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: as workers in S&E occupations (6.7 million), as holders of S&E degrees (23.2 million), or as those who use S&E technical expertise on the job (19.4 million). The estimated size of the S&E workforce varies depending on the definitional criteria chosen.

- In 2015, estimates of the size of the S&E workforce ranged from over 6 million to more than 23 million depending on the definition used.
- In 2015, an estimated 6.4 million college graduates were employed in S&E occupations in the United States. The largest S&E occupations were computer and mathematical sciences (3.1 million), followed by engineering (1.7 million). Occupations in life sciences (631,000), social sciences (570,000), and physical sciences (331,000) combined to about the size of the engineering component.

In 2015, about 23.2 million individuals in the United States had a bachelor's or higher level degree in an S&E field of study. Of these 23.2 million individuals, the majority (17.3 million) held their highest level of degree (which can be a bachelor's, master's, professional, or doctorate) in an S&E field, the remainder held their highest level of degree in an S&E-related or non-S&E field. Of these S&E highest degrees, the most common fields were social sciences (6.8 million) and engineering (3.8 million). Computer and mathematical sciences (2.9 million), life sciences (2.8 million), and physical sciences (1.0 million) together were slightly less than the size of the social sciences component.

- Not all S&E degree holders work in jobs formally designated as 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 S&E (19.4 million) is substantially higher than the number employed in S&E occupations (6.4 million), suggesting that the application of S&E knowledge and skills is widespread across the technologically sophisticated U.S. economy and not limited to jobs classified as S&E.

The S&E workforce has grown steadily over time.

- Between 1960 and 2015, the number of workers in S&E occupations grew at an average annual rate of 3%, compared with the 2% growth rate for the total workforce.
- During and immediately after the 2007-09 economic downturn, trends in S&E employment fared relatively better compared to overall employment trends. Between 2007 and 2010, S&E employment level remained stable whereas total employment declined. Both employment levels have risen since 2010.

S&E Workers in the Economy

Scientists and engineers work for all types of employers.

- The majority of scientists and engineers (individuals trained or employed in S&E) are employed in the business sector (71%), followed by the education (19%) and government (11%) sectors. Within the business sector, for-profit businesses employ the bulk of scientists and engineers.

- Among individuals with S&E doctorates, the proportion working in the business sector is 48%, and the proportion working in the education sector is 43%. Within the education sector, over 90% work in 4-year colleges and universities, including those in postdoctoral and other temporary positions.
- The majority of educational institutions and government entities that employ scientists and engineers are large employers (i.e., having 100 or more employees). In contrast, scientists and engineers working in the business sector are distributed across firms of different sizes.
- Within the business sector, the industry with the largest number of workers in S&E occupations is professional, scientific, and technical services.
- 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 in 2015 accounted for 19% of nationwide S&E employment, compared to 9% of all employment.

S&E Labor Market Conditions

Whether measured by S&E occupation or degree, S&E workers have higher earnings than other comparable workers.

- Half of the workers in S&E occupations earned $84,000 or more in 2016, which is more than double the median salaries ($37,000) of the total workforce.
- Employed college graduates with a highest degree in S&E earn more than those with non-S&E degrees (median salaries in 2015 were $68,000 and $55,000, respectively). For the most part, the earnings premium associated with an S&E degree is present across early, mid-, and later career stages.

The S&E labor force is less likely than others to experience unemployment.

- Unemployment rates for college-educated individuals 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 February 2015, about 3.3% of scientists and engineers and 3.5% of all college-educated individuals in the labor force were unemployed, which are both substantially less than the official unemployment rate for the entire U.S. labor force (5.8%).
- Unemployment rates for S&E doctorate (2.6%) and master's degree holders (2.8%) are even lower than those for S&E bachelor's degree holders (4.0%).

Demographics of the S&E Workforce

Mirroring U.S. population trends, the S&E labor force is aging. Additionally, a larger proportion of older scientists and engineers remain in the labor force in 2015 than in 1993.

- The median age of scientists and engineers in the labor force was 43 years in 2015, compared to 41 years in 1995.
- Between 1993 and 2015, an increasing percentage 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 in the labor force in 1993, the comparable percentage rose to 62% in 2015.

Women remain underrepresented in the S&E workforce, but less so than in the past.

- In 2015, women constituted 50% of the college-educated workforce, 40% of employed individuals whose highest degree was in an S&E field, and 28% of those in S&E occupations. The corresponding 1993 shares were 43%, 30%, and 23%, respectively.
- Women employed in S&E occupations are concentrated in different occupational categories than men, with relatively high proportions in social sciences (60%) and life sciences (48%) and relatively low proportions in engineering (15%), physical sciences (28%), and computer and mathematical sciences (26%).

Historically underrepresented racial and ethnic groups, particularly blacks and Hispanics, continue to be part of the S&E workforce at rates lower than their presence in the U.S. population, whereas Asians and foreign-born individuals are represented in the S&E workforce at substantially higher rates.

- Hispanics, blacks, and American Indians or Alaska Natives together make up 27% of the U.S. population age 21 and older but a much smaller proportion of the S&E workforce: 15% of S&E highest degree holders and 11% of workers in S&E occupations.
- Conversely, Asians make up 6% of the U.S. population age 21 and older but account for 21% of those employed in S&E occupations. Asians have a large presence in engineering and computer sciences occupations, particularly among computer software and hardware engineers, software developers, computer and information research scientists, and postsecondary teachers in engineering.
- About 67% 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 (66%).
- Foreign-born individuals account for 29% of all workers in S&E occupations, which is substantially higher than their share of the entire college-educated workforce (17%).
- 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 post-recession increase in the immigration of scientists and engineers following a temporary decline during the 2007–09 economic downturn.

- The issuance of new H-1B visas, which languished during the recession, continued to increase since 2009 and, by 2015, exceeded the pre-recession levels.
- About 70% of temporary visa holders earning a U.S. S&E doctorate are in the United States at least 5 years later. This proportion reached 67% in 2005, declined during the economic downturn, and then rose to 70% in 2015.

Global S&E Labor Force

Worldwide, the number of workers engaged in research has been growing. This includes "professionals engaged in the conception or creation of new knowledge" who "conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods" (OECD 2015).

- Among countries with large numbers of researchers—defined as workers engaged in the conception or creation of new knowledge—growth since 2000 has been most rapid in China and South Korea.
- The United States and the European Union experienced steady growth but at lower rates than China or South Korea.

- Russia and, to some extent, Japan were exceptions to the worldwide trend. Between 2000 and 2014, the number of researchers in Japan rose very slightly; in Russia, the number declined.

Introduction

Chapter Overview

Policymakers and scholars emphasize innovation based on S&E R&D as a vehicle for a nation's economic growth and global competitiveness. In the increasingly interconnected world of the 21st century, workers with S&E expertise are integral to 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 and useful products and services. As a result, these workers make important contributions to improving the nation's living standards.

Chapter Organization

The U.S. S&E 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 reported 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 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 choice of occupation.

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, with a focus on recent S&E graduates.

The next three sections cover workforce 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.

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/National Center for Science and Engineering Statistics' (NSF/NCSES's) National Survey of College Graduates (NSCG), Survey of Doctorate

Recipients (SDR), Survey of Earned Doctorates (SED), and Survey of Graduate Students and Postdoctorates in Science and Engineering; 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 the various topics. (See sidebar NSF/NCSES's Data on Scientists and Engineers and Table 3-1.) Although data collection methods and definitions can differ across surveys in ways that affect estimates, presenting data from different sources facilitates a more accurate and comprehensive picture of the very specialized S&E workforce. Long-term trends, international trends, and comparisons of S&E and non-S&E workers are discussed whenever data are available.

TABLE 3-1

Major sources of data on the U.S. labor force

(Data sources and information)

Data source	Data collection agency	Data years	Major topics	Respondent	Coverage
Occupational Employment Statistics (OES), https://www.bls.gov/oes/	Department of Labor, Bureau of Labor Statistics	Through 2016	Worker occupation, salary, industry, employer location (national, state, metropolitan statistical area)	Employing organizations	All full-time and part-time wage and salary workers in nonfarm industries; does not cover self-employed, owners and partners in unincorporated firms, household workers, or unpaid family workers
National Survey of College Graduates (NSCG), https://www.nsf.gov/statistics/srvygrads/; see sidebar NSF/NCSES's Data on Scientists and Engineers	National Science Foundation, National Center for Science and Engineering Statistics	Through 2015	Employment status, occupation, job characteristics (work activities, technical expertise), salary, detailed educational history, demographic characteristics	Individuals	Individuals with a bachelor's degree or higher in any field, including an oversample of individuals with a bachelor's degree or higher in an S&E or S&E-related field or with non-S&E degrees but working in an S&E or S&E-related occupation
Survey of Doctorate Recipients (SDR), https://www.nsf.gov/statistics/srvydoctoratework/; see sidebar NSF/NCSES's Data on Scientists and Engineers	National Science Foundation, National Center for Science and Engineering Statistics	Through 2015	Employment status, occupation, job characteristics (work activities, technical expertise), salary, detailed educational history, demographic characteristics	Individuals	Individuals with U.S.-awarded research doctorates (includes both U.S. and non-U.S. residents)
American Community Survey (ACS), https://www.census.gov/programs-surveys/acs/	Department of Commerce, Census Bureau	Through 2015	Employment status, occupation, educational attainment, demographic characteristics	Households	U.S. population
Current Population Survey (CPS), https://www.census.gov/cps/	Department of Labor, Bureau of Labor Statistics	Through 2015	Employment status, occupation	Households	Civilian noninstitutional population ages 16 or over

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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 presents multiple categorizations for measuring the size of the S&E workforce.[1] In general, this section defines the S&E workforce to include people who either work in S&E occupations or hold S&E degrees. Because the application of S&E knowledge and skills is not limited to jobs classified as S&E, the number of workers 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 jobs in the economy with a formal S&E label. Therefore, this section also presents data on the use of S&E technical expertise on the job to provide an estimate of the 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. NSF and Census Bureau occupation data are based on information provided by individuals or household members and classified into categories based on the Standard Occupational Classification (SOC) system (see Appendix Table 3-1).[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 occupation data.

NSF uses a 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.

TABLE 3-2

Classification of degree fields and occupations

(Classifications, fields, and occupations)

Classification	Degree field	Occupation	Occupation classification	
			STEM	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		
S&E-related	Health fields	Health-related occupations		
	-	S&E managers	X	
	Science and math teacher education	S&E precollege teachers		
	Technology and technical fields	S&E technicians and technologists	X	X
	Architecture	Architects		
	Actuarial science	Actuaries		
	-	S&E-related postsecondary teachers		
Non-S&E	Management and administration	Non-S&E managers		
		Management-related occupations		
	Education (except science and math teacher education)	Non-S&E precollege teachers		
		Non-S&E postsecondary teachers		
	Social services and related fields	Social services occupations		
	Sales and marketing	Sales and marketing occupations		
	Arts and humanities	Arts and humanities occupations		
	Other fields	Other occupations		

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

Note(s)

The designations STEM and S&T refer to occupations only. S&E occupations require at least a bachelor's degree in an S&E field of study, and S&E-related occupations require S&E knowledge or training but not necessarily at the bachelor's degree level. 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, National Survey of College Graduates (NSCG), https://www.nsf.gov/statistics/srvygrads/.

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Indicative of a knowledge-based economy, 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 jobs that are categorized as S&E. Therefore, a relatively narrow definition of the S&E workforce consists of workers in occupations that NSF designates as S&E occupations. In comparison, a much broader definition of an S&E worker, used by NSF's data on scientists and engineers, includes any individual with a bachelor's or higher level degree in an S&E or S&E-related field of study or a college graduate with a degree in any field employed in an S&E or S&E-related occupation.

As noted, 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 these three definitions: those who work in S&E occupations, those who hold S&E degrees, and those whose jobs require S&E technical expertise.

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.

SIDEBAR

NSF/NCSES's Data on Scientists and Engineers

The data on scientists and engineers from the National Center for Science and Engineering Statistics within the National Science Foundation provide detailed employment, education, and demographic information for scientists and engineers under age 76 residing in the United States. Scientists and engineers are defined as individuals who have college degrees in S&E or S&E-related fields or who have only a non-S&E degree at the bachelor's level or higher and 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, this chapter uses the term "scientists and engineers" to refer to this broad definition and the term "college graduates" to refer to the population with at least a bachelor's degree. The data available on scientists and engineers are collected by two large demographic and workforce surveys of individuals conducted by NCSES: the National Survey of College Graduates (NSCG) and the Survey of Doctorate Recipients (SDR).

The NSCG and SDR provide the most comprehensive information about the size and characteristics of the S&E workforce. As a result, information obtained through these surveys is critically important to understand the education and employment patterns of scientists and engineers. Because the NSCG covers the entire population of college graduates residing in the United States, this survey provides information on individuals educated or employed in S&E fields as well as those educated or employed in non-S&E fields. The data presented in this chapter for all scientists and engineers and for all college graduates (regardless of S&E background) are mostly based on the NSCG.

Whereas NSCG data cover the general college-educated population, the SDR data provide information on scientists and engineers who earned their research doctoral degree in a science, engineering, or health (SEH) field from a U.S. academic institution. The SDR is a biennial survey that has been conducted since 1973; it is a unique source of information on educational and occupational achievements and career movements of the nation's doctoral scientists and engineers. Some data presented in this chapter for doctoral scientists and engineers are based on the SDR.

In prior editions of *Science and Engineering Indicators*, an integrated data system, the Scientists and Engineers Statistical Data System (SESTAT), was used as the main source of data within this chapter. SESTAT was formed through the integration of the NSCG, SDR, and the National Survey of Recent College Graduates (NSRCG), with the NSRCG providing data on recent bachelor's and master's degree recipients in S&E fields.

Recent sample design improvements to the NSCG increased the survey's population coverage of recent college graduates and eliminated the need for the NSRCG. In addition, the SDR recently expanded its sample to allow for the evaluation of employment characteristics at the fine field of study level for the first time. These recent survey changes provided an opportunity to use the NSCG and SDR data individually for this chapter.

Size of the S&E Workforce

When defined by occupation only, the S&E workforce totals approximately 6.7 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 5.0 million and 6.4 million.[4] By far the largest categories of S&E occupations are in computer and mathematical sciences and in engineering, which together account for about 76% (among college-educated workers) to 85% (among workers of all education levels) of all employed workers in S&E occupations (Figure 3-1). Occupations in life, social, and physical sciences each employ a smaller proportion of S&E workers.

TABLE 3-3

Measures and size of U.S. S&E workforce: 2015 and 2016

(Number)

Measure	Education coverage	Data source	Individuals
Occupation			
Employed in S&E occupations	All education levels	2016 BLS OES survey	6,747,000
Employed in S&E occupations	Bachelor's and above	2015 NSF/NCSES NSCG	6,407,000
Employed in S&E occupations	All education levels	2015 Census Bureau ACS	6,703,000
Employed in S&E occupations	Bachelor's and above	2015 Census Bureau ACS	5,036,000
Education			
At least one degree in S&E field	Bachelor's and above	2015 NSF/NCSES NSCG	23,160,000
Highest degree in S&E field	Bachelor's and above	2015 NSF/NCSES NSCG	17,289,000
Job closely related to highest degree	Bachelor's and above	2015 NSF/NCSES NSCG	6,437,000
S&E occupation	Bachelor's and above	2015 NSF/NCSES NSCG	3,445,000
Other occupation	Bachelor's and above	2015 NSF/NCSES NSCG	2,993,000
Job somewhat related to highest degree	Bachelor's and above	2015 NSF/NCSES NSCG	4,148,000
S&E occupation	Bachelor's and above	2015 NSF/NCSES NSCG	1,122,000
Other occupation	Bachelor's and above	2015 NSF/NCSES NSCG	3,026,000
Job requires S&E technical expertise at bachelor's level			
In one or more S&E fields	Bachelor's and above	2015 NSF/NCSES NSCG	19,366,000
Engineering, computer science, mathematics, or natural sciences	Bachelor's and above	2015 NSF/NCSES NSCG	14,140,000
Social sciences	Bachelor's and above	2015 NSF/NCSES NSCG	8,919,000

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.

Note(s)

Estimates of the S&E workforce vary across the example surveys because of differences in the scope of the data collection (the NSCG collects data from individuals with bachelor's degrees and above only); because of the survey respondent (the NSCG collects data from individuals, the OES survey collects data from establishments, and the 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 NSCG 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. The totals for at least one degree in S&E field and highest degree in S&E field include individuals who are employed as well as those who are unemployed and out of the labor force.

Source(s)

BLS, OES survey (2016); Census Bureau, ACS (2015); NSF/NCSES, NSCG (2015), https://www.nsf.gov/statistics/srvygrads/.

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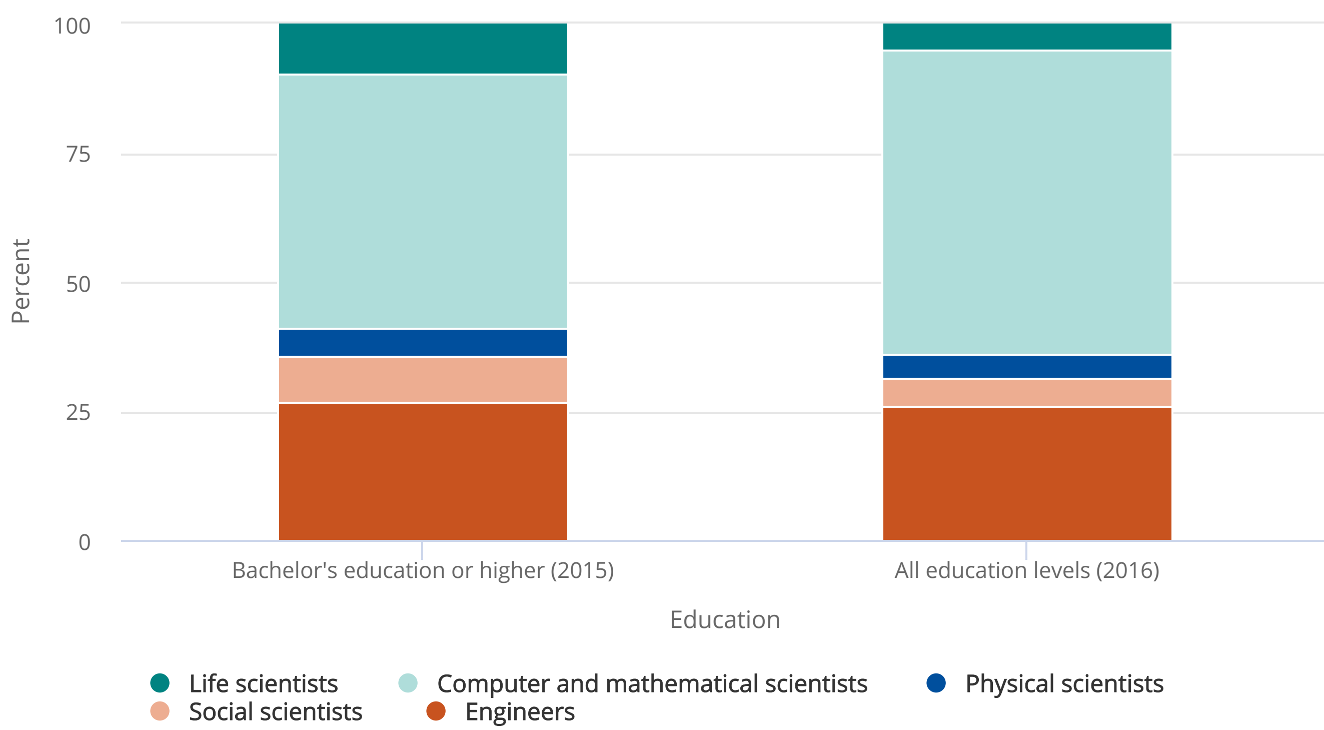
FIGURE 3-1

Employment in S&E occupations, by broad occupational category: 2015 and 2016



Source(s)

Bureau of Labor Statistics, Occupational Employment Statistics (OES) Survey (2016); National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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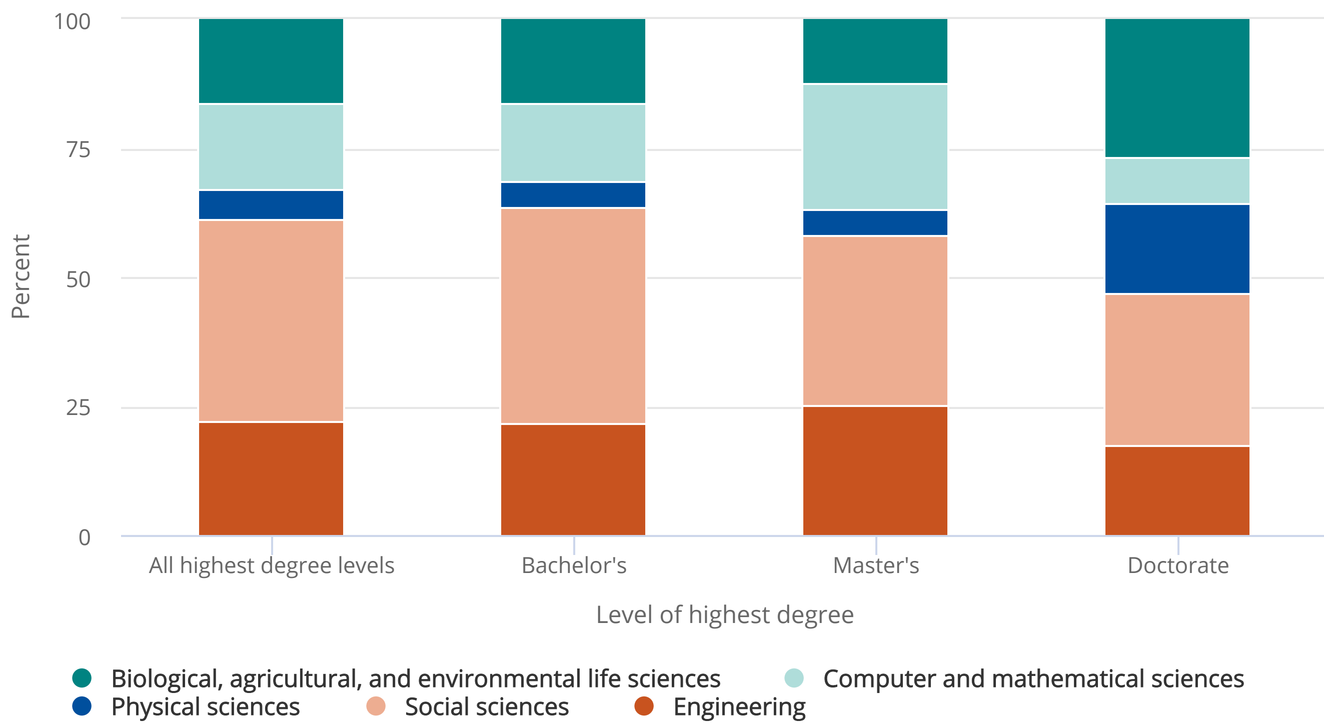
As noted earlier, S&E degree holders greatly outnumber those currently employed in S&E occupations. In 2015, about 23 million college graduates in the United States had a bachelor's or higher level degree in an S&E field of study (Table 3-3). About three-fourths of these college graduates (17.3 million) attained their highest degree—a bachelor's, master's, professional, or doctorate—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 generally provided for highest degree. Overall, across all S&E highest degrees, social sciences and engineering were the most common degree fields (Figure 3-2).[5] The 17.3 million college graduates with an S&E highest degree includes 12.4 million with bachelor's degrees, 3.7 million with master's degrees, 1.2 million with doctorates, and 37,000 with professional degrees.

FIGURE 3-2

S&E degrees among college graduates, by field and level of highest degree: 2015



Note(s)

All highest degree levels includes professional degrees not shown separately.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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A majority of S&E degree holders (61%) reported that their job was either closely or somewhat related to their field of highest degree (Table 3-3). Because 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 limited to occupations classified as S&E.

The extensive use of S&E expertise in the workplace is also evident from the number of college graduates who indicate that their job requires technical expertise at the bachelor's degree level in S&E fields. Nearly 19.4 million college graduates, regardless of field of degree or occupation, reported that their jobs required at least this level of technical expertise in one or more S&E fields (Table 3-3); this figure is three times as large as the 6.4 million college graduates employed in S&E occupations.

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 6.7 million in 2015 (Figure 3-3).[6] This represents an average annual growth rate of 3%, compared to a 2% growth rate in total employment during this period. S&E occupational employment as a share of total employment doubled, from about 2% in 1960 to about 4% in 2015. See sidebar Projected Growth of Employment in S&E Occupations for BLS data on occupational projections for the period 2014–24.

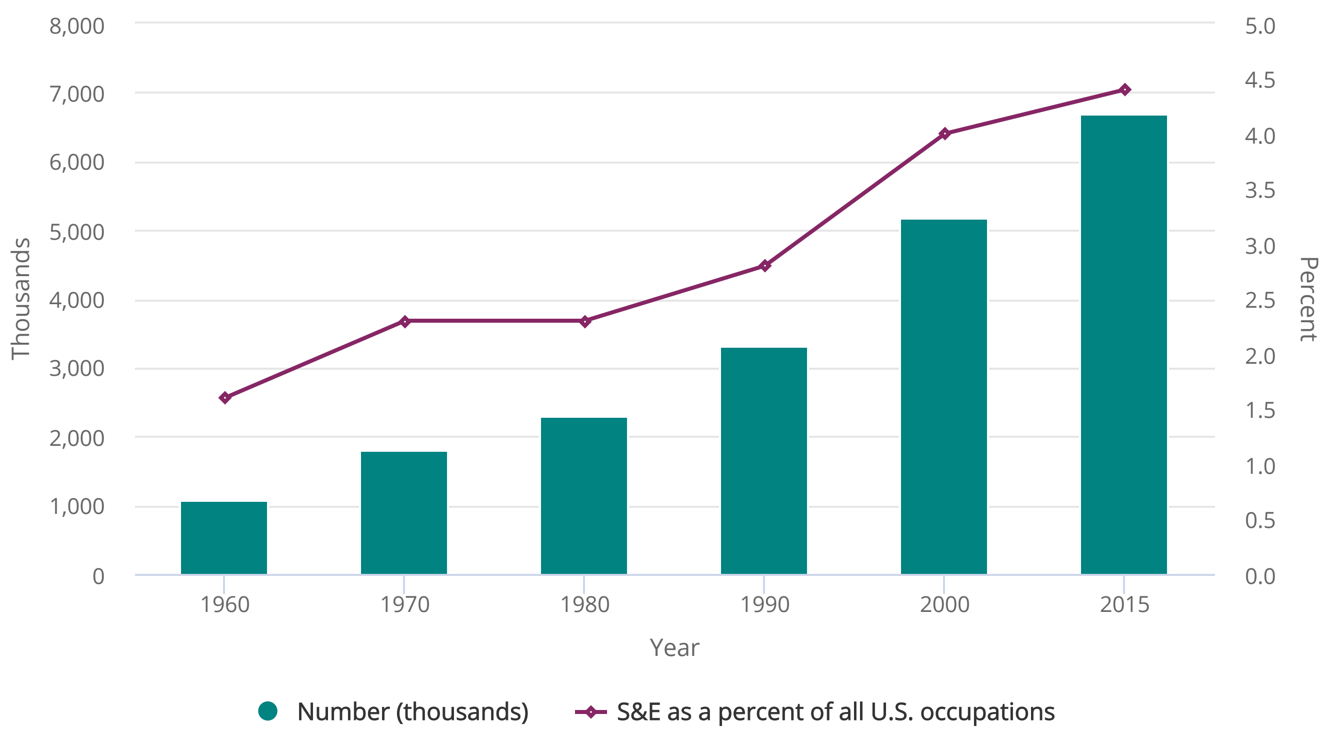
Data indicate that trends in S&E employment fared relatively better than overall employment trends during and after the 2007–09 economic downturn. Occupation-based estimates from BLS indicate that the size of the S&E workforce stayed relatively steady between May 2007 (5.6 million) and May 2010 (5.5 million) and then rose to 6.7 million by May 2016. The broader STEM workforce—including S&E technicians and managers—by May 2016 had increased to 8.7 million from 7.6 million in May 2007. The total workforce fell by 7.3 million between May 2007 (134 million) and May 2010 (127 million) and then rose to 140 million by May 2016.

The growth in the number of individuals with S&E degrees in recent years can be examined using NSF survey data on scientists and engineers. The total number of S&E highest degree holders employed in the United States grew from 9.6 million to 13.5 million between 2003 and 2015, reflecting a 2.9% annual average growth rate. Most broad S&E degree fields exhibited growth (Figure 3-4). (See Chapter 2 for a fuller discussion of S&E degrees.)

A number of factors have contributed to the growth in the 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, racial and ethnic minority groups, and foreign-born individuals; temporary and permanent migration to the United States of those with foreign S&E educations; and the rising number of scientists and engineers who are delaying their retirement. 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, racial and ethnic minorities, and foreign-born individuals.

FIGURE 3-3

Individuals employed in S&E occupations in the United States: Selected years, 1960–2015



Note(s)

Data include people at all education levels.

Source(s)

Census Bureau, Decennial Census (1960–2000), and American Community Survey (ACS) (2015) microdata, downloaded from the Integrated Public Use Microdata Series (IPUMS), University of Minnesota, https://www.ipums.org.

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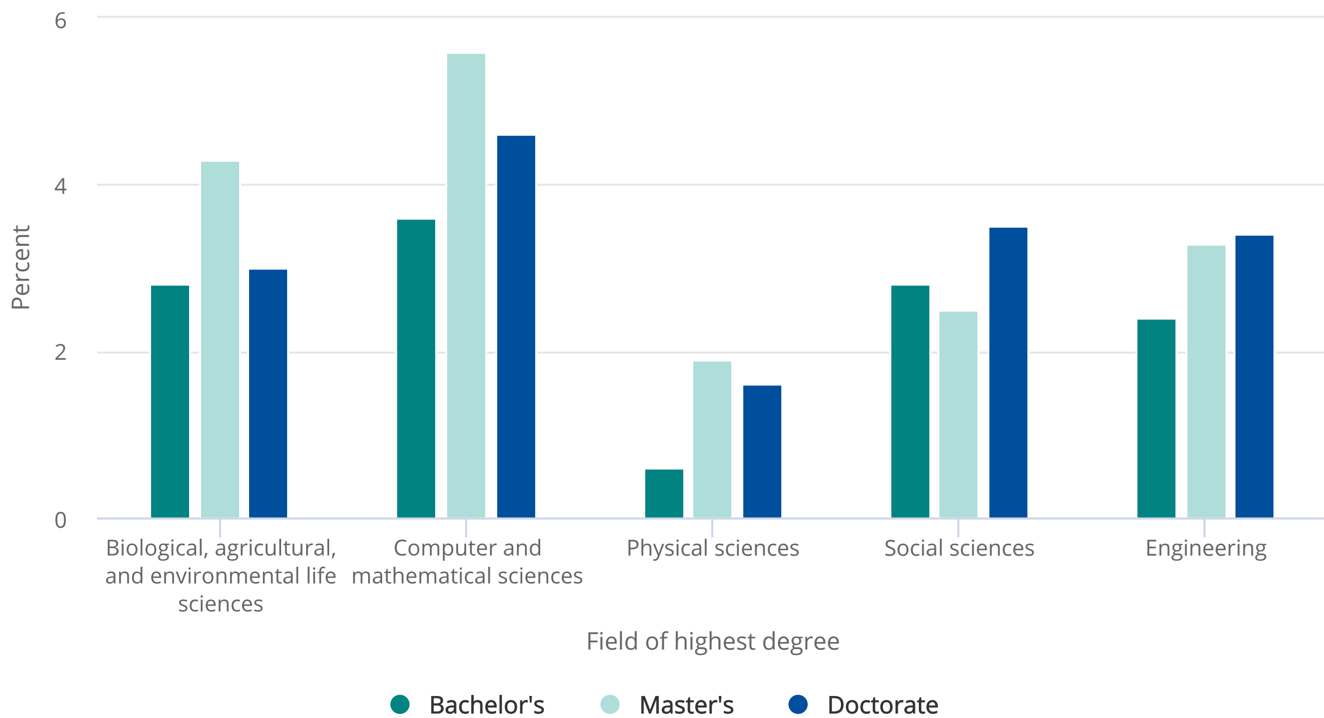
FIGURE 3-4

Average annual growth in the total number of employed individuals with highest degree in S&E, by field and level of highest degree: 2003–15



Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2003), https://www.nsf.gov/statistics/sestat/, and National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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SIDEBAR

Projected Growth of Employment in S&E Occupations

This sidebar presents the most recent data from the Bureau of Labor Statistics (BLS) on occupation projections for the period 2014–24. While interpreting the data, readers should keep in mind that 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.*

BLS occupational projections for the period 2014–24 suggest that total employment in occupations that NSF classifies as S&E will increase at a faster rate (11%) than employment in all occupations (7%) (Table 3-A; Figure 3-A; Appendix Table 3-2). 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.
Job openings include both new jobs and openings caused by existing workers permanently leaving the occupations. During the period 2014–24, job openings in NSF-identified S&E occupations are projected to represent nearly one-third (30%) of current employment in 2014, which is similar to the proportion of job openings in all occupations (31%) (Figure 3-B).

TABLE 3-A

Bureau of Labor Statistics projections of employment and job openings in S&E and other selected occupations: 2014–24

(Thousands)

Occupation	BLS National Employment Matrix 2014 estimate	BLS projected 2024 employment	Job openings from growth and net replacements, 2014–24	10-year growth in total employment (%)	10-year job openings as percentage of 2014 employment
All occupations	150,540	160,329	46,507	6.5	30.9
All S&E	6,262	6,957	1,881	11.1	30.0
Computer and mathematical scientists	3,714	4,268	1,064	14.9	28.6
Life scientists	311	330	117	6.1	37.5
Physical scientists	297	317	93	6.7	31.2
Social scientists	304	341	97	12.4	31.9
Engineers	1,636	1,701	511	4.0	31.2
S&E-related occupations					
S&E managers	919	1,034	308	12.5	33.5
S&E technicians and technologists	1,158	1,172	335	1.2	28.9
Computer programmers	329	302	81	-8.0	24.7
Health care practitioners and technicians	8,237	9,585	3,162	16.4	38.4
Selected other occupations					
Postsecondary teachers	1,869	2,089	551	11.7	29.5
Lawyers	779	823	158	5.6	20.3

BLS = Bureau of Labor Statistics.

Note(s)

Estimates of current and projected employment for 2014–24 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 the OES survey, CPS, or other employment surveys alone. BLS does not make projections for S&E occupations as a group nor does it do so for some of the S&E and S&E-related occupational categories as defined by the National Science Foundation (NSF); numbers in the table are based on the sum of BLS projections for occupations that the NSF includes in the respective categories. See Appendix Table 3-2.

Source(s)

BLS, Employment Projections program, 2014–24, special tabulations of 2014–24 Employment Projections.

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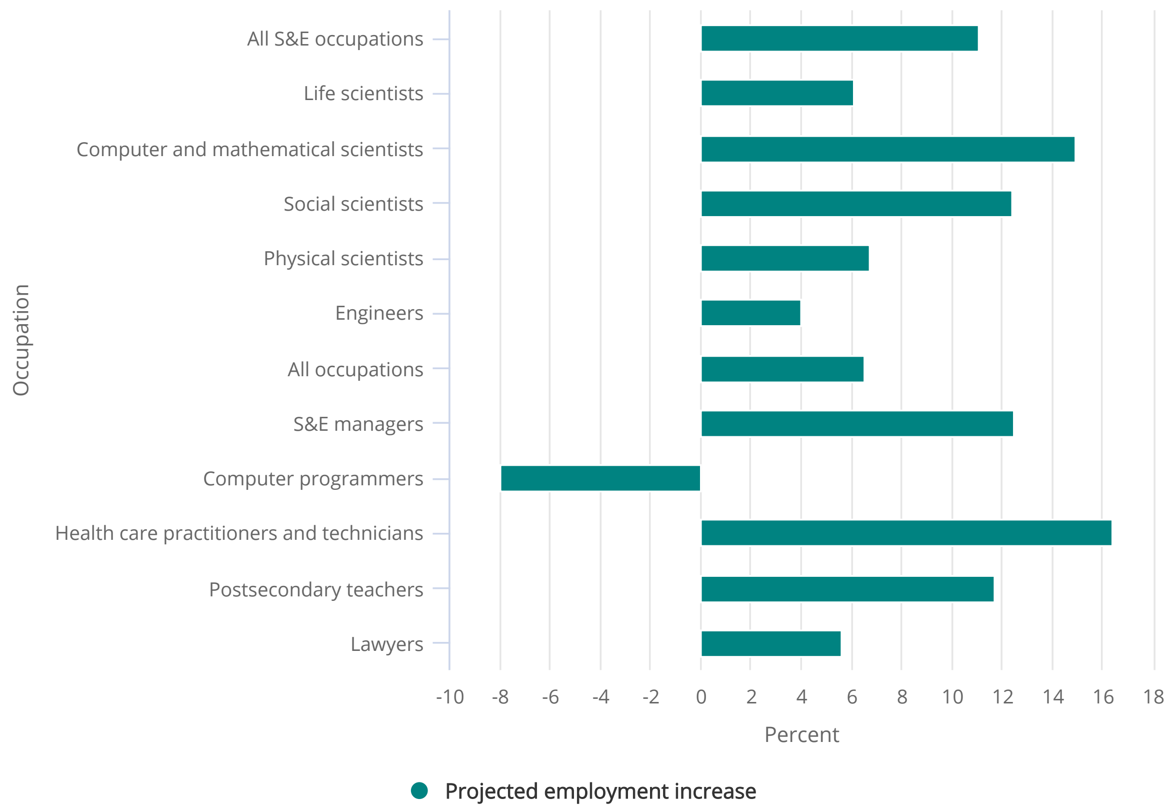
FIGURE 3-A

Projected increases in employment for S&E and other selected occupations: 2014–24



Source(s)

Bureau of Labor Statistics, Employment Projections program, special tabulations (2015) of 2014–24 Employment Projections, https://www.bls.gov/emp/. See Appendix Table 3-2.

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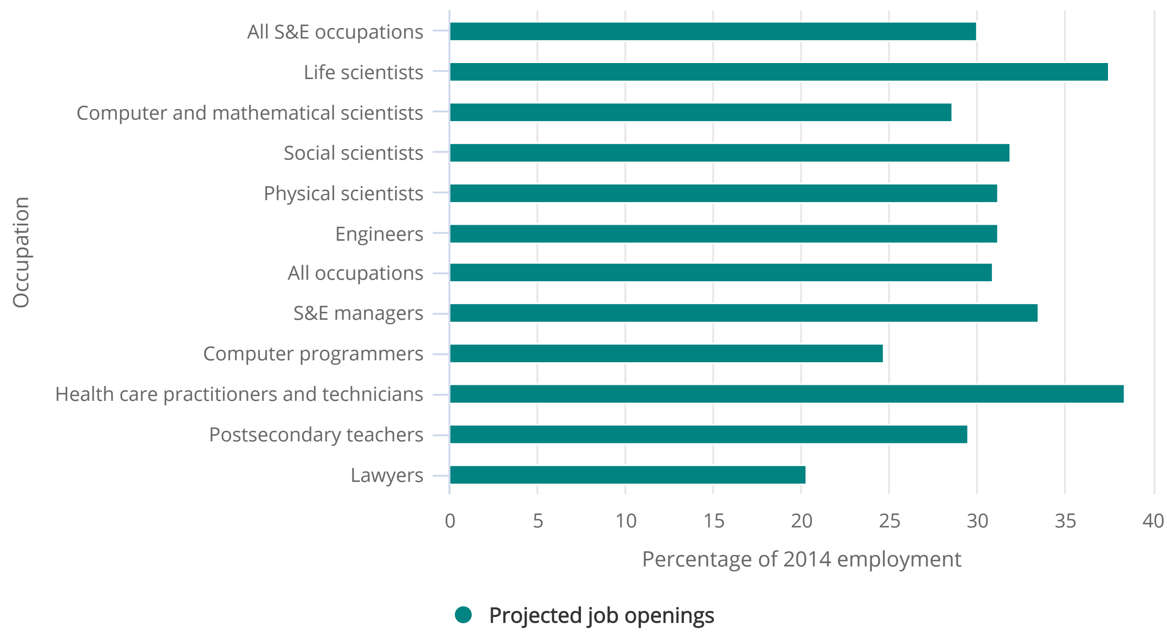
FIGURE 3-B

Projected job openings in S&E and other selected occupations: 2014–24



Source(s)

Bureau of Labor Statistics, Employment Projections program, special tabulations (2015) of 2014–24 Employment Projections, https://www.bls.gov/emp/. See Appendix Table 3-2.

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Of the BLS-projected net job openings in NSF-identified S&E occupations, the majority (57%) are projected to be in computer and mathematical sciences occupations, the largest subcategory of S&E occupations (Table 3-A). This occupational group also has the largest projected growth rate (15%) among NSF-identified S&E groups. Engineering occupations, the second largest subcategory of S&E occupations, are expected to generate about one-fourth (27%) of all job openings in S&E occupations during the period 2014–24; however, the growth rate in these occupations (4%) is projected to be lower than the growth rate for all occupations (7%). The other broad categories of S&E occupations—life sciences, social sciences, and physical sciences occupations—account for much smaller proportions of S&E occupations and are projected to have a growth rate between 6% and 12%. Job openings in the broad categories of S&E occupations are projected to represent relatively similar proportions of current employment in their respective fields, ranging from 29% to 38%.

In addition to S&E occupations, Table 3-A also shows S&E-related and selected other occupations that include significant numbers of S&E-trained workers. Among these occupations, the health care practitioners and technicians group, which employs more workers than all S&E occupations combined, is projected to grow 16%, more than double the growth rate for all occupations. The postsecondary teachers group, which includes all fields of instruction, and the S&E

managers group are projected to grow 12% and 13%, respectively, both of which are slightly higher than the 11% projected growth rate for all S&E occupations. In contrast, BLS projects that the computer programmers group and the S&E technicians and technologists group will grow more slowly than all S&E occupations, with the computer programmers group declining in number during this time period.

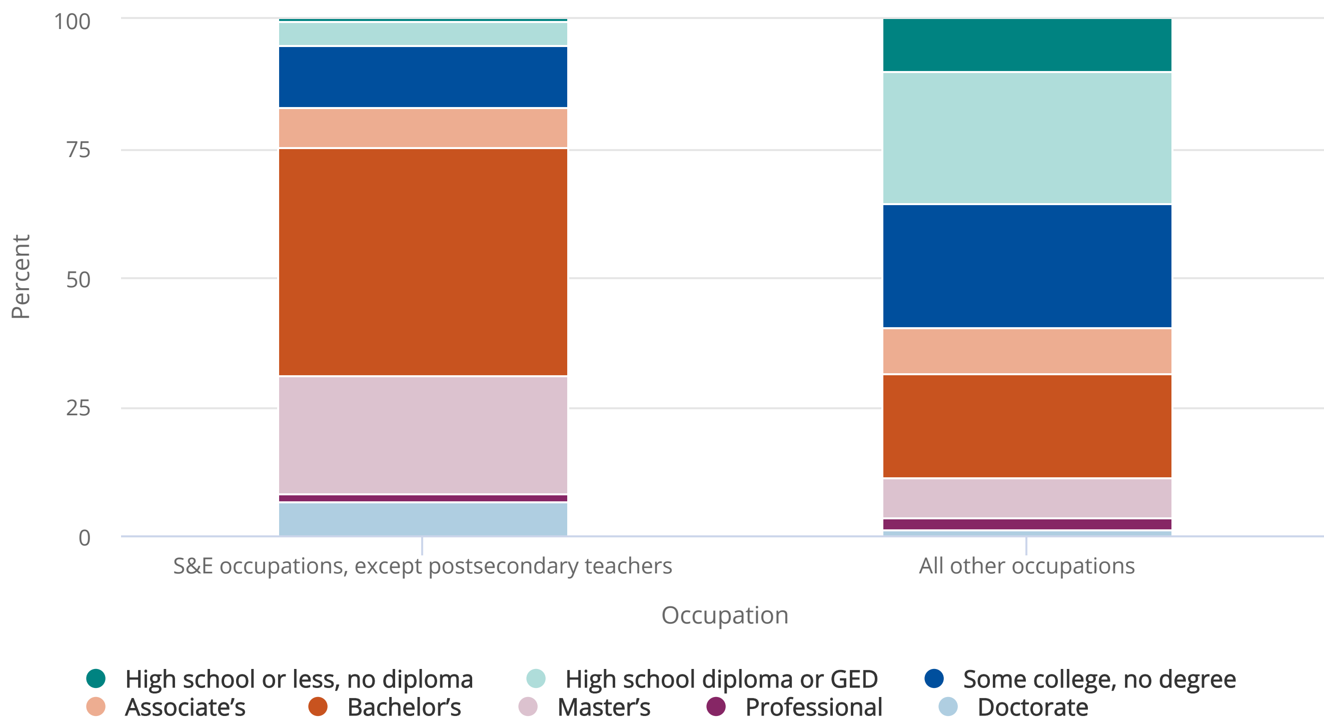
* The mean absolute percentage error in the 1996 BLS projection of 2006 employment in detailed occupations was 17.6% (Wyatt 2010). The inaccuracies in the 1996 projection of 2006 employment were primarily the result of not anticipating the housing bubble or increases in oil prices (Wyatt 2010).

Educational Distribution of Workers in S&E Occupations

Workers in S&E occupations have undergone more formal training than the general workforce (Figure 3-5). Data from the 2015 ACS indicate that a larger proportion of workers in S&E occupations (75%) (which in the ACS excludes postsecondary teachers) hold a bachelor's or higher degree than workers in all other occupations (31%).[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 (again excluding postsecondary teachers) have doctorates.

FIGURE 3-5

Educational attainment, by type of occupation: 2015



GED = General Equivalency Diploma.

Source(s)

Census Bureau, American Community Survey (ACS) (2015).

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Compared with the rest of the workforce, very few of those employed in S&E occupations have only a high school degree. However, 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; some also 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 examinations, not formal degrees, to judge skills. (See sidebar A Broader Look at the S&E Workforce and the discussion of community college in the Chapter 2 section Institutions Providing S&E Education.)

Formal S&E training is the usual pathway into S&E occupations. According to the 2015 NSCG, the vast majority (83%) of college graduates employed in S&E occupations have at least a bachelor's degree in an S&E field (Table 3-4). However, the prevalence of a degree in the same broad field as one's S&E occupation varies across occupational categories. For example, among computer and mathematical scientists, less than one-half (45%) have a bachelor's or higher level degree in a field of study that is equivalent to the field in which they work, and about one-fifth (21%) have no degree in any S&E or S&E-related field of study. In contrast, 76% of life scientists, 76% of physical scientists, 81% of social scientists, and 81% of engineers have a bachelor's or higher level degree in their respective broad field. The next section presents data on the proportion of S&E degree holders who are employed in S&E and non-S&E occupational categories.

TABLE 3-4

Educational background of college graduates employed in S&E occupations, by broad S&E occupational category: 2015

(Percent)

Educational background	All S&E occupations	Biological, agricultural, and environmental life scientists	Computer and mathematical scientists	Physical scientists	Social scientists	Engineers
Total (number)	6,407,000	631,000	3,156,000	331,000	570,000	1,719,000
At least one S&E degree	82.8	88.6	75.0	97.6	86.5	91.1
At least one S&E degree in field	62.4	76.1	44.8	75.5	80.9	81.0
Highest degree in field	75.8	66.9	40.6	70.1	70.2	74.5
All degrees in S&E	71.0	71.5	65.0	90.3	58.6	82.4
No S&E degrees but at least one S&E-related degree	4.3	5.7	4.4	1.5	2.5	4.6
No S&E or S&E-related degree but at least one non-S&E degree	12.9	5.7	20.6	0.9	11.1	4.3

Note(s)

At least one S&E degree in field is the proportion of workers in a particular S&E occupational category with at least one bachelor's or higher level 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 bachelor's or higher level 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(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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

Using data from the NSCG, which provides information on both degree achievement and occupational employment of scientists and engineers in the United States, this section analyzes the interplay between degree and occupation for individuals who earned a highest degree in an S&E discipline and those who earned a highest degree in a non-S&E discipline.

Although an S&E degree is often necessary to obtain S&E employment, many individuals with S&E degrees pursue careers in non-S&E fields. However, most workers with S&E training who work in non-S&E jobs reported that their work is related to their S&E training, suggesting that the application of S&E skills and expertise extends well beyond jobs formally classified as S&E occupations. (The 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 those with a highest degree in S&E are employed in an S&E (36%) or S&E-related (15%) occupation; the other 50% are employed in non-S&E occupations. Figure 3-6 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 these S&E degree holders is management and management-related occupations (2.5 million workers), followed by sales and marketing (1.1 million workers) (the non-S&E category "Other non-S&E occupations" has a larger total of S&E degree holders, however, it includes a wide variety of non-S&E occupations) (Appendix Table 3-3). Other non-S&E occupations with a large number of S&E-trained workers include social services (429,000) and college and precollege teaching in non-S&E areas (404,000). S&E degree holders also work in S&E-related jobs such as health (666,000), S&E management (477,000), S&E technician or technologist (506,000), and precollege teaching in S&E areas (269,000).

Most individuals with a highest degree in S&E but working in non-S&E occupations still see S&E technical expertise as relevant to their jobs. Most indicate that their jobs are either closely (35%) or somewhat (35%) related to their highest degree field (Table 3-5). A distinctive feature of the U.S. workforce is the multiple pathways that S&E workers take from degree to profession. The National Science Board reports that "[S&E] knowledge and skills enable multiple, dynamic pathways to [S&E] and non-[S&E] occupations alike." (NSB 2015) For example, among S&E degree holders in non-S&E management and management-related occupations, about three-quarters indicate that their jobs are either closely (31%) or somewhat (43%) related to their S&E degree. Among those in social services and related occupations, these numbers are higher (91%); among those in sales and marketing, these numbers are lower (51%).

TABLE 3-5

Relationship of highest degree to job among S&E highest degree holders not in S&E occupations, by degree level: 2015

(Percent)

Highest degree	Degree related to job (%)		
	Closely	Somewhat	Not
All degree levels	34.6	35.0	30.4
Bachelor's	29.9	36.3	33.7
Master's	50.2	30.2	19.7
Doctorate	47.4	36.3	16.4

Note(s)

All degree levels includes professional degrees not broken out separately. Detail may not add to total because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/, and the Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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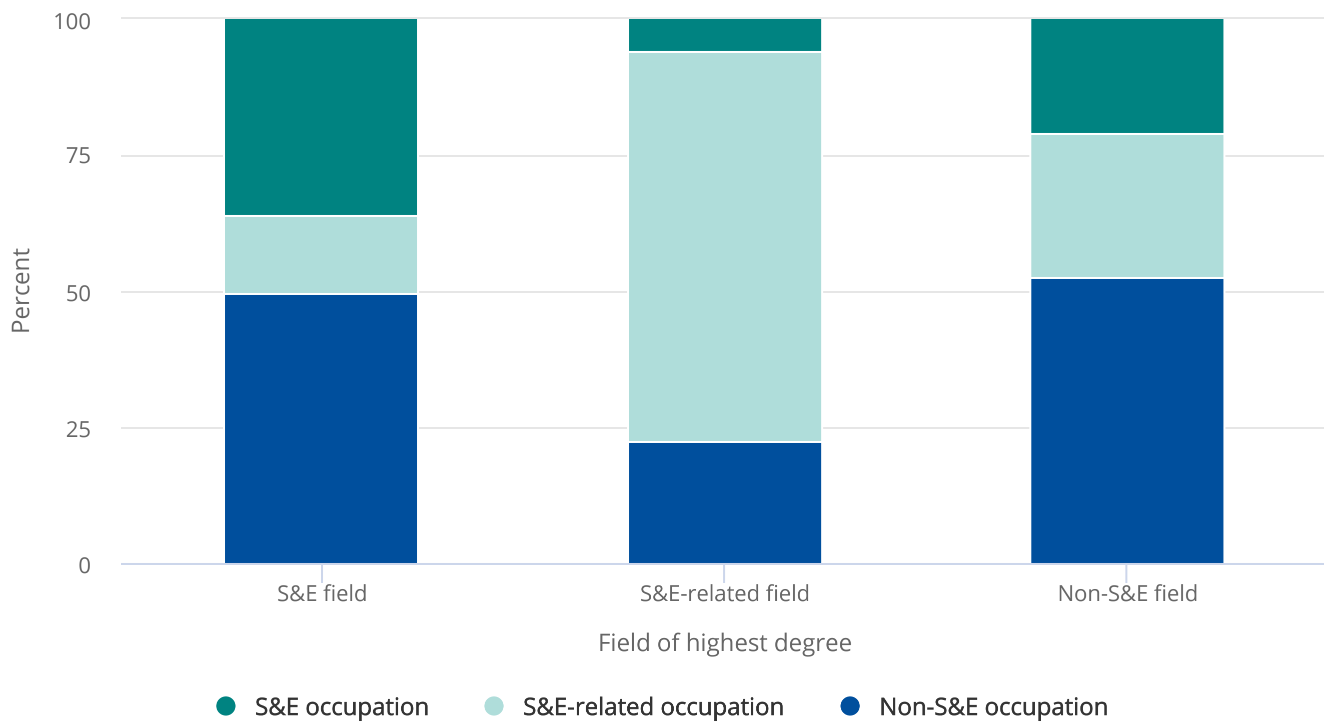
Unlike individuals with an S&E highest degree, at least half of those whose highest degrees are either in S&E-related or non-S&E fields are employed in their corresponding broad occupational categories (Figure 3-6). For those with an S&E-related highest degree, the largest category of jobs is health occupations (3.7 million); for those with a non-S&E highest degree, the largest category of jobs is non-S&E management and management-related occupations (1.0 million) (Appendix Table 3-3). Significant numbers of individuals with a non-S&E highest degree work in computer and information sciences (731,000), health-related occupations (532,000), and precollege teaching in S&E areas (526,000) or as lawyers or judges (594,000).

The pattern of a large proportion of individuals with a highest degree in S&E being employed in areas other than S&E occupations has been robust over time. 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 comparable proportion in 2015 was also 36% (Figure 3-6).

FIGURE 3-6

Occupational distribution of scientists and engineers, by broad field of highest degree: 2015



Note(s)

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(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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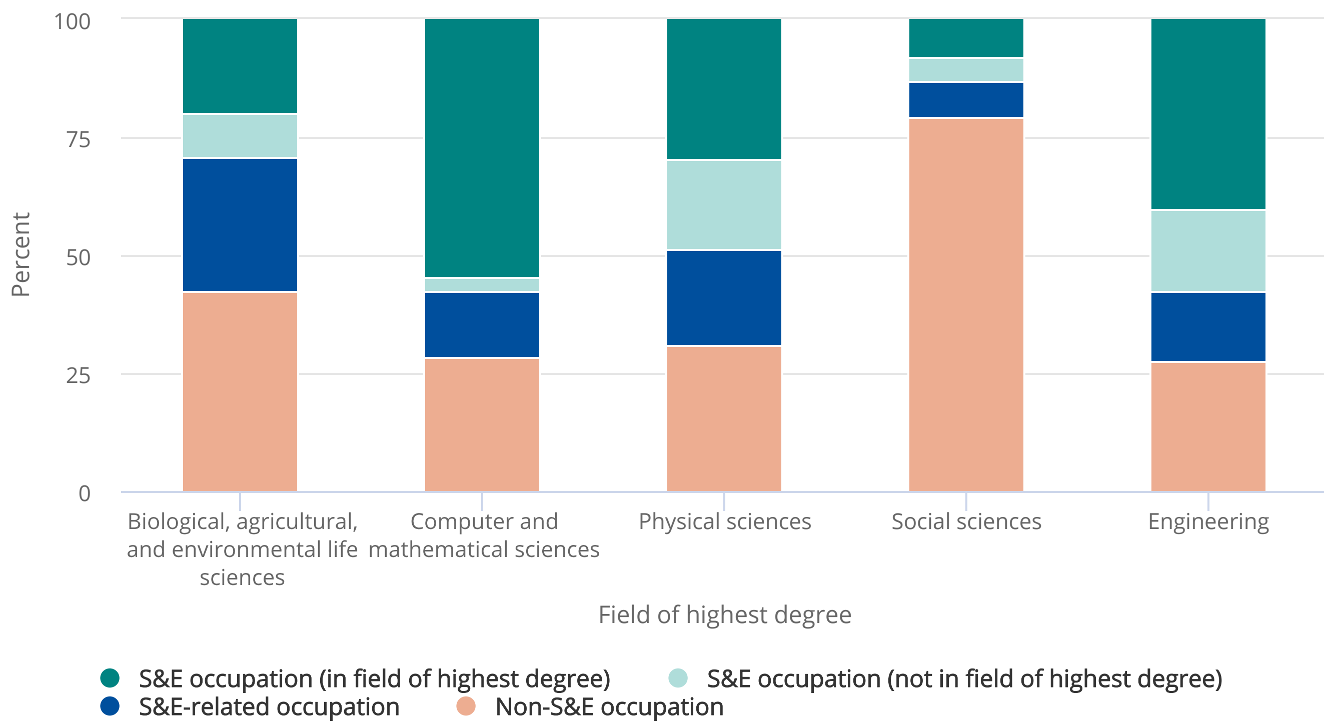
The proportion of S&E highest degree holders who go on to work in S&E occupations varies substantially by S&E degree fields and level of degree. Overall, this proportion is heavily influenced by individuals with social sciences degrees, who are the least likely to work in S&E occupations (13%); these individuals work primarily in non-S&E occupations (79%) (Figure 3-7) such as non-S&E management and management-related occupations, sales and marketing, and social services and related occupations including clergy, counselors, and social workers. In contrast, at least half of individuals with a highest degree in computer and mathematical sciences (58%), physical sciences (49%), or engineering (58%) reported working in S&E occupations. This general pattern between study field of degrees and occupations is similar at the bachelor's and master's degree levels but not at the doctoral level (Figure 3-8), where S&E doctorate holders most often work in an S&E occupation similar to their doctoral field.

FIGURE 3-7

Occupational distribution of S&E highest degree holders, by field of highest degree: 2015



Note(s)

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 the broad field of computer and 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 and mathematical sciences occupations.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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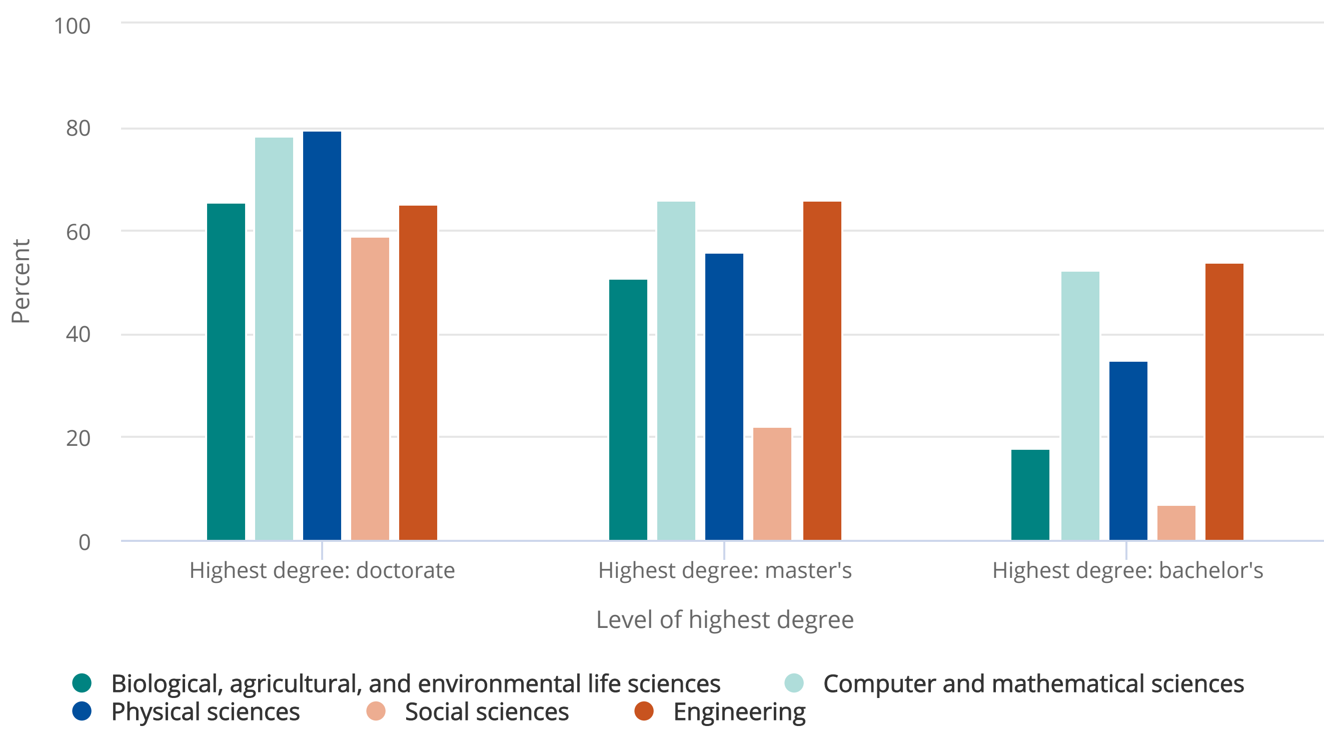
FIGURE 3-8

S&E degree holders working in S&E occupations, by level and field of S&E highest degree: 2015



Note(s)

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

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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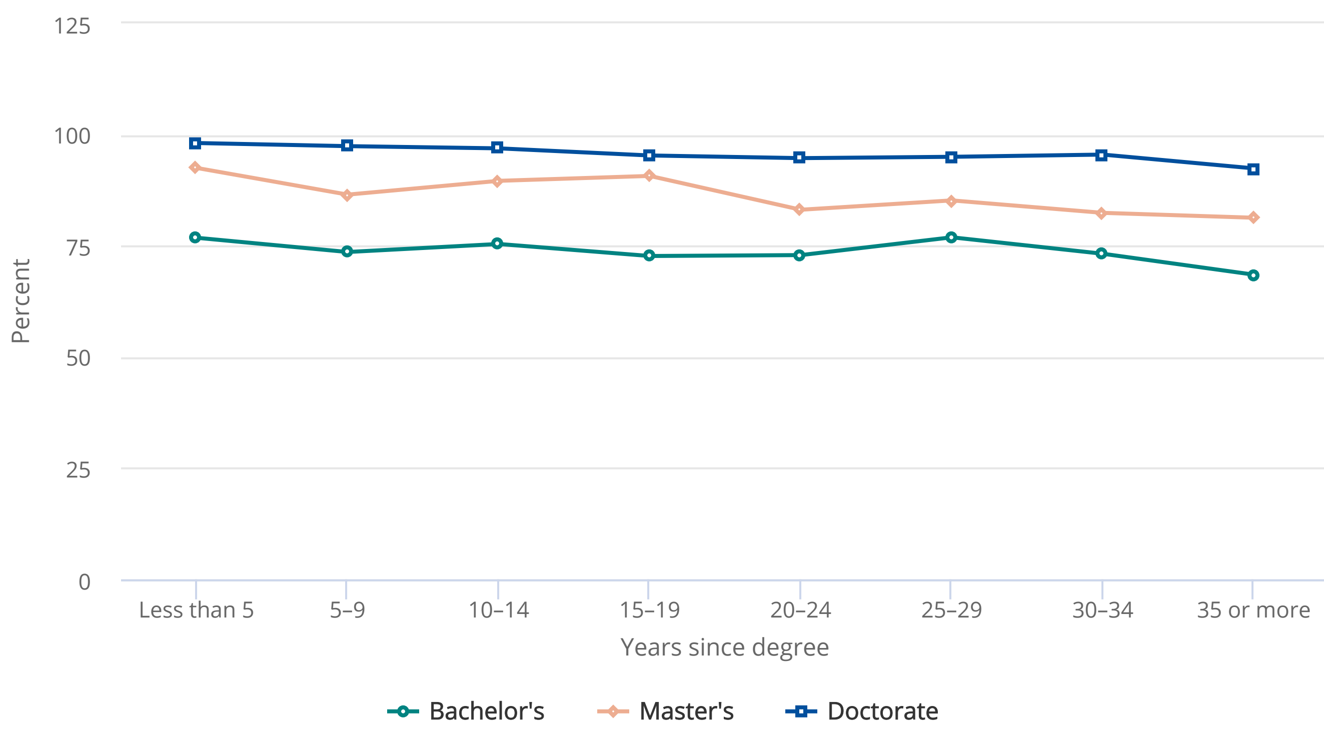
Whereas Figure 3-8 shows the proportion of S&E degree holders employed in S&E occupations, Figure 3-9 shows what proportions of S&E degree holders reported that their work is related (closely or somewhat) to their S&E degree. Workers with more advanced S&E training were more likely than those with only bachelor's degrees to work in a job related to their degree field. Regardless of degree level, most degree holders in life sciences (76%), physical sciences (79%), computer and mathematical sciences (89%), and engineering (90%) considered their jobs to be related to their degree field. The corresponding percentage of social scientists was 68%.

The pattern of a stronger relationship between S&E jobs and S&E degrees among master's degree or doctorate holders compared with bachelor's degree holders 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 3-9). However, at each degree level, the percentage of S&E degree holders employed in jobs related to their field of highest degree declines as the number of years since degree increases. This suggests that the relationship between job and field of highest degree becomes weaker over time, particularly toward the later career stages. 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 3-9

S&E degree holders employed in jobs related to highest degree, by level of and years since highest degree: 2015



Note(s)

Data include those who reported that their job is either closely or somewhat related to the field of their highest degree.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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[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. Unless otherwise noted, 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 system is used by federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, and disseminating data. The Current Population Survey currently uses the 2010 Census occupational classification derived from the 2010 Standard Occupational Classification (SOC). The Census classification uses the same basic structure as the SOC but is generally less detailed. Detailed information on the SOC system is available at https://www.bls.gov/SOC/.

[3] As expected, this subjective measure—of the use of technical knowledge, skills, or expertise on the job—varies across occupations. For example, in 2015, among postsecondary teachers of chemistry, almost all those surveyed said that their job required at least a bachelor's degree level of knowledge in engineering, computer sciences, mathematics, or natural sciences. Among postsecondary teachers of business commerce or marketing, 86% said that their job required at least this level of expertise in other fields such as health, business, or education. Among those with at least one degree at the bachelor's level or higher in an S&E or S&E-related field whose occupation is secretary, receptionist, or typist, only about 5% said that their job required a bachelor's degree level of knowledge in engineering, computer sciences, mathematics, or natural sciences; about 9% said that their job required at least a bachelor's degree level of knowledge in social sciences; and 12% said that their job required at least a bachelor's degree level of expertise in other fields such as health, business, or education.

[4] Estimates of the size of the S&E workforce may vary across the different surveys because of differences in the scope of the data collection (the NSCG collects data from individuals with at least a bachelor's degree); because of the type of survey respondent (the NSCG collects data from individuals, the OES survey collects data from employers, and the 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. For example, the NSCG 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 levels for 1960 and 2015 are calculated using the Census Bureau's 1960 Decennial Census and 2015 ACS microdata, respectively, adjusted by the Integrated Public Use Microdata Series (IPUMS) from the University of Minnesota's Minnesota Population Center (https://www.ipums.org). Occupational classification systems have changed over time, which limits the comparability of occupational counts over time. For example, computer occupations were not present in the occupational classification system used in 1960. For more information on the change in occupational classification systems, see Wyatt and Hecker (2006). S&E employment levels for 1960 and 2015 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 2015 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, the inclusion of 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 2015 ACS.

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

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 economic sector, size, and other characteristics of organizations that employ scientists and engineers (defined both by occupation and field of education). It also describes the distribution of S&E workers within particular sectors. The analysis covers all sectors: private and public educational institutions; for-profit businesses and nonprofit organizations; and federal, state, and local governments. It also examines self-employed scientists and engineers and the concentration of S&E workers by industry sectors and by geography.

The S&E labor force is a national resource that contributes to productivity increases and innovative capacities required to fuel long-term economic growth and public welfare. The section concludes with examinations of R&D activity and work-related training as indicators of worker skill level, productivity, and innovative capacity. It distinguishes between analyses based on S&E degree field and S&E occupation.

Employment Sectors

The business sector is by far the largest employer of the broad S&E workforce (including those with at least an S&E or S&E-related bachelor's degree and those working in an S&E or S&E-related occupation regardless of having an S&E degree). In 2015, the business sector—mostly for-profit businesses—employed about 71% of such individuals (Table 3-6). The education sector, including private and public institutions, employed another 19%, the bulk in 2-year and precollege institutions. The government sector—federal, state, and local—employed another 11%. This distribution pattern has been quite stable for decades, except for a small rise in the nonprofit segment and a small decline in government (Appendix Table 3-4).

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 scientists and engineers with doctorates, although the business sector is the largest employer of scientists and engineers overall. Whereas individuals employed in engineering occupations and computer and mathematical sciences occupations are largely concentrated in the business sector, those employed as life scientists, physical scientists, and social scientists are more evenly distributed between the business sector and education and government sectors together. The following discussion provides a deeper analysis of the economic sectors in which scientists and engineers work.

TABLE 3-6

Employment sector of scientists and engineers, by broad occupational category and degree field: 2015

(Percent)

Employment sector	All employed scientists and engineers	Highest degree in S&E	S&E occupations	S&E-related occupations	Non-S&E occupations
Total (number)	25,306,000	13,497,000	6,407,000	7,867,000	11,031,000
Business or industry	70.7	72.3	71.5	69.9	70.8
For-profit businesses	53.7	58.9	63.6	47.7	52.4
Nonprofit organizations	10.8	7.3	4.7	17.9	9.3
Self-employed, unincorporated businesses	6.2	6.1	3.2	4.3	9.3
Education	18.5	15.8	17.2	21.8	16.9
4-year institutions	7.8	8.8	14.2	6.2	5.3
2-year and precollege institutions	10.7	7.1	3.0	15.6	11.6
Government	10.8	11.9	11.3	8.4	12.2
Federal	4.6	5.3	5.8	3.7	4.5
State or local	6.2	6.5	5.5	4.7	7.7

Note(s)

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. Detail may not add to total because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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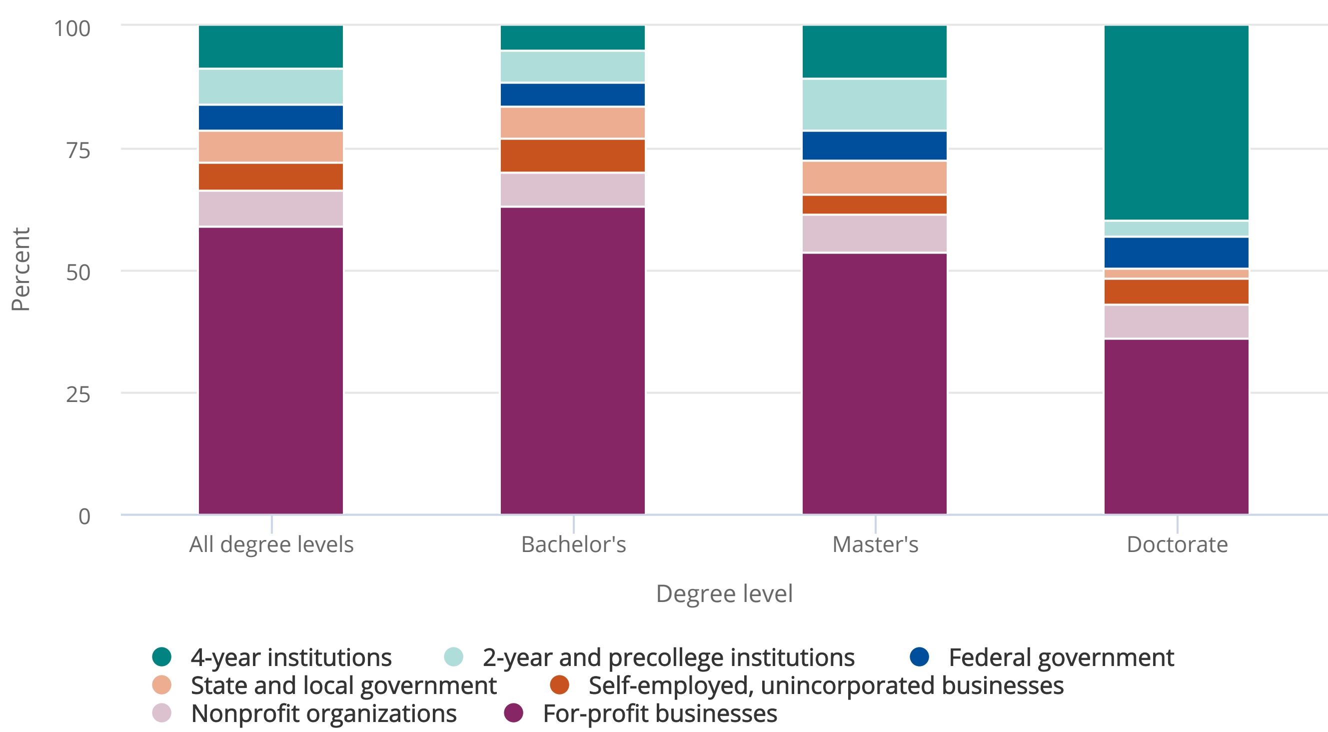
Education Sector

The education sector employs nearly one-fifth of the S&E workforce but is segmented by level of S&E education (Table 3-6; Figure 3-10; Appendix Table 3-5). The vast majority of S&E doctorate holders in this sector work in 4-year institutions as faculty, postdoctorates (postdocs), research staff, and a variety of other full- and part-time positions. The majority of bachelor's level scientists and engineers work in 2-year and precollege institutions. (See Chapter 5 for additional detail on academic employment of science, engineering, and health [SEH] doctorate holders.)

The subsectoral employment distribution also differs for those in S&E occupations. Larger proportions of life, physical, and social scientists work in the education sector, compared with engineers or computer and mathematical scientists (Figure 3-11). Within the education sector, the vast majority (82%) of those in S&E occupations are concentrated in 4-year institutions. In contrast, 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 (71% and 69%, respectively), and the bulk of them are employed as teachers.

FIGURE 3-10

S&E highest degree holders, by degree level and employment sector: 2015



Note(s)

All degree levels includes professional degrees not shown separately.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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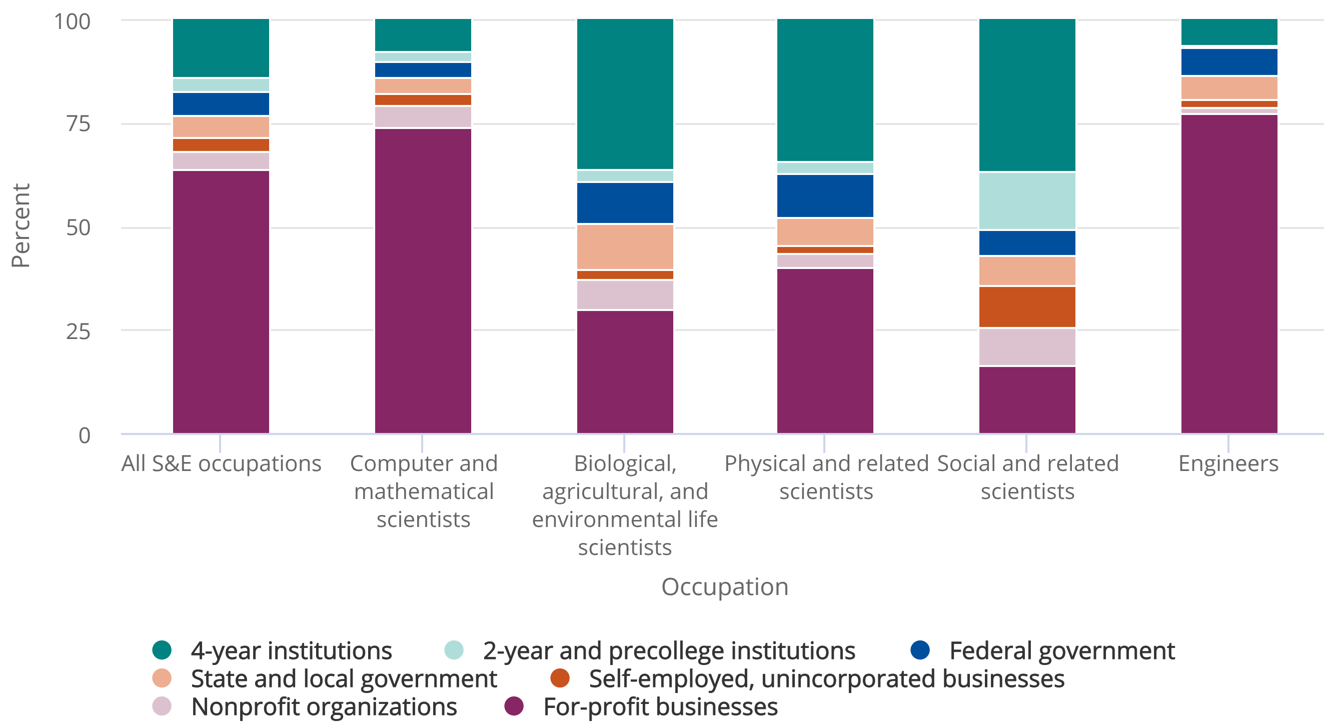
FIGURE 3-11

Broad S&E occupational categories, by employment sector: 2015



Note(s)

Percentages may not add to 100% because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Business Sector

For-profit businesses. For-profit businesses employ the largest proportion of scientists and engineers (Table 3-6). At the doctorate level, however, the proportions employed by for-profit businesses (36%) and 4-year educational institutions (40%) are similar (Figure 3-10; Appendix Table 3-5; also, see sidebar Patterns of Mobility of New S&E PhDs into the Business Sector). Employment also varies by occupational categories. The majority of those working in computer and mathematical sciences occupations (74%) and in engineering occupations (77%) are employed by for-profit businesses, but the proportions are much lower for those in other S&E occupations, ranging from 16% for social scientists to 40% for physical scientists (Figure 3-11).

Nonprofit organizations. Employment of scientists and engineers in nonprofit businesses has grown (Appendix Table 3-4), with particularly strong growth among S&E-related occupations, which include health-related jobs. Continuing the trend seen in the broader economy, the number of health-related jobs in nonprofit organizations has risen dramatically from 97,000 in 1993 to 1.2 million in 2015. As a result, the total share of all health-related occupations in nonprofit organizations has risen from 13% in 1993 to 25% in 2015. Nearly half (47%) of such workers are employed as registered nurses, dieticians, therapists, physician assistants, and nurse practitioners.

Among those in S&E occupations, the proportion employed by nonprofit organizations is much smaller (5%) (Table 3-6), with substantial variation among different fields, ranging from 2% of engineers to 10% of social scientists and 7% of life scientists (Figure 3-11).

Self-employment. In 2015, almost 4.3 million scientists and engineers (17%) reported being self-employed in either an unincorporated or incorporated business, professional practice, or farm (Table 3-7).[1] Those working in S&E-related or non-S&E occupations reported higher levels of self-employment (15% and 22%, respectively) than those working in S&E occupations (11%). Among those with a highest degree in S&E, individuals with professional degrees reported substantially higher rates of self-employment (35%) than those with a bachelor's degree (17%), master's degree (12%), or doctorate (12%) as their highest degree.

Incorporated businesses account for at least half of self-employed scientists and engineers in most fields (Table 3-7). However, most of those in social science occupations worked in unincorporated businesses, which was largely driven by psychologists. In 2015, among the 213,000 employed psychologists, 28% were self-employed, mostly in unincorporated businesses. In addition, 39% of professional degree holders in a field of psychology were self-employed, also with most employed in unincorporated businesses.

TABLE 3-7

Self-employed scientists and engineers, by education, occupation, and type of business: 2015

(Percent)

Characteristic	Total	Unincorporated business	Incorporated business
All employed scientists and engineers	16.8	6.2	10.7
Highest degree in S&E field	16.6	6.1	10.4
Biological, agricultural, and environmental life sciences	16.4	6.7	9.7
Computer and mathematical sciences	13.3	3.6	9.6
Physical sciences	11.2	4.3	6.7
Social sciences	19.0	8.6	10.4
Engineering	16.6	4.2	12.4
S&E highest degree level			
Bachelor's	17.0	6.3	10.7
Master's	12.3	4.3	8.1
Doctorate	11.6	5.1	6.4
Professional	34.5	12.5	22.0
Occupation			
S&E occupation	10.6	3.2	7.5
Biological, agricultural, and environmental life scientists	5.1	2.1	3.0
Computer and mathematical scientists	11.4	2.9	8.5
Physical scientists	6.0	2.1	3.9
Social scientists	14.0	9.8	4.0
Engineers	11.1	2.0	9.0
S&E-related occupations	15.1	4.3	10.8
Non-S&E occupations	21.6	9.3	12.4

Note(s)

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. Detail may not add to total because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Government Sector

Federal government. According to data from the U.S. Office of Personnel Management (OPM), the federal government employed approximately 329,000 people in S&E occupations in 2016, which represents about 16% of the federal civilian workforce.[2] ,[3] Federal workers in S&E occupations are almost evenly distributed among computer and mathematical sciences occupations (33%); engineering occupations (31%); and life sciences, physical sciences, and social sciences occupations (36%). The majority (81%) 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 their workforce in S&E jobs are those with strong scientific missions: the National Aeronautics and Space Administration (66%), the Nuclear Regulatory Commission (63%), the Environmental Protection Agency (61%), NSF (41%), and the Department of Energy (33%). The Department of Defense has the largest number of workers in S&E occupations (154,000), accounting for 47% of the federal workforce in S&E occupations.[4]

State and local government. In 2015, about 1.6 million scientists and engineers (6%) were working in state and local governments in the United States (Table 3-6). Public educational institutions are included in the education sector and excluded here. State and local governments employ about 7% of both S&E bachelor's degree holders and S&E master's degree holders, compared to only 2% of S&E doctorate holders (Figure 3-10). Among those employed in S&E occupations, larger proportions of life scientists, physical scientists, and social scientists work in state and local governments, compared with computer and math scientists (Figure 3-11).

SIDEBAR

Patterns of Mobility of New S&E PhDs into the Business Sector

About half of the 500,000 new S&E doctorate recipients during the 2001–15 period reported postgraduation plans for employment, and of those, a quarter were going into the business sector. Data from the Survey of Earned Doctorates (SED) can track the geographic mobility of newly minted S&E PhDs from training to industry employment, which not only informs the understanding of geographic patterns of R&D activity but is also an important indicator of local knowledge spillovers from academia to the business sector (Stephan 2007). Firms hire new S&E PhDs for their ability to contribute to R&D and other innovative activities within the organization. Where they are placed is an important indicator of regional innovative capacity. In addition, the resulting knowledge flows from academia to industry via employment of new S&E doctorate holders are related to the innovative capacity of a region. Following Stephan (2007), SED data from 2001–15 were examined to analyze the geographic mobility of new PhDs with postgraduation plans for business-sector employment in the United States.

From 2001 to 2015, nearly 57,000 new doctorate recipients in S&E fields had postgraduation plans for non-postdoc employment in industry in the United States (Table 3-B). The rate at which these newly graduated students entered into business-sector employment in the region in which they trained is an indicator of local knowledge spillover effects from academia to the business sector. These rates vary substantially by region, ranging from a high of 77% remaining in the Pacific and Insular region, which includes the Pacific states and Puerto Rico and outlying territories (see Table 3-C for a list of states and territories included in each region), to nearly one-third (32%) in the East South Central United States. States vary considerably in terms of economic and employment opportunities. The Pacific and Insular region attracted the most S&E PhDs overall for business-sector employment (17,332), regardless of where training occurred, followed by the Middle Atlantic region (9,601). In comparison, the East South Central region attracted the lowest number of S&E PhDs to work in industry (951) during this time period.

TABLE 3-B

Doctorate recipients in S&E fields with postgraduation plans for non-postdoc employment in the United States in the business or industry sector, by region of doctoral institution and region of employment: 2001–15 combined

(Number and percent distribution)

Region of employment	Region of doctoral institution									
	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific and Insular	All doctoral institutions
Number										
All employment[a]	4,566	9,106	10,212	3,756	9,325	1,652	5,110	2,979	10,119	56,825
New England	2,212	722	545	176	495	71	150	98	293	4,762
Middle Atlantic	786	4,700	1,256	368	1,084	150	297	178	782	9,601
East North Central	176	411	3,867	454	566	190	244	96	245	6,249
West North Central	59	112	386	1,342	180	60	109	58	97	2,403
South Atlantic	262	640	675	287	4,149	229	268	125	311	6,946
East South Central	19	45	89	54	116	525	62	19	22	951
West South Central	162	329	574	248	595	136	2,910	249	311	5,514
Mountain	75	202	285	143	253	53	142	1,438	225	2,816
Pacific and Insular	786	1,900	2,491	666	1,839	233	906	706	7,805	17,332
Percent distribution of region of doctoral institution across regions of employment										
All employment[b]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Region of employment	Region of doctoral institution									
	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific and Insular	All doctoral institutions
New England	48.4	7.9	5.3	4.7	5.3	4.3	2.9	3.3	2.9	8.4
Middle Atlantic	17.2	51.6	12.3	9.8	11.6	9.1	5.8	6.0	7.7	16.9
East North Central	3.9	4.5	37.9	12.1	6.1	11.5	4.8	3.2	2.4	11.0
West North Central	1.3	1.2	3.8	35.7	1.9	3.6	2.1	1.9	1.0	4.2
South Atlantic	5.7	7.0	6.6	7.6	44.5	13.9	5.2	4.2	3.1	12.2
East South Central	0.4	0.5	0.9	1.4	1.2	31.8	1.2	0.6	0.2	1.7
West South Central	3.5	3.6	5.6	6.6	6.4	8.2	56.9	8.4	3.1	9.7
Mountain	1.6	2.2	2.8	3.8	2.7	3.2	2.8	48.3	2.2	5.0
Pacific and Insular	17.2	20.9	24.4	17.7	19.7	14.1	17.7	23.7	77.1	30.5

[a] Total employment counts include doctorate recipients reporting unknown U.S. location.

[b] Employment percentages do not sum to 100% because total counts include doctorate recipients reporting unknown U.S. location.

Note(s)

Numbers are based on doctorate recipients reporting definite commitments for non-postdoc employment in the year after doctoral degree award. S&E fields include life sciences, physical and earth sciences, mathematics and computer sciences, psychology and social sciences, and engineering. Business or industry sector includes self-employment and excludes not-for-profit organizations.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2017), Survey of Earned Doctorates (SED) (2015).

Science and Engineering Indicators 2018

TABLE 3-C

Region and state of doctoral institution and employment of doctorate recipients in S&E fields with postgraduation plans for non-postdoc employment in the United States in the business or industry sector: 2001–15 combined

(Number)

Region and state	PhDs trained in state or region	New PhDs working in state or region	Number of new PhDs produced that stay in state or region	Percent of new PhDs produced that stay in state or region
New England	4,566	4,762	2,212	48.4
Connecticut	669	859	171	25.6
Maine	40	57	16	40.0
Massachusetts	3,379	3,401	1,556	46.0
New Hampshire	159	195	32	20.1
Rhode Island	279	126	56	20.1
Vermont	40	124	19	47.5
Middle Atlantic	9,106	9,601	4,700	51.6
New Jersey	1,561	2,700	690	44.2
New York	4,273	4,741	1,744	40.8
Pennsylvania	3,272	2,160	879	26.9
East North Central	10,212	6,249	3,867	37.9
Illinois	3,291	2,149	929	28.2
Indiana	1,641	780	225	13.7
Michigan	2,100	1,502	701	33.4
Ohio	1,913	1,165	613	32.0
Wisconsin	1,267	653	290	22.9
West North Central	3,756	2,403	1,342	35.7
Iowa	761	274	142	18.7
Kansas	451	253	128	28.4
Minnesota	1,311	1,124	467	35.6
Missouri	820	527	236	28.8

Region and state	PhDs trained in state or region	New PhDs working in state or region	Number of new PhDs produced that stay in state or region	Percent of new PhDs produced that stay in state or region
Nebraska	242	134	77	31.8
North Dakota	109	55	32	29.4
South Dakota	62	36	18	29.0
South Atlantic	9,325	6,946	4,149	44.5
Delaware	395	320	61	15.4
District of Columbia	369	521	61	16.5
Florida	1,717	1,062	647	37.7
Georgia	1,772	806	427	24.1
Maryland	1,258	1,175	402	32.0
North Carolina	1,699	1,236	627	36.9
South Carolina	445	317	125	28.1
Virginia	1,505	1,415	526	35.0
West Virginia	165	94	39	23.6
East South Central	1,652	951	525	31.8
Alabama	483	292	143	29.6
Kentucky	340	179	91	26.8
Mississippi	233	87	45	19.3
Tennessee	596	393	178	29.9
West South Central	5,110	5,514	2,910	56.9
Arkansas	144	128	65	45.1
Louisiana	414	250	110	26.6
Oklahoma	379	261	108	28.5
Texas	4,173	4,875	2,348	56.3
Mountain	2,979	2,816	1,438	48.3
Arizona	961	1,010	360	37.5

Region and state	PhDs trained in state or region	New PhDs working in state or region	Number of new PhDs produced that stay in state or region	Percent of new PhDs produced that stay in state or region
Colorado	918	891	473	51.5
Idaho	99	205	44	44.4
Montana	59	36	20	33.9
Nevada	139	114	68	48.9
New Mexico	189	213	74	39.2
Utah	549	310	206	37.5
Wyoming	65	37	20	30.8
Pacific and Insular	10,119	17,332	7,805	77.1
Alaska	18	39	7	38.9
California	8,690	13,150	6,180	71.1
Hawaii	71	86	42	59.2
Oregon	416	2,088	207	49.8
Washington	847	1,878	401	47.3
Puerto Rico and outlying territories	77	91	66	85.7

Note(s)

Numbers and percentages are based on doctorate recipients reporting definite commitments for non-postdoc employment in the year after doctoral degree award, with response to location of employment. S&E fields include life sciences, physical and earth sciences, mathematics and computer sciences, psychology and social sciences, and engineering. Business or industry sector includes self-employment and excludes not-for-profit organizations.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2017), Survey of Earned Doctorates (SED) (2015).

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As S&E doctorate recipients become increasingly geographically concentrated by region of planned employment in the business sector, the share of where they are trained by region has remained fairly stable since 2001. Table 3-D and Table 3-E show the number and share of new S&E doctorate holders with postgraduation plans for employment in business or industry by region of doctoral institution and by location of employment, respectively, for three 5-year cohorts. While the Pacific and Insular region accounts for just under 20% of the training of the three graduating cohorts, between 27% and 34% of these cohorts are planning to work in the business sector in this region. This suggests that this region increasingly accounts for a larger share of new S&E PhD workers in the business sector, while the share trained there remains stable over this time period. The Middle Atlantic region has declined in its share of business-sector employment plans of these new graduates, down from 19% in the first cohort to 15% in the most recent cohort. The South Atlantic region saw a slight decline in its share of those planning to be employed in the business sector there, while the West South Central region saw a modest increase.

TABLE 3-D

Doctorate recipients in S&E fields with postgraduation plans for non-postdoc employment in the United States in the business or industry sector, by region of doctoral institution: 5-year cohorts, 2001–15

(Number and percent)

Region	2001–05	2006–10	2011–15
	Number		
All regions	16,328	19,584	20,913
New England	1,298	1,576	1,692
Middle Atlantic	2,673	3,159	3,274
East North Central	3,034	3,449	3,729
West North Central	1,111	1,287	1,358
South Atlantic	2,564	3,191	3,570
East South Central	453	574	625
West South Central	1,395	1,699	2,016
Mountain	850	1,040	1,089
Pacific and Insular	2,950	3,609	3,560
	Percent		
All regions	100.0	100.0	100.0
New England	7.9	8.0	8.1
Middle Atlantic	16.4	16.1	15.7
East North Central	18.6	17.6	17.8
West North Central	6.8	6.6	6.5
South Atlantic	15.7	16.3	17.1
East South Central	2.8	2.9	3.0
West South Central	8.5	8.7	9.6
Mountain	5.2	5.3	5.2
Pacific and Insular	18.1	18.4	17.0

Note(s)

Numbers and percentages are based on doctorate recipients reporting definite commitments for non-postdoc employment in the year after doctoral degree award, with response to location of employment. S&E fields include life sciences, physical and earth sciences, mathematics and computer sciences, psychology and social sciences, and engineering. Business or industry sector includes self-employment and excludes not-for-profit organizations.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2017), Survey of Earned Doctorates (SED) (2015).

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TABLE 3-E

Doctorate recipients in S&E fields with postgraduation plans for non-postdoc employment in the United States in the business or industry sector, by region of employment: 5-year cohorts, 2001–15

(Number and percent)

Region	2001–05	2006–10	2011–15
Number			
All regions[a]	16,328	19,584	20,913
New England	1,438	1,592	1,732
Middle Atlantic	3,132	3,325	3,144
East North Central	1,909	2,099	2,241
West North Central	703	790	910
South Atlantic	2,145	2,428	2,373
East South Central	269	333	349
West South Central	1,417	1,984	2,113
Mountain	858	1,002	956
Pacific and Insular	4,391	5,904	7,037
Percent			
All regions[b]	100.0	100.0	100.0
New England	8.8	8.1	8.3
Middle Atlantic	19.2	17.0	15.0
East North Central	11.7	10.7	10.7
West North Central	4.3	4.0	4.4
South Atlantic	13.1	12.4	11.3
East South Central	1.6	1.7	1.7
West South Central	8.7	10.1	10.1
Mountain	5.3	5.1	4.6
Pacific and Insular	26.9	30.1	33.6

[a] Totals include doctorate recipients with unknown region of U.S. employment.

[b] Percentages do not sum to 100% because total counts include doctorate recipients with unknown region of U.S. employment.

Note(s)

Numbers and percentages are based on doctorate recipients reporting definite commitments for non-postdoc employment in the year after doctoral degree award, with response to location of employment. S&E fields include life sciences, physical and earth sciences, mathematics and computer sciences, psychology and social sciences, and engineering. Business or industry sector includes self-employment and excludes not-for-profit organizations.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2017), Survey of Earned Doctorates (SED) (2015).

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The flow of new S&E PhDs with postgraduation plans for business-sector employment outside of the region in which they trained increased slightly from the turn of the century until 2015 (Table 3-F). The rate at which these students plan to remain in their region of training for postgraduation industry employment has declined overall from 53% in the earliest cohort to 49% in the most recent cohort. The only region that saw an increase in the rate at which new S&E PhDs remain for business-sector employment was the Pacific and Insular region, where the proportion rose slightly from 76% in both the 2001–05 and 2006–10 cohorts, respectively, to 79% in the most recent cohort overall. This proportion declined in the South Atlantic region from 49% in 2001–05 to 41% in 2011–15 and also in the Middle Atlantic region from 56% to 48%. Table 3-C breaks down these proportions by state for the entire period of 2001–15, showing that in the Pacific and Insular region, California accounts for the largest share of new S&E PhDs trained and employed there. Within this region, California has one of the highest rates at which those trained in that state also remain there for business-sector employment.

TABLE 3-F

Doctorate recipients in S&E fields with postgraduation plans for non-postdoc employment in the United States in the business or industry sector, by region of doctoral institution: 5-year cohorts, 2001–15

(Number and percent)

Region	2001–05	2006–10	2011–15
Number of new doctorates trained in region			
All regions	16,328	19,584	20,913
New England	1,298	1,576	1,692
Middle Atlantic	2,673	3,159	3,274
East North Central	3,034	3,449	3,729
West North Central	1,111	1,287	1,358
South Atlantic	2,564	3,191	3,570
East South Central	453	574	625
West South Central	1,395	1,699	2,016
Mountain	850	1,040	1,089
Pacific and Insular	2,950	3,609	3,560
Number of new doctorates produced that stay in region			
All regions[a]	8,703	9,933	10,340
New England	639	744	829
Middle Atlantic	1,501	1,635	1,564
East North Central	1,246	1,273	1,348
West North Central	416	429	497
South Atlantic	1,246	1,442	1,461
East South Central	160	173	192
West South Central	790	995	1,125
Mountain	449	485	504
Pacific and Insular	2,245	2,743	2,817
Percent of new doctorates produced that stay in region			

Region	2001–05	2006–10	2011–15
All regions	53.3	50.7	49.4
New England	49.2	47.2	49.0
Middle Atlantic	56.2	51.8	47.8
East North Central	41.1	36.9	36.1
West North Central	37.4	33.3	36.6
South Atlantic	48.6	45.2	40.9
East South Central	35.3	30.1	30.7
West South Central	56.6	58.6	55.8
Mountain	52.8	46.6	46.3
Pacific and Insular	76.1	76.0	79.1

[a] Totals include doctorate recipients with unknown region of U.S. employment.

Note(s)

Numbers and percentages are based on doctorate recipients reporting definite commitments for non-postdoc employment in the year after doctoral degree award, with response to location of employment. S&E fields include life sciences, physical and earth sciences, mathematics and computer sciences, psychology and social sciences, and engineering. Business or industry sector includes self-employment and excludes not-for-profit organizations.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2017), Survey of Earned Doctorates (SED) (2015).

Science and Engineering Indicators 2018

Overall, while the geographic distribution of S&E PhDs by educational institution has remained stable among all nine U.S. regions since 2001, the plans for industry employment of these new graduates has shifted toward the Pacific Coast—primarily California. The Middle Atlantic and South Atlantic regions seem to be the hardest hit by the shift, having the largest drops in the percentage of S&E doctorate holders who plan to remain and work in industries located in those regions after graduation. There is wide variation in the geographic distribution of S&E PhDs by both region of training and region of employment. Of the nearly 57,000 new S&E PhDs planning to work in the business sector, most are in the Pacific and Insular region, and the East South Central region has the fewest training and planning to work in industry in that area.

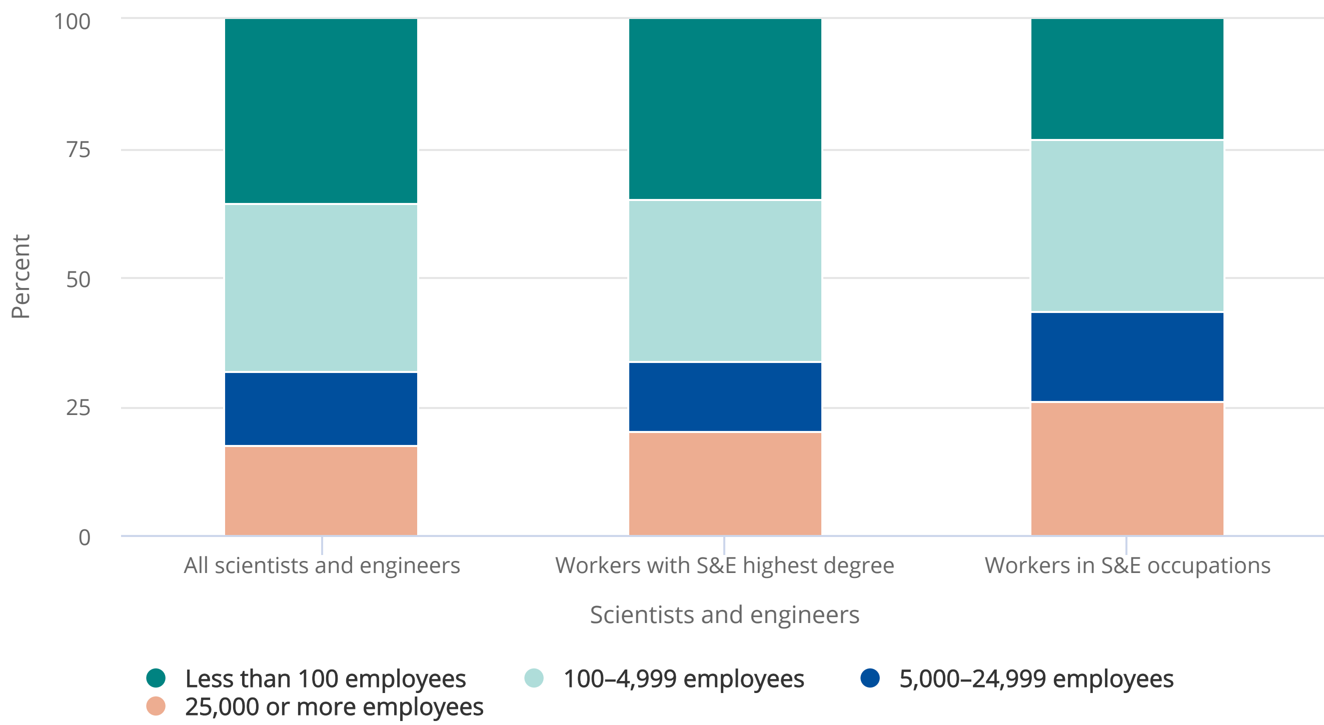
Employer Size

The majority of educational institutions and government entities that employ individuals trained in S&E fields or working in S&E occupations are large employers (i.e., having 100 or more employees). These large organizations employ 87% 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 different sizes (Figure 3-12).

Many scientists and engineers who are self-employed work in businesses with 10 or fewer employees. In all, 84% of self-employed individuals in unincorporated businesses and 45% of self-employed individuals in incorporated businesses 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.

FIGURE 3-12

Scientists and engineers employed in the business sector, by employer size: 2015



Note(s)

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. Percentages may not add to 100% because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Industry Employment

The OES survey provides detailed estimates for employment in S&E occupations by type of industry; however, it excludes self-employed individuals, those employed in private households, and some individuals employed in agriculture. Industries vary in their proportions of S&E workers (Table 3-8). In 2016, the industry group with the largest S&E employment was professional, scientific, and technical services (2.1 million),[5] followed by manufacturing (937,000) (Table 3-8). The government sector, which includes federal, state, and local governments, employed 652,000 S&E workers; educational services, including private and public educational institutions, employed another 702,000 S&E workers. These four industry groups—professional, scientific, and technical services; manufacturing; government; and educational services—had a disproportionate concentration of S&E workers and together accounted for about 66% of S&E employment, compared with 31% of total employment.

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 (20%) and by management of companies and enterprises (14%) (Table 3-8). The broad industry sectors with S&E employment intensity below the national average (4.8%) together employed 60% of all workers in 2016 but only 14% of workers in S&E occupations. These sectors 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. The health care and social assistance industry employed a large number of health workers who fall under NSF's category of S&E-related occupations (Table 3-2).

TABLE 3-8

Employment in S&E occupations, by major industry: May 2016

(Number)

Industry	Workers employed		Industry workforce in S&E occupations (%)
	All occupations	S&E occupations	
U.S. total — all industries	140,400,040	6,746,600	4.8
Agriculture, forestry, fishing, and hunting	416,600	1,660	0.4
Mining	649,130	50,140	7.7
Utilities	549,960	60,770	11.0
Construction	6,687,380	66,570	1.0
Manufacturing	12,337,520	937,150	7.6
Wholesale trade	5,840,730	246,330	4.2
Retail trade	15,982,520	50,140	0.3
Transportation and warehousing	5,606,180	44,880	0.8
Information	2,762,090	563,200	20.4
Finance and insurance	5,775,240	355,630	6.2
Real estate, rental, and leasing	2,110,600	17,180	0.8
Professional, scientific, and technical services	8,739,110	2,136,370	24.4
Management of companies and enterprises	2,302,590	312,650	13.6
Administrative and support and waste management and remediation	9,070,140	266,330	2.9
Educational services	12,982,910	701,850	5.4
Health care and social assistance	19,257,910	217,230	1.1
Arts, entertainment, and recreation	2,322,400	12,190	0.5
Accommodation and food services	13,338,870	4,390	0.0
Other services (except federal, state, and local government)	4,078,800	49,640	1.2
Federal, state, and local government (OES designation)	9,589,350	652,280	6.8

OES = Occupational Employment Statistics.

Note(s)

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 private households (NAICS 814). In the employment total for agriculture, forestry, fishing, and hunting, only the following industries are included: logging (NAICS 1133), support activities for crop production (NAICS 1151), and support activities for animal production (NAICS 1152). As a result, the data do not represent total U.S. employment. Differences between any two industry groups may not be statistically significant. Detail may not add to total because of rounding.

Source(s)

Bureau of Labor Statistics, special tabulations (2017) of May 2016 OES Survey.

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Employment by Metropolitan Area

The availability of a skilled workforce is an important indicator 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 (OMB 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, and (2) the proportion of the entire metropolitan area workforce in S&E occupations. Data on the metropolitan areas with the largest proportion of workers in S&E occupations in 2016 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 19% of nationwide employment in S&E jobs, compared to about 9% of employment in all occupations.

TABLE 3-9

Metropolitan areas with largest proportion of workers in S&E occupations: May 2016

(Number)

Metropolitan area	Workers employed		Metropolitan area workforce in S&E occupations (%)
	All occupations	S&E occupations	
U.S. total	140,400,040	6,746,600	4.8
California-Lexington Park, MD	44,000	8,250	18.8
San Jose-Sunnyvale-Santa Clara, CA	1,045,430	179,820	17.2
Boulder, CO	176,230	25,780	14.6
Framingham, MA NECTA Division	174,430	22,680	13.0
Huntsville, AL	218,260	28,250	12.9
San Francisco-Redwood City-South San Francisco, CA Metropolitan Division	1,067,130	117,500	11.0
Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Division	2,490,690	267,000	10.7
Seattle-Bellevue-Everett, WA Metropolitan Division	1,588,590	169,210	10.7
Durham-Chapel Hill, NC	292,800	30,620	10.5
Lowell-Billerica-Chelmsford, MA-NH NECTA Division	151,310	15,730	10.4
Silver Spring-Frederick-Rockville, MD Metropolitan Division	581,380	58,830	10.1
Corvallis, OR	32,930	3,270	9.9
Ann Arbor, MI	210,990	19,100	9.1
Trenton, NJ	225,950	20,180	8.9
Madison, WI	381,890	34,080	8.9
Raleigh, NC	595,370	52,690	8.8
Boston-Cambridge-Newton, MA NECTA Division	1,803,030	159,430	8.8
Ames, IA	43,690	3,850	8.8
Ithaca, NY	50,590	4,450	8.8
Austin-Round Rock, TX	965,100	81,190	8.4

NECTA = New England City and Town Area.

Note(s)

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(s)

Bureau of Labor Statistics, Occupational Employment Statistics (OES) survey (May 2016).

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Scientists and Engineers and Innovation-Related Activities

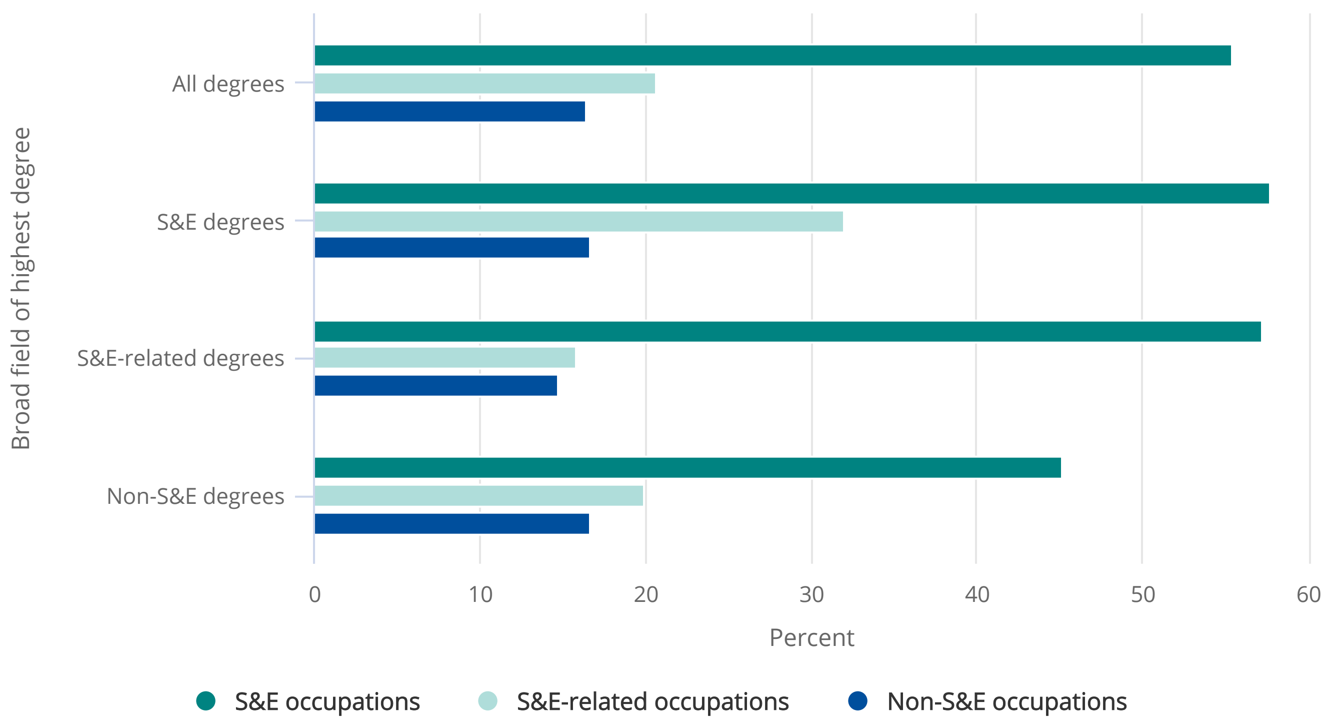
Who Performs R&D?

R&D creates new types of goods and services that can contribute to economic and productivity growth and enhance living standards. Thus, the status of the nation's R&D workforce is a policy area of concern nationally, regionally, and, increasingly, locally. This section uses NSF's NSCG data to examine the R&D activity of scientists and engineers. In this section, the R&D workforce 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 that rank first or second in total work hours from a list of 14 activities).[6]

Overall, 28% of employed scientists and engineers in 2015 reported R&D as a primary or secondary work activity; the proportions who did so vary substantially across occupations and degrees (Figure 3-13). The majority of individuals in S&E occupations (55%) reported performing R&D, but so did a considerable proportion of those in S&E-related occupations (21%) and non-S&E occupations (16%). This indicates that, although R&D activity spans a broad range of occupations, it is concentrated in S&E occupations. Among those with a non-S&E highest degree but working in an S&E occupation, a sizeable proportion reported R&D activity (45%), although this proportion is lower than for their colleagues with a highest degree in an S&E field (58%). A sizeable proportion of those with S&E degrees do not perform R&D—among them, many S&E degree holders subsequently earn degrees in fields such as medicine, law, or business. In 2015, the majority of S&E bachelor's degree holders who subsequently obtained an advanced degree (60%) earned it in an S&E-related field (18%) or non-S&E field (42%). Additionally, among S&E bachelor's degree holders who reported a second major for their bachelor's degree, about 59% designated an S&E-related field (4%) or non-S&E field (55%) as their second major.

FIGURE 3-13

Employed scientists and engineers with R&D activity, by broad field of highest degree and broad occupational category: 2015



Note(s)

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 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(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Most individuals in the S&E workforce who reported performing R&D have a bachelor's (52%) or master's (33%) degree as their highest degree; those with doctorates account for 12% of researchers but only 5% of the S&E workforce. 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).[7] Overall, among those employed in S&E occupations, about three-quarters of life and physical scientists reported R&D activity, whereas approximately half of social scientists (51%) and computer and mathematical scientists (45%) reported R&D activity (Table 3-10).

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: 2015

(Percent)

Highest degree level	Biological, agricultural, and environmental life scientists	Computer and mathematical scientists	Physical scientists	Social scientists	Engineers
All degree levels	74.5	45.1	73.1	50.9	65.2
Bachelor's	65.1	44.7	64.3	53.3	63.3
Master's	76.3	43.2	70.6	51.0	65.0
Doctorate	83.1	71.8	84.9	52.7	85.0

Note(s)

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. 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 field in 2015. All degree levels includes professional degrees not broken out separately.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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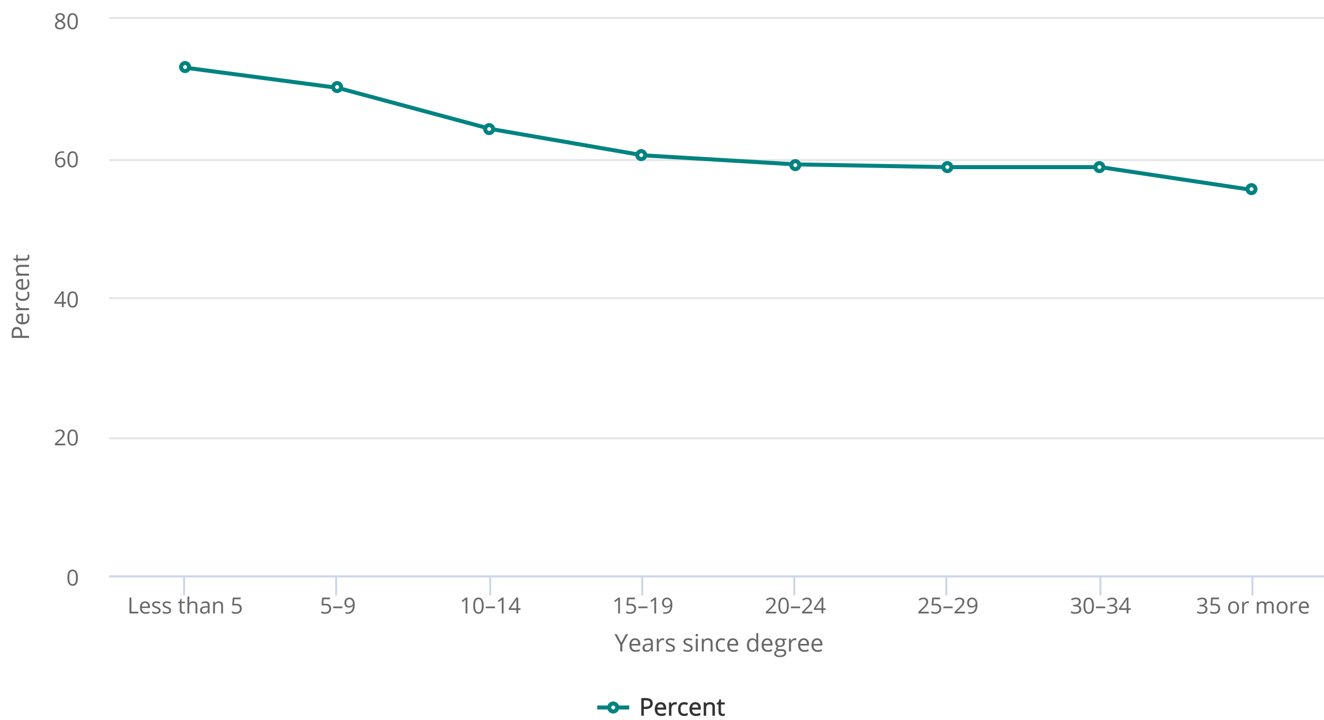
R&D activity tends to decline in later career stages (Figure 3-14). Among SEH doctorate holders who earned their doctorate in 2006 or later, 73% reported R&D activity in 2015. Among those receiving degrees between 1986 and 2005, 60% reported R&D activity in 2015. For those with degrees predating 1986, 56% reported R&D activity in 2015. The decline in R&D activity over the course of individuals' careers may reflect movement into teaching or 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.

FIGURE 3-14

Employed SEH doctorate holders with R&D activity, by years since doctoral degree: 2015



SEH = science, engineering, and health.

Note(s)

R&D activity 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(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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Work-Related Training

In addition to formal education, workers receive work-related training. Such training can contribute to innovation and productivity growth by enhancing skills, efficiency, and knowledge. In 2015, 52% of scientists and engineers reported participating in work-related training within the past 12 months of being surveyed (Table 3-11).[8] Among those who were employed, workers in S&E-related jobs (e.g., health-related occupations, S&E managers, S&E precollege teachers, and S&E technicians and technologists) exhibited higher rates of training (71%) than workers in S&E (54%) or non-S&E occupations (58%). Women participated in work-related training at a higher rate than men (55% versus 49%) (Appendix Table 3-6). This difference exists regardless of labor force status.

Among scientists and engineers who participated in such work-related training, most stated that their most important reason for participation was to improve skills or knowledge in their current occupational field (52%) (Appendix Table 3-7).[9] Others did so for licensure or certification in their current occupational field (20%) or because it was required or expected by their employer (19%). Relative to those who were employed or not in the labor force, those who were unemployed more frequently reported that they engaged in work-related training to facilitate a change to a different occupational field. Those who were not in the labor force more frequently 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: 2015

(Number and percent)

Labor force status and occupation	Number	Percent
All scientists and engineers	16,243,000	52.1
Employed	15,431,000	61.0
S&E occupations	3,444,000	53.8
Biological, agricultural, and environmental life scientists	367,000	58.2
Computer and mathematical scientists	1,499,000	47.5
Physical scientists	175,000	52.9
Social scientists	379,000	66.5
Engineers	1,024,000	59.6
S&E-related occupations	5,585,000	71.0
Non-S&E occupations	6,104,000	58.0
Unemployed	282,000	32.5
S&E occupations	57,000	31.3
Biological, agricultural, and environmental life scientists	5,000	20.0
Computer and mathematical scientists	29,000	33.3
Physical and related scientists	3,000	27.9
Social and related scientists	13,000	64.1
Engineers	6,000	16.7
S&E-related occupations	63,000	43.4
Non-S&E occupations	162,000	32.5
Not in labor force	530,000	10.6

Note(s)

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 2015. 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(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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[1] The data on self-employment from NSCG 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 and those whose principal employer is a business owner. This is a major reason why the NSCG estimate of self-employed workers in S&E occupations is higher than those from other surveys (e.g., the Census Bureau's ACS).

[2] The source of the federal S&E employment data is OPM's Enterprise Human Resources Integration-Statistical Data Mart. Coverage is limited to federal civilian employees on pay status with certain exclusions. For information on specific exclusions and inclusions, see the coverage definition on OPM's Federal Human Resources Data (FedScope) Web page: https://www.fedscope.opm.gov/datadefn/aehri_sdm.asp#cpdf3.

[3] Employment in the federal government is largely limited to those with U.S. citizenship. Many federal workers with S&E employment are in occupations that, nationwide, include relatively large concentrations of foreign-born persons, some of whom are ineligible for many federal jobs because they are not U.S. citizens.

[4] This list does not include the National Institutes of Health, which is a part of the Department of Health and Human Services (HHS). S&E employment accounted for 19% of total HHS employment in 2016.

[5] The establishments in this sector provide professional, scientific, and technical services to clients in a variety of industries as well as households. The services provided by S&E workers in this industry sector may include computer services; engineering and specialized design services; consulting services; research services; advertising services; and other professional, scientific, and technical services.

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

[7] Social scientists were exceptions. In 2015, a larger proportion of social scientists with doctorates reported R&D activity than social scientists with master's degrees; however, the difference in R&D activity rates between social scientists with doctorates and social scientists with bachelor's degrees was not statistically significant.

[8] Work-related training includes conferences and professional meetings only if the conference or meeting attendance also includes attending a training session. It does not include college coursework while enrolled in a degree program.

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

S&E Labor Market Conditions

This section assesses the overall health of the labor market for scientists and engineers. Indicators of labor market participation (such as rates of unemployment and working involuntarily 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.[1] 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, unemployment rates among scientists and engineers tend to be lower than the rates for the labor force as a whole. In February 2015 (the reference month for the NSCG), an estimated 3.3% of scientists and engineers were unemployed (Appendix Table 3-8); the comparable unemployment rate for the entire U.S. labor force was higher, 5.8%.[2] Although the unemployment rate among scientists and engineers has gradually declined since the Great Recession, the rate in February 2015 continued to exceed the October 2006 (2.5%) pre-recession rate (Appendix Table 3-8). This shows clearly that the nation's S&E population, although somewhat sheltered, is not immune from fluctuations in broader economic conditions.

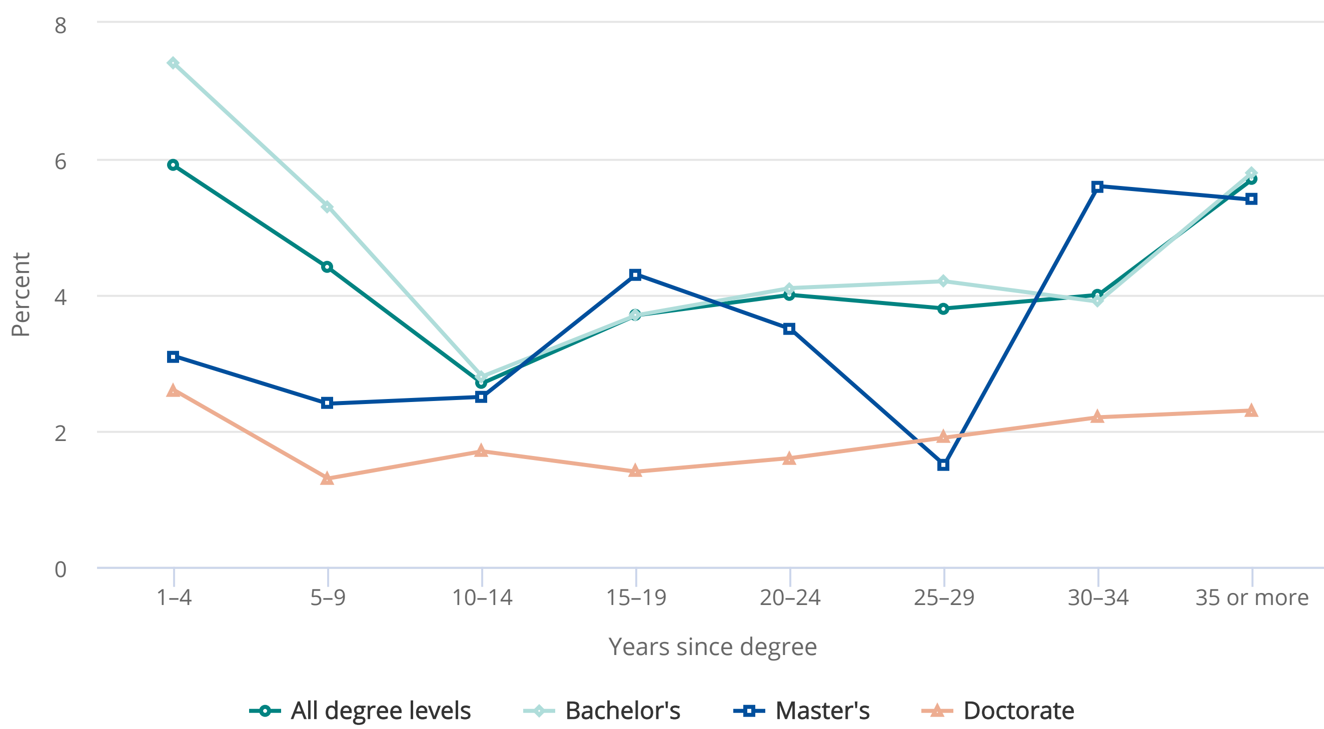
In 2015, unemployment rates varied across occupational categories. Among those in S&E occupations, unemployment rates ranged from 2.1% (among engineers) to 4.1% (among life scientists); among those in S&E-related and non-S&E occupations, the rate was 1.8% and 4.3%, respectively (Appendix Table 3-8). Additionally, advanced degree holders were generally less vulnerable to unemployment than those with only a bachelor's degree (Appendix Table 3-8).

The extent of unemployment also varies by career stages. S&E highest degree holders within 5–30 years after obtaining their highest degree were, for the most part, less likely to be unemployed than those at earlier points in their careers (Figure 3-15). 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, for those in the very late career stages (30 or more years after obtaining their highest degree), the unemployment rates turn higher than for those within 5–30 years after obtaining their highest degree. Growing selectivity about desirable work, skill obsolescence, and other factors may contribute to this phenomenon. The trends of lower unemployment during early- to mid-career stages compared with very early or very late stages hold for the bachelor's and doctoral degree levels, but not for the master's level (Figure 3-15).

CPS unemployment rates over the past two decades indicate that workers in S&E occupations have historically experienced lower unemployment rates than the overall labor force (Figure 3-16).[3] In addition, unemployment for all groups peaked after the 1990–91, 2001, and 2007–09 recessions, indicating once again that S&E workers are not immune from economic fluctuations.

FIGURE 3-15

Unemployment rates of S&E highest degree holders, by level of and years since highest degree: 2015



Note(s)

All degree levels includes professional degrees not shown separately. Detail may not add to total because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/, and the Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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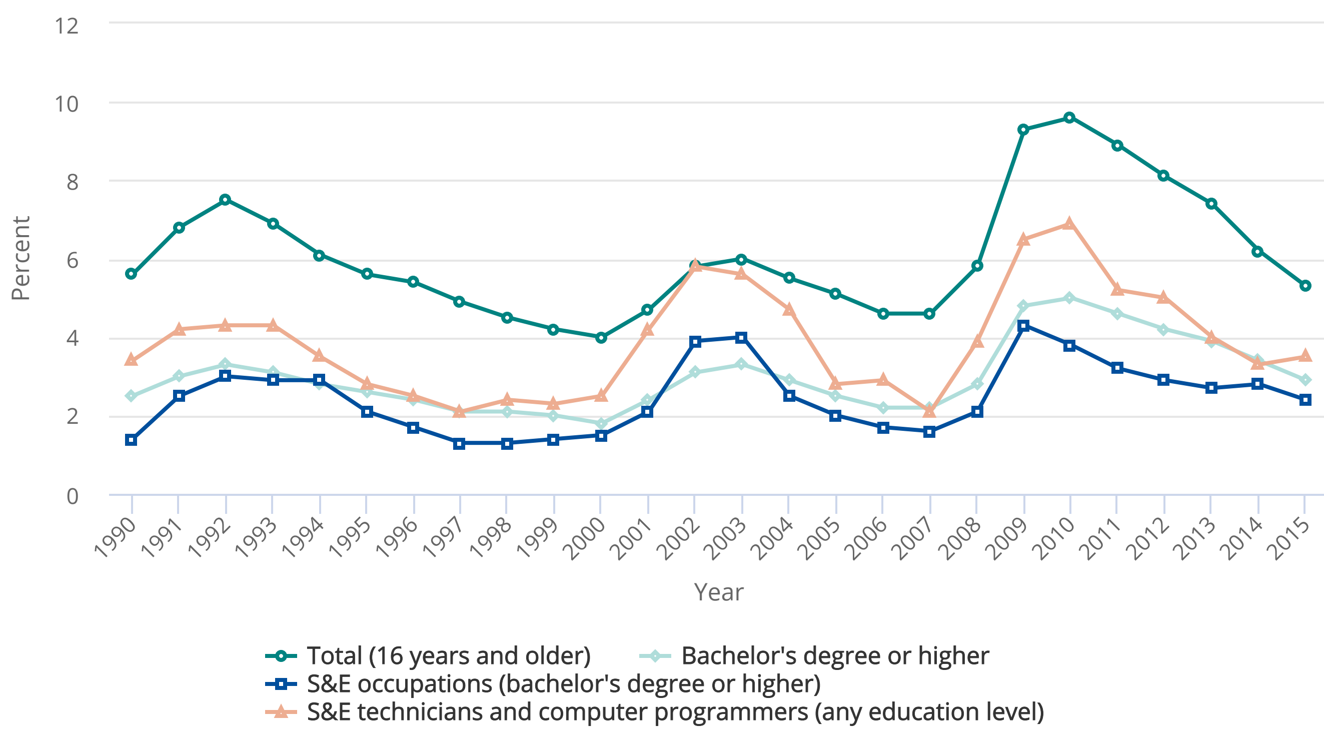
FIGURE 3-16

Unemployment rate, by selected groups: 1990–2015



Source(s)

National Bureau of Economic Research, Merged Outgoing Rotation Group files (1990–2015) and the Bureau of Labor Statistics, Current Population Survey (CPS).

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Working Involuntarily Out of One's Field of Highest Degree

Individuals invest time and financial resources in developing their knowledge and skills. Working outside of one's chosen field of education for involuntary reasons may create skills mismatches and economic inefficiencies that can be viewed as one indicator of labor market stress. Individuals work outside their highest degree field for a variety of reasons. Those who reported that they did so because suitable work was not available in their degree field are referred to here as involuntarily out-of-field (IOF) workers, and their number relative to all employed individuals is the IOF rate.

Of the 25 million employed scientists and engineers in 2015, almost 1.6 million reported working out of their field of highest degree because of a lack of suitable jobs in their degree field, yielding an IOF rate of 6.3%. For the more than 13.5 million whose highest degree was in an S&E field, the IOF rate was 7.9% (Table 3-12). NCSES survey respondents were allowed to provide more than one reason for working out of field. Other reasons cited by S&E degree holders included pay and promotion opportunities (reported by 1.8 million individuals), change in career or professional interests (1.2 million), working conditions (1.4 million), family-related reasons (751,000), job location (1.5 million), and other reasons (347,000). This suggests that, in addition to lack of a suitable job, various job-related and personal attributes such as compensation, location, and professional interest may result in out-of-field employment.

TABLE 3-12

Scientists and engineers who are working involuntarily out of field, by S&E degree field: Selected years, 2003–15

(Percent)

S&E degree field	2003	2006	2008	2010	2013	2015
All scientists and engineers	5.9	6.2	5.3	6.4	6.7	6.3
Highest degree in S&E field	7.8	8.1	7.1	8.4	8.3	7.9
Biological, agricultural, and environmental life sciences	10.1	9.7	10.1	10.1	9.4	10.4
Computer and mathematical sciences	4.9	5.7	4.5	5.1	4.1	4.0
Physical sciences	8.8	8.6	7.1	8.2	8.3	9.3
Social sciences	10.1	10.6	9.2	11.3	11.8	11.4
Engineering	4.2	4.5	3.6	4.9	4.6	3.2

Note(s)

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(s)

National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2003–13), https://www.nsf.gov/statistics/sestat/, and the National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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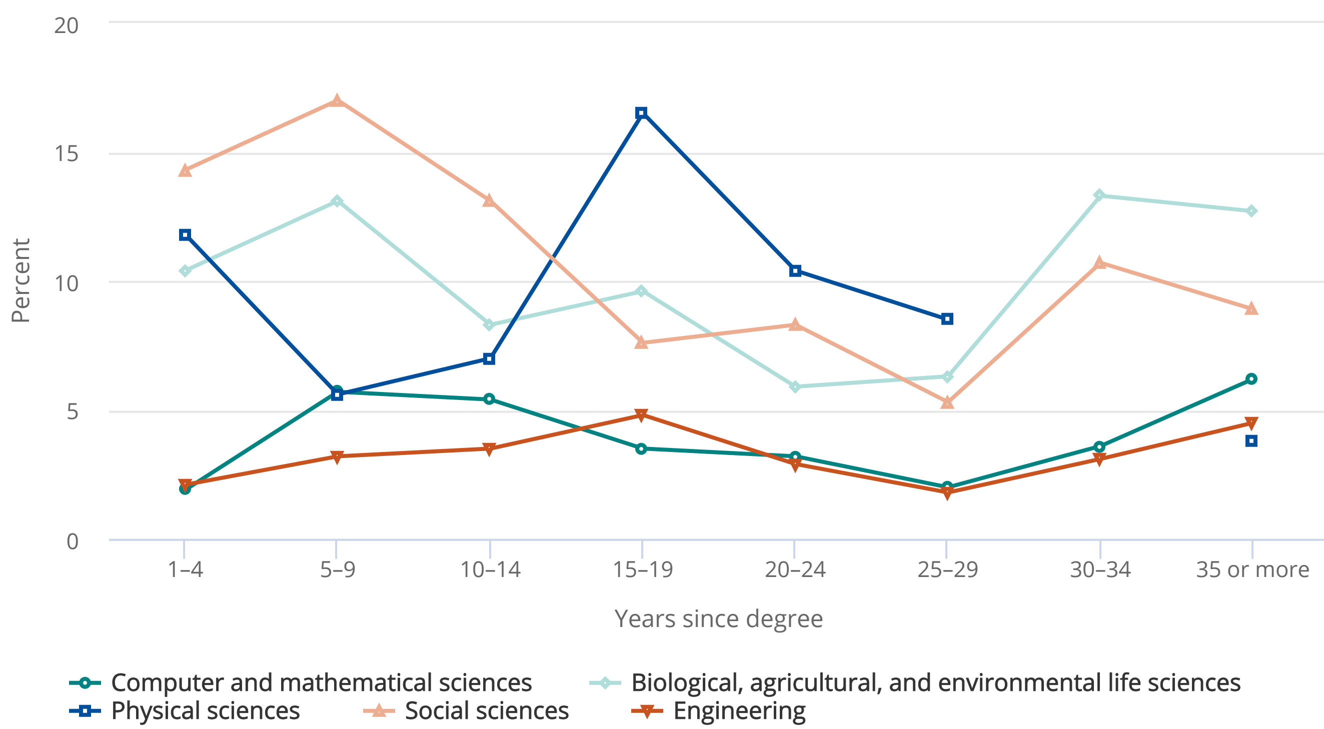
IOF rates vary by S&E degree fields and levels. Those with a highest degree in engineering or computer and mathematical sciences display lower IOF rates than those with a highest degree in physical, life, or social sciences (Table 3-12). The high IOF rates among social sciences degree holders, particularly in comparison with engineering and with computer and mathematical sciences degree holders, are evident across most of the career cycle (Figure 3-17). Additionally, S&E advanced degree holders are less likely to work IOF than those with S&E bachelor's degrees only: in 2015, the IOF rate was 1.8% among S&E doctorate holders, 4.2% among those with S&E master's degrees, and 9.7% among those with S&E bachelor's degrees.

FIGURE 3-17

S&E highest degree holders working involuntarily out of field, by field of and years since highest degree: 2015



Note(s)

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. Missing data have been suppressed for reasons of confidentiality and/or reliability.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Earnings

According to the OES survey, individuals in S&E occupations earn considerably more than the overall workforce. The median annual salary in 2016 in S&E occupations (regardless of education level or field) was $83,900, which is more than double the median for all U.S. workers ($37,040) (Table 3-13). This reflects a high level of formal education and technical skills associated with S&E occupations. Median S&E salaries in 2013–16 rose at about the same rate (1.7%) as that for all U.S. workers (1.8%). In 2016, median salaries for workers in S&E occupations ranged from $73,060 for social scientists to $91,430 for engineers. Salaries for workers in S&E-related occupations displayed similar patterns of higher earnings relative to the overall workforce. Health-related occupations, the largest segment of S&E-related occupations, cover a wide variety of workers ranging from physicians, surgeons, and practitioners to nurses, therapists, pharmacists, and health technicians; as a result, these occupations display a large variation in salary levels (Table 3-13).

TABLE 3-13

Annual salaries in science, technology, and related occupations: May 2013–May 2016

(Dollars)

Occupation	Mean			Median		
	Annual salaries in 2013	Annual salaries in 2016	Average annual growth rate 2013–16 (%)	Annual salaries in 2013	Annual salaries in 2016	Average annual growth rate 2013–16 (%)
All U.S. employment	46,440	49,630	2.2	35,080	37,040	1.8
STEM occupations	83,860	89,350	2.1	77,360	81,660	1.8
S&E occupations	84,400	89,750	2.1	79,670	83,900	1.7
Computer and mathematical scientists	81,830	87,890	2.4	77,710	82,780	2.1
Life scientists	80,770	84,660	1.6	71,490	73,270	0.8
Physical scientists	84,730	88,220	1.4	75,680	78,210	1.1
Social scientists	74,230	81,070	3.0	68,310	73,060	2.3
Engineers	92,770	97,170	1.6	87,640	91,430	1.4
Technology occupations	80,500	86,390	2.4	66,430	70,070	1.8
S&E-related occupations (not listed above)	76,200	81,140	2.1	62,600	65,050	1.3
Health-related occupations	76,120	81,070	2.1	62,370	64,820	1.3
Registered nurses	68,910	72,180	1.6	66,220	68,450	1.1
Dentists, general	164,570	173,860	1.8	146,340	153,900	1.7
Family and general practitioners	183,940	200,810	3.0	176,530	190,490	2.6
Other S&E-related occupations	81,040	85,280	1.7	73,740	76,310	1.1
Non-STEM occupations	41,700	44,450	2.2	31,940	33,840	1.9
Chief executives	178,400	194,350	2.9	171,610	181,210	1.8
General and operations manager	116,090	122,090	1.7	96,430	99,310	1.0

Occupation	Mean			Median		
	Annual salaries in 2013	Annual salaries in 2016	Average annual growth rate 2013–16 (%)	Annual salaries in 2013	Annual salaries in 2016	Average annual growth rate 2013–16 (%)
Education administrators, postsecondary	100,600	102,610	0.7	87,410	90,760	1.3
Management analysts	89,990	91,910	0.7	79,870	81,330	0.6
Financial analysts	91,620	97,640	2.1	78,380	81,760	1.4
Lawyers	131,990	139,880	2.0	114,300	118,160	1.1
Technical writers	70,290	73,160	1.3	67,900	69,850	0.9

STEM = science, technology, engineering, and mathematics.

Note(s)

See Table 3-2 for classifications of S&E, S&E-related, and STEM occupations. Occupational Employment Statistics (OES) survey employment data do not cover employment in some sectors of the agriculture, forestry, fishing, and hunting industry; in private households; or among self-employed individuals. As a result, the data do not represent total U.S. employment.

Source(s)

Bureau of Labor Statistics, special tabulations (2014 and 2017) of May 2013 and May 2016 OES Survey.

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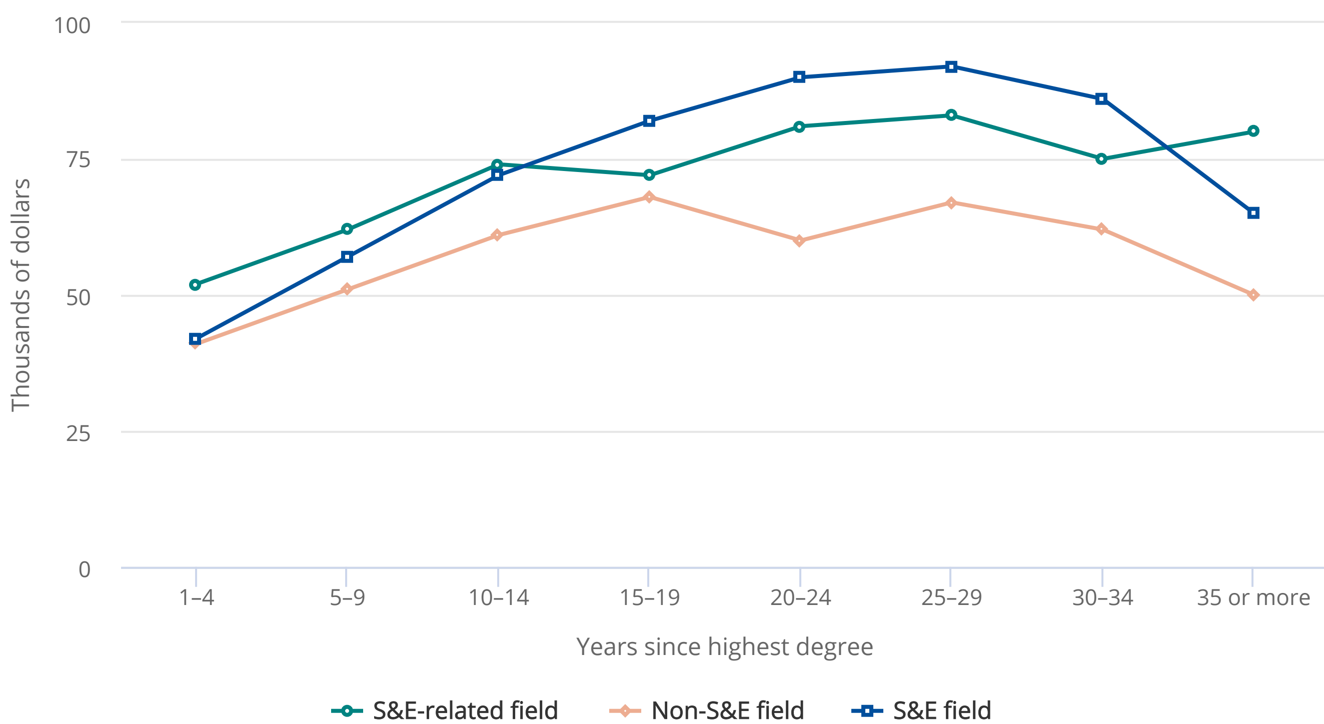
Overall, college-educated individuals with an S&E or S&E-related degree enjoy an earnings premium compared to those with a non-S&E degree; for the most part, this earnings premium is present across career stages. Figure 3-18 presents data on median salaries for groups with S&E, S&E-related, or non-S&E 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, and both are lower than the median salary for S&E-related degree holders, the rise in earnings associated with career progression is much steeper among individuals with S&E degrees. Among S&E highest degree holders, those with engineering or computer and mathematical sciences degrees earn more than degree holders in other broad S&E fields during early to mid-career stages; engineering degree holders continue to enjoy an earnings premium through later career stages compared with their counterparts with degrees in most other broad S&E fields (Figure 3-19).

FIGURE 3-18

Median salaries for employed, college-educated individuals, by broad field of and years since highest degree: 2015



Note(s)

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

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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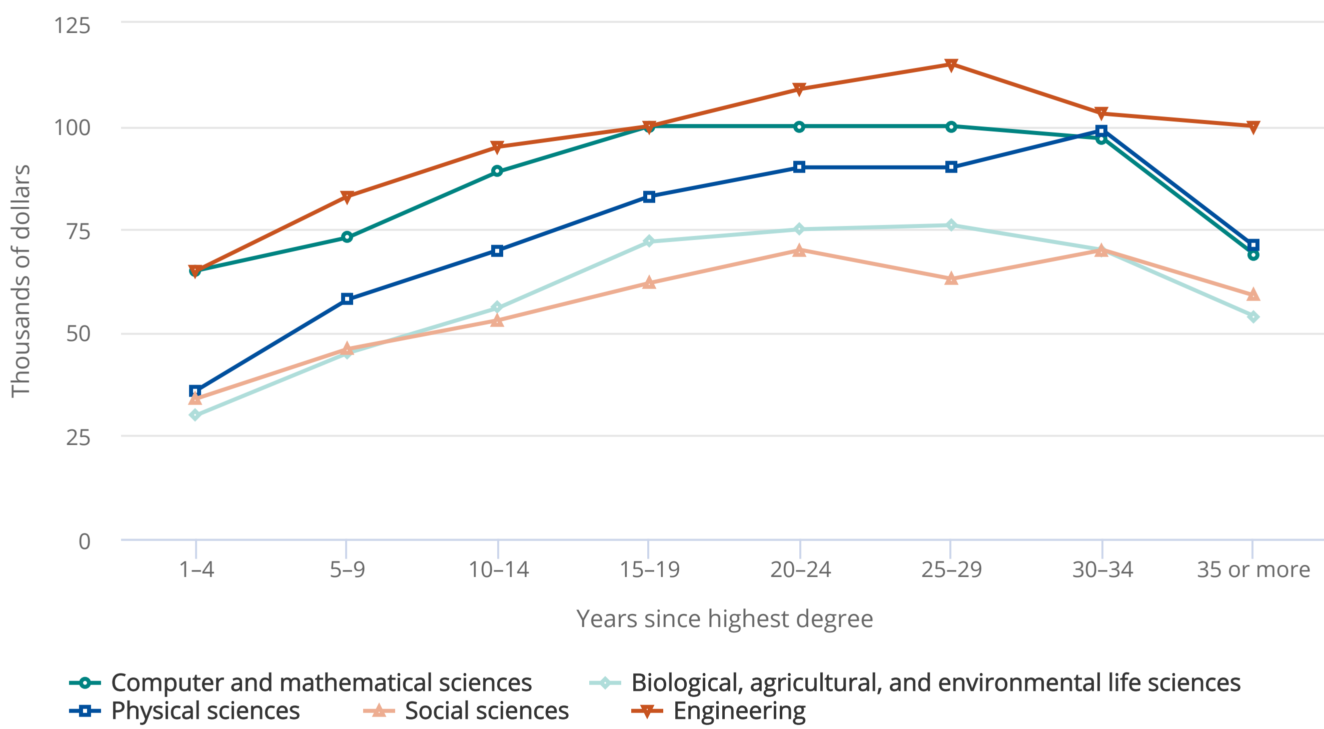
FIGURE 3-19

Median salaries for S&E highest degree holders, by broad field of and years since highest degree: 2015



Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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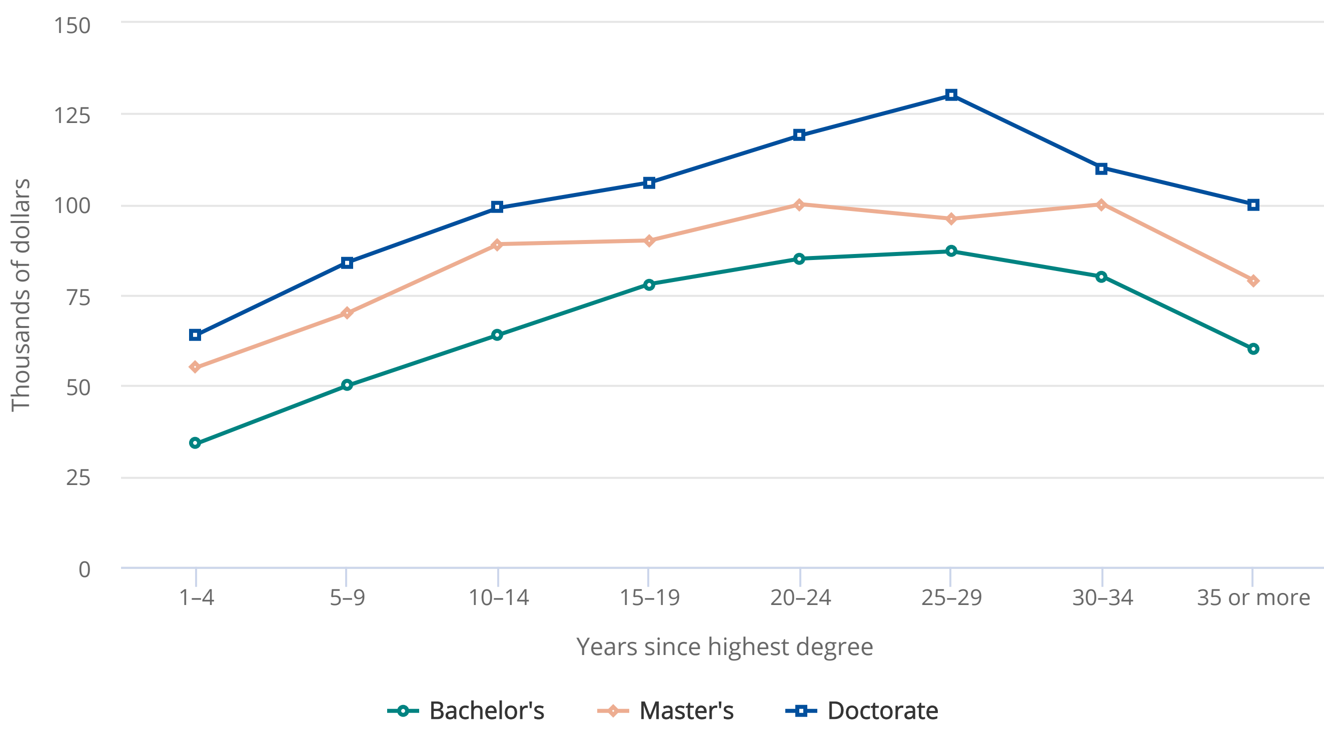
Earnings also vary by degree levels. For those with an S&E highest degree, annual median salaries are higher with a master's or doctoral degree (Appendix Table 3-9), and this pattern holds across career stages (Figure 3-20). Among all occupations, those with an S&E-related or non-S&E highest degree, professional degree holders earn the most (Appendix Table 3-9). The relatively high median salaries among S&E-related or non-S&E professional degree holders are driven primarily by medical practitioners and lawyers, respectively. A majority of college graduate workers whose highest degree is a professional degree in an S&E-related field (68%) work as a diagnosing or treating practitioner (with a median salary of $139,000); a majority of those whose highest degree is a professional degree in a non-S&E field (77%) work as a lawyer or judge (with a median salary of $124,000).

FIGURE 3-20

Median salaries for S&E highest degree holders, by level of and years since highest degree: 2015



Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Among employed individuals without a bachelor's degree, workers in S&E occupations have more stable jobs with higher salaries than those in non-S&E occupations. (See sidebar A Broader Look at the S&E Workforce.)

SIDEBAR

A Broader Look at the S&E Workforce

Although National Center for Science and Engineering Statistics (NCSES) data provide detailed information on college-graduate scientists and engineers, NCSES lacks similar data on individuals whose highest level of education is either high school, some college, or a 2-year degree. Sometimes referred to as the "sub-baccalaureate," "career and technical," or the "skilled technical" workforce (as used herein), these workers employ significant levels of S&E and technical knowledge in their jobs and are a considerable segment of the overall S&E workforce in the United States. This sidebar presents nationally representative data from the Census Bureau's American Community Survey (ACS) on employment trends among this group, showing solid career opportunities with lower unemployment rates and higher salaries than their non-S&E counterparts. About 6.1 million skilled technical workers age 25 and older were employed in an S&E or S&E-related occupation in 2015.*

The skilled technical workforce accounts for a considerable part of S&E employment in the United States—about one-quarter of all S&E jobs (1.6 million) and 40% of all S&E-related jobs (4.5 million) in 2015. About 13% of skilled technical workers in these occupations were black, 10% were Hispanic, 4% were Asian, and about 11% were foreign born. The corresponding shares among college-educated workers in S&E or S&E-related occupations were 7% black, 6% Hispanic, 17% Asian, and 24% foreign born. Thus, in terms of demographic composition, skilled technical workers were more likely to be black or Hispanic than their counterparts with bachelor's degrees.

Skilled technical workers were employed in large numbers in computer occupations and health occupations. Among the 1.6 million skilled technical workers employed in S&E occupations, 69% were concentrated in computer occupations; computer support specialists accounted for the largest subset (27%) of these workers. In comparison, 47% of the college-educated workers in S&E occupations held computer jobs; software developers represented the largest subset (41%) of these workers.

Health occupations accounted for the largest subset of workers in S&E-related occupations (74%). However, skilled technical workers were concentrated in different categories of health occupations than those with a bachelor's degree. For example, about 60% of health workers at the sub-baccalaureate degree level of educational attainment were employed as health technicians or technologists; only 13% of health workers with a college degree were employed in these occupations. Conversely, a larger proportion of health workers with a college degree were employed as registered nurses (61% with a bachelor's degree or higher and 40% of sub-baccalaureate workers, respectively).

Relative to other occupations, S&E and S&E-related occupations provide sound employment for workers at the sub-baccalaureate degree level. In 2015, the median earnings of skilled technical workers in S&E ($60,000) or S&E-related ($45,000) occupations were significantly higher than the median earnings in other occupations ($29,000). The unemployment rate among these workers in S&E (4%) or S&E-related (3%) occupations was lower than the rate in other occupations (7%). Among skilled technical workers in S&E or S&E-related occupations, median salaries ranged from about $35,000 among health care technicians and technologists to $50,000 among S&E technicians, $51,000 among registered nurses, and $60,000 among computer workers. The unemployment rate ranged from 2% among registered nurses to 3% among health care technicians and 4% among computer workers and S&E technicians.

Workers employed in S&E or S&E-related occupations received more formal training (even if they did not have a bachelor's degree) than those employed in other occupations; therefore, it is not surprising that salaries were higher in these jobs. Among skilled technical workers, 69% of those employed in S&E occupations and 73% of those employed in

S&E-related occupations had an associate's degree or 1 or more years of college credit, compared to 36% of those employed in other occupations.

* 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 2015 ACS.

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 3-14 summarizes some basic labor market statistics in 2015 for recent recipients of S&E degrees. *Recent* here is defined as between 1 and 5 years since receiving the highest degree. Among the over 25 million scientists and engineers employed in February 2015, 2.6 million were recent S&E degree recipients. Overall, the unemployment rate among recent S&E graduates was 5.6%, compared with the 3.3% unemployment rate overall among scientists and engineers.

Among recent bachelor's degree holders, the unemployment rate averaged 6.8%, ranging from about 3% for those with computer and mathematical sciences degrees to 12.1% for those with biological, agricultural, and environmental life sciences degrees. Overall, unemployment was generally lower for those with recent doctorates and master's degrees than for those with recent bachelor's level 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 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 (i.e., the IOF rate). Of the nearly 2.6 million employed scientists and engineers who received their highest degree in an S&E field in the previous 5 years, an estimated 10.4% indicated working involuntarily out of field in 2015 (Table 3-14). Therefore, the IOF rate among recent S&E degree recipients in 2015 was higher than the IOF rate among all S&E highest degree holders (7.9%). NSF survey respondents were allowed to report more than one reason for working out of field, as well as the most important reason for working out of field. When asked about the most important reason for working out of field, the reasons most frequently cited by recent S&E degree recipients were lack of a suitable job in their degree field (cited by 32% of those working out of field), followed by pay and promotion opportunities (18%) and change in career or professional interests (14%). The responses provided by all S&E highest degree holders working out of field (regardless of graduation year) were similar, but the factors were ranked differently: the most frequently cited reasons were pay and promotion opportunities (cited by 24% of all S&E highest degree holders working out of field), followed by change in career or professional interests (19%) and lack of a suitable job in their degree field (19%).

IOF rates vary across S&E degree levels and fields. Overall, IOF rates are lower among advanced degree holders compared with those with only bachelor's level degrees, but significant variation exists across degree fields. Among recent bachelor's degree holders, the IOF rate ranged from 3.9% among recent engineering graduates to 19.4% among recent graduates in the social sciences (Table 3-14). Among recent bachelor's degree holders in social sciences, IOF rates were high in most major fields, including political sciences, psychology, and sociology and anthropology.

The median salary for recent S&E bachelor's degree recipients in 2015 was $37,000, ranging from $30,000 in life sciences and physical sciences to $62,000 in engineering (Table 3-14). Recent master's degree recipients had a median salary of $58,000, and recent doctorate recipients had a median salary of $66,000.

TABLE 3-14

Labor market indicators for recent S&E degree recipients up to 5 years after receiving degree, by level and field of highest degree: 2015

(Percent and dollars)

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	5.6	9.2	2.3	4.7	5.3	5.4
Bachelor's	6.8	12.1	2.9	s	5.7	s
Master's	2.8	1.9	s	s	4.6	2.5
Doctorate	2.5	s	s	s	2.4	s
Involuntarily out-of-field (IOF) rate (%)						
All degree levels	10.4	11.3	3.3	11.9	16.2	3.2
Bachelor's	13.3	15.0	4.1	15.1	19.4	3.9
Master's	4.9	s	2.9	s	7.7	2.5
Doctorate	0.6	s	s	s	s	s
Median annual salary ($)						
All degree levels	43,000	31,000	61,000	39,000	35,000	66,000
Bachelor's	37,000	30,000	50,000	30,000	32,000	62,000
Master's	58,000	30,000	79,000	50,000	46,000	75,000
Doctorate	66,000	46,000	100,000	50,000	66,000	98,000

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

Note(s)

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 February 2010 to February 2014. 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(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Recent Doctorate Recipients

The career rewards of highly skilled individuals in general, and of 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 can expand career and salary opportunities, these opportunities may come at the price of many years of lost labor market earnings due to the number of years required to earn the degree.

Unemployment. In February 2015, the unemployment rate for SEH doctorate recipients up to 3 years after receiving their doctorates was 2.7% (Table 3-15), compared to an unemployment rate of 1.8% for all SEH doctorates. The unemployment rate for recent SEH doctorate recipients was also lower than the unemployment rate for the entire population of scientists and engineers, regardless of level or year of award of highest degree (3.3%).

TABLE 3-15

Employment characteristics of recent SEH doctorate recipients up to 3 years after receiving doctorate, by field of degree: 2001–15

(Number and percent)

Field of doctorate	Recent doctorates (number)							Unemployment rate (%)							Involuntarily out-of-field (IOF) rate (%)						
	2001	2003	2006	2008	2010	2013	2015	2001	2003	2006	2008	2010	2013	2015	2001	2003	2006	2008	2010	2013	2015
All recent SEH doctorates	48,700	43,700	49,500	52,600	52,700	45,500	49,400	1.3	2.5	1.2	1.5	2.3	2.7	2.7	2.8	2.1	1.4	1.3	1.8	2.3	1.7
Biological, agricultural, and environmental life sciences	12,300	11,200	12,600	13,400	14,100	12,200	12,900	1.4	2.4	0.9	1.7	1.5	3.4	3.2	2.6	1.0	0.3	1.0	1.5	2.6	0.8
Computer and information sciences	1,600	1,400	1,500	2,400	2,500	2,000	2,400	0.3	4.1	1.9	s	s	s	s	s	s	2.6	1.4	s	s	s
Mathematics and statistics	2,200	1,600	2,000	2,400	2,400	2,200	2,600	0.2	3.4	s	s	s	s	s	1.4	3.4	2.2	1.1	s	s	s
Physical sciences	7,700	6,500	7,400	7,500	7,700	6,400	6,900	1.5	1.3	1.1	3.0	2.6	4.8	4.4	5.4	4.2	2.6	2.3	1.4	1.7	3.0
Psychology	7,200	6,300	7,000	5,800	5,400	4,700	5,000	1.5	2.7	1.2	0.8	3.8	s	2.0	3.0	1.5	1.4	0.8	2.0	s	2.1
Social sciences	5,800	6,000	6,200	5,900	6,000	5,400	6,100	1.6	3.1	1.4	2.1	3.4	3.8	1.7	3.3	3.0	2.3	3.4	3.5	5.9	3.4
Engineering	9,400	8,000	9,500	12,000	11,300	9,600	10,300	1.5	3.0	1.8	1.2	2.7	2.1	3.0	2.0	3.0	1.6	0.7	1.9	2.2	2.0
Health	2,400	2,700	3,200	3,300	3,400	3,000	3,200	0.4	0.7	0.9	1.2	s	s	3.1	s	1.1	s	s	s	s	s

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

SEH = science, engineering, and health.

Note(s)

IOF 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; data for 2013 and 2015 include graduates from 19 months to 36 months prior to the survey reference date. Detail may not add to total because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2001–15), https://www.nsf.gov/statistics/srvydoctoratework/.

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Working involuntarily out of field. About 1.7% of 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 3-15). This was relatively better than the IOF rate for all S&E highest degree holders (7.9%).

Tenure-track positions. Although many science doctorate recipients aspire to tenure-track academic appointments (Sauermann and Roach 2012), most end up working in other types of positions and sectors. In 2015, about 14% of those who had earned their SEH doctorate within the previous 3 years had a tenured or tenure-track faculty appointment (Table 3-16).[4] Across the broad SEH fields, this proportion varied significantly, from less than 10% among recent doctorates in life sciences, physical sciences, and engineering to 38% among those in the social sciences.

The proportion of SEH doctorates who hold a tenured or tenure-track faculty appointment increases with years of experience. In 2015, 18% of SEH doctorates in the labor market for 3–5 years had tenure or a tenure-track appointment, compared with 14% of their colleagues who were within 3 years of doctorate receipt (Table 3-16). The extent of the increase varies across the broad areas of training. In the social sciences, for example, a relatively large percentage of individuals obtain a tenured or tenure-track position within 3 years of earning their doctorate, and the percentage associated with 3–5 years of labor market exposure remains similar; in others fields, such as physical sciences or engineering, this percentage increases. (See Chapter 5 for an in-depth discussion of various types of academic positions held by S&E doctorate holders.)

TABLE 3-16

Employed SEH doctorate recipients holding tenured and tenure-track appointments at academic institutions, by field of and years since degree: Selected years, 1993–2015

(Percent)

Years since doctorate and field	1993	1995	1997	1999	2001	2003	2006	2008	2010	2013	2015
Less than 3 years											
All SEH fields	18.1	16.3	15.8	13.5	16.5	18.6	17.7	16.2	14.7	12.4	14.4
Biological, agricultural, and environmental life sciences	9.0	8.5	9.3	7.7	8.6	7.8	7.2	6.5	7.6	5.3	5.0
Computer and information sciences	31.5	36.5	23.4	18.2	20.7	32.5	31.2	22.0	20.8	21.1	20.8
Mathematics and statistics	40.9	39.8	26.9	18.9	25.2	38.4	31.6	31.3	26.1	25.0	19.2
Physical sciences	8.8	6.9	8.5	7.8	10.0	13.3	9.8	8.8	6.8	6.9	6.2
Psychology	12.8	13.6	14.7	16.0	15.6	14.6	17.0	18.1	16.0	11.1	17.0
Social sciences	43.5	35.9	37.4	35.4	38.5	44.8	39.3	45.4	41.1	38.0	37.9
Engineering	15.0	11.5	9.4	6.4	11.3	10.8	12.4	9.3	7.5	6.6	8.2
Health	33.9	34.2	30.1	28.1	32.1	30.3	36.2	27.7	24.2	20.7	25.8
3–5 years											
All SEH fields	27.0	24.6	24.2	21.0	18.5	23.8	25.9	22.9	19.7	19.4	17.7
Biological, agricultural, and environmental life sciences	17.3	17.0	18.1	16.4	14.3	15.5	13.7	14.3	10.6	10.6	8.1
Computer and information sciences	55.7	37.4	40.7	25.9	17.3	32.2	45.7	37.8	22.2	13.8	23.3
Mathematics and statistics	54.9	45.5	48.1	41.0	28.9	45.5	50.6	40.7	41.7	29.6	23.1
Physical sciences	18.8	15.5	14.5	11.9	15.8	18.3	19.7	16.5	14.7	14.3	16.1
Psychology	17.0	20.7	16.8	17.6	17.5	19.9	23.8	18.3	19.1	17.6	22.4
Social sciences	54.3	52.4	50.4	46.5	38.8	46.0	50.4	48.9	46.7	48.5	38.0
Engineering	22.7	19.3	19.4	12.6	10.8	15.9	16.3	15.5	13.0	14.6	11.3
Health	47.4	40.2	41.1	39.5	25.1	40.8	43.1	34.4	33.3	32.4	30.6

SEH = science, engineering, and health.

Note(s)

Proportions are calculated on the basis of all doctorate recipients 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; data for 2013 and 2015 include graduates from 19 months to 60 months prior to the survey reference date.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (1993–2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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Desirable nonacademic employment opportunities may provide an alternative career path to that of a tenured or tenure-track appointment. Among recent doctorates in most S&E fields, median salaries are significantly higher in the business sector than in tenured or tenure-track academic positions (Table 3-17). The proportion of recent graduates who obtain tenure or tenure-track employment has declined since 1993 in a number of broad areas of SEH training (Table 3-16). One of the steepest declines occurred in computer sciences, particularly among individuals within 3–5 years of receiving their doctorates, despite the high demand for computer sciences faculty.

Salaries for recent SEH doctorate recipients. For all SEH degree fields in 2015, the median annual salary for recent doctorate recipients within 5 years after receiving their degrees was $74,000 (Table 3-17). Across various SEH degree fields, median annual salaries ranged from a low of $54,000 in biological sciences to a high of $114,000 in computer and information sciences. Between 2013 and 2015, median salaries increased overall among recent recipients of SEH doctorates; the median salary for recent SEH doctorate recipients in 2013 was $70,000.

By type of employment, salaries for recent doctorate recipients ranged from $47,000 for postdoctoral positions in 4-year institutions to $99,000 for those employed in the business sector (Table 3-17). Each sector, however, exhibited substantial internal variation by SEH fields of training.

TABLE 3-17

Median salaries for recent SEH doctorate recipients up to 5 years after receiving degree, by field of degree and employment sector: 2015

(Dollars)

Field of doctorate	All sectors	Education					Government	Business or industry
		4-year institutions			2-year or precollege institutions			
		All positions	Tenured or tenure-track position	Postdoc				
All SEH fields	74,000	57,000	72,000	47,000	54,000		82,000	99,000
Biological, agricultural, and environmental life sciences	54,000	48,000	68,000	46,000	44,000		65,000	77,000
Computer and information sciences	114,000	80,000	84,000	63,000	s		102,000	137,000
Mathematics and statistics	77,000	57,000	62,000	53,000	s		99,000	114,000
Physical sciences	72,000	53,000	69,000	48,000	50,000		82,000	95,000
Psychology	67,000	60,000	66,000	47,000	65,000		82,000	76,000
Social sciences	68,000	63,000	69,000	50,000	62,000		85,000	95,000
Engineering	95,000	68,000	83,000	48,000	44,000		93,000	104,000
Health	80,000	74,000	80,000	45,000	s		89,000	96,000

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

SEH = science, engineering, and health.

Note(s)

Salaries are rounded to the nearest $1,000. Data include graduates from 19 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(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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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. Postdoc positions are defined as temporary, short-term positions, primarily for acquiring additional training in an academic, a government, an industry, or a nonprofit setting.[5] In many S&E disciplines, a postdoc position is generally expected to be competitive for obtaining a faculty position.

Individuals in postdoc positions often perform cutting-edge research and receive valuable training. These positions, however, generally offer lower salaries than permanent positions. A factor that has received much attention in science policy is the growth seen over the last three decades in the number of postdocs in both traditional (e.g., life sciences and physical sciences) and nontraditional (e.g., social sciences and engineering) academic disciplines and in an environment where the availability of research-intensive academic positions—the type of jobs for which postdocs are typically trained—have not risen at a similar pace (ACS 2013; NAS/NAE/IOM 2000, 2014; 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.

Number of postdocs. The estimated number of postdocs varies depending on the data source used. No single data source measures the entire population of postdocs. Three NSF surveys—the SDR, the Survey of Graduate Students and Postdoctorates in Science and Engineering, and the Early Career Doctorates Survey (ECDS)[6] —include data related to the number of postdocs in the United States. The three surveys overlap in some populations (such as U.S.-trained doctorate holders and those working in academia) but differ in others. For instance, the SDR covers U.S.-trained postdocs in all sectors—academic, industry, and government—whereas the Survey of Graduate Students and Postdoctorates in Science and Engineering and the ECDS cover both U.S.- and foreign-trained doctorate holders in academia but not all postdocs in the industry and government sectors.[7] In addition, the titles of postdoc researchers vary across organizations and often change as individuals advance through their postdoc appointments; both factors further complicate the data collection process (NIH 2012).

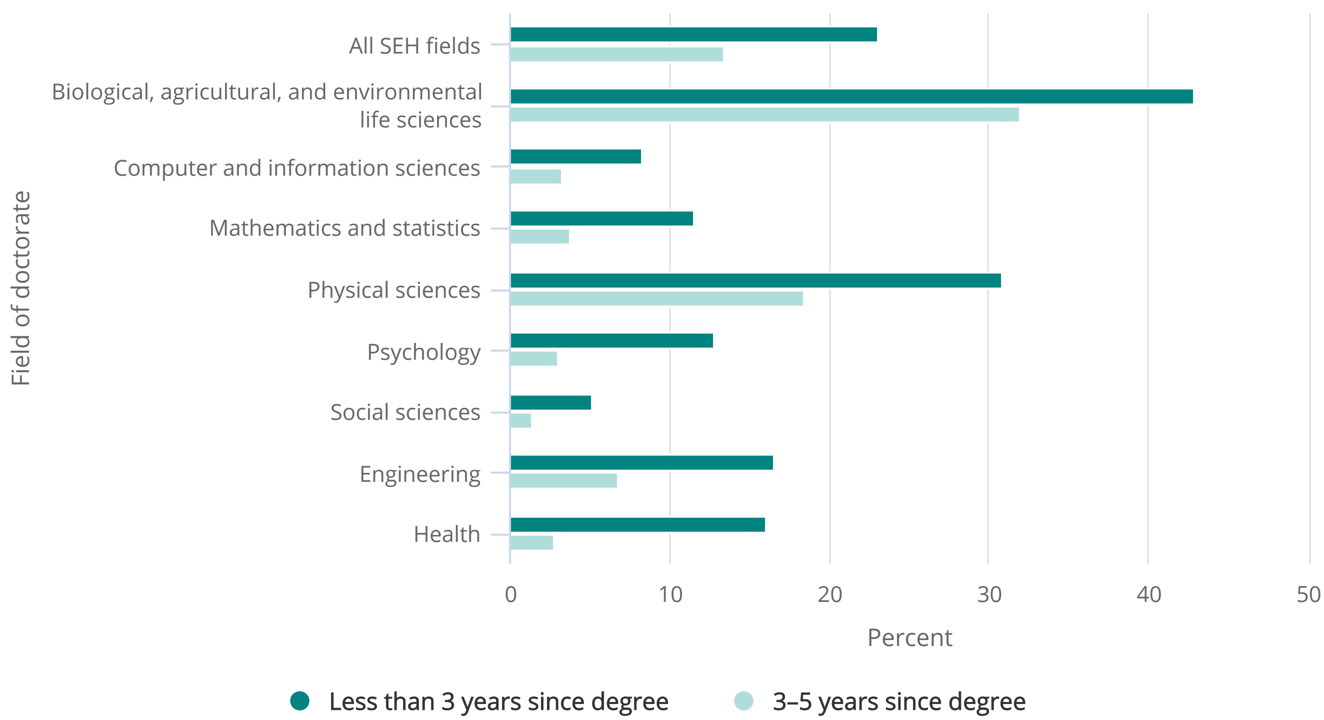
The SDR estimated that 26,700 U.S. SEH doctorate recipients in 2015 were employed in postdoc positions. The majority of these postdoc positions were in 4-year academic institutions (72%), with the remainder in the business sector (19%) and government sector (9%). Within the business sector, nonprofit organizations accounted for most of the postdoc positions. The estimated totals from NCSES's Survey of Graduate Students and Postdoctorates in Science and Engineering and the ECDS are significantly higher: 63,900 and 69,600, respectively, in 2015 (Arbeit and Kang 2017; NSF/NCSES 2017; Phou 2017). Both the SDR and the Survey of Graduate Students and Postdoctorates in Science and Engineering report increases in the number of postdocs since 2003. The SDR reported 30,800 postdocs in 2010 and 19,800 over a decade earlier in 2003, while the Survey of Graduate Students and Postdoctorates in Science and Engineering gives past totals of postdocs at 63,400 in 2010 and 46,700 in 2003.

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. Postdocs have historically been more common in life sciences and physical sciences than in other fields such as social sciences and engineering. Among new doctorate recipients in 2015, 63% in life sciences (including agricultural sciences and natural resources, biological and biomedical sciences, and health sciences) and 64% in physical sciences indicated they would take a postdoc appointment, compared to 38% in psychology and social sciences and 36% in engineering (Appendix Table 3-10).[8] However, in life sciences and physical sciences, the proportion of new doctorate recipients indicating that they would take a postdoc position rose significantly between the mid-1970s and the mid-1990s and has fluctuated within a relatively narrow range since then. In the social sciences, the comparable proportion has continued to rise gradually since the early 1970s. In engineering, the comparable proportion has risen overall between 1975 and 2015, despite periodic fluctuations within this 40-year period.

Another indicator of the variation in postdoc appointments across S&E disciplines is the proportion of recent graduates who are currently employed as a postdoc (as opposed to those who plan to take a postdoc position after graduation). In 2015, over 40% of those who had received their doctorates in the previous 3 years in biological, agricultural, and environmental life sciences and nearly one-third in physical sciences (31%) were employed in postdoc positions, compared to only 5% of those who received doctorates in the social sciences (Figure 3-21).

FIGURE 3-21

Recent U.S. SEH doctorate recipients in postdoc positions, by field of and years since doctorate: 2015



SEH = science, engineering, and health.

Note(s)

Proportions are calculated on the basis of all doctorates working in all sectors of the economy. Data include graduates from 19 months to 60 months prior to the survey reference date (February 2013). Data for computer and information sciences doctorates are suppressed for reasons of confidentiality and/or reliability.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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Postdoc compensation. Low compensation for postdocs is frequently raised as a concern by those who are worried about the effect of the increasing number of postdoc positions on the attractiveness of science careers. In 2015, among individuals who had received their doctorate within the past 5 years, the median salary for postdocs ($47,000) was just over half the median salary for individuals in other positions (i.e., non-postdoc positions) ($82,000) (Table 3-18). The difference in median salary between postdocs and non-postdocs ranged from about half among individuals with doctorates in engineering (52%) and computer and information sciences (53%) to over two-thirds among those with doctorates in the biological, agricultural, and environmental life sciences (69%).

TABLE 3-18

Median salaries for recent U.S. SEH doctorate recipients in postdoc and non-postdoc positions up to 5 years after receiving degree: 2015

(Dollars)

Field of doctorate	All positions	Postdocs	Non-postdocs
All SEH	74,000	47,000	82,000
Biological, agricultural, and environmental life sciences	54,000	46,000	67,000
Computer and information sciences	114,000	63,000	118,000
Mathematics and statistics	77,000	57,000	80,000
Physical sciences	72,000	48,000	84,000
Psychology	67,000	47,000	69,000
Social sciences	68,000	46,000	70,000
Engineering	95,000	51,000	99,000
Health	80,000	45,000	83,000

SEH = science, engineering, and health.

Note(s)

Salaries are rounded to the nearest $1,000. Data include graduates from 19 months to 60 months prior to the survey reference date.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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Based on SDR data, among recent graduates, somewhat larger proportions of postdocs than non-postdocs have access to certain employer-provided benefits, such as health insurance (96% of postdocs and 92% of non-postdocs) and paid vacation, sick, or personal days (89% of postdocs and 85% of non-postdocs). However, a much smaller proportion of recent graduates in postdoc positions have access to employer-provided pensions or retirement plans (52% of postdocs and 82% of non-postdocs) or profit-sharing plans (8% of postdocs and 23% 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 employers, and type of retirement benefits and profit-sharing plans—is not available.

Reasons for taking postdoc positions. The 2015 SDR asked individuals in postdoc positions to report their primary reason for accepting these appointments. 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” (32%), “additional training in PhD field” (17%), “training in an area outside of PhD field” (15%), or “work with a specific person or place” (15%). A smaller proportion (14%) of those in postdoc appointments reported lack of other suitable employment as the primary reason for accepting these positions.

Characteristics of postdocs. According to the Survey of Graduate Students and Postdoctorates in Science and Engineering, women held 40% of the nearly 64,000 academic postdoc positions in 2015 in SEH fields.[9] Temporary visa holders accounted for 55% of the academic postdocs, and U.S. citizens and permanent residents accounted for the remaining 45%. Among postdocs in engineering, however, the proportion of women was lower (22%) and the proportion of temporary visa holders was higher (67%) than the overall SEH shares. Between 1979 and 2015, the number of academic postdocs increased more than threefold, driven primarily by temporary visa holders, who accounted for nearly two-thirds (64%) of the total increase. The majority of academic postdocs (62%) in 2015 were supported by research grants; the rest were supported by fellowships, traineeships, or other mechanisms.

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[1] 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 https://www.nber.org/cycles/recessions.html for additional information. Data on unemployment is from the Bureau of Labor Statistics: https://data.bls.gov/timeseries/LNU04000000 (accessed 14 August 2017). The unemployment rate rose from 9.7% in June 2009, the official end of the recession, until it peaked at 10.6% in January of 2010. It did not fall below the June 2009 rate again until April 2010.

[2] The BLS civilian unemployment rate for persons 16 years and over, not seasonally adjusted, is available at https://data.bls.gov/timeseries/LNU04000000 (accessed 15 December 2016).

[3] The CPS is the source of the official U.S. unemployment rate.

[4] In this chapter, someone who is on tenure track but not yet tenured is referred to as "tenure-track" faculty.

[5] 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.

[6]These estimates are new to this report and are based on the results of NSF's ECDS. This pilot survey was developed to gather in-depth information about postdoc researchers and other early-career doctorate holders. The ECDS collects 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, a federally funded research and development center (FFRDC), or with one of the National Institutes of Health Intramural Research Programs (NIH IRP).

[7]While these surveys do not cover postdocs working in industry and government for the most part, they do collect data on postdocs in FFRDCs, which may be run by for-profit or nonprofit businesses, and the NIH IRP, which is in the government sector.

[8] These data are from the SED, which is administered to individuals receiving research doctoral degrees from all accredited U.S. institutions.

[9] The data tables for the 2015 Survey of Graduate Students and Postdoctorates in Science and Engineering are available at https://ncsesdata.nsf.gov/datatables/gradpostdoc/2015/ (accessed 2 June 2017).

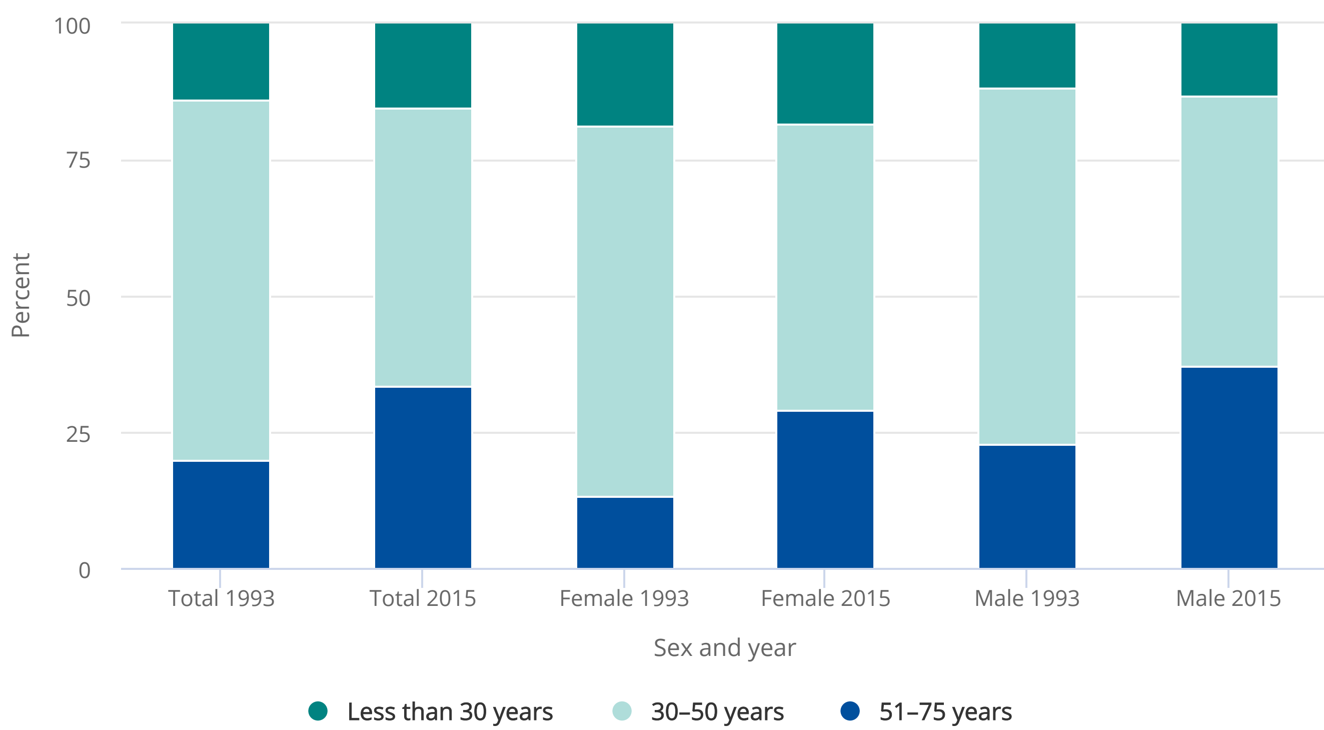
Age and Retirement of the S&E Workforce

The U.S. S&E workforce, reflecting overall population trends, is aging. This section focuses on indicators of the aging of the S&E workforce, including retirement patterns of S&E workers and workforce participation levels among older individuals. The age distribution and retirement patterns of S&E workers have important implications for the supply of S&E expertise in the economy, but the overall effect is uncertain. Over time, members of the S&E labor force may gain skills, experience, and judgment that translate into rising output and productivity. Consequently, the retirement of large numbers of experienced workers could mean the 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. (See Stephan and Levin [1992]; Jones, Reedy, and Weinberg [2014]; and Blau and Weinberg [2017] for in-depth discussions on age and scientific productivity.)

The aging of the S&E labor force is reflected in the median age, which has risen from 40 years in 1993 to 43 years in 2015. For proper context, the median age nationally for the U.S. population was 34 years in 1993 and 38 years in 2015.[1] Another indicator, the percentage of individuals in the S&E labor force between 51 and 75 years of age, has risen from about 20% in 1993 to 33% in 2015. Over that period, this proportion rose for both men and women, but the women in the labor force continue to be younger relative to their male counterparts (Figure 3-22). In 1993, the median ages were 38 years for women and 41 years for men, whereas in 2015 the median ages were 41 years for women and 45 years for men.

FIGURE 3-22

Age distribution of scientists and engineers in the labor force, by sex: 1993 and 2015



Note(s)

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 2013 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) and the National Survey of College Graduates (NSCG) do not cover scientists and engineers over age 75.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993), https://www.nsf.gov/statistics/sestat/, and NSCG (2015), https://www.nsf.gov/statistics/srvygrads/.

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Age Differences among Occupations

College graduate workers in S&E occupations are younger than those in S&E-related or non-S&E occupations (Figure 3-23). In 2015, 28% of those in S&E occupations were between 51 and 75 years of age, compared to 33% of those in S&E-related occupations and 37% of those in non-S&E occupations. The median age of those employed in S&E occupations was 40 years, compared to 43 years among those employed in S&E-related occupations and 44 years for those employed in non-S&E

occupations. This may suggest, among other things, that as S&E workers age, they transition from S&E occupations to S&E-related (e.g., S&E managers) or non-S&E (e.g., non-S&E managers or other management-related) occupations.

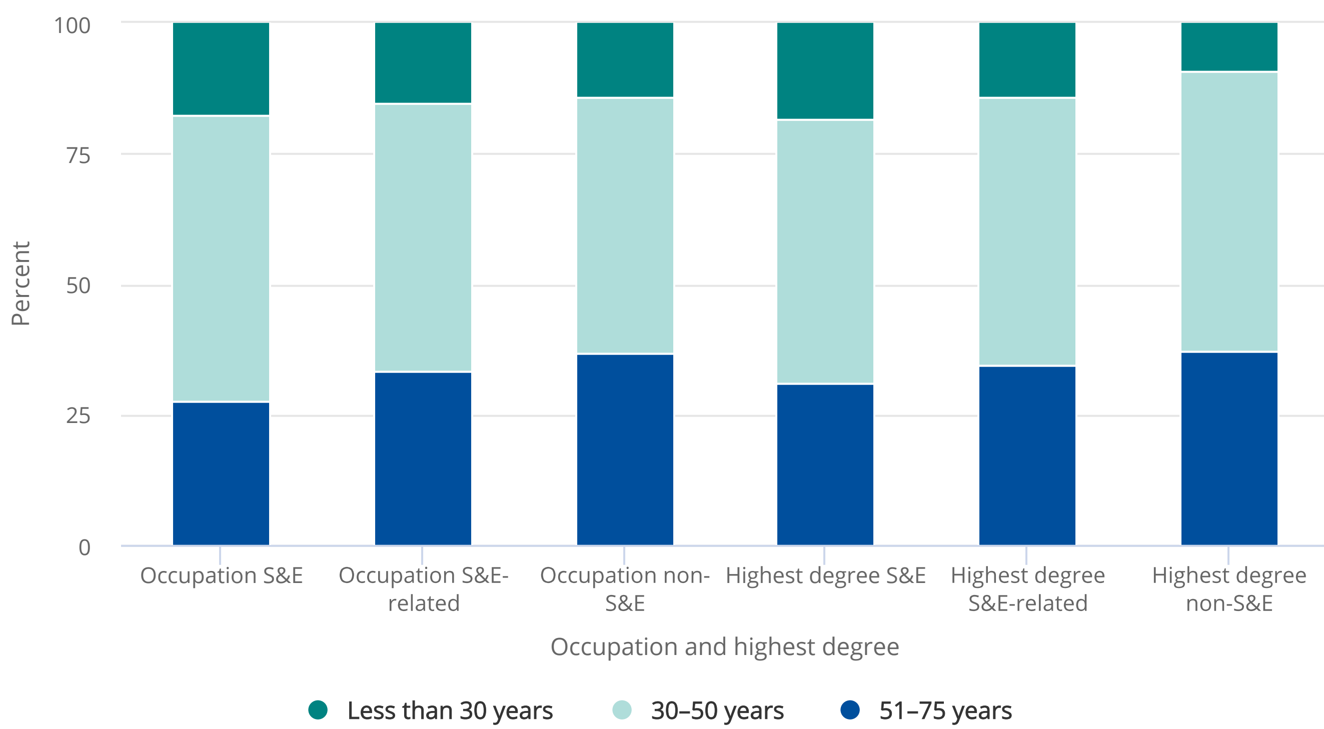
Age Differences among Degree Fields

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 3-23). In 2015, a smaller proportion of S&E highest degree holders (31%) than S&E-related (35%) or non-S&E (37%) highest degree holders were between 51 and 75 years of age. In addition, degree holders in different S&E fields varied in their ages. S&E highest degree holders in physical sciences, particularly the men in this group, were older than those in other broad S&E fields (Appendix Table 3-11). S&E highest degree holders in computer and information sciences, a relatively new field with rapid growth, were relatively young: only about one-fourth were between 51 and 75 years of age.

Within broad degree areas, the age profile of different degree fields varies (Appendix Table 3-11). For example, within life sciences degree fields, between 23% and 29% of highest degree holders in biological sciences and environmental life sciences were between 51 and 75 years of age, compared with 50% of highest degree holders in agricultural and food sciences. In all broad S&E fields of highest degree except computer and mathematical sciences, women were younger than their male counterparts, reflecting the rising proportions of women in S&E (Appendix Table 3-11). Age differences among fields of study vary based on many different considerations, including the recent development of a field or a decline in new participants to a field as that field becomes less relevant to changes in the economy. Age variation may also indicate a situation in which experience is valued over new knowledge.

FIGURE 3-23

Age distribution of employed scientists and engineers, by broad occupational category and broad field of highest degree: 2015



Note(s)

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 National Survey of College Graduates (NSCG) does not cover scientists and engineers over age 75. Percentages may not add to 100% because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, NSCG (2015), https://www.nsf.gov/statistics/srvygrads/.

Science and Engineering Indicators 2018

Retirement

Trends in labor force participation among older individuals provide useful information about retirement patterns and how these patterns 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 the labor force participation rate among scientists and engineers begins to decline sometime between the ages of 55 and 60 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 3-24, which shows the proportions of older scientists and engineers working full time. In 2015, at age 50, 78% of scientists and engineers worked full time (35 hours or more per week) in their principal job. Among individuals in their late 50s, this proportion dropped steeply. Among those in their late 60s, for example, less than one-third worked full time.

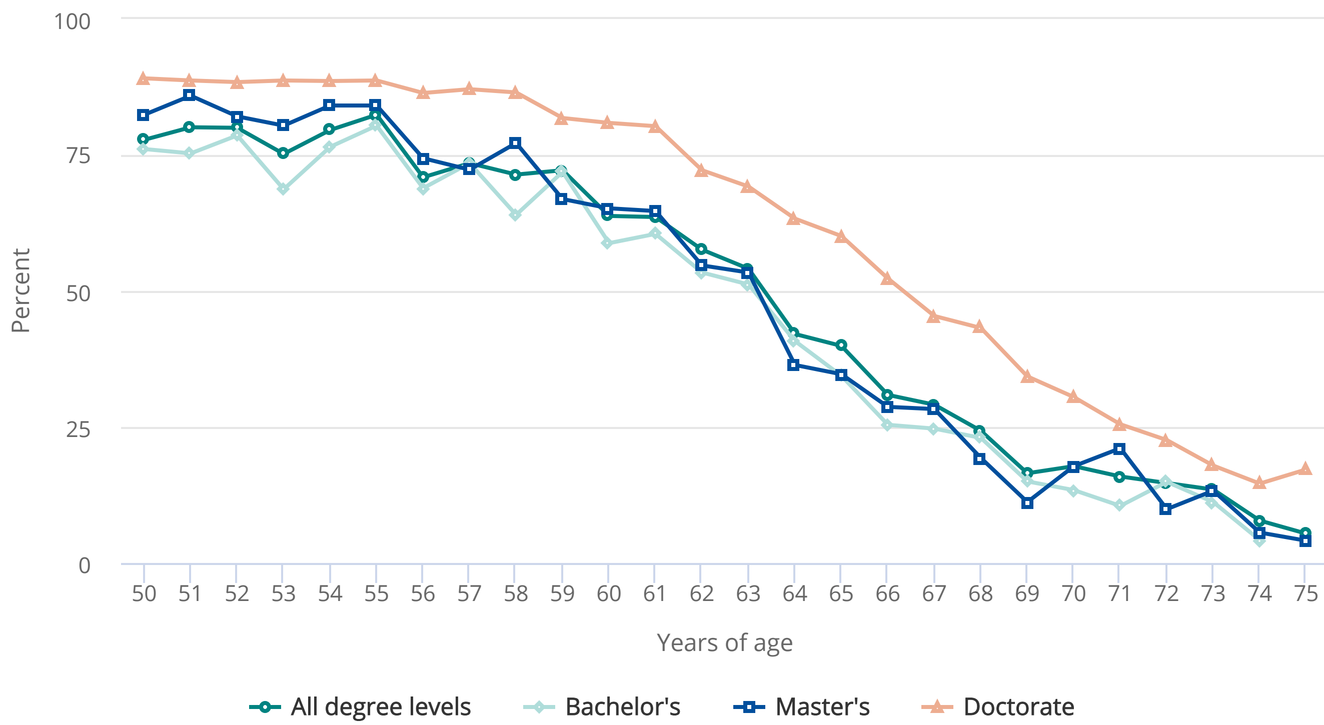
Between 1993 and 2015, increasing proportions of scientists and engineers in their 60s reported still being in the labor force. Whereas 69% of those aged 60–64 were in the labor force in 1993, by 2015 this had risen to 74%. For those between the ages of 65 and 69, the proportion rose from 39% in 1993 to 47% in 2015.[2] (See section Age Composition of the Academic Doctoral Workforce in Chapter 5 for a discussion of the age profile and retirement patterns of the academic S&E doctoral workforce.)

Reasons provided for labor force nonparticipation or part-time work status also shed light on the relationship between age and retirement (Figure 3-25 illustrates the relationship between age and labor force nonparticipation because of retirement). In 2015, about 3.3 million scientists and engineers reported that they were out of the labor force because of retirement. The vast majority (91%) of retired individuals were 60–75 years of age. Individuals with doctorates typically reported lower rates of retirement than those without doctorates.

Retirement 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 1.8 million employed scientists and engineers in 2015 reported that they had previously retired from a job. A total of 793,000 scientists and engineers working part time in 2015 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).

FIGURE 3-24

Older scientists and engineers who work full time, by age and highest degree level: 2015



Note(s)

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. All degree levels includes professional degrees not shown separately. Missing data have been suppressed for reasons of confidentiality and/or reliability.

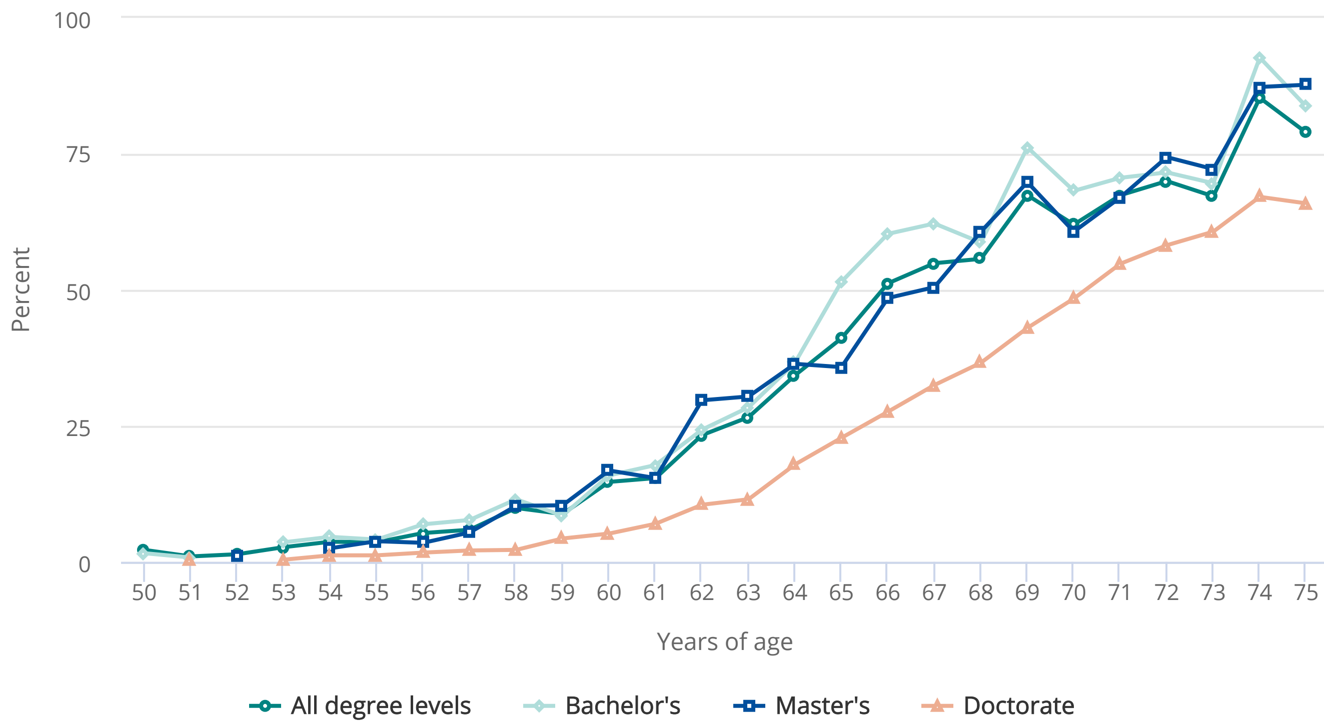
Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/, and the Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

Science and Engineering Indicators 2018

FIGURE 3-25

Older scientists and engineers who report not working because of retirement, by age and highest degree level: 2015



Note(s)

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. All degree levels includes professional degrees not shown separately. Missing data have been suppressed for reasons of confidentiality and/or reliability.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/, and the Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

Science and Engineering Indicators 2018

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[1] The 2015 data on median age for the U.S. population are from the U.S. Census Bureau's American FactFinder and are available at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_DP05&src=pt. The 1993 data are available at https://www.census.gov/population/estimates/nation/intfile3-1.txt (accessed 16 October 2017).

[2] In 1994, the Age Discrimination in Employment Act of 1967 became fully applicable to universities and colleges, prohibiting the forced retirement of faculty at any age.

Women and Minorities in the S&E Workforce

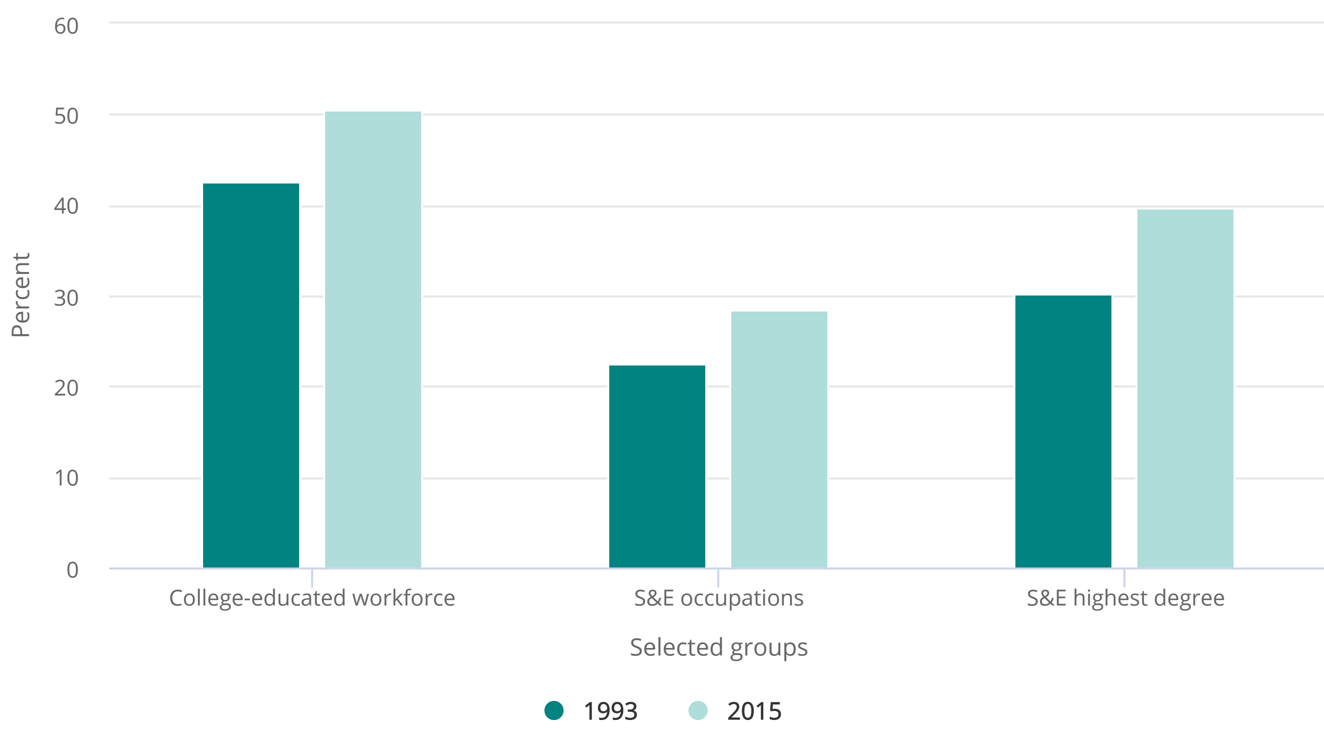
As researchers and policymakers increasingly emphasize the need for expanding S&E capabilities in the United States, demographic groups with lower rates of S&E participation represent an underutilized source of human capital for S&E work. The lower participation signals a lack of diversity in the workplace, negatively impacting productivity and innovation (see Hewlett, Marshall, and Sherbin [2013] and Ellison and Mullin [2014] for discussions on the impact of diversity on workplace productivity and innovation). Historically, in the United States, S&E fields have had particularly low representation of women and members of several 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 overall representation in the general population. More recently, however, women and racial and ethnic minorities increasingly have been choosing a wider range of degrees and occupations. This section presents data on S&E participation among women and among 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 in both S&E employment and S&E training. Although the number of women in S&E occupations or with S&E degrees has doubled over the past two decades, the disparity has narrowed only modestly. This imbalance is still particularly pronounced in S&E occupations. In 2015, women constituted only 28% of workers in these occupations, although they accounted for half of the college-educated workforce overall. Among S&E degree holders, the disparity was smaller but nonetheless significant, with women representing 40% of employed individuals with a highest degree in S&E (Figure 3-26).

FIGURE 3-26

Women in the workforce and in S&E: 1993 and 2015



Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT), https://www.nsf.gov/statistics/sestat/, and the National Survey of College Graduates (NSCG) (1993, 2015), https://www.nsf.gov/statistics/srvygrads/.

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Women in S&E Occupations

Although women represented only 28% of individuals in S&E occupations in 2015, women's participation varies widely across S&E occupational fields (Figure 3-27; Appendix Table 3-12). The percentage of female S&E workers continues to be lowest in engineering, where women constituted 15% of the workforce in 2015. Among engineering occupations with large numbers of workers, women accounted for only 9% of the workforce of mechanical engineers and about 10% to 13% of the workforce of electrical and computer hardware engineers and of aerospace, aeronautical, and astronautical engineers. However, among civil engineers, women make up about one-fifth of the workers (Appendix Table 3-12).

Other disproportionately male S&E occupations include physical scientists (28% women) and computer and mathematical scientists (26% women). Within computer and mathematical sciences occupations, the largest component, computer and information scientists, has a smaller proportion of women (24%) compared with the mathematical scientists component, which is closer to parity (43% women).

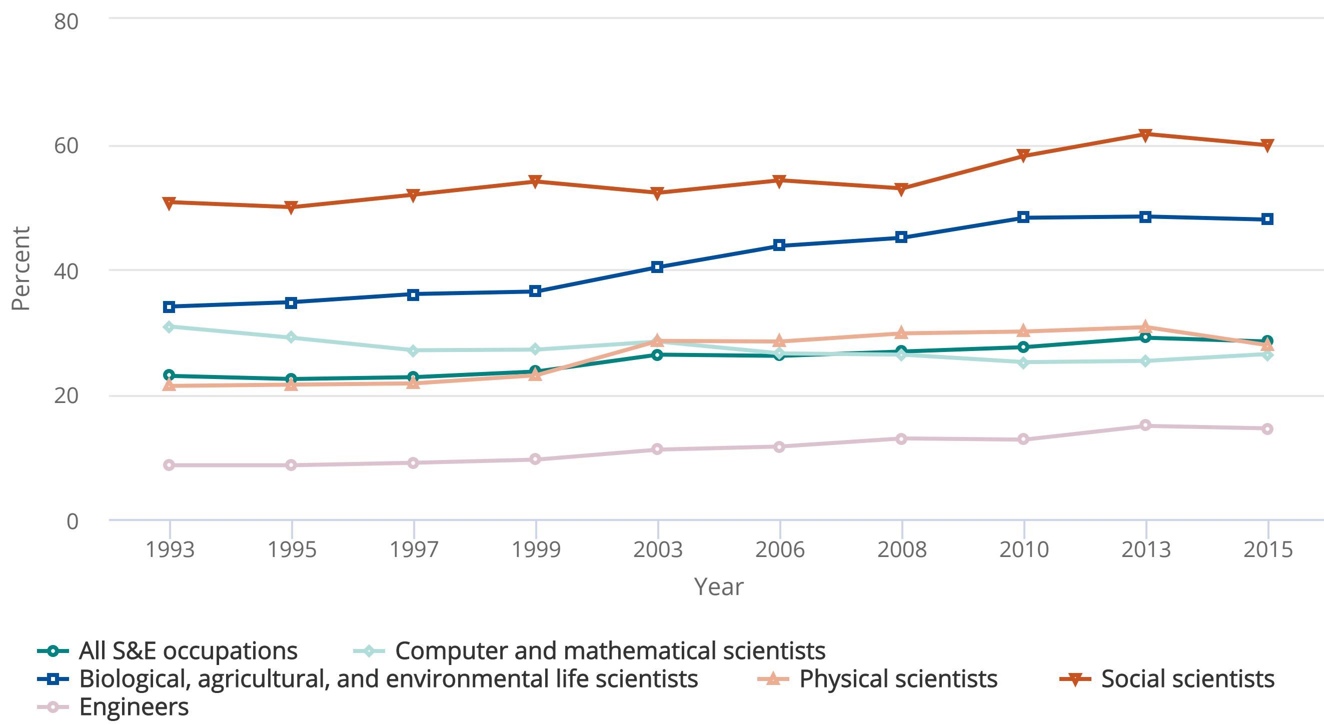
In 2015, sex parity in S&E occupations was close among life scientists (48% women). The largest component of life sciences, biological and medical scientists, had reached gender parity (53% women). The field of social sciences was majority female (60%). Occupations within social sciences, however, varied widely: women accounted for only 38% of economists but for 73% of psychologists. Psychologists, estimated at about 213,000 total workers (Appendix Table 3-12), are 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 (58%) are held by women (Appendix Table 3-12). The largest component, health-related occupations, has a large share of women (70%) whose jobs are primarily as nurse practitioners, pharmacists, registered nurses, dietitians, therapists, physician assistants, and health technologists and technicians; women represented the majority of workers in these particular health occupations. In contrast, among health occupations such as diagnosing and treating practitioners, women accounted for a much smaller proportion (42%).

Since the early 1990s, the number of women working in each broad S&E occupational category has risen significantly (Figure 3-27). The rate of growth has been strong among life scientists, computer and mathematical scientists, and social scientists. These three broad S&E fields together employed 81% of women in S&E occupations in 2015, compared with 63% of men in S&E occupations (Appendix Table 3-12). Between 1993 and 2015, the number of women nearly tripled among life scientists (an increase of 175%) and more than doubled among social scientists (an increase of 112%). 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 3-27

Women in S&E occupations: 1993–2015



Note(s)

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

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993–2013), https://www.nsf.gov/statistics/sestat/, and the National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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During the same period, the number of women in computer and mathematical sciences occupations also nearly tripled (an increase of 173%). However, this new, rapidly growing and changing field attracted relatively more men than women (male participation grew 239%). The result has been an overall decline in the proportion of women, from 31% to 26%. These trends make the gender disparity among computer and mathematical scientists second only to the gender disparity among engineers. However, the declining proportion of women in computer and mathematical sciences occupations does not extend to doctorate-level workers: Among those with a doctorate, the proportion of women increased, from 16% in 1993 to 26% in 2015.

During the past two decades, the proportion of women also increased among workers in engineering (from 9% to 15%) and in physical sciences (from 21% to 28%). In these two occupational categories, this increase was led by an expansion of women's numbers in the workforce (by 108% in engineering and 53% in physical sciences), while men's numbers barely changed between 1993 and 2015.

Women among S&E Highest Degree Holders

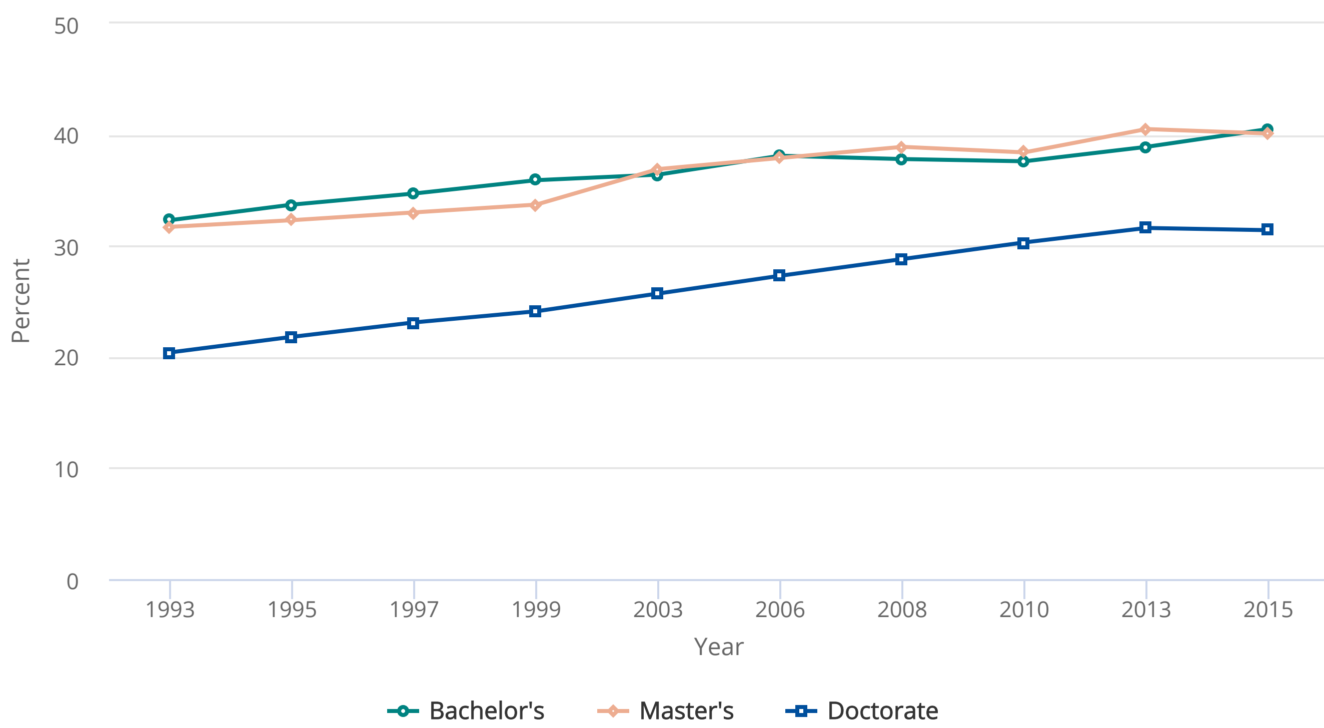
The sex disparity among employed S&E highest degree holders is less than the disparity among those in S&E occupations. In 2015, among individuals with a highest degree in an S&E field, women constituted 40% of those who were employed, up from 30% in 1993 (Figure 3-26). The pattern of variation in the proportion of men and women among degree fields echoes the pattern of variation among occupations associated with those fields (Appendix Table 3-13). In 2015, 57% of S&E highest degree holders in social sciences fields were women, as were 51% of those with a highest degree in the biological and related sciences. Men outnumbered women among computer and mathematical sciences highest degree holders (28% women) and among physical sciences highest degree holders (34% women). Disparities, however, were greatest among those with a highest degree in engineering (15% women).

In all broad S&E fields except computer and mathematical sciences, the proportion of women in the workforce with associated highest degrees has been increasing since 1993. In computer and mathematical sciences, this proportion has declined as the number of women with a highest degree in the field has risen, but women's numbers have increased less than those of men in this new and rapidly growing field.

Sex differences are not limited to the field of degree but also extend to the level of S&E degree. Overall, men outnumber women among S&E highest degree holders at the bachelor's, master's, and doctoral degree levels. The sex disparity is more severe among S&E doctorate holders than among S&E bachelor's or master's degree holders. For example, in 2015, women accounted for 41% and 40% of those whose highest degree in S&E was at the bachelor's or master's degree level, respectively, but for 31% of those whose highest degree in S&E was at the doctoral level. Engineering was an exception: in this field, women represented similar proportions of highest degree holders at the bachelor's (15%) and doctorate degree levels (13%). However, for S&E fields overall at all three degree levels, the proportion of women has risen in the past two decades (Figure 3-28).

FIGURE 3-28

Employed women with highest degree in S&E, by degree level: 1993–2015



Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1993–2013), https://www.nsf.gov/statistics/sestat/, and the National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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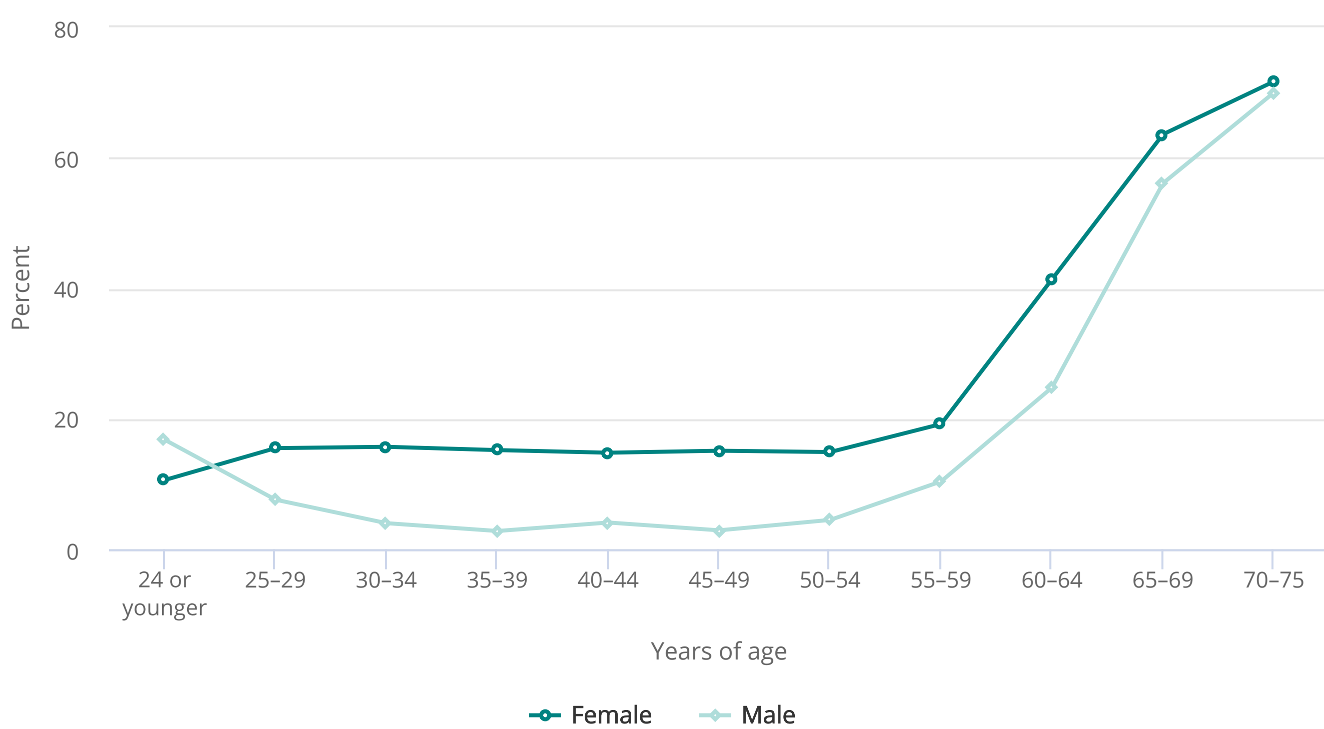
Working men and women with S&E highest degrees also differ in the extent to which they are employed in the same field as their S&E highest degree. This disparity is largely the result of women having a high concentration in the two degree areas —social sciences and life sciences—where degree holders most often work in an occupation outside of S&E. In 2015, these two broad fields accounted for nearly three-fourths (74%) of all employed women with S&E highest degrees, compared with 40% of all employed men with S&E highest degrees (Appendix Table 3-13).

Across all S&E degree areas, 18% of women with an S&E highest degree are employed in the S&E field in which they earned their highest degree, compared with 33% of men (Appendix Table 3-14). However, the pattern varies by degree fields. Among life sciences and engineering degree holders, similar proportions of men and women are employed in the broad S&E field in which they earned their degree. Computer and mathematical sciences fields represent an exception in which a larger proportion of men (59%) than women (43%) work in an occupation that matches their broad degree field and a larger proportion of women (37%) than men (25%) work in non-S&E occupations. The majority of social sciences degree holders work in non-S&E occupations, and this pattern is observed among both male (78%) and female (81%) degree holders.

Men and women with a highest degree in an S&E field also differ in their labor force nonparticipation rates. Compared with men, women are more likely to be out of the labor force (22% versus 16% for men). The difference in nonparticipation was particularly pronounced between the ages of 30 and 65 (Figure 3-29). In 2015, 19% of the women in this age group with an S&E highest degree were out of the labor force, compared with 8% of the men. Many women in this group identified family reasons as an important factor: 44% of women reported that family was a factor for their labor force nonparticipation, compared with 12% 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 (29% of women versus 17% of men). Men, on the other hand, were much more likely than women to cite retirement as a reason for not working (24% of women versus 50% of men).

FIGURE 3-29

Highest degree holders in S&E not in the labor force, by sex and age: 2015



Note(s)

Not in the labor force includes those neither working nor looking for work in the 4 weeks prior to February 2015.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2015), https://www.nsf.gov/statistics/sestat/.

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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.[1] Like the preceding section, this section draws on data from NSF's 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 a combination of the two, the majority of scientists and engineers in the United States are non-Hispanic whites. The next largest group of scientists and engineers are Asians. 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 3-19).

Race and Ethnicity Trends in S&E Occupations

In 2015, among the 6.4 million workers employed in S&E occupations, 67% were white, which is close to the proportion (66%) in the U.S. population age 21 and older (Table 3-19). However, S&E participation by whites varied across the broad S&E occupational categories, from 62% of computer and mathematical scientists to 70% or more among the remaining broad S&E occupational fields of biological and life scientists, physical and related scientists, social scientists, and engineers (Appendix Table 3-15). The concentration of whites in some occupations was more pronounced: they accounted for at least 90% of workers among forestry and conservation scientists and geologists and earth scientists.

Asians, with 1.3 million workers in S&E occupations, accounted for 21% of S&E employment, much higher than their share of the U.S. population age 21 and older (6%). Asians had a large presence in computer and engineering occupations, constituting 38% of computer software engineers, 34% of software developers, 34% of computer hardware engineers, 36% of computer and information research scientists, and 30% of postsecondary teachers in engineering (Appendix Table 3-15). On the contrary, the proportion of Asians in social sciences occupations was much lower than their proportions in other S&E fields.

Overall, Hispanics accounted for 6% of employment in S&E occupations, which is lower than their share of the U.S. population age 21 and older (15%) (Table 3-19). Hispanics had a particularly large presence among psychologists (13%) and economists (13%); aerospace, aeronautical, or astronautical engineers (12%); and industrial engineers (9%). Blacks accounted for 5% of S&E employment, which is lower than their share of the U.S. population age 21 and older (12%). Blacks had relatively high participation rates among computer systems analysts (8%), computer support specialists (10%), information security analysts (13%), psychologists (9%), and industrial engineers (9%).

TABLE 3-19

Racial and ethnic distribution of U.S. residents, and of employed individuals in S&E occupations, with S&E degrees, and with college degrees: 2015

(Percent)

Race and ethnicity	S&E occupations	S&E highest degree holders	College degree holders	U.S. residential population[a]
Total (number)	6,407,000	13,497,000	45,941,000	231,875,000
American Indian or Alaska Native	0.2	0.3	0.3	0.6
Asian	20.6	15.1	8.7	5.5
Black	4.8	6.4	7.5	11.8
Hispanic	6.0	8.4	8.2	14.9
Native Hawaiian or Other Pacific Islander	0.2	0.3	0.4	0.1
White	66.6	67.6	72.9	65.6
More than one race	1.6	1.9	2.0	1.5

[a] Age 21 and older.

Note(s)

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(s)

Census Bureau, American Community Survey (ACS) (2015); National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Over the past two decades, the U.S. workforce in S&E occupations has become more diverse, with increasing proportions of Asians, blacks, and Hispanics and a decreasing proportion of whites (Table 3-20). In 1993, 84% of workers in S&E occupations reported their race as white. By 2015, this proportion had declined to 67%. 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 increases in the proportion of other groups, particularly Hispanics.

Some of the changes by race over time may reflect changes in the way that NSF and other federal agencies collect information on this topic as well as changes in racial composition of the general population over time. After 2000, respondents to NSF surveys were able to report more than one race. Some of those who self-reported as white in the 1990s may have instead reported a multiracial identity after 2000 once they were given this 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 2015.

TABLE 3-20

Distribution of workers in S&E occupations, by race and ethnicity: Selected years, 1993–2015

(Percent)

Race and ethnicity	1993	1995	1997	1999	2003	2006	2008	2010	2013	2015
American Indian or Alaska Native	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.2	0.2	0.2
Asian	9.1	9.6	10.4	11.0	14.2	16.1	16.9	18.5	17.4	20.6
Black	3.6	3.4	3.4	3.4	4.3	3.9	3.9	4.6	4.8	4.8
Hispanic	2.9	2.8	3.1	3.4	4.4	4.6	4.9	5.2	6.1	6.0
Native Hawaiian or Other Pacific Islander	NA	NA	NA	NA	0.3	0.5	0.4	0.2	0.2	0.2
White	84.1	83.9	82.9	81.8	75.2	73.2	71.8	69.9	69.9	66.6
More than one race	NA	NA	NA	NA	1.4	1.4	1.7	1.4	1.5	1.6

NA = not available.

Note(s)

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. Before 2003, respondents could not classify themselves in more than one racial and ethnic category, and Asian included Native Hawaiian and Other Pacific Islander. Percentages may not add to 100% because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1993–2013), https://www.nsf.gov/statistics/sestat/, and the National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Racial and Ethnic Differences among S&E Degree Holders

Among those in the workforce whose highest degree is in S&E, the shares of racial and ethnic groups vary similarly across degree fields, as they do in occupations (Table 3-21; Appendix Table 3-16). Compared to most other broad S&E fields, Asians have higher participation rates among those with degrees in engineering and in computer and mathematical sciences; blacks have higher participation rates among those with degrees in computer and mathematical sciences and in social sciences; Hispanics have slightly lower participation rates among those with degrees in computer and mathematical sciences and in physical sciences. Whites represent smaller segments of degree holders in engineering and computer and mathematical sciences than in life, physical, and social sciences.

TABLE 3-21

Racial and ethnic distribution of employed individuals with S&E highest degree, by field of highest degree: 2015

(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 (number)	13,497,000	2,116,000	2,346,000	789,000	5,056,000	3,190,000
American Indian or Alaska Native	0.3	0.3	0.1	s	0.4	0.3
Asian	15.1	13.3	23.1	17.5	7.1	22.5
Black	6.4	5.4	7.3	3.2	8.6	3.8
Hispanic	8.4	8.2	5.8	5.4	10.0	8.7
Native Hawaiian or Other Pacific Islander	0.3	0.2	0.3	s	0.5	0.2
White	67.6	71.1	61.6	72.4	70.9	63.1
More than one race	1.9	1.6	1.8	1.0	2.5	1.4

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

Note(s)

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. Percentages may not add to 100% because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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The demographic groups also differ in the level of their S&E highest degree (Table 3-22), with Asians accounting for larger proportions of those whose highest degree is at the master's or doctoral level, relative to their counterparts with a highest degree at the bachelor's level. Conversely, blacks, Hispanics, and whites all represent larger proportions of those whose highest degree is at the bachelor's degree level, relative to those with a doctorate as their highest degree.

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. Among black, Hispanic, and white S&E degree holders, between 20% and 26% work in their same broad field, compared to 37% among Asian S&E degree holders (Appendix Table 3-14).

TABLE 3-22

Racial and ethnic distribution of employed individuals with S&E highest degree, by level of highest degree: 2015

(Percent)

Race and ethnicity	Bachelor's	Master's	Doctorate
Employed with highest degree in S&E (number)	9,539,000	2,934,000	992,000
American Indian or Alaska Native	0.3	0.2	s
Asian	11.2	25.0	23.2
Black	7.1	5.4	3.4
Hispanic	9.1	7.3	4.6
Native Hawaiian or Other Pacific Islander	0.4	0.1	s
White	69.9	60.4	66.9
More than one race	2.0	1.6	1.3

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

Note(s)

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(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Women in S&E by Race and Ethnicity

The rise in female participation in S&E over the past two decades was the result of increasing participation by all race and ethnic groups, although the growth among Asian and Hispanic women was particularly strong. Among workers in S&E occupations, the number of women who identified themselves as Asian or Hispanic increased sixfold between 1995 and 2015. As a result, both the Asian share and the Hispanic share of female workers in S&E occupations rose during this period (Table 3-23). The number of women employed in S&E occupations who reported themselves as black more than doubled (rising by 159%) between 1995 and 2015. In comparison, although the number of female workers who identified themselves as being white and not of Hispanic origin rose substantially (97%), their participation did not grow as steeply as members of other race and ethnic groups, resulting in an overall decline in the share of white female S&E workers over time (Table 3-23). A broadly similar pattern is observed among female S&E highest degree holders.

TABLE 3-23

Racial and ethnic distribution of employed women in S&E occupations and with S&E highest degrees: 1995 and 2015

(Percent)

Race and ethnicity	Women in S&E occupations		Women with S&E highest degrees	
	1995	2015	1995	2015
Total (number)	714,000	1,818,000	2,391,000	5,376,000
American Indian or Alaska Native	0.3	0.1	0.3	0.2
Asian	9.8	22.9	7.2	14.1
Black	5.6	5.7	7.9	8.2
Hispanic	2.9	6.4	3.8	10.2
Native Hawaiian or Other Pacific Islander	NA	0.1	NA	0.2
White	81.3	62.9	80.8	64.9
More than one race	NA	1.7	NA	2.2

NA = not available.

Note(s)

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. In 1993, respondents could not classify themselves in more than one racial and ethnic category, and Asian included Native Hawaiian and Other Pacific Islander. Percentages may not add to 100% because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1995), https://www.nsf.gov/statistics/sestat/, and the National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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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 3-24). However, salary differences between men and women were somewhat larger than salary differences among racial and ethnic groups (Table 3-24; Appendix Table 3-17 and Appendix Table 3-18).

TABLE 3-24

Median annual salary among S&E highest degree holders working full time, by sex, race, and ethnicity: 1995, 2003, and 2015

(Dollars)

Characteristic	1995	2003	2015
All	44,000	60,000	75,000
Sex			
Female	34,000	45,000	57,000
Male	49,000	68,000	86,000
Race and ethnicity			
American Indian or Alaska Native	s	48,000	62,000
Asian	45,000	64,000	85,000
Black	35,000	48,000	55,000
Hispanic	38,000	50,000	59,000
Native Hawaiian or Other Pacific Islander	NA	56,000	74,000
White	45,000	60,000	78,000
More than one race	NA	50,000	61,000

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

Note(s)

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(s)

National Science Foundation, National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) (1995, 2003), https://www.nsf.gov/statistics/sestat/, and the National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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Effects of Education, Employment, and Experience on Salary Differences

Salaries differ across degree field, occupational field and sector, and experience. Such differences in degree and occupational fields account for a portion of the salary differences by sex and by race and ethnicity. Median salaries in 2015 were generally higher among full-time workers with a highest degree in engineering ($92,000), computer and mathematical sciences ($97,000), or physical sciences ($78,000) than for those with a highest degree in life sciences ($62,000) or social sciences ($69,000). Degree areas with lower salaries generally have higher concentrations of women and of racial and ethnic minorities. Disproportionately larger shares of degree holders in life sciences, and particularly in social sciences, compared with other S&E degree fields, work in occupations not categorized as S&E, and the salaries for these occupations are generally lower than for S&E occupations (Appendix Table 3-17).

Salaries also differ across employment sectors. Academic and nonprofit employers typically pay less for similar skills than employers in the private sector, and government compensation generally falls somewhere between these two groups. These differences are important 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 and years since completing one's degree. Because of the rapid increase in female participation in S&E fields in recent years, women with S&E degrees who are employed full time generally have fewer years of labor market experience than their male counterparts: the median number of years since highest degree is 14 years for women versus 17 years for men; the median age is 39 years for women versus 43 years for men. Whites with S&E degrees who are employed full time also generally have more years of labor market experience than other racial and ethnic groups: the median number of years since highest degree is 18 years for whites, 14 years for Asians, 11 years for Hispanics, and 12 years for blacks.

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 differences 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 analyses presented in this section show that statistical models used to control for effects of education, experience, and other factors on salaries tend to reduce, but not fully eliminate, the disparities. 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, occupational field and sector, number of children, and other relevant characteristics that are likely to influence salaries. Data related to salary differences between minorities (American Indians or Alaska Natives, blacks, Hispanics, Native Hawaiians or Other Pacific Islanders, and those reporting more than one race) and Asians and whites are also included.

Accounting only for level of degree, women working full time whose highest S&E degree is at the bachelor's level earned 30% less than men (Figure 3-30).[2] The salary difference is smaller but substantial at both the master's level (28%) and the doctoral level (21%). The salary differences for non-Asian minorities relative to whites and Asians are narrower (Figure 3-31). On average, minority salary levels are 24% lower than those of whites and Asians at the bachelor's level, 18% lower at the master's level, and 14% lower at the doctoral level.

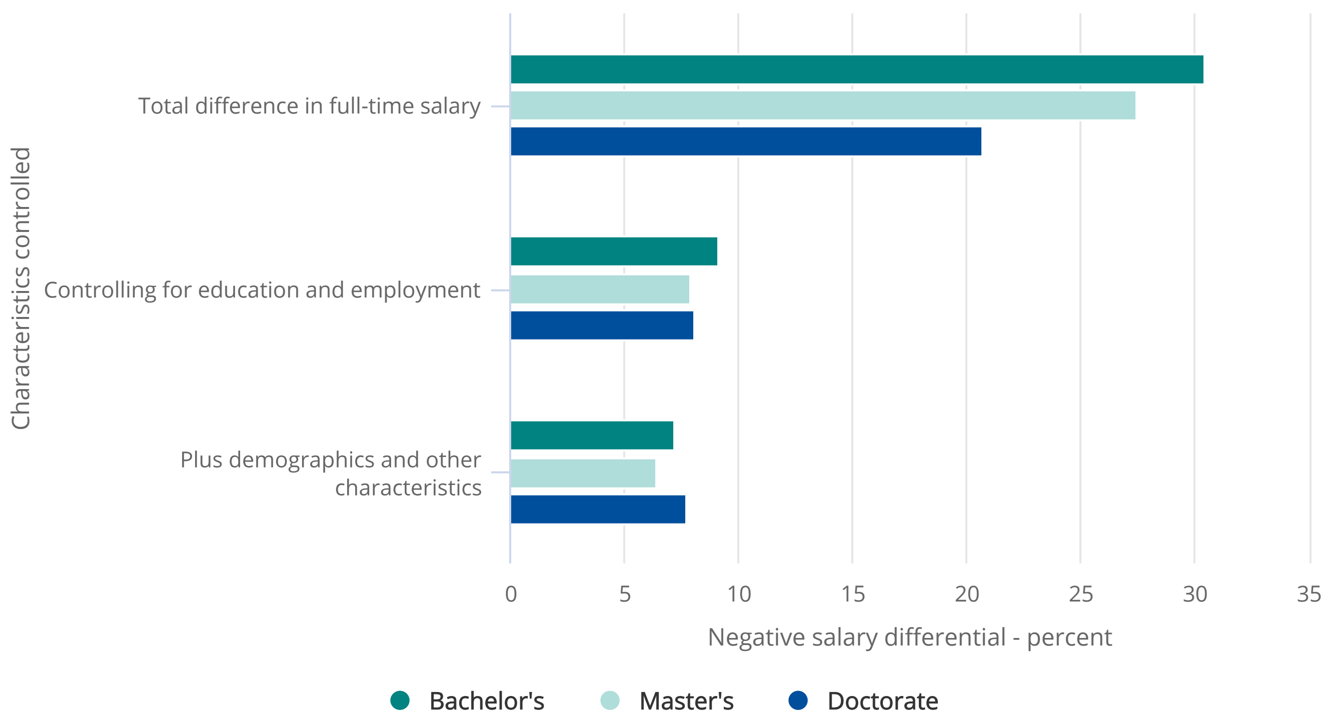
Controlling for the effects of differences in field of highest degree, degree-granting institution, field of occupation, employment sector, and experience,[3] the estimated salary difference between men and women narrows by more than half (Figure 3-30). However, women still earn 9% less than men among individuals whose highest degree is at the bachelor's level, and 8% less than men among individuals whose highest degree is at the master's or doctoral level. The pattern by degree level is similar among racial and ethnic groups: compared with whites and Asians, S&E highest degree holders in other racial and ethnic groups working full time earn 9% and 5% less for the bachelor's and doctoral degree levels, respectively (Figure 3-31). [4]

The analysis of salary differences suggests that attributes related to human capital (fields of education and occupation, employment sector, and experience) rather than socioeconomic and demographic attributes have a greater influence 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.[5]

Readers should keep in mind that the interaction between demographic attributes and those related to human capital are complicated. For instance, among scientists and engineers who are not working, women are more likely than men to report family reasons for not working, and this pattern is quite robust across race and ethnic groups (it holds for Asians, whites, and underrepresented minorities). Furthermore, women who remain in the workforce may choose labor-force pathways that are more amenable to having a family. For example, among scientists and engineers who work part time, women are more likely than men to cite family reasons for working part time.[6] These factors are likely to affect labor market outcomes for women and thus complicate the analysis involving human capital, demographic attributes, and salary differences.

FIGURE 3-30

Estimated salary differences between women and men with highest degree in S&E employed full time, controlling for selected characteristics, by degree level: 2015



Note(s)

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 the dependent variable and then transformed into percentage difference. Controlling for education and employment includes 20 field-of-degree categories (out of 21 S&E fields), 38 occupational categories (out of 39 categories), 6 employment sector categories (out of 7 categories), years since highest degree, and years since highest degree squared. In addition to the above education- and employment-related variables, plus demographics and other characteristics includes the following indicators: nativity and citizenship, race and ethnic minority, marital status, disability, number of children living in the household, geographic region (classified into 9 U.S. Census divisions), and whether either parent holds a bachelor's or higher-level degree.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/, and the Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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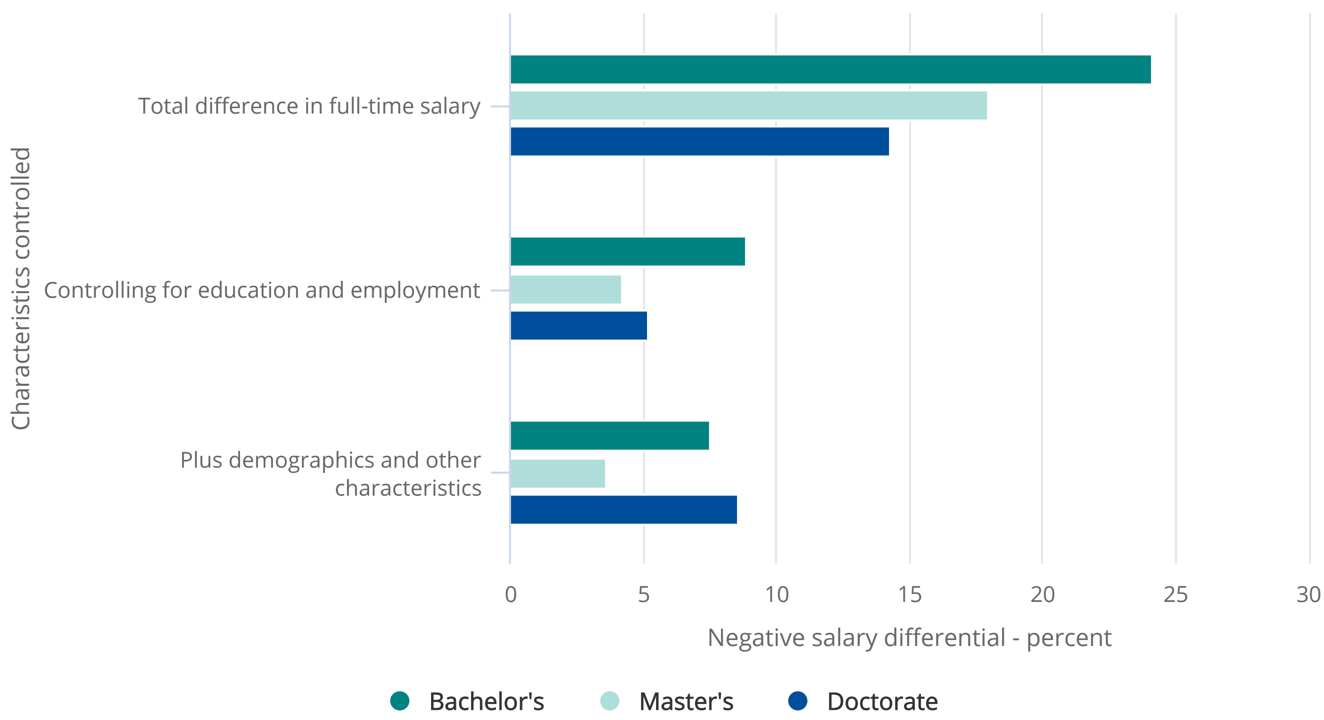
FIGURE 3-31

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: 2015



Note(s)

The estimates for master's degrees in the "controlling for education and employment" and "plus demographics and other characteristics" categories are not statistically significant at the 90% confidence level. 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 the dependent variable and then transformed into percentage difference. Minorities include American Indians or Alaska Natives, blacks, Hispanics (of any race), Native Hawaiians or Other Pacific Islanders, and those reporting more than one race. Controlling for education and employment includes 20 field-of-degree categories (out of 21 S&E fields), 38 occupational categories (out of 39 categories), 6 employment sector categories (out of 7 categories), years since highest degree, and years since highest degree squared. In addition to the above education- and employment-related variables, plus demographics and other characteristics includes the following indicators: nativity and citizenship, sex, marital status, disability, number of children living in the household, geographic region (classified into 9 U.S. Census divisions), and whether either parent holds a bachelor's or higher-level degree.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/, and the Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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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, including (but not limited to) factors affecting individual career- and education-related decisions, differences in how individuals balance family obligations and career aspirations, and 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 such measures of personal and family characteristics to education, occupation, and experience results in only marginal changes in the estimated salary differences between men and women, and among racial and ethnic groups,[7] compared with estimates that account for education, occupation, and experience alone. Women's adjusted salary differentials are 8% among S&E doctorates—7% among S&E bachelor's degree and 6% among master's degree holders (Figure 3-30). Adjusted salary differences among racial and ethnic groups are approximately 8% and 9% among bachelor's degree and doctorate holders, respectively (Figure 3-31).[8]

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[1] 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.

[2] 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 February 2015. Coefficients are estimated in an ordinary least squares regression model using a 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 earnings.

[3]Included are 20 NCSES-classified field-of-degree categories (out of 21 S&E fields), 38 NCSES-classified occupational categories (out of 39 categories), 6 NCSES-classified employment sector categories (out of 7), years since highest degree, and years since highest degree squared.

[4] The estimates in Figure 3-31 for the last two models of the master's degree level, 4.2 and 3.6, respectively, are not significant at the 90% confidence level.

[5] 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).

[6] See Figures 6-B and 6-C in "Employment Status" from National Science Foundation, National Center for Science and Engineering Statistics (2017).

[7]In addition to the education- and employment-related variables, the following indicators are included in wage regression models: 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.

[8] The estimates in Figure 3-31 for the last two models of the master's degree level, 4.2 and 3.6, respectively, are not significant at the 90% confidence level.

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. doctorates remain in the United States after earning their degree. Data from various sources, including NSF (the NSCG and SED), the Census Bureau, and the U.S. Citizenship and Immigration Services (USCIS) are discussed to study the immigrant S&E workforce in the United States.[1]

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.

Nationally representative survey data, such as NSF and Census survey data, although collected in different ways, yield broadly consistent estimates of the number of foreign-born scientists and engineers in the United States. In 2015, foreign-born individuals accounted for 29% to 30% of college-educated workers employed in S&E occupations in the United States (Table 3-25), which is higher than their representation in both the overall population (13%) and among all college graduates (17%). Both the number and proportion of foreign-born workers employed in S&E occupations in the United States have risen over time (Table 3-25).

TABLE 3-25

Foreign-born workers in S&E occupations, by education level: 1993, 2003, and 2015

(Percent)

Education	1993	2003		2015	
	SESTAT	SESTAT	ACS	NSCG	ACS
All college educated	15.8	22.6	25.2	30.0	28.8
Bachelor's	11.4	16.4	18.7	21.2	21.1
Master's	20.7	29.4	32.0	40.6	38.2
Doctorate	26.8	36.4	38.7	42.3	45.3

ACS = American Community Survey; NSCG = National Survey of College Graduates; SESTAT = Scientists and Engineers Statistical Data System.

Note(s)

All college educated includes professional degree holders not broken out separately. The data from the ACS include all S&E occupations except postsecondary teachers of S&E because these occupations are not separately identifiable in the ACS data files.

Source(s)

Census Bureau, ACS Public Use Microdata Sample (PUMS) (2003, 2015); National Science Foundation, National Center for Science and Engineering Statistics, SESTAT (1993, 2003), https://www.nsf.gov/statistics/sestat/, and NSCG (2015), https://www.nsf.gov/statistics/srvygrads/.

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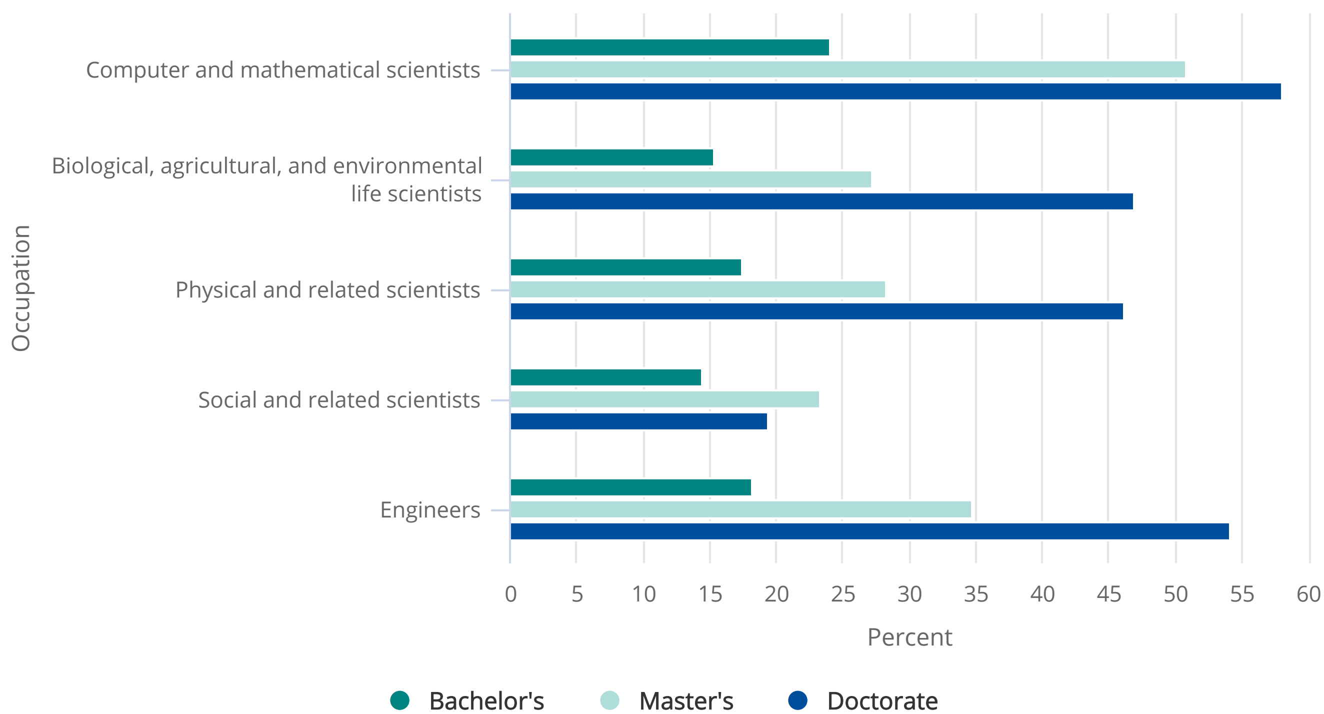
Characteristics of Foreign-Born Scientists and Engineers

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, 17% of foreign-born workers have a doctorate, compared to 10% of U.S. native-born individuals 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 3-32). This association is strongest among computer and mathematical scientists and engineers. In 2015, at the bachelor's degree level, the proportion of foreign-born individuals in S&E occupations ranged from 14% (social scientists) to 24% (computer and mathematical scientists). However, at the doctoral level, over 45% were foreign born in each S&E occupation except social sciences.

FIGURE 3-32

Foreign-born scientists and engineers employed in S&E occupations, by highest degree level and broad S&E occupational category: 2015



Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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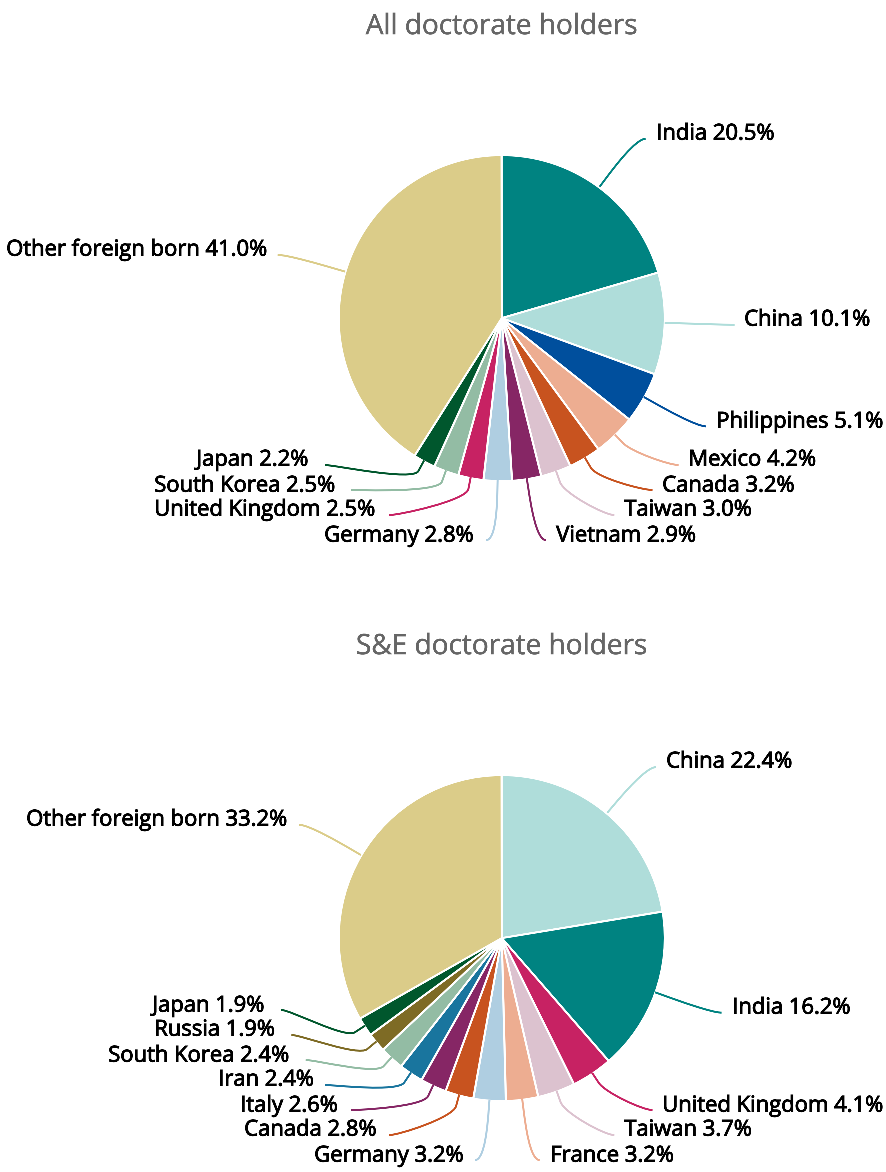
In 2015, among scientists and engineers employed in S&E occupations, foreign-born workers (median age 39 years) were younger than their native-born counterparts (median age 42 years). The distribution by sex was largely similar across foreign-born (30% female) and native-born (28% female) workers in S&E occupations. Asians accounted for 61% of foreign-born workers in S&E occupations but for only 3% of U.S. native-born workers in these occupations (Appendix Table 3-19). In comparison, whites represented 24% of foreign-born workers in S&E occupations but 85% of native-born workers in these occupations. Nearly 90% of all Asians employed in S&E occupations were foreign born.

In 2015, 58% of foreign-born individuals in the United States with an S&E highest degree were from Asia; another 13% were from Europe. North and Central America, the Caribbean, South America, and Africa each supplied from 3% to 5% of the foreign-born S&E highest degree holders in the United States. In 2015, the leading country of origin among these immigrants was India, which accounted for 21% of the foreign-born S&E degree holders in the United States (Figure 3-33). With nearly half the total for India, China was the second leading country with 10%. Source countries for the 464,000 foreign-born holders of S&E doctorates were somewhat more concentrated, with China providing a higher proportion (22%) than India (16%). These patterns by source region and country for foreign-born S&E highest degree holders in the United States have been stable since at least 2003.

FIGURE 3-33

Foreign-born individuals with highest degree in S&E living in the United States, by place of birth: 2015



Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

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The NSCG asks respondents to provide information on where they received their postsecondary degrees and their motivation for coming to the United States. This information sheds light on the educational and career paths of foreign-born scientists and engineers in the United States and possible factors that influence these paths. Approximately half of foreign-born scientists and engineers in the United States received their initial university training abroad. In 2015, there were about 5.1 million college-educated, foreign-born scientists and engineers employed in the United States; of these, 2.5 million received their first bachelor's degree abroad. Many of these individuals came to the United States for job or economic opportunities (34%), family-related reasons (26%), or educational opportunities (29%). In contrast, only 7% of foreign-born scientists and engineers with a U.S. bachelor's degree cited job or economic opportunities, and many more cited family-related reasons (44%) or educational opportunities (24%) as their primary reasons for coming to the United States.

A substantial number of foreign-born scientists and engineers in the United States appear to come here for further higher education after receiving their initial university training abroad. Nearly two-thirds (62%) of the 1.3 million employed foreign-born scientists and engineers who received their initial university training abroad and who hold a master's degree, doctorate, or professional degree completed their highest degree in the United States. Among these individuals, the most frequently cited reason for coming to the United States was educational opportunities (62%). Family-related reasons (13%) and job or economic opportunities (15%) were cited by much smaller proportions. Among the foreign-born doctorate holders employed in the United States, 66% received this degree from a U.S. 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. However, recent data indicate that this period of decline was 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

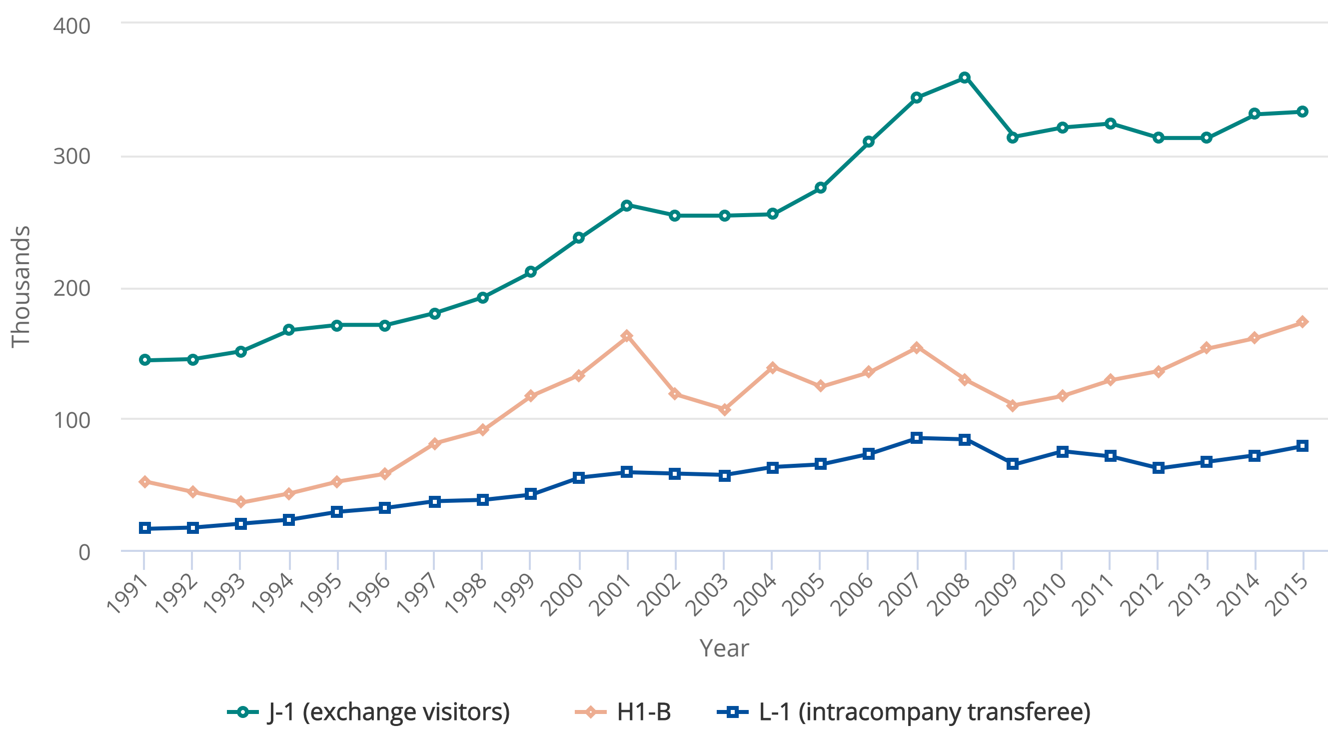
The number of temporary work visas issued for high-skill workers provides an indication of how many new immigrant workers are entering the U.S. labor force.[2] After several years of growth, the largest classes of these temporary visas declined during the recent economic downturn. Despite the increases in the issuance of temporary visas since FY 2009, the total numbers of visas issued in some categories have not yet reached the recent highs seen in FY 2007, before the beginning of the economic downturn (Figure 3-34). A decline in the issuance of these visas, particularly H-1B visas, also occurred following the milder 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 2015, the United States issued about 173,000 H-1B visas, up 57% from the recent low in 2009 (110,000) and higher than the recent peak in 2007 (154,000).

Issuance of visas in other temporary work categories that usually contain large numbers of high-skill workers has also risen since 2009; however, the H-1B visa category has shown continued increase since 2009, unlike certain other visa classes such as the J-1 and L-1 categories.

FIGURE 3-34

Temporary work visas issued in categories with many high-skill workers: FYs 1991–2015



Note(s)

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

Source(s)

U.S. Department of State, Nonimmigrant Visa Issuances by Visa Class and by Nationality, and Nonimmigrant Visas by Individual Class of Admission, https://travel.state.gov/content/visas/en/law-and-policy/statistics/non-immigrant-visas.html (accessed 17 January 2017).

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Characteristics of H-1B Visa Recipients

The majority of H-1B visa recipients work in S&E or S&E-related occupations. 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 FY 2016, workers in computer-related occupations as classified by USCIS were the most common recipients of H-1B visas, accounting for 61% of new H-1B visas issued (Appendix Table 3-20). The total number of newly initiated H-1B visas for workers in computer-related fields has increased substantially since 2010, following a steep decline between 2008 and 2009 during the economic downturn (DHS/USCIS 2010, 2012, 2013, 2015, 2016, 2017). The 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 a bachelor's or higher-level degree. In FY 2016, nearly half of new H-1B visa recipients (44%) had a bachelor's degree; the rest (55%) had an advanced degree, including 45% with a master's degree, 3% with a professional degree, and 7% with a doctorate (DHS/USCIS 2017). In FY 2016, 62% of new H-1B visa recipients were from India, and 15% were from China (DHS/USCIS 2017). The preponderance of advanced degrees notwithstanding, H-1B visa recipients were relatively young. In FY 2016, 41% of new H-1B visa recipients were between the ages of 25 and 29, and 30% were between the ages of 30 and 34 (DHS/USCIS 2017).

Table 3-26 shows the starting salaries of new recipients of H-1B visas by occupation group. These starting salaries are reported by employers in the final visa application forms sent to USCIS and differ from the H-1B salaries that firms report earlier in the process on their applications to the Department of Labor. The relatively low median salaries for workers in life sciences may reflect the use of H-1B visas to hire individuals for relatively low-paying postdoc positions.

TABLE 3-26

Annual salaries for new H-1B visa recipients, by occupation: FY 2016

(Dollars)

Occupation	Median	Mean
Administrative specializations	62,000	74,000
Architecture, engineering, and surveying	75,000	83,000
Art	56,000	71,000
Computer-related occupations	72,000	80,000
Education	55,000	68,000
Entertainment and recreation	61,000	71,000
Law and jurisprudence	105,000	116,000
Life sciences	52,000	63,000
Managers and officials	71,000	83,000
Mathematics and physical sciences	75,000	81,000
Medicine and health	70,000	119,000
Miscellaneous professional, technical, and managerial	84,000	93,000
Museum, library, and archival sciences	44,000	51,000
Religion and theology	36,000	40,000
Social sciences	88,000	104,000
Writing	45,000	52,000

Source(s)

Department of Homeland Security, U.S. Citizenship and Immigration Services, *Characteristics of H-1B Specialty Occupation Workers, Fiscal Year 2016 Annual Report to Congress* (May 5,2017), https://www.uscis.gov/sites/default/files/USCIS/Resources/Reports%20and%20Studies/H-1B/h-1B-FY16.pdf.

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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.

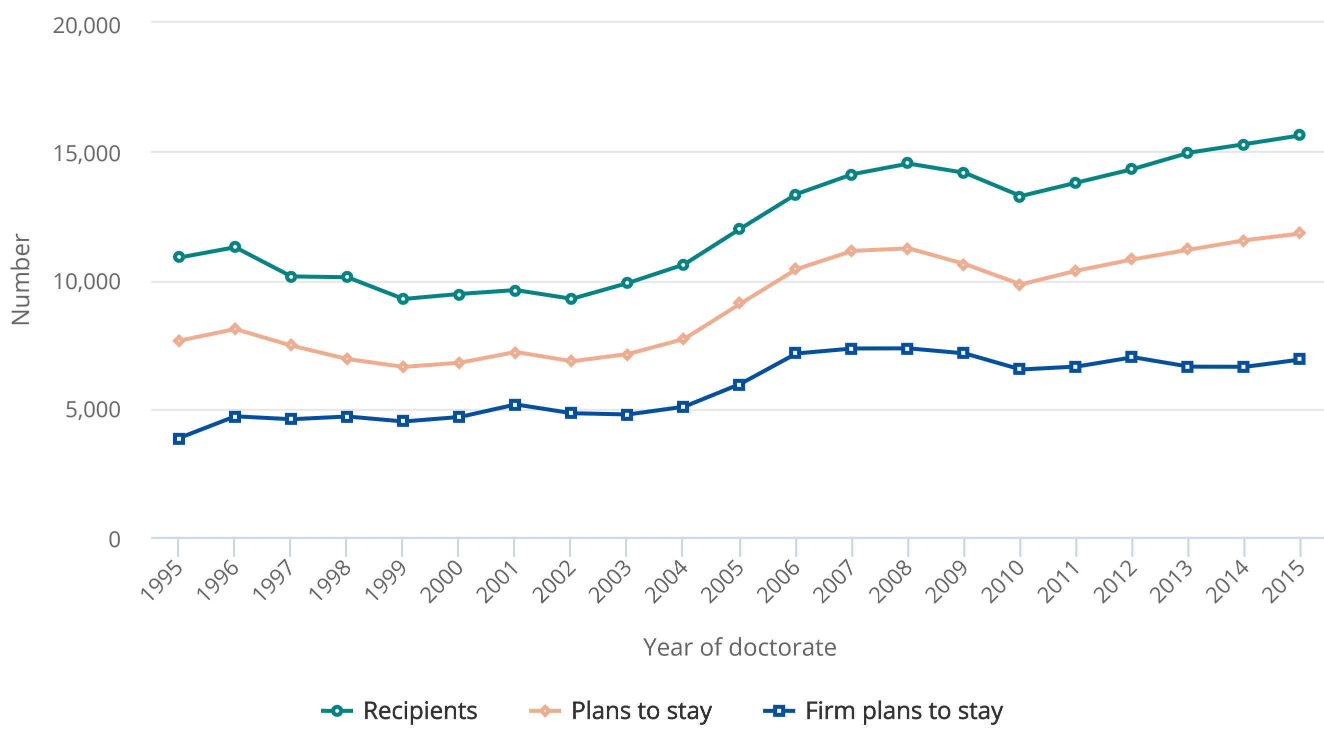
At the time that they receive their doctorates, foreign-born students at U.S. universities report whether they intend to stay in the United States and whether they have a firm offer to work in the United States (either a postdoc or a job) the following year.[3] These responses provide estimates of short-term stay rates.[4]

Most foreign-born noncitizen recipients of U.S. S&E doctorates (including those on temporary and permanent visas) plan to stay in the United States after graduation (Figure 3-35). According to the most recent 2015 estimates, at the time of doctorate receipt, 76% of foreign-born noncitizen recipients of U.S. S&E doctorates planned to stay in the United States, and 44% had either accepted an offer of postdoc study or employment or were continuing employment in the United States. Both of these proportions have risen since the 1980s. In 1995, 70% planned to stay in the United States after graduation, and 35% said they had firm offers in hand. Throughout the 1980s, these proportions were about 50% and 33%, respectively (NSB 2012).

Although stay rates have risen over an extended period, they have fluctuated within a relatively narrow range since the beginning of the 2000s (Figure 3-35; Appendix Table 3-21). Among foreign-born S&E doctorate recipients, both the percentage reporting plans to stay in the United States and the percentage reporting firm offers to stay have declined since the years just before 2008–2011, a period marked by the economic downturn and its aftermath. The overall number of foreign-born S&E doctorate recipients also declined in 2009 and 2010, although the numbers have since risen, and the 2015 level exceeded the recession-era peak seen in 2008.

FIGURE 3-35

Plans at graduation of foreign recipients of U.S. S&E doctoral degrees to stay in the United States, by year of doctorate: 1995–2015



Note(s)

Data include foreign doctorate recipients on temporary and permanent visas and also those with unknown visa status.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2016), Survey of Earned Doctorates (SED) (2015).

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Overall, S&E short-term stay rates are high in the mathematics and computer sciences, biological and biomedical sciences, physical and earth sciences, and engineering fields (Appendix Table 3-21). According to the most recent estimates, the short-term stay rates in these four fields ranged from 77% to 81%, 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 psychology and social sciences (56%) were substantially lower.

Stay rates vary by place of origin. Between 2012 and 2015, the vast majority of U.S. S&E doctorate recipients from China (83%) and from India (87%) reported plans to stay in the United States, and approximately half of these individuals reported accepting firm offers for employment or postdoc research in the United States (Appendix Table 3-21). 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. No more than half of U.S. S&E doctorate recipients from Turkey and Germany had firm plans to stay in the United States after graduation. 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.

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 mid-2000s (Appendix Table 3-21).

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

Long-term stay rates indicate the degree to which foreign-born noncitizen recipients of U.S. S&E doctorates enter and remain in the U.S. workforce to pursue their careers. For a particular graduating cohort of foreign-born noncitizen S&E doctorate recipients, the proportion of that cohort who report living in the United States a given number of years after receiving their degrees is an indicator of the cohort's long-term stay rate. For example, 10-year and 5-year stay rates in 2015 refer to the proportion of 2005 and 2010 graduating cohorts, respectively, who reported living in the United States in 2015.[5]

Five- and 10-year stay rates by degree field show similar patterns—with the highest stay rates in the computer and mathematical sciences and engineering (Table 3-27). By country of citizenship at time of degree, China and India, two countries that are the source of more S&E doctorate recipients than any other countries, have the highest 5- and 10-year stay rates (Table 3-28). Overall, the 5-year and 10-year stay rates were both 70% in 2015.

TABLE 3-27

Temporary visa holders receiving S&E doctorates in 2010 and 2005 who were in the United States in 2015, by S&E degree field

(Number and percent)

Degree field	2010 foreign doctorate recipients	5-year stay rate (%)	2005 foreign doctorate recipients	10-year stay rate (%)
Total	36,700	70	31,600	70
Biological, agricultural, health, and environmental life scientists	9,100	72	7,400	69
Computer and mathematical scientists	4,900	76	3,700	74
Physical scientists	5,600	66	4,900	69
Social scientists	4,800	49	4,800	51
Engineering	12,300	75	10,900	76

Note(s)

Detail may not add to total because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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TABLE 3-28

Temporary visa holders receiving S&E doctorates in 2010 and 2005 who were in the United States in 2015, by country of citizenship at time of degree

(Number and percent)

Country of citizenship	2010 foreign doctorate recipients (number)	5-year stay rate (%)	2005 foreign doctorate recipients (number)	10-year stay rate (%)
Total	36,700	70	31,600	70
China (including Hong Kong)	10,600	85	10,700	90
India	6,300	83	3,500	85
South Korea	3,600	66	3,000	56
West Asia	3,200	61	2,700	56
Europe	3,900	64	3,800	65
North and South America	3,800	53	3,500	50
All other countries	5,400	49	4,500	45

Note(s)

Detail may not add to total because of rounding.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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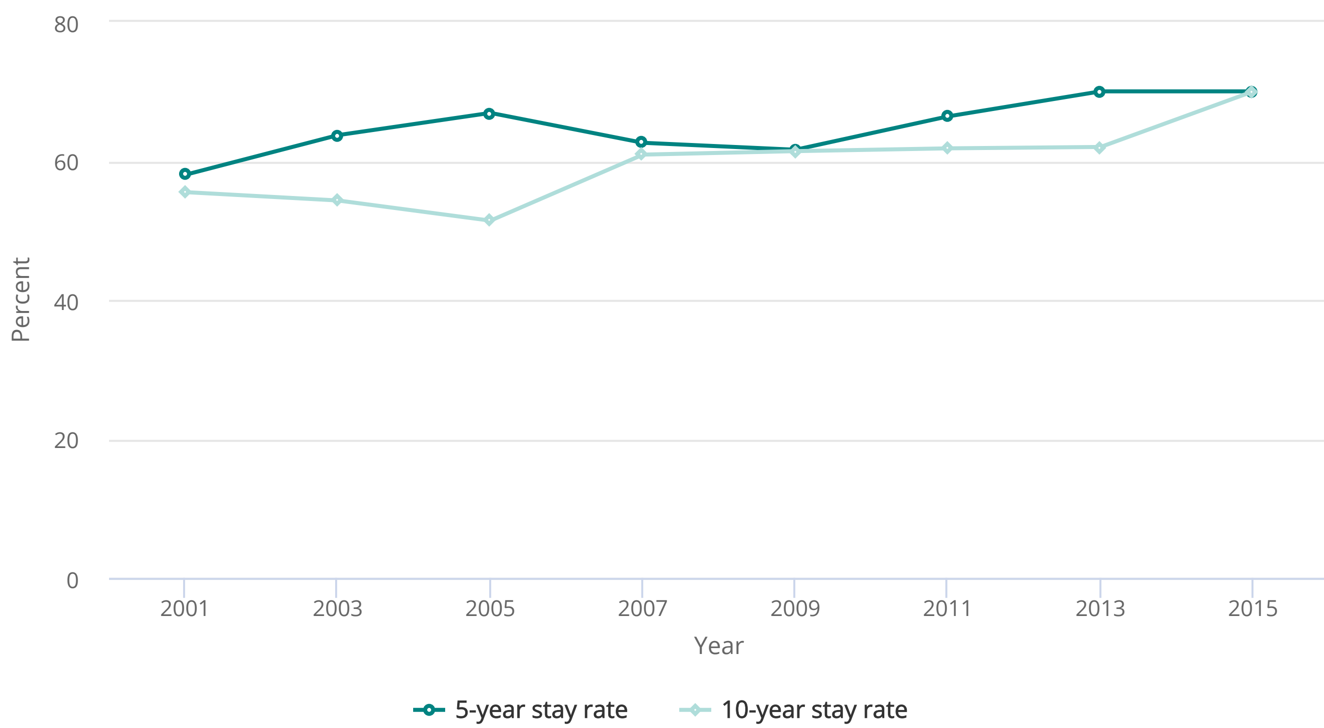
It is also important to know how these estimates compare with earlier estimates based on previous cohorts so as to determine if the stay rates for more recent cohorts have declined or increased. Figure 3-36 shows the 5- and 10-year stay rates measured every 2 years since 2001 for those on temporary visas at the time they received their degrees. The 5-year stay rate shows increases through 2005, a temporary period of decline in 2007 and 2009, and then increases to the highest levels in 2013 and 2015. The 10-year stay rate also increased substantially from 2001 to 2015. The 2015 stay rates are at an all-time high for temporary visa holders, both 5 years and 10 years after degree receipt.

Figure 3-37 highlights a group of U.S. S&E doctorate recipients who display lower-than-average stay rates. These are temporary visa holders who indicated that they received foreign financial support during graduate school. It is understandable that these doctorate recipients would have closer ties to a foreign country—presumably, in most cases, their home country—and might have both more opportunity and greater sense of obligation to leave after completing the doctorate. However, the vast majority of temporary visa holders do not report foreign support as a primary or secondary source of their graduate study. This was true for 94% of temporary visa holders in 2005 and 95% in 2010. Therefore, even though those who receive foreign support have much lower stay rates, there is little influence on aggregate stay rates due to the small size of the group receiving this type of support.

FIGURE 3-36

Five-year and ten-year stay rates for U.S. S&E doctoral degree recipients with temporary visas at graduation: 2001–15



Note(s)

Data are available for odd-numbered years only.

Source(s)

Finn M, *Stay Rates of Foreign Doctoral Recipients from U.S. Universities*: *2011*, Oak Ridge Institute for Science and Education 2014 (2001–11); National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2013, 2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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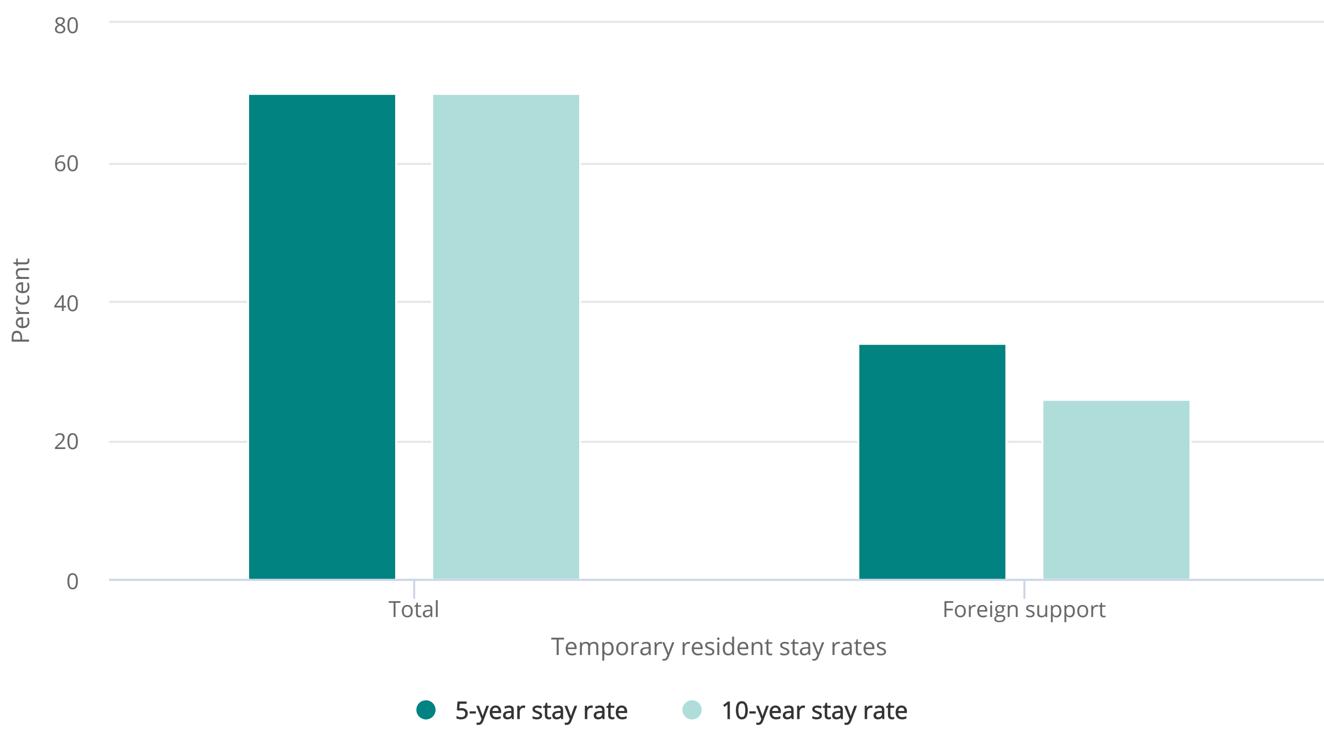
FIGURE 3-37

Five-year and ten-year stay rates for temporary residents receiving S&E doctorates in 2005 and 2010, by foreign support: 2015



Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR) (2015), https://www.nsf.gov/statistics/srvydoctoratework/.

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[1] For information on high-skill migration worldwide, see Defoort (2008); Docquier and Rapoport (2012); Docquier, Lowell, and Marfouk (2009); and Docquier and Marfouk (2006).

[2] 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.

[3] This question is part of the SED, which is administered to individuals receiving research doctoral degrees from all accredited U.S. institutions. For information on the SED, see https://www.nsf.gov/statistics/srvydoctorates/. The information on plans to stay or definite commitments to stay reflects intentions within the year after graduation as reported by the doctorate recipients around their graduation date. Therefore, any changes in intentions after survey completion are not captured.

[4] 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 May 2016, those earning a degree in STEM fields could apply for an extension of their OPT to a total of 36 months. Data from the Department of Homeland Security's Student and Exchange Visitor Information System (https://www.ice.gov/sevis) show that 68% of students with F-1 visas who completed a doctorate in any field between 1 November 2015 and 31 October 2016 had applied for OPT.

[5] To reduce the standard error of the estimates, a 3-year average was used to calculate the long-term stay rates. For example, the 10-year stay rate was based on the proportion of the 2004, 2005, and 2006 cohorts who reported living in the United States in 2015.

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. However, much of the work 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). 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, including those educated or employed in S&E fields, are increasingly mobile. 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 are very limited, which makes it difficult to analyze the precise size and characteristics of this specialized workforce. Internationally comparable data are limited to establishment surveys that provide basic information about workers in S&E occupations or on workers with training in S&E disciplines. In contrast, NCSES data on scientists and engineers include far more information on members of the U.S. S&E labor force than is available in other national statistical systems. Additionally, although surveys that collect workforce data are conducted in many OECD member countries, they do not cover several countries—including Brazil and India—that have high and rising levels of S&T 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.

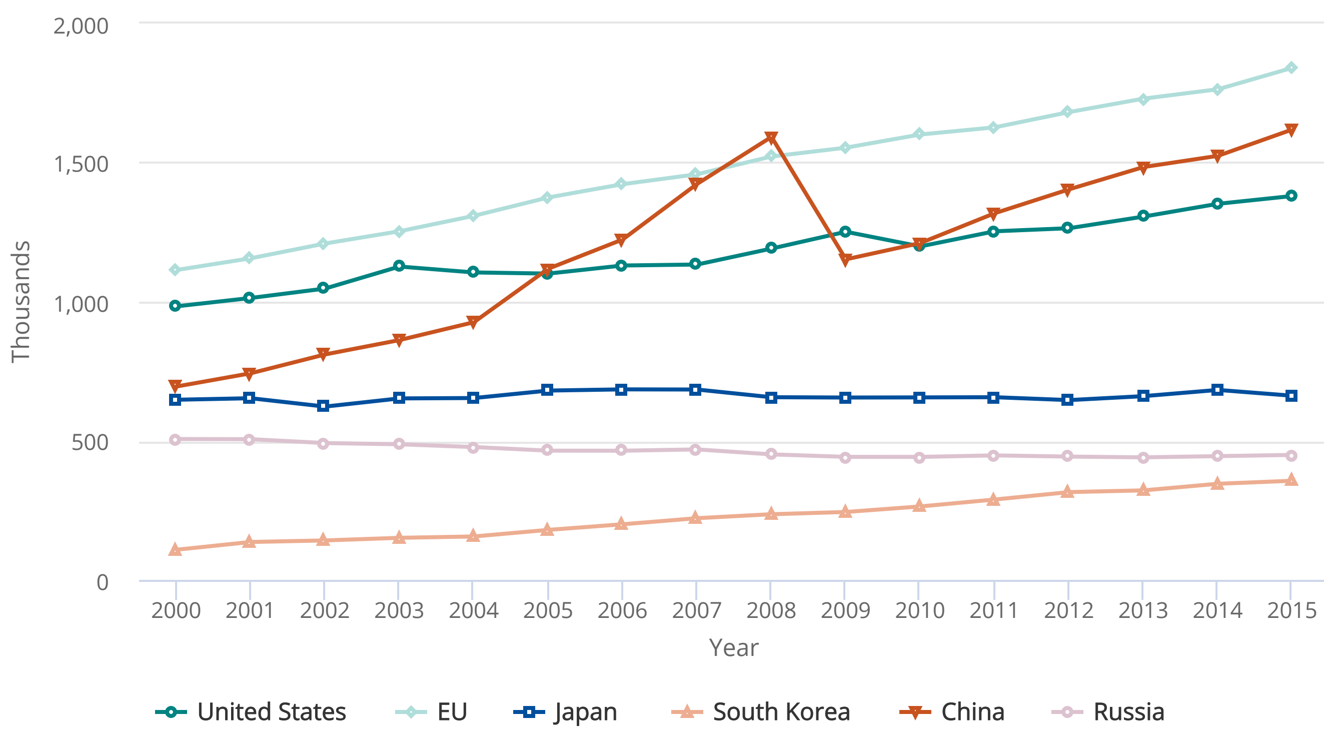
OECD data covering substantial, internationally comparable segments of the S&E workforce provide strong evidence of its widespread, though uneven, growth in the world's developed nations. OECD countries, which include most of the world's highly developed nations, compile data on researchers from establishment surveys in member and selected nonmember countries. These surveys generally use a standardized occupational classification that defines researchers as "professionals engaged in the conception or creation of new knowledge" who "conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods" (OECD 2015). 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 3.1 million in 2000 to 4.8 million in 2015. OECD also publishes estimates for seven nonmember economies, including China and Russia. Adding these to the OECD member total for 2015 yields a worldwide estimate of 7.1 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 nonmember 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 from 2009 onward have been collected in accordance with OECD definitions and standards, whereas the data before 2009 are not consistent with OECD standards. South Korea's data before 2007 exclude social sciences and humanities researchers and are therefore not consistent with the data from 2007 onward.

Despite these limitations for making worldwide estimates of the number of researchers, the OECD data provide a reasonable starting point for estimating the rate of worldwide growth. For most economies with large numbers of researchers, the number of researchers has grown substantially since 2000 (Figure 3-38). China, whose pre-2009 data did not entirely correspond to the OECD definition, reported more than twice the number of researchers in 2008 than in 2000 and, likewise, reported substantial growth since the end of the recession in 2009. South Korea nearly doubled its number of researchers between 2000 and 2006 and continued to grow strongly between 2007 and 2015. The United States and the EU experienced steady growth but at a lower rate; the number of researchers grew 40% in the United States between 2000 and 2015 and 65% in the EU between 2000 and 2015. Exceptions to the overall worldwide trend included Japan (which experienced a relatively small change of about 2%) and Russia (which experienced a decline; see also Gokhberg and Nekipelova [2002]). Trends in numbers of full-time equivalent R&D personnel were generally parallel to those for researchers in those cases for which both kinds of data are available (Appendix Table 3-22).

FIGURE 3-38

Estimated number of researchers in selected regions or countries: 2000–15



EU = European Union.

Note(s)

Data are not available for all regions or countries for all years. Researchers are full-time equivalents. Counts for China before 2009 are not consistent with Organisation for Economic Co-operation and Development (OECD) standards. Counts for South Korea before 2007 exclude social sciences and humanities researchers.

Source(s)

OECD, Main Science and Technology Indicators (2017/1), https://www.oecd.org/sti/msti.htm, accessed 22 September 2017.

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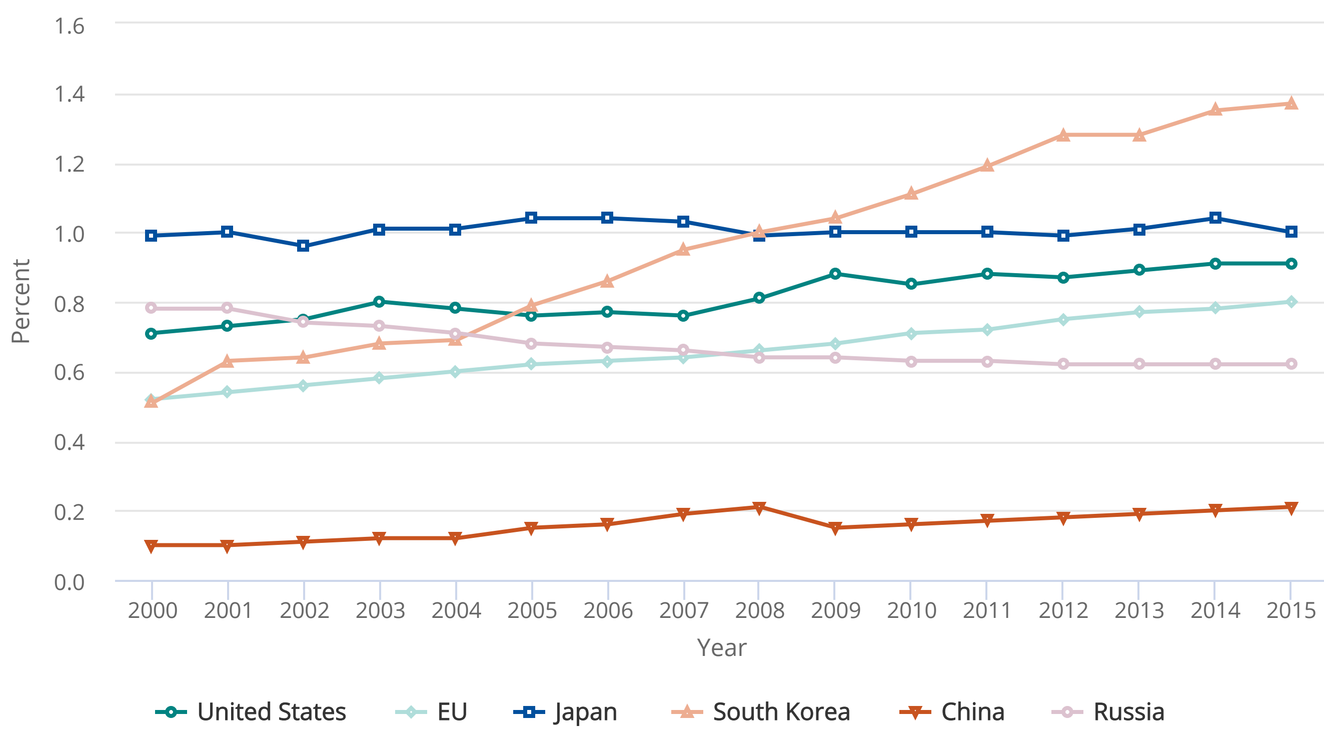
OECD also estimates the proportion of researchers in the workforce. In OECD's most recent estimates, small economies in Scandinavia (Denmark, Finland, Norway, Sweden) reported that between 1% and 2% of their employed workforce are researchers; small economies in East Asia (Singapore, Taiwan) reported that about 1% of their workforce are researchers (Appendix Table 3-23). Among economies with more than 200,000 researchers, OECD's latest estimates are that researchers make up the highest proportions of the workforce in South Korea (1.4%), Japan (1.0%), the United States (0.9%), and the United Kingdom (0.9%). Although China reported a large number of researchers, these workers represent a much smaller percentage of China's workforce (0.2%) than in OECD member countries. Additionally, China and South Korea have shown marked increases in the percentage of their workforce employed as researchers (Figure 3-39). Since 2000, this percentage remained mostly steady in Japan, rose slightly in the United States, and rose steadily in the EU.

FIGURE 3-39

Researchers as a share of total employment in selected regions or countries: 2000–15



EU = European Union.

Note(s)

Data are not available for all regions or countries for all years. Researchers are full-time equivalents. Counts for China before 2009 are not consistent with Organisation for Economic Co-operation and Development (OECD) standards. Counts for South Korea before 2007 exclude social sciences and humanities researchers.

Source(s)

OECD, Main Science and Technology Indicators (2017/1), https://www.oecd.org/sti/msti.htm, accessed 22 September 2017.

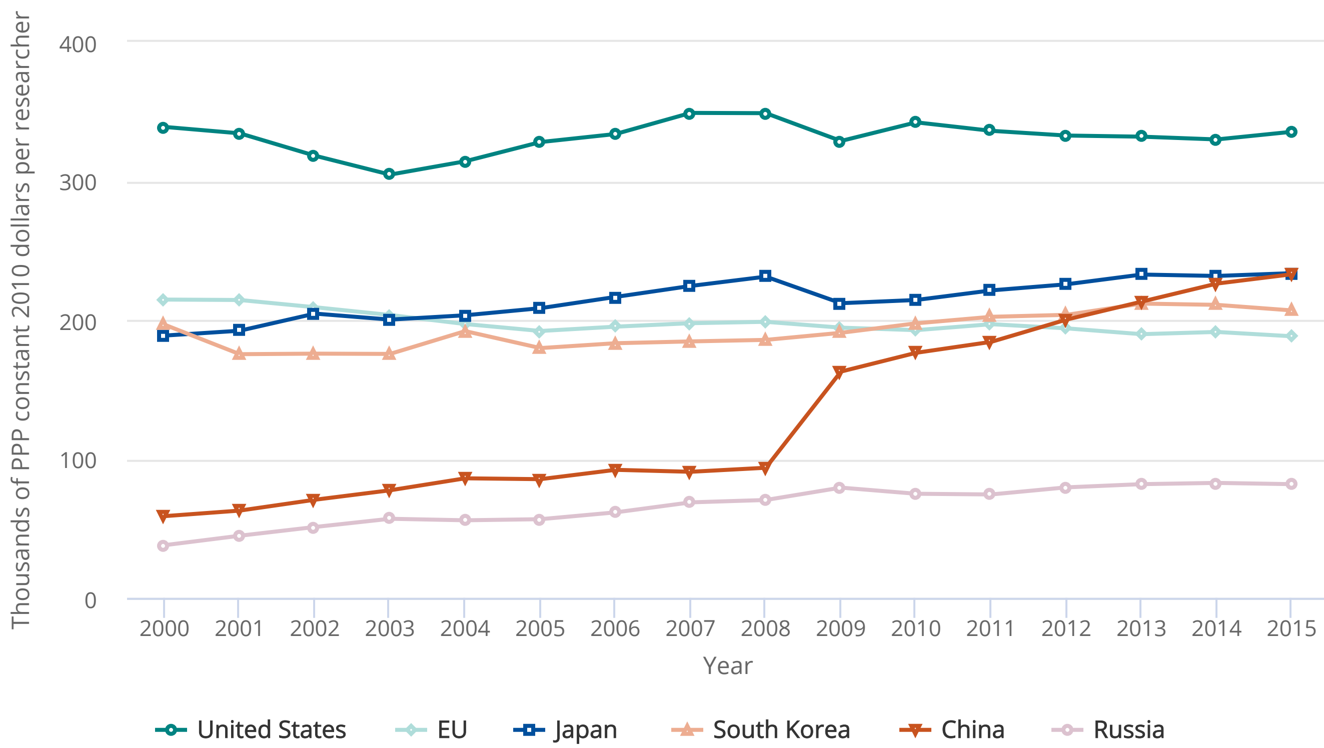
Science and Engineering Indicators 2018

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 (15% women) and South Korea (19% women) have a significant imbalance among researchers. By comparison, several European countries such as Belgium, Italy, Finland, Sweden, Spain, Norway, United Kingdom, Russia, and Poland, and several other countries such as Turkey and Singapore are more balanced, with women representing between 30% and 46% of researchers. In France and Germany, just over one-quarter of researchers are women.

OECD also provides data on gross domestic expenditures on R&D (GERD), which covers all R&D performed within the region, country, or economy in a given year. The data on GERD may be combined with the data on researchers to get an estimate of R&D spending per researcher, which is another useful indicator of national resources devoted to advancing science and engineering. According to the most recent estimates, the United States, Germany, and Austria have the highest R&D expenditures per researcher (Appendix Table 3-23). Japan, South Korea, and China spend relatively similar amounts per researcher, although the number of researchers as a proportion of total employment is significantly lower in China than in Japan and South Korea. Other countries with large numbers of researchers, such as Canada, the United Kingdom, Spain, and Russia, spend much less. Additionally, since 2000, GERD per researcher (in constant prices and purchasing power parity) has fluctuated within a relatively narrow range in the United States, the EU, and South Korea (Figure 3-40). China, whose pre-2009 data did not entirely correspond to the OECD definition, reported nearly 60% more GERD per researcher in 2008 than in 2000, and this number continued to grow between 2009 and 2015.

FIGURE 3-40

Gross domestic expenditures on R&D (GERD) per researcher in selected regions or countries: 2000–15



EU = European Union; PPP = purchasing power parity.

Note(s)

Data are not available for all regions or countries for all years. Researchers are full-time equivalents. The data for China before 2009 are not consistent with Organisation for Economic Co-operation and Development (OECD) standards. The data for South Korea before 2007 exclude social sciences and humanities R&D.

Source(s)

OECD, Main Science and Technology Indicators (2017/1), https://www.oecd.org/sti/msti.htm, accessed 22 September 2017.

Science and Engineering Indicators 2018

Conclusion

The S&E workforce 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 make important contributions to the nation's welfare. 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 limited to S&E occupations.

In both the United States and the rest of the world, the S&E workforce has experienced strong growth. During the 2007–09 recession, U.S. S&E employment remained more resilient than overall employment. Policymakers with otherwise divergent perspectives agree that jobs involving S&E are good for workers and for the economy as a whole. These jobs pay more, even when compared to non-S&E jobs requiring similar levels of education and comparably specialized skills. Although S&E workers are not totally shielded 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, and 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, but the number of researchers in the struggling Japanese economy has somewhat stagnated.

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—women and, to a lesser degree, blacks and Hispanics—have played an increasing role in the 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 S&E compared to their overall labor force participation. For example, women account for less than one-third 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—data since the downturn suggest that the decline may have been temporary.

In today's dynamic marketplace, where information flows rapidly and technology is always evolving, labor market conditions change fast. Numerous factors—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.

Glossary

Definitions

European Union (EU): The EU comprises 28 member nations: Austria, Belgium, Bulgaria, Croatia, 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. Unless otherwise noted, Organisation for Economic Co-operation and Development data on the EU include all 28 nations.

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 who 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, South 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 nonmember countries.

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

Stay rate: The proportion of foreign recipients of U.S. S&E doctorates who stay in the United States after receiving their doctorate.

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

Key to Acronyms and Abbreviations

ACS: American Community Survey

BLS: Bureau of Labor Statistics

CPS: Current Population Survey

ECDS: Early Career Doctorates Survey

EU: European Union

FedScope: Federal Human Resources Data

FY: fiscal year

GED: General Equivalency Diploma

GERD: gross domestic expenditures on R&D

HHS: Department of Health and Human Services

IOF: involuntarily out-of-field

IPUMS: Integrated Public Use Microdata Series

NAICS: North American Industry Classification System

NCSES: National Center for Science and Engineering Statistics

nec: not elsewhere classified

NECTA: New England City and Town Area

NSB: National Science Board

NSCG: National Survey of College Graduates

NSF: National Science Foundation

NSRCG: National Survey of Recent College Graduates

OECD: Organisation for Economic Co-operation and Development

OES: Occupational Employment Statistics

OPM: Office of Personnel Management

OPT: optional practical training

PPP: purchasing power parity

R&D: research and development

S&E: science and engineering

S&T: science and technology

SDR: Survey of Doctorate Recipients

SED: Survey of Earned Doctorates

SEH: science, engineering, and health

SESTAT: Scientists and Engineers Statistical Data System

SET: science, engineering, and technology

SOC: Standard Occupational Classification

STEM: science, technology, engineering, and mathematics

USCIS: U.S. Citizenship and Immigration Services

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