuals who are otherwise similar in age, work experience, field of highest degree, type of academic institution awarding highest degree (Carnegie classification and public/private status), occupational field and sector, and other relevant characteristics that are likely to influence salaries. Data bearing on salary differences between minorities (American Indians or Alaska Natives, blacks, Hispanics, Native Hawaiians or Other Pacific Islanders, and those reporting more than one race) relative to Asians and whites are also included.

Without accounting for any factors except level of degree, women working full time whose highest degree is at the bachelor's level in an S&E field earned 31% less than men (figure 3-33).[22] The salary difference is smaller, but nonetheless substantial, at both the master's level (29%) and the doctoral level (22%). The salary differences for non-Asian minorities relative to whites and Asians are narrower (figure 3-34). On average, minority salary levels are 22% lower than those of whites and Asians at the bachelor's level, 14% lower at the master's level, and 16% lower at the doctoral level.

Effects of Education, Employment, and Experience on Salary Differences

Salaries differ across degree field, occupational field and sector, and experience. For example, median salaries in 2010 were generally higher among individuals with highest degrees in engineering ($86,000), physical sciences ($68,000), or computer and mathematical sciences ($79,000) compared with those with highest degrees in life sciences ($50,000) or social sciences ($50,000). Degree areas with lower salaries generally have higher concentrations of women and of racial and ethnic minorities. Disproportionately larger proportions of degree holders in life sciences, and particularly in the social sciences, relative to other S&E degree fields, work in occupations not categorized as S&E, where salaries are generally lower than in S&E occupations (appendix table 3-18). As a result, differences in degree and occupational fields are likely to explain much of the salary differences by sex and by race and ethnicity.

Salaries also differ across employment sector. Academic and non-profit employers typically pay less for similar skills than employers in the private sector, and government compensation falls somewhere between these two groups. These differences are salient for understanding salary variations by sex and by race and ethnicity because men, Asians, and whites are more highly concentrated in the private for-profit sector.

Salaries also vary by indicators of experience, such as age or years since completing one's degree. Because of the rapid increase in female participation in S&E fields in recent years, female S&E highest degree holders employed full time are younger than their male counterparts (median age 40 years for women versus 44 years for men), which translates to fewer years of labor market experience for women relative to men. White S&E highest degree holders with similar characteristics are also older (44 years) compared with Asians (39 years) and most other racial and ethnic minorities (Hispanics: 39 years, blacks: 42 years, American Indians or Alaska Natives: 43 years, and Native Hawaiians or Other Pacific Islanders: 33 years).

After controlling for differences in field of highest degree, degree-granting institution, field of occupation, employment sector, and experience,[23] the estimated salary difference between men and women narrows by more than half (figure 3-33). However, among men and women in similar jobs, and with similar highest degree fields and levels of experience, women still earn 12% less than men among individuals whose highest degree is at the bachelor's level, 10% less than men among individuals whose highest degree is at

Figure 3-33
Estimated salary differences between women and men with highest degree in S&E employed full time, controlling for selected characteristics, by degree level: 2010

NOTES: Salary differences represent the estimated percentage difference in women's average full-time salary relative to men's average full-time salary. Coefficients are estimated in an ordinary least squares regression model using the natural log of full-time annual salary as dependent variable and then transformed into percentage difference.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (2010), http://sestat.nsf.gov.

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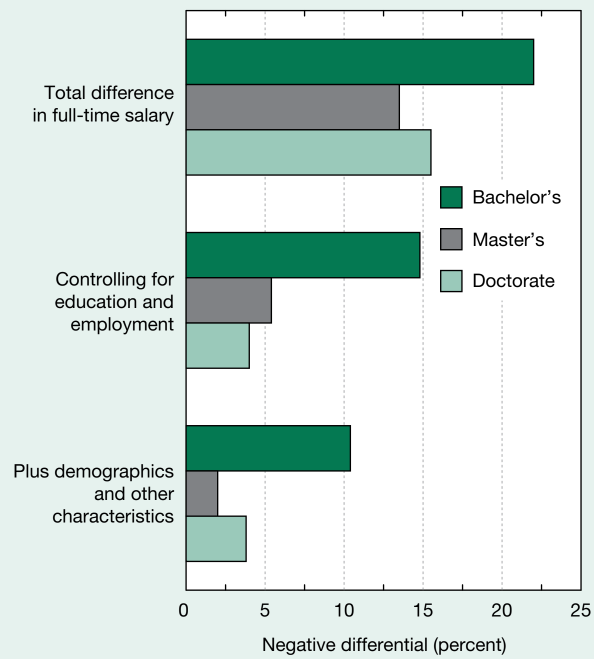
Figure 3-34
Estimated salary differences between minorities and whites and Asians with highest degree in S&E employed full time, controlling for selected characteristics, by degree level: 2010



NOTES: Salary differences represent the estimated percentage difference in the average full-time salary of minorities relative to the average full-time salary of whites and Asians. Coefficients are estimated in an ordinary least squares regression model using the natural log of full-time annual salary as dependent variable and then transformed into percentage difference. Minorities include American Indian or Alaska Natives, blacks, Hispanics (of any race), Native Hawaiian or Other Pacific Islanders, and those reporting more than one race.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (2010), http://sestat.nsf.gov.

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the master's level, and 9% less than men among individuals whose highest degree is at the doctoral level.

Compared with whites and Asians, other racial and ethnic groups with their highest degree at the bachelor's level also earn less (15%) after controlling for education, occupation, and experience (figure 3-34). Although the initial salary gap for racial and ethnic minorities is smaller than for women, less of this initial salary gap is explained by differences in education, occupation, and experience. Among those whose highest degree is at the bachelor's level, after controlling for education, occupation, and experience, more than half of the initial salary gap among racial and ethnic minorities persists, compared to less than half of the initial salary gap persisting among women. In comparison, among those with a master's or doctoral degree, the salary gap across racial and ethnic groups is significantly attenuated: after controlling for these factors, the salary gap is only 5% for those at the master's degree level and only 4% for those at the doctorate level.

Effects of Demographic and Other Factors on Salary Differences

Salaries vary by factors beyond education, occupation, and experience. For example, marital status, the presence of children, parental education, and other personal characteristics are often associated with salary differences. These differences reflect a wide range of issues, both voluntary and involuntary, including, but not limited to, factors affecting individual career- and education-related decisions, differences in how individuals balance family obligations and career aspirations, productivity and human capital differences among workers that surveys do not measure, and possible effects of employer prejudice or discrimination. Salaries also differ across regions, partly reflecting differences in the cost of living across geographic areas.

However, adding measures of personal and family characteristics that may affect compensation[24] to education, occupation, and experience results in only marginal changes in the estimated salary differences between men and women compared with estimates that account for education, occupation, and experience alone. Women who are similar to men along all of these dimensions receive salaries that are 11% (among bachelor's degree holders) to 8% (among doctoral degree holders) less than their male counterparts (figure 3-33). The salary difference among racial and ethnic groups largely disappears among advanced degree holders, but a significant amount of the difference remains among bachelor's degree holders (figure 3-34).

The analysis of salary differences suggests that attributes related to human capital (fields of education and occupation, employment sector, and experience) are much more important than socioeconomic and demographic attributes in explaining the salary differences observed among S&E highest degree holders by sex and across racial and ethnic groups. Nonetheless, the analysis also shows that measurable differences in human capital do not entirely explain income differences between demographic groups.[25]

Salary Differences among Recent Graduates

Salary differences among recent S&E graduates warrant particular attention. Employment metrics of recent graduates are important indicators of current conditions in the labor market, particularly for young people considering S&E careers. Salary differences among recent S&E graduates, particularly across racial and ethnic groups, are substantially narrower than in the population of S&E degree holders as a whole. This suggests that recent cohorts of S&E highest degree holders are much closer to earnings parity than their older counterparts. For example, in 2010, among recent graduates who attained their highest degree in or after 2005, minorities working full time earned 7% (among those whose S&E highest degree was at the bachelor's or doctorate level) to 8% (among those whose S&E highest degree was at the master's level) less than Asians and whites. These salary differences are substantially higher, ranging from 14% to 22%, among all S&E highest degree holders (regardless of graduation year) (figure 3-34). After accounting for differences in education, occupation, and experience, the salary differences for recently graduated minorities relative to whites and Asians are almost attenuated among bachelor's degree holders (a 3% salary gap remains) and completely attenuated among advanced degree holders. In contrast, when all S&E highest degree holders (regardless of graduation cohort) are included in the analysis, a significant amount of the salary gap remains unexplained by these human capital attributes, particularly among bachelor's degree holders (figure 3-34).

After controlling for differences in education, employment, demographic, and socioeconomic attributes, the gender salary gap among recent graduates is not completely attenuated, but it is lower. After controlling for these factors, women earn about 5% to 9% less than men among recent graduates, compared with about 8% to 11% less among all S&E highest degree holders (regardless of graduation cohort).

Immigration and the S&E Workforce

The industrialized nations of the world have long benefitted from the inflow of foreign-born scientists and engineers and the S&E skills and knowledge they bring. S&E skills are more easily transferrable across international borders than many other skills, and many countries have made it a national priority to attract international talent in S&E (NSB 2008). A large proportion of workers employed in S&E fields in the United States are foreign born. This section presents data on foreign-born scientists and engineers in the U.S. economy, including recent indicators of migration to the United States and the rate at which foreign-born recipients of U.S. doctoral degrees remain in the United States after earning their degree (stay rates). Data from various sources, including the Census Bureau, the U.S. Citizenship and Immigration Services (USCIS), and NSF (SESTAT and SED) are discussed to study the immigrant S&E workforce in the United

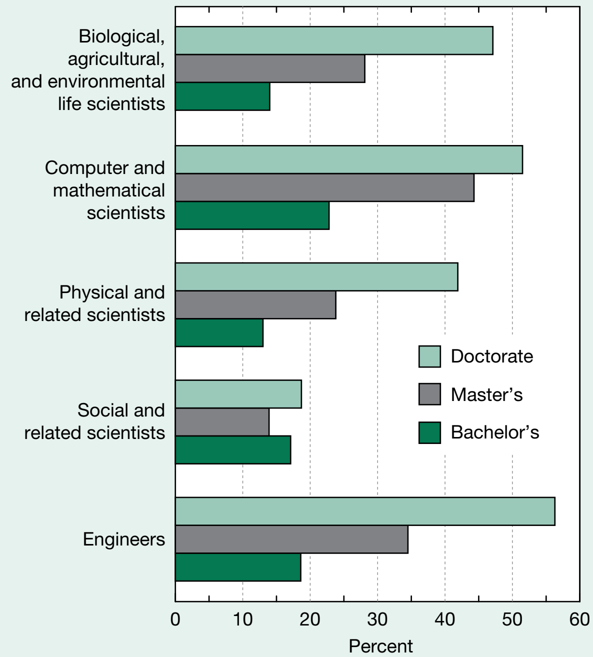
States. This section ends with a discussion of the global migration patterns of high-skill workers.

"Foreign-born" is a broad category, ranging from long-term U.S. residents with strong roots in the United States to recent immigrants who compete in global job markets and whose main social, educational, and economic ties are in their countries of origin. When interpreting data on foreign-born workers, the range of individuals in this category should be kept in mind. Both the number and proportion of foreign-born workers employed in S&E occupations in the United States have risen over time (table 3-27). Nationally representative survey data, such as SESTAT and ACS, although collected in different ways, yield broadly consistent estimates of the number of foreign-born scientists and engineers in the United States. In 2011, foreign-born individuals accounted for 21% of workers employed in nonacademic S&E occupations in the United States, which is higher than their representation in the overall population (13%). Among college-educated workers in nonacademic S&E occupations, the proportion of foreign-born individuals is higher: 26%, which is up from 22% in 2000 (table 3-27).

Characteristics of Foreign-Born Scientists and Engineers

Compared to the entire college-educated workforce, college graduates employed in S&E occupations are disproportionately foreign born. Among SESTAT respondents employed in S&E occupations in 2010, 27% were foreign born. Among all college-educated workers (regardless of occupational category) in 2010, 15% were foreign born. In general, foreign-born workers employed in S&E occupations tend to have higher levels of education than their U.S. native-born counterparts. Among individuals employed in S&E occupations, 19% of foreign-born scientists and engineers have a doctorate, compared to 10% of U.S. native-born scientists and engineers in these occupations. In most S&E occupations, the higher the degree level, the greater the proportion of the workforce who are foreign born (figure 3-35). This relationship is weakest among social scientists and strongest among computer and mathematical scientists and engineers. In 2010, at the bachelor's degree level, the

Figure 3-35
Foreign-born scientists and engineers employed in S&E occupations, by highest degree level and broad occupational category: 2010



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2010), http://sestat.nsf.gov.

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Table 3-27
Foreign-born workers in S&E occupations, by education level: Selected years, 2000–11
(Percent)

Education	2000 Decennial census	2003 SESTAT	2003 ACS	2006 SESTAT	2006 ACS	2008 SESTAT	2008 ACS	2009 ACS	2010 SESTAT	2010 ACS	2011 ACS
All college educated[a]	22.4	22.6	24.2	23.8	25.3	24.6	24.9	25.2	27.4	26.5	26.2
Bachelor's	16.5	16.4	17.7	17.3	18.1	17.2	18.4	18.3	20.1	19.0	19.0
Master's	29.0	29.4	32.0	31.7	33.5	32.7	32.7	33.4	34.9	35.0	34.3
Doctorate	37.6	36.4	37.8	36.6	41.8	37.8	40.9	41.6	41.5	44.2	43.2

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

[a] Includes professional degrees not broken out separately.

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

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (2003–10), http://sestat.nsf.gov; Census Bureau, 2000 Decennial Census Public Use Microdata Sample (PUMS), and ACS (2003, 2006, 2008, 2009, 2010, 2011).

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proportion of foreign-born individuals in S&E occupations ranged from 13% (physical scientists) to 23% (computer and mathematical scientists). However, at the doctoral level, over 40% were foreign born in each S&E occupation except the social sciences.

Among SESTAT respondents employed in S&E occupations, foreign-born workers (median age 40 years) are younger than their native-born counterparts (median age 43). The distribution by sex is largely similar across foreign-born (26% female) and native-born (28% female) workers in S&E jobs. Asians account for the majority (60%) of foreign-born workers in S&E occupations but only a very small segment (3%) of U.S. native-born workers in these occupations (appendix table 3-20). In comparison, whites represent 27% of foreign-born workers in S&E jobs but 86% of native-born workers in these jobs. Nearly 90% of all Asians employed in S&E occupations are foreign-born.

In 2010, 56% of the foreign-born S&E highest degree holders in the United States were from Asia; 21% were from Europe. The remaining foreign-born workers came from North America, Central America, the Caribbean, South America, and Africa, each of which supplied 4% to 5% of the foreign-born S&E highest degree holders in the United States. In 2010, the leading country of origin among immigrants with a highest degree in S&E was India, which accounted for 19% of the foreign-born S&E highest degree holders (figure 3-36). With less than half the total for India, China was the second leading country with 8%. Source countries for the nearly 395,000 foreign-born holders of S&E doctorates are somewhat more concentrated, with China providing a higher proportion (23%) than India (13%). These patterns by source region and country for foreign-born S&E highest degree holders in the United States have been stable since 2003.

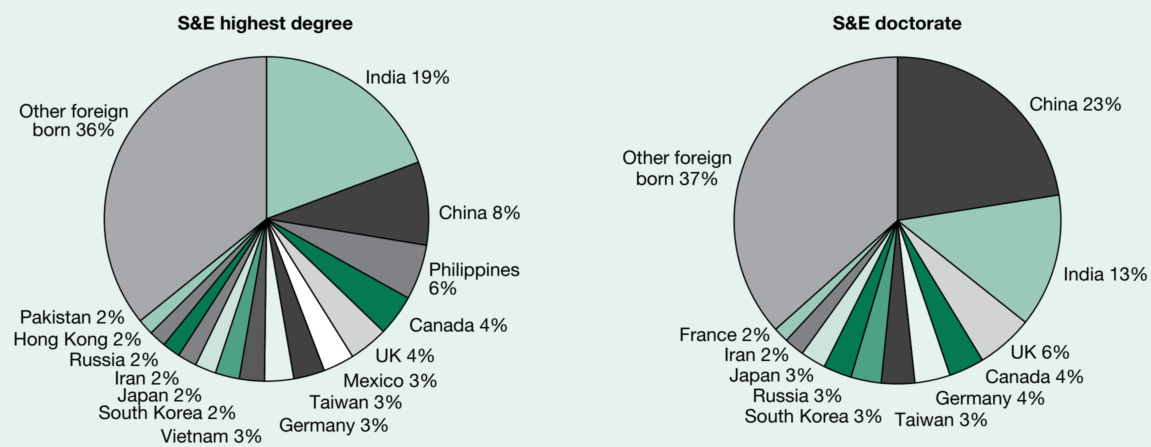
Source of Education

The SESTAT surveys ask respondents to provide information on where they received their postsecondary degrees. They also ask foreign-born respondents to provide information on why they came to the United States. Together, this information is helpful for understanding the educational and career paths of foreign-born scientists and engineers working in the United States and possible factors that influence these paths.

The majority of foreign-born scientists and engineers in the United States received their initial university training abroad. In 2010, there were about 4.3 million college-educated, foreign-born individuals employed in the United States with an S&E degree or in an S&E occupation; of these, 2.3 million received their first bachelor's degree abroad. Many of these individuals came to the United States for job or economic opportunities, educational opportunities, or family-related reasons.[26] Among employed foreign-born scientists and engineers, 54% of those whose highest degree is at the bachelor's level received their initial university degree from a foreign institution. The proportion is similar among foreign-born scientists and engineers with advanced degrees (53%), although SESTAT lacks information for a small proportion of individuals in this group.[27]

Many foreign-born scientists and engineers in the United States appear to come here for further higher education after receiving their initial university training abroad. Of the 2.1 million foreign-born scientists and engineers who are employed in the United States and hold an advanced degree,

Figure 3-36
Foreign-born individuals with highest degree in S&E living in the United States, by place of birth: 2010



UK = United Kingdom.

NOTE: Percentages 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) (2010), http://sestat.nsf.gov.

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two-thirds completed their highest degree in the United States, divided almost evenly between those who received their first bachelor's degree abroad (671,000) and those who received their first bachelor's degree in the United States (647,000). Almost one-fourth of foreign-born scientists and engineers with an advanced degree (472,000) received both their initial university degree and advanced (highest) degree abroad. In contrast, only a small number of foreign-born scientists and engineers (35,000) received their first bachelor's degree in the United States and their highest degree abroad.

The information provided by foreign-born scientists and engineers on factors that influenced their migration to the United States reinforces the patterns seen in the migration data. Among those who obtained their initial university degree abroad but their highest degree in the United States, the most commonly cited reason for coming to the United States was educational opportunities (27%). Family-related reasons (9%) and job/economic opportunities (7%) were cited by much smaller proportions. In comparison, among those who received both degrees abroad, the most commonly cited reasons for coming to the United States were job/economic opportunities (29%) and family-related reasons (23%), followed by scientific or professional infrastructure (11%), and educational opportunities (10%).

Among the foreign-born doctorate holders employed in the United States, 58% received this degree from a U.S. institution and 83% (of those for whom SESTAT contains information on first bachelor's degree) received their initial university degree from a foreign institution.

New Foreign-Born Workers

During the 2007–09 economic downturn, two indicators—the number of temporary work visas issued by the U.S. government in visa classes for high-skill workers and the stay rates of foreign-born U.S. doctorate recipients—showed evidence that the volume of new foreign-born workers entering the U.S. S&E workforce might be declining. Recent data, however, indicate that this period of decline may be temporary. In addition to these two indicators, this section discusses characteristics of workers with temporary work visas and country profiles of new foreign-born workers.

Temporary Visas

The number of temporary work visas issued for high-skill workers provides an indication of new immigrant workers entering the U.S. labor force.[28] After several years of growth, the largest classes of these temporary visas declined during the recent economic downturn (figure 3-37). Data since the downturn, however, suggest that growth has resumed in recent years. Despite the increases in the issuance of temporary visas since fiscal year (FY) 2009, the numbers have not yet reached the recent highs seen in FY 2007, before the beginning of the economic downturn (figure 3-37). A decline in the issuance of these visas, particularly H-1B visas, also occurred around the more mild recession in 2001.

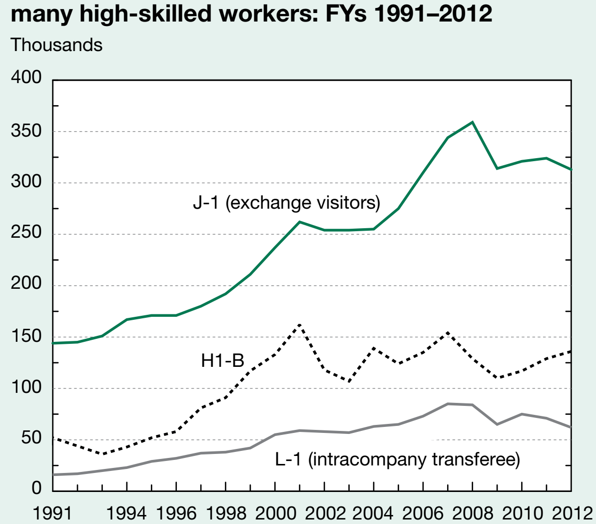
H-1B visas account for a significant proportion of foreign-born high-skill workers employed by U.S. firms on temporary visas. This type of visa is issued to individuals who seek temporary entry into the United States in a specialty occupation that requires professional skills. It is issued for up to 3 years with the possibility of an extension to 6 years. In 2012, the United States issued nearly 136,000 H-1B visas, up 23% from the recent low in 2009 (110,000) but still down from the recent peak of about 154,000 issued in 2007 (figure 3-37).

Issuance of visas in other temporary work categories that usually contain large numbers of high-skill workers also rose since 2009; however, the H-1B visa category has shown continued increase since 2009, unlike the J-1 and L-1 categories (figure 3-37).

Characteristics of H-1B Visa Recipients

Although H-1B visas are not issued exclusively for scientists and engineers, the majority of H-1B visa recipients work in S&E or S&E-related occupations (appendix table 3-21). However, precise counts of H-1B visas issued to individuals in these occupations cannot be obtained because USCIS does not classify occupations with the same taxonomy used by NSF. In 2011, workers in computer-related occupations as classified by USCIS were the most common recipients of H-1B visas, accounting for almost half (48%) of new H-1B visas issued. The total number of newly initiated H-1B visas for workers in computer-related fields increased significantly between 2010 and 2011, following a steep decline between 2008 and 2009 during the economic downturn. The

Figure 3-37
Temporary work visas issued in categories with many high-skilled workers: FYs 1991–2012



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

SOURCE: U.S. Department of State, Nonimmigrant Visa Issuances by Visa Class and by Nationality and Nonimmigrant Visas by Individual Class of Admission, http://www.travel.state.gov/visa/statistics/nivstats/nivstats_4582.html (accessed 12 April 2013).

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proportion of H-1B recipients who worked in computer sciences was considerably lower in the earlier part of the 2000s. For example, in 2002, only 25% of H-1B visa recipients worked in computer-related fields (NSB 2012).

H-1B visa recipients tend to possess advanced degrees. In FY 2011, 55% of new H-1B visa recipients had an advanced degree, including 39% with master's degrees, 5% with professional degrees, and 12% with doctorates (DHS USCIS 2012). The degree distribution differs by occupations. In FY 2009, for example, the vast majority of mathematical and physical scientists (83%) and life scientists (87%) with H-1B visas held advanced degrees; 44% of mathematical and physical scientists and 61% of life scientists with H-1B visas had doctorates (NSB 2012).

In 2011, 53% of new H-1B visa recipients were from India, and another 10% were from China (DHS USCIS 2012). H-1B visa recipients are relatively young. In 2011, 46% of new H-1B visa recipients were between the ages of 25 and 29, and another 25% were between the ages of 30 and 34 (DHS USCIS 2012).

Table 3-28 shows salaries paid to new recipients of H-1B visas by occupation group. These starting salaries, taken from final visa application forms sent to USCIS, are different from 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 median salaries for workers in life sciences may reflect the common use of H-1B visas to hire individuals for relatively low-paying postdoc positions.

Table 3-28
Annual salaries for new H-1B visa recipients, by occupation: FY 2011
(Dollars)

Occupation	Median	Mean
Administrative specializations	55,000	67,000
Architecture, engineering, and surveying	72,000	79,000
Art	45,000	54,000
Computer-related occupations	64,000	70,000
Education	46,000	56,000
Entertainment and recreation	35,000	43,000
Law and jurisprudence	85,000	106,000
Life sciences	47,000	56,000
Managers and officials nec	81,000	103,000
Mathematics and physical sciences	70,000	74,000
Medicine and health	57,000	93,000
Miscellaneous professional, technical, and managerial	70,000	82,000
Museum, library, and archival sciences	48,000	58,000
Religion and theology	36,000	41,000
Social sciences	65,000	78,000
Writing	43,000	51,000

nec = not elsewhere classified.

SOURCE: Department of Homeland Security (DHS), U.S. Citizenship and Immigration Services; *Characteristics of H-1B Specialty Occupation Workers, Fiscal Year 2011 Annual Report to Congress*, http://www.uscis.gov/USCIS/Resources/Reports%20and%20Studies/H-1B/h1b-fy-11-characteristics.pdf, accessed 20 December 2012.

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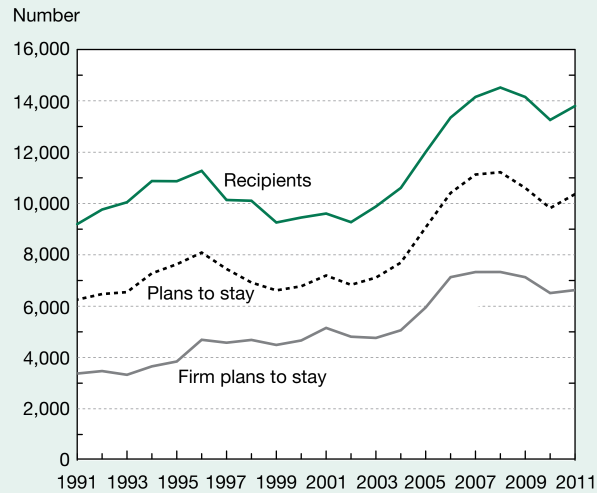
Short-Term Stay Rates for U.S. S&E Doctorate Recipients

Among doctorate recipients, the period immediately after earning their doctorate is a pivotal point that can substantially affect long-term career trajectories. During this period, foreign-born doctorate recipients who remain in the United States may set themselves on a path to long-term residency.

At the time they receive their doctorates, foreign-born students at U.S. universities report whether they intend to stay in the United States and whether they have a firm offer to work in the United States (either a postdoc or a job) the following year.[29] These responses provide estimates of short-term stay rates.[30]

Most foreign-born noncitizen recipients of U.S. S&E doctorates plan to stay in the United States after graduation. At the time of doctorate receipt, 75% of foreign-born recipients of U.S. S&E doctorates, including those on both temporary and permanent visas, plan to stay in the United States, and 48% have either accepted an offer of postdoc study or employment or are continuing employment in the United States (figure 3-38). The proportion of foreign-born S&E doctorate recipients planning to stay in the United States has risen over time. In 1991, 68% of foreign students who earned S&E doctorates at U.S. universities reported that they planned to stay in the United States after graduation,

Figure 3-38
Plans of foreign recipients of U.S. S&E doctoral degrees at graduation to stay in the United States, by year of doctorate: 1991–2011



NOTE: Data include doctorate recipients on temporary and permanent visas.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2013) of the Survey of Earned Doctorates (SED) (1991–2011).

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and 37% said that they had firm offers for postdoc study or employment. Throughout the 1980s, these proportions were about 50% and 33%, respectively (NSB 2012).

During the latter part of the decade 2000–09, a period marked by the economic downturn and financial crisis, both the percentage of foreign-born S&E doctorate recipients reporting plans to stay in the United States and the percentage of those reporting firm offers to stay declined slightly (figure 3-38). The overall number of foreign-born S&E doctorate recipients also declined in 2009 and 2010. Although the numbers have since risen in 2011, the levels remain below the recent peaks seen in 2008.

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 (appendix table 3-22). Between 2008 and 2011, the short-term stay rates in these four fields ranged from 77% to 83%, as measured by reports of intentions to stay in the United States. However, the short-term stay rates for foreign-born U.S. S&E doctorate recipients in health fields (71%) were somewhat lower, and those in the social sciences (57%) were substantially lower.

Stay rates vary by place of origin. Between 2008 and 2011, the vast majority of U.S. S&E doctorate recipients from China (86%) and from India (87%) reported plans to stay in the United States, and close to 60% of these individuals reported accepting firm offers for employment or postdoc research in the United States (appendix table 3-22). U.S. S&E 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). About half of U.S. S&E doctorate recipients from Europe had firm plans to stay in the United States after graduation (appendix table 3-22). In North America, the percentage of U.S. S&E doctorate recipients who had definite plans to stay in the United States was higher for those from Canada than for those from Mexico (appendix table 3-22).

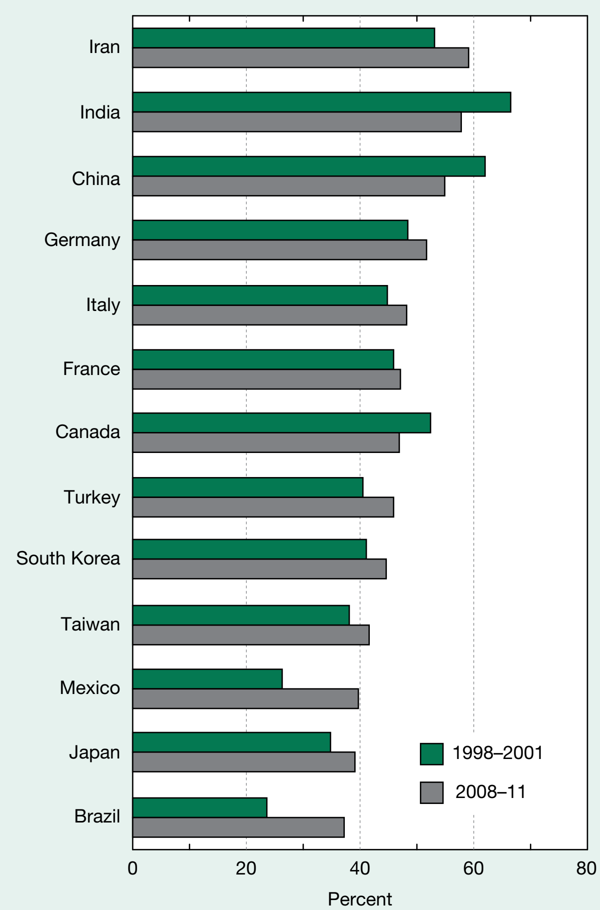
Among U.S. S&E doctorate recipients from the two top countries of origin, China and India, the proportions reporting plans to stay in the United States have declined since the early part of the decade of the 2000s (appendix table 3-22).

Long-Term Stay Rates for U.S. S&E Doctorate Recipients

Long-term stay rates indicate the degree to which foreign-born recipients of U.S. S&E doctorates enter and remain in the U.S. labor force to pursue their careers. For a particular cohort of foreign-born noncitizen S&E doctorate recipients, the proportion of that cohort that pays federal taxes a given number of years after receiving their degrees is an indicator of the cohort's long-term stay rate.[31] Estimates of short-term stay rates are derived from data on reported intentions to stay in the United States within the year after graduation. Stay rates over the short term can be compared with those over a longer duration to analyze how stated intentions for the period immediately after graduation compare with actual behavior some years later.

Stay rate data include foreign-born noncitizen recipients of U.S. S&E doctorates who were on either a permanent or a temporary visa at the time they received their doctorates. For the 2001 and 2006 graduating cohorts, stay rate data are available separately for permanent and temporary visa holders. Within these cohorts, stay rates are particularly stable over time among individuals who received their doctorates while on a permanent visa (figure 3-40). Temporary residents, who account for the vast majority of noncitizen recipients of U.S. S&E doctorates, have lower stay rates than do permanent residents, and their stay rates decline with additional years

Figure 3-39
Plans of foreign recipients of U.S. S&E doctoral degrees at graduation to stay in the United States, by place of origin and year of doctorate: 1998–2001 and 2008–11



NOTES: Data reflect proportions of each group reporting firm commitment to postgraduation employment in the United States. Data include doctorate recipients on temporary and permanent visas. Data for China include Hong Kong.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2013) of Survey of Earned Doctorates (SED).

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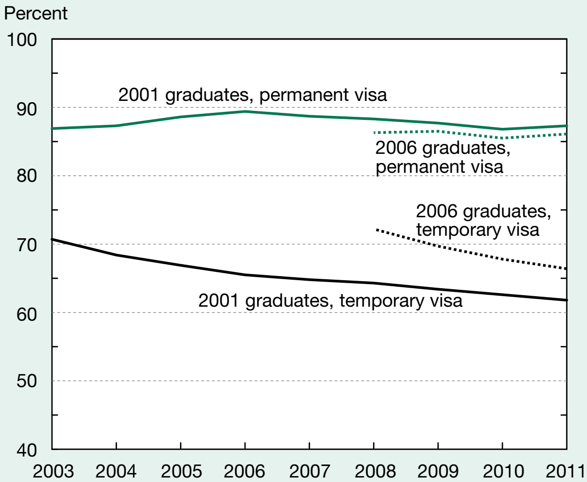
since degree. For example, among foreign-born U.S. S&E doctorate recipients from the 2001 cohort, those who were on a temporary visa at the time they earned their degree had a 2-year stay rate in 2003 that was 16 percentage points lower than those with a permanent visa. This difference grew wider over time, reaching almost 26 percentage points by 2011, as stay rates for temporary visa holders fell while stay rates for permanent residents changed little.

The stay rates within the entire 2001 and 2006 cohorts of foreign-born noncitizen recipients of U.S. S&E doctorates fell with additional years since graduation (Finn 2014); this was a result of the declining stay rates among temporary visa holders, who accounted for nearly 90% of all noncitizen U.S. S&E doctorate recipients in these cohorts. The 2001 cohort had a stay rate after 2 years of 73%; after 10 years, this rate declined by 8 percentage points. The 2006 cohort had a 2-year stay rate of 74%, which declined to 68% after 5 years. In comparison, among the cohort of foreign-born U.S. S&E doctorate recipients who earned their degrees in 1995, stay rates were relatively stable as additional years passed since graduation. The 1995 cohort had a 2-year stay rate of 65%, which dropped to 61% after 16 years (Finn 2014). Stay rate data for the 1995 cohort, however, are not separately available for permanent and temporary residents. Data from earlier and subsequent years suggest that temporary visa holders accounted for the vast majority of foreign-born noncitizen recipients of U.S. S&E doctorates in 1995 (Finn 2012); as a result, temporary residents likely played an important role in the overall stability of the stay rate within this cohort.

In recent years, long-term stay rates have fluctuated within a fairly narrow range, neither increasing nor declining consistently (table 3-29). Among U.S. S&E doctorate recipients with a temporary visa at graduation, 5-year stay rates rose in the latter part of the decade of the 2000s after declining for several years around the 2007–09 economic downturn. While figure 3-40 shows the stay rate data annually for fixed cohorts (2001 and 2006 graduating cohorts), table 3-29 presents data on 5-year stay rates during the 2001–11 period. Data for each year reflect the stay rate in that year for the cohort that received their doctorates 5 years earlier. The 5-year stay rate rose to 66% in 2011, close to the recent high level seen in 2005 (67%).

The trends in the 5-year stay rates vary across source countries (table 3-29). Among foreign-born recipients from China (the largest source country) who were temporary residents at the time they received their U.S. S&E doctorates,

Figure 3-40
Stay rates for U.S. S&E doctorate recipients with permanent or temporary visas at graduation, by selected year of doctorate: 2003–11



SOURCE: Finn M. 2014 (forthcoming). *Stay Rates of Foreign Doctoral Recipients from U.S. Universities: 2011*. Oak Ridge, TN: Oak Ridge Institute for Science and Education.

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Table 3-29
Five-year stay rates for U.S. S&E doctorate recipients with temporary visas at graduation, by selected country/region/economy: 2001–11
(Percent)

Country/region/economy	2001	2003	2005	2007	2009	2011
All countries/regions/economies	58	64	67	63	62	66
China	98	93	95	94	89	85
India	89	90	89	83	79	82
Europe	53	63	67	67	60	62
Canada	66	63	60	56	53	55
South Korea	22	36	44	42	42	42
Japan	24	39	41	33	40	38
Taiwan	41	48	52	43	37	38
Mexico	31	22	32	33	35	39
Brazil	26	26	31	32	33	37

NOTE: Data for each year reflect the stay rate in that year for the cohort that received their doctoral degrees 5 years earlier.

SOURCE: Finn M. 2014 (forthcoming). *Stay Rates of Foreign Doctoral Recipients from U.S. Universities: 2011.* Oak Ridge, TN: Oak Ridge Institute for Science and Education.

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the 5-year stay rate declined in 2011, continuing the trend since before the economic downturn. However, even with this decline, rates remain higher than those of other major locations. Foreign-born U.S. S&E doctorate recipients from other major source countries/economies, like India and Taiwan, saw slight increases in the 5-year stay rate between 2009 and 2011, although their stay rate overall declined between 2001 and 2011. Among foreign-born recipients of U.S. S&E doctorates from South Korea who were on a temporary visa at the time they received their doctorate, stay rates remained stable between 2007 and 2011 after doubling during the first half of the decade.

Data from the 2006 cohort suggest that among temporary visa holders receiving U.S. S&E doctorates, stated intentions to stay in the United States (short-term stay rates) are reasonable indicators of stay rates some years later (Finn 2014). Among temporary residents who received their U.S. S&E doctorate in 2006 and reported definite plans to stay in the United States within the year after graduation, 94% were in the United States 1 year later and 80% remained 5 years later. Among the 2006 cohort of temporary residents who reported plans to stay in the United States (as opposed to firm employment offers), 86% were in the United States 1 year later and 72% remained 5 years later. A number of factors are likely to affect how precisely short-term intentions to stay in the United States predict actual behavior some years later. Among these are overall economic conditions and job opportunities in the United States, comparable conditions in the doctorate recipient's country of origin, and family-related and other personal considerations.

High-Skill Migration Worldwide

No worldwide or internationally comparable data exist on the migration of workers in S&E occupations or with college-level S&E degrees. Docquier and Rapoport (2012) compiled and analyzed data on international migration to OECD countries by educational attainment in 1990 and 2000 (see also Docquier, Lowell, and Marfouk 2009; Docquier and Marfouk 2006). They defined high-skill migrants as the total number of foreign-born individuals, age 25 and over, with some postsecondary education living in an OECD country. They gathered data for nearly 200 source countries (which included OECD and non-OECD countries), all but a handful of which are independent nations. More recent and comprehensive data on global high-skill migration patterns are not currently available. However, the flow of migration historically has been from developing to developed nations, and the OECD data for the 1990 to 2000 period confirm this pattern. As R&D activity expands in developing countries, press reports suggest increased movement in the opposite direction; however, systematic and recent data do not exist to address that pattern.

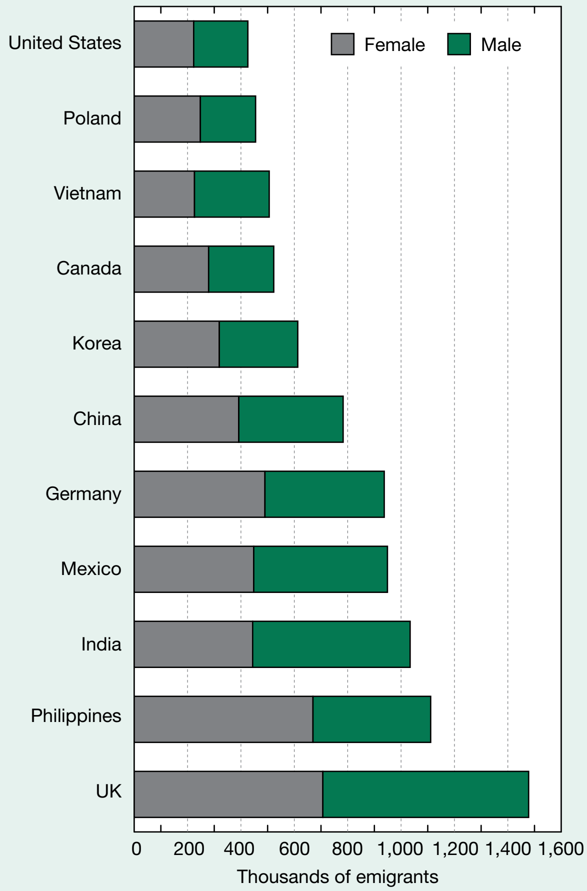
The data on migration to OECD countries indicate several patterns in international migration of individuals age 25 and older:

- Between 1990 and 2000, the total number of immigrants (regardless of skill level) in OECD countries increased from about 42 million to about 59 million.
- Globally, OECD countries account for the vast majority of high-skill immigrants. The migration rate among high-skill individuals to the OECD nations changed only slightly between 1990 and 2000 (rising from 5.1% to 5.5%). Nonetheless, because worldwide education levels are rising, the proportion of high-skill individuals among those who immigrated to OECD countries rose during this period, from 30% to 35%.
- Rates of legal emigration were much greater among high-skill individuals (5.5% in 2000) than among those with less education (1.3% in 2000).
- In countries that the World Bank classifies as low income, the gap in emigration rates between high- and low-skill groups (7.6% and 0.3%, respectively, in 2000) was especially large. In comparison, the rates of high- and low-skill emigration rates were similar in countries that the World Bank classifies as high income (3.9% and 3.6%, respectively, in 2000).
- Between 1990 and 2000, the proportion of women among high-skill migrants rose, partly because of the worldwide increase in the proportion of individuals with some postsecondary education who are women.
- In 2000, the countries estimated to have the largest number of high-skill emigrants living in OECD countries 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 3-41). The proportion of high-skill emigrants who are women varied considerably across source countries (figure 3-41; see also Docquier, Lowell, and Marfouk 2009).

In a more limited study covering six major destination countries (United States, Canada, Australia, Germany, United Kingdom, and France), Defoort (2008) concluded that worldwide emigration rates for high-skill persons between 1975 and 2000 were stable in a large number of countries. Stable rates of emigration, however, would produce an increase in the total number of high-skill emigrants due to rising levels of worldwide education and skill.

Regarding high-skill migration to the United States, college-educated foreign-born workers in the United States are disproportionately found in S&E occupations and disproportionately have advanced degrees (see "Characteristics of the Foreign-Born Scientists and Engineers"). However, current international data do not enable researchers to assess whether and how migration rates globally or to OECD countries vary among different categories of high-skill workers.

Figure 3-41
Top countries of origin of foreign-born persons residing in OECD countries and having at least a tertiary education, age 25 years or more, by sex: 2000



OECD = Organisation for Economic Co-operation and Development; UK = United Kingdom.

NOTE: Tertiary education is 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.

SOURCE: Docquier F, Lowell B, Marfouk A. 2009. A gendered assessment of highly skilled emigration. *Population and Development Review* 35(2):297–321, http://onlinelibrary.wiley.com/doi/10.1111/j.1728-4457.2009.00277.x/abstract (accessed 22 January 2013).

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Global S&E Labor Force

The rising emphasis on developing S&E expertise and technical capabilities has been a global phenomenon. S&E work is not limited to developed economies; it occurs throughout the world. Such work, however, is concentrated in developed nations, where a significant portion of 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 educated or employed in S&E fields, are increasingly mobile, and the number that 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).

Data on the global S&E workforce, however, are very limited, which makes it difficult to analyze the precise size and characteristics of this specialized workforce. 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. In contrast, SESTAT 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 OECD member countries, they do not cover several countries—including Brazil, India, and Israel—that have high and rising levels of science and technology capability, and they do not provide fully comparable data for China.

This section provides information about the size and growth of workforce segments whose jobs involve R&D in nations for which relevant data exist.

Size and Growth of the 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 generally 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 2002:93). Because this definition can be applied differently when different nations conduct surveys, international comparisons should be made with caution. OECD also reports data on a broader measure of all personnel employed directly in R&D. In addition to researchers, the data on total R&D personnel include those who provide direct services to R&D such as clerical and administrative staff employed in R&D organizations.

OECD reports an estimated increase in the number of researchers in its member countries from 2.8 million in 1995 to 4.2 million in 2007. OECD also publishes estimates for seven non-member economies, including China and Russia; adding these to the OECD member total for

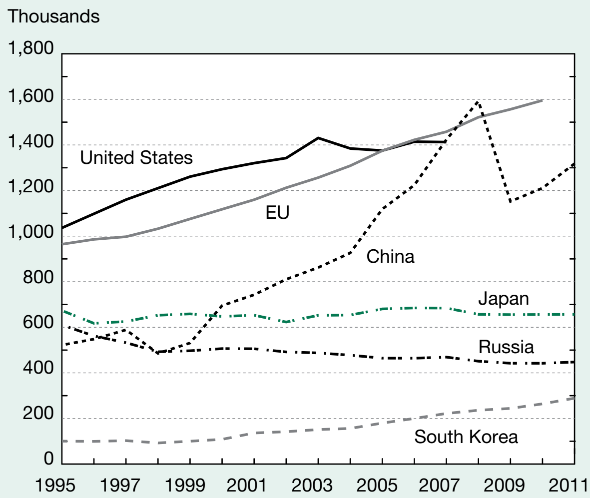
2007 yields a worldwide estimate of 6.3 million researchers. However, numerous uncertainties affect this estimate, including, but not limited to, lack of coverage of countries with significant R&D enterprise, as well as methodological inconsistencies over time and across countries. For example, some non-member countries that engage in large and growing amounts of research (e.g., India, Brazil) are omitted entirely from these totals. In addition, for some countries and regions, including the United States and the European Union (EU; see glossary for member countries), OECD estimates are derived from multiple national data sources and not from a uniform or standardized data collection procedure. For example, China's data after 2008 are collected in accordance with OECD definitions and standards; compared to China's estimate for 2008, these data yield estimates of about 440,000, 382,000, and 274,000 fewer researchers in 2009, 2010, and 2011, respectively.

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 3-42). 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 2011. The United States and the EU experienced steady growth but at a lower rate; the number of researchers grew 36% in the United States between 1995 and 2007 and 65% in the EU between 1995 and 2010. Exceptions to the overall worldwide trend included Japan (which experienced little change) and Russia (which experienced a decline, especially early in the period; see also Gokhberg and Nekipelova 2002). 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 3-23).

OECD also estimates the proportion of researchers in the workforce. In OECD's most recent estimates, small economies in Scandinavia (Denmark, Finland, Norway, Sweden) report that between 1% and 2% of their employed workforce are researchers; small economies in East Asia (Singapore, Taiwan) report that about 1% of their workforce are researchers (appendix table 3-24). 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 (1.0%), South Korea (1.2%), and the United States (0.95%). Although China reports a large number of researchers, they are a much smaller percentage of its workforce (0.17%) than in OECD member countries.

Several Asian economies have shown marked and continuous increases in the percentage of their workforce employed as researchers. These include China, South Korea, Singapore, and Taiwan (appendix table 3-24). In the United States and Japan, where growth occurred at all, it took place mostly between the mid-1990s and the early 2000s (figure 3-43). Patterns and trends in the proportion of the workforce

Figure 3-42
Estimated number of researchers in selected countries/regions: 1995–2011



EU = European Union.

NOTES: Data are not available for all countries/regions for all years. 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* (2013/1 and earlier years), http://www.oecd.org/sti/msti.htm.

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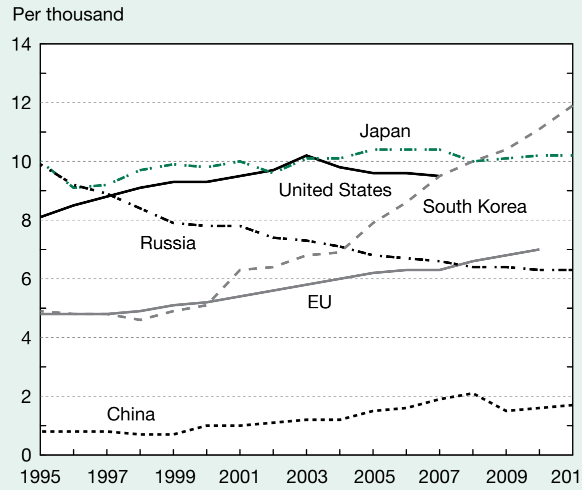
Figure 3-43
Researchers as a share of total employment in selected countries/regions: 1995–2011



EU = European Union.

NOTES: Data are not available for all countries/regions for all years. 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* (2013/1 and earlier years), http://www.oecd.org/sti/msti.htm.

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classified as R&D personnel are generally similar to those for researchers.

The proportion of female researchers varies considerably across OECD economies. According to the most recent estimates for the selected OECD countries for which data by sex are available, Japan (14% women) and South Korea (17% women) have a significant imbalance among researchers. By comparison, Turkey, Sweden, Spain, and Poland are more balanced with women representing between 35% and 40% of researchers.

R&D Employment Abroad by U.S. Companies

R&D jobs located abroad in U.S.-owned companies are an indicator of global engagement by U.S. companies in the world's S&E workforce. Data from NSF's Business R&D and Innovation Survey (BRDIS) 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. 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. Chapter 4 includes a detailed analysis of BRDIS data on R&D employment abroad by U.S. companies.

Conclusion

The S&E labor force may be defined in a variety of ways. At its core are individuals in S&E occupations, but those with S&E degrees who are employed in a variety of other jobs also play a role. Many more individuals hold S&E degrees than work in S&E occupations. Indicative of a knowledge-based economy, many of those in non-S&E occupations report that their work nonetheless requires at least a bachelor's degree level of S&E knowledge and skills. This suggests that the application of S&E knowledge and technical expertise is widespread across the U.S. economy and not just limited to S&E occupations.

In both the United States and the rest of the world, the S&E workforce has experienced strong growth over time. During the 2007–09 economic downturn, S&E employment remained more resilient in the United States than overall employment. 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 levels of education and comparably specialized skills. Although S&E workers are not totally exempt from joblessness, workers with S&E training or in S&E occupations are less often exposed to periods of unemployment.

Innovation based on S&E R&D is globally recognized as an important vehicle for a nation's economic growth and competitive advantage. As such, it is not surprising that growing numbers of workers worldwide are engaged in research. Growth has been especially marked in rapidly developing economies, such as China and South Korea, 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 whereas the number of researchers in the struggling Japanese economy has been stagnant.

The demographic composition of the S&E workforce in the United States is changing. The baby boom portion of the S&E workforce continues to age into retirement. However, increasing proportions of scientists and engineers are postponing retirement to somewhat later ages. At the same time, members of historically underrepresented groups (e.g., women, blacks, Hispanics) have played an increasing role in the U.S. S&E labor force, although this has been more the case in some fields (e.g., life sciences and social sciences) than in others (e.g., computer and mathematical sciences, physical sciences, and engineering). Despite the recent increases in S&E participation by women and by racial and ethnic minorities, both groups remain underrepresented in the U.S. S&E workforce compared to their overall labor force participation. For example, women account for slightly more than one-fourth of all workers employed in S&E occupations in the United States despite representing half of the college-educated workforce.

The United States has remained an attractive destination for foreign students and workers with advanced S&E training. In the wake of the 2001 recession, there were increases in both temporary work visas and stay rates of foreign recipients of S&E doctorates. Although declines occurred during the 2007–09 economic downturn—a period marked by rising unemployment in the United States among workers in S&E as well as in other occupations—growth has since resumed.

In today's dynamic marketplace, where information flows rapidly and technology is always evolving, labor market conditions change fast. Numerous factors—such as global competition, demographic trends, aggregate economic activities, and S&E training pathways and career opportunities—will affect the availability of workers equipped with S&E expertise as well as the kinds of jobs that the U.S. economy generates in the future. As a result, comprehensive and timely analysis of current labor force and demographic trends will play a critical role in providing the information needed to understand the dynamic S&E landscape both in the United States and globally.

Notes

1. The standard definition of the term *labor force* is 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. 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. The SOC is used by federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, and disseminating data. Detailed information on the SOC is available at http://www.bls.gov/SOC/.

3. Despite the limitations of this subjective measure, variations among occupations in the proportions of workers who say that they need this level of S&E technical expertise are in accordance with common sense. For example, among postsecondary teachers of physics, 95% said that their job required at least a bachelor's degree level of knowledge in engineering, computer sciences, mathematics, or the natural sciences. Among postsecondary teachers of business commerce or marketing, 83% said that their job required at least this level of expertise in other fields such as health, business, or education. Among the SESTAT population whose occupation is secretary/receptionist/typist, fewer than 10% said that their job required bachelor's level S&E expertise of any kind, and 12% said that their job required at least this level of expertise in other fields such as health, business, or education.

4. 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 at least a bachelor's degree); because of the type of 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 classifying a reported occupation into a standard occupational category. All of these differences can affect the estimates. For example, the SESTAT estimate of the number of workers in S&E occupations includes postsecondary teachers of S&E fields; however, postsecondary teachers in ACS are grouped under a single occupation code regardless of field and are therefore not included in the ACS estimate of the number of workers in S&E occupations.

5. Among those with doctorates in an S&E field, life sciences and social sciences were the most common fields, followed by physical sciences, engineering, and computer and mathematical sciences.

6. The data on S&E employment level for 1960 are calculated using the Census Bureau's 1960 Decennial Census microdata, adjusted by the Integrated Public Use Microdata Series (IPUMS) from the University of Minnesota's Minnesota Population Center (http://www.ipums.org). The data for 2011 are calculated using the 2011 American Community Survey (ACS) public use microdata sample (PUMS) files from the Census Bureau (http://www.census.gov/acs/www/data_documentation/public_use_microdata_sample/). S&E employment levels for 1960 and 2011 include workers at all education levels and do not include S&E postsecondary teachers. Although the 1960 Decennial Census data allow for separate identification of S&E postsecondary teachers, the 2011 ACS data aggregate all postsecondary teachers into one occupation code and therefore do not allow for separate identification of S&E postsecondary teachers. For 1960, including S&E postsecondary teachers would increase the number of workers employed in S&E occupations to nearly 1.2 million. See appendix table 3-1 for a list of S&E occupations in the 1960 Decennial Census and 2011 ACS.

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

8. The data on self-employment from SESTAT include those who report being self-employed or employed by a business owner in either an unincorporated or incorporated business, professional practice, or farm. As a result, the data may capture both self-employed individuals in their own businesses as well as those whose principal employer is a business owner. This is a major reason why the SESTAT estimate of self-employed workers in S&E occupations is higher than those from other surveys (e.g., the Census Bureau's ACS).

9. Employment in the federal government is largely limited to those with U.S. citizenship. In the competitive civil service, only U.S. citizens and nationals may be appointed; however, in the excepted service or the Senior Executive Service, certain noncitizens who meet specific employability requirements may be employed. Many federal workers with S&E employment are 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.

10. This list does not include the National Institutes of Health, which is a part of the Department of Health and Human Services (DHHS). DHHS accounted for 5% of total federal S&E employment in 2012.

11. The other 10 activities are used to define four additional broad categories of primary/secondary work activities, including teaching; management and administration; computer applications; and professional services, production workers, or other work activities not specified.

12. Social scientists were exceptions. In 2010, the difference in R&D activity rates between social scientists with doctorates and social scientists with bachelor's degrees was not statistically significant.

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

14. Although SESTAT respondents were allowed to provide more than one reason for participating in work-related training, the data presented in this section are on the most important reason for participating in such training.

15. 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.

16. The Bureau of Labor Statistics civilian unemployment rate for persons 16 years and over, not seasonally adjusted, is available at http://data.bls.gov/timeseries/LNU04000000 (accessed 4 December 2012).

17. Social scientists were exceptions. The change in the unemployment rate from 2006 to 2010 among social scientists was not statistically significant.

18. The CPS is the source of the official unemployment rate.

19. 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 generally considered a temporary position that individuals take primarily for additional training—a period of advanced professional apprenticeship—after completion of a doctorate.

20. NSF is currently developing a data collection strategy as part of its Early Career Doctorates Project (ECDP) to gather in-depth information about postdoc researchers and other early career doctorates. The ECDP will collect information related to educational achievement, professional activities, employer demographics, professional and personal life balance, mentoring, training and research opportunities, and career paths and plans for individuals who earned their doctorate in the past 10 years and are employed in an academic institution or a research facility.

21. In this chapter, American Indian or Alaska Native, Asian, black, Native Hawaiian or Other Pacific Islander, white, and more than one race refer to individuals who are not of Hispanic origin. Hispanics may be any race.

22. Salary differences represent estimated percentage differences in women's reported full-time annual salary relative to men's reported full-time annual salary as of October 2010. Coefficients are estimated in an ordinary least squares regression model using natural log of full-time annual salary as the dependent variable. This estimated percentage difference in earnings differs slightly from the observed difference in median earnings by sex because the former addresses differences in mean earnings rather than median.

23. Included are 20 SESTAT field of degree categories (out of 21 S&E fields), 38 SESTAT occupational categories (out of 39 categories), 6 SESTAT employment sector categories (out of 7), years since highest degree, years since highest degree squared, Carnegie classification of school awarding highest degree, and private/public status of postsecondary institution awarding highest degree.

24. In addition to the education- and employment-related variables, the following indicators are included: nativity and citizenship, marital status, disability, number of children living in the household, geographic region (classified into nine U.S. Census divisions), and whether either parent holds a bachelor's or higher level degree. The sex regression controls for racial and ethnic minority status, and the race and ethnicity regression controls for sex.

25. The regression analysis addresses major factors that affect differences in earnings but does not attempt to cover all possible sources of difference. For a more detailed discussion on the topic, see Blau and Kahn (2007), Mincer (1974), Polachek (2008), and Xie and Shauman (2003).

26. When asked about the most important reason for coming to the United States, many foreign-born scientists and engineers who obtained their initial university degree abroad cited family-related reasons (24%), job or economic opportunities (23%), and educational opportunities (14%).

27. For an additional 15% (about 321,000) of foreign-born employed SESTAT respondents who hold an advanced degree, SESTAT lacks information on first bachelor's degree, including the country in which they received their bachelor's degree. Nearly three-fourths of these individuals received their highest degree from a foreign institution. The vast majority of foreign-born advanced degree holders for whom SESTAT contains information on first bachelor's degree and who received their advanced degree abroad also received their initial university education abroad. It is therefore highly likely that a significant portion of the group for whom SESTAT is missing first bachelor's degree information also received this degree abroad.

28. 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.

29. This question is part of the Survey of Earned Doctorates (SED), which is administered to individuals receiving research doctoral degrees from all accredited U.S. institutions. For information on the SED, see http://www.nsf.gov/statistics/srvydoctorates/. The information on plan to stay or definite commitment to stay reflects intentions within the year after graduation as reported by the doctorate recipient around the graduation date. As such, any changes in intentions after survey completion are not captured.

30. Many foreign recipients of U.S. doctorates who report that they plan to stay in the United States the year after graduation may do so using their student (F-1) visa and never obtain a new visa that would permit a longer stay. Student visas permit an additional 12-month stay in the United States after graduation if a student applies for optional practical training (OPT). OPT refers to paid or unpaid work that is performed at least 20 hours a week and that is related to a student's field of study. Starting in April 2008,

those earning a degree in science, technology, engineering, and mathematical (STEM) fields could apply for an extension of their OPT to a total of 29 months. Data from the Department of Homeland Security's Student and Exchange Visitor Information System show that 75.6% of students with F-1 visas completing a doctorate in any field between 2004 and 2009 had applied for OPT.

31. Tax data that are used for estimating stay rates are reported by tax authorities in aggregate forms for groups of individuals in order to protect confidentiality of individual tax payers.

Glossary

European Union (EU): As of June 2013, the EU comprised 27 member nations: 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. Croatia joined the EU in July 2013. Unless otherwise noted, OECD data on the EU include all 28 members; data on the EU from other sources are limited to the 27 nations that were members as of June 2013.

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. The IOF rate is the proportion of all employed individuals that report IOF employment.

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 34 countries headquartered in Paris, France. The member countries are Australia, Austria, Belgium, Canada, Chile, Czech Republic, Estonia, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, 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 non-profit organization, primarily for gaining additional education and training in research after completion of a doctorate.

Scientists and Engineers Statistical Data System (SESTAT): A system of three surveys conducted by the National Science Foundation that measure the educational, occupational, and demographic characteristics of the S&E 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 foreign recipients of U.S. S&E doctoral degrees who stay in the United States after receiving their doctorate.

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

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

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