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Labor Force

Science and Engineering Labor Force

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This publication is part of the *Science and Engineering Indicators* suite of reports. *Indicators* is a congressionally mandated report on the state of the U.S. science and engineering enterprise. It is policy relevant and policy neutral. *Indicators* is prepared under the guidance of the National Science Board by the National Center for Science and Engineering Statistics, a federal statistical agency within the National Science Foundation. With the 2020 edition, *Indicators* is changing from a single report to a set of disaggregated and streamlined reports published on a rolling basis. Detailed data tables will continue to be available online.

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Executive Summary

Key takeaways:

- The estimated size of the science and engineering (S&E) workforce ranges from nearly 7 million in S&E occupations to nearly 25 million with an S&E degree (at the bachelor's level or higher). The S&E workforce can be defined in a variety of ways: as workers in S&E occupations, as holders of S&E degrees, or as those who use S&E technical expertise on the job.
- The business sector employs most S&E workers with a bachelor's degree or higher (71%), followed by the education (18%) and government (11%) sectors; for S&E doctorate holders, both the business (48%) and education (43%) sectors are prominent employers.
- The number of women in S&E occupations or with S&E bachelor's level degrees doubled over the past two decades. In 2017, they were underrepresented in S&E occupations (29%) and S&E degrees (40%) relative to their proportion of the U.S. residential population age 21 or older (52%).
- The number of blacks, Hispanics, and American Indians or Alaska Natives with their highest degree in S&E collectively increased nearly four-fold since 1993. They are underrepresented in S&E occupations (13%) and degrees (16%) relative to their proportion of the U.S. residential population age 21 or older (28%).
- There are over 17 million workers in the skilled technical workforce (STW)—those with some high school or a high school diploma, some college or an associate's degree, or equivalent training in occupations that employ significant levels of S&E expertise and technical knowledge.
- Individuals in the S&E workforce, including skilled technical workers, tend to have higher incomes and lower unemployment rates than their counterparts in the general workforce.

Individuals in the S&E workforce make important contributions to improve a nation's living standards, economic growth, and global competitiveness. They fuel a nation's innovative capacity through their research, development, and other technologically advanced work activities. The emphasis on developing S&E expertise and technical capabilities has been a global phenomenon. Internationally comparable data, although limited, provide strong evidence of a widespread, but uneven, growth in the S&E workforce of the world's developed nations.

In a knowledge-based economy like the United States, the application of S&E expertise is widespread across economic sectors. As such, the S&E workforce may be defined in various ways. At its core are individuals in S&E occupations; however, those with S&E degrees who are employed in a variety of other occupations make important contributions to the nation's welfare. In addition, skilled technical workers—those with some high school or a high school diploma, some college or associate's degree working in occupations that require significant scientific and technological expertise—provide critical support to scientific research and development.

Regardless of how they are identified, S&E workers are employed in all sectors of the economy including industry, government, and education. Over half (53%) find employment in the private, for-profit sector. Doctoral S&E workers continue to be employed in large numbers in 4-year academic institutions mostly in full-time faculty positions. However, as a proportion of all academic doctoral positions, faculty positions (full, associate, and assistant professors) have declined, while other positions (research associates, adjunct appointments, and administrative positions) rose over time.

Workers employing S&E and technological expertise in their occupations experience better labor market outcomes than those in many other types of jobs. These positions pay more and tend to have lower unemployment rates than the overall workforce. 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.

The link between one's educational training and subsequent occupation provides insight into the opportunities and challenges workers may encounter in pursuing S&E careers. The S&E pathway from postsecondary training to subsequent work varies by both the field and level of degree. In general, S&E doctorates tend to work in S&E occupations, while the link between S&E field of study and S&E occupation is less salient at the bachelor's and master's degree levels. Furthermore, those with social science degrees are less likely to work in S&E occupations than those with degrees in computer and mathematical sciences, life sciences, physical sciences, and engineering.

The demographic composition of the S&E workforce in the United States is changing. Members of historically underrepresented groups—women and blacks, Hispanics, and American Indians or Alaska Natives—have increased their representation in the S&E labor force in recent decades, although this has been more prominent in some fields (e.g., life sciences and social sciences) than others (e.g., computer and mathematical sciences, physical sciences, and engineering). Despite the recent increases, these demographic groups are underrepresented in S&E overall. Women, for example, account for less than one-third of all workers (with bachelor's or higher-level degrees) employed in S&E occupations despite representing half of the college-educated workforce. Among skilled technical workers, the racial and ethnic distribution of workers mostly mirrors that of the overall workforce; however, the majority of these workers are men.

Foreign-born individuals account for a considerable share of S&E employment in the United States (nearly 30%). Foreign-born noncitizens comprise a large proportion of S&E doctorate holders; for the most part, these doctorate recipients intend to stay in the United States to pursue their careers upon graduation—with many securing firm offers of work within a year of graduation. Furthermore, the bulk of these students remain working in the United States 5 to 10 years later, indicating that their contributions to the U.S. economy continue well after their training in U.S. institutions ends.

Introduction

This report provides an analytical overview of the U.S. S&E labor force. Although a variety of data sources are used throughout, demographic and workforce surveys conducted by the National Center for Science and Engineering Statistics (NCSES) are a major source of data for this report. These surveys cover the labor force with a bachelor's degree or higher, and as a result, much of the analysis in this report is focused on this group. In addition, we use data from the U.S. Census Bureau and the Bureau of Labor Statistics to analyze the S&E workforce at all education levels, including the skilled technical workforce. Topics covered in this report include the definition, size, and growth of the S&E workforce as well as career pathways from education to employment. Employment sector and industry, salary, and unemployment rates provide information on where S&E workers are in the economy and their labor market conditions. A brief examination of the demographic makeup and the role of foreign-born S&E workers concludes the report.

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

Definition of the S&E Workforce

Because there is no single standard for defining the S&E workforce, this report takes a broad approach to measuring the workforce in multiple ways, including by S&E occupation, S&E field of degree, and use of technical expertise on the job. The S&E workforce (also referred to as scientists and engineers in this report) is defined generally in this report as either those who have an S&E or S&E-related bachelor's or higher degree or who work in an S&E or S&E-related occupation. However, in most cases, we will specify the workforce analyzed based on type of occupation, degree type and/or level, or—less frequently—by use of technical expertise on the job.

S&E degree fields include computer and mathematical sciences, life sciences, physical sciences, social sciences, and engineering. S&E occupations fall into these same five broad occupational categories and include postsecondary teachers of these same broad fields of study. S&E-related degree fields of study include those in health sciences and health technology and technical fields. S&E-related occupations include those workers in health, precollege science teachers, S&E managers, and S&E technicians and technologists (for a detailed list of the fields of degrees and occupations included in these definitions, see NCSSES *SESTAT 2013*: **Table A-1** and **A-2**).

The bachelor's degree is the most prevalent S&E degree, accounting for nearly 70% of S&E postsecondary degrees awarded (see *Indicators 2020* report "Higher Education in Science and Engineering"). Unless otherwise noted, the data provided here for scientists and engineers include those with at least a bachelor's degree. An individual's highest degree—a bachelor's, master's, professional, or doctorate (in the context of this report)¹—is often an accurate representation of the skills and credentials that one employs in the labor market, which is why the data presented by educational attainment are generally provided for highest degree (in this report, these individuals are referred to as *S&E*, *S&E-related*, or *non-S&E highest degree holders*).

In certain instances, the data allow for analysis of S&E occupations for all educational attainment levels. For example, using data from the Census Bureau (Census) and the Bureau of Labor Statistics (BLS), this report explores workers in S&E occupations, at all education levels. Also, the Census Bureau's American Community Survey (ACS) is used to analyze the skilled technical workforce (STW). These workers use S&E and technical expertise in their jobs and have some high school, a high school diploma, some college, an associate's degree, or a similar level of educational attainment (see the **Technical Appendix** for more details on data and the methodological approach used to define the STW). Individuals in the STW may have certifications and other credentials beyond those earned with a college education at a 2- or 4-year institution, but the ACS does not collect this information.

Unless otherwise specified, the analysis throughout this report will primarily cover the S&E workforce with a bachelor's degree or higher.

Size of the S&E Workforce

The estimated number of scientists and engineers varies based on the criteria used to define the S&E workforce. Estimates range from nearly 7 million workers (with a bachelor's or higher-level degree) employed in S&E occupations to nearly 25 million individuals who have an S&E degree at the bachelor's level or higher (**Table 3-1**). About 18 million individuals attained their highest degree—a bachelor's, master's, professional, or doctorate—in an S&E field. By far, the largest categories of S&E occupations are in computer and mathematical sciences and in engineering; occupations in life, social, and physical sciences each employ a smaller proportion of S&E workers (**Figure 3-1**). In addition, there are over 17 million workers in the STW, which includes occupations that require significant technological skills and knowledge but do not necessarily require an S&E bachelor's degree for entry (**Table 3-1**).

TABLE 3-1

Measures and size of U.S. S&E labor force: 2017

(Number)

Measure	Education coverage	Individuals
Occupation		
Skilled technical workforce (STW)	Some primary or secondary education; high school diploma or equivalent; some college, no degree; associate's degree	17,003,000
Employed in S&E occupations	Bachelor's, master's, doctorate, professional degree	6,769,000
Education		
At least one degree in S&E field (S&E degree holders)	Bachelor's, master's, doctorate, professional degree	24,521,000
Highest degree in S&E field (S&E highest degree holders)	Bachelor's, master's, doctorate, professional degree	18,339,000
Job requires S&E technical expertise at bachelor's level		
In one or more S&E fields	Bachelor's, master's, doctorate, professional degree	20,935,000

Note(s)

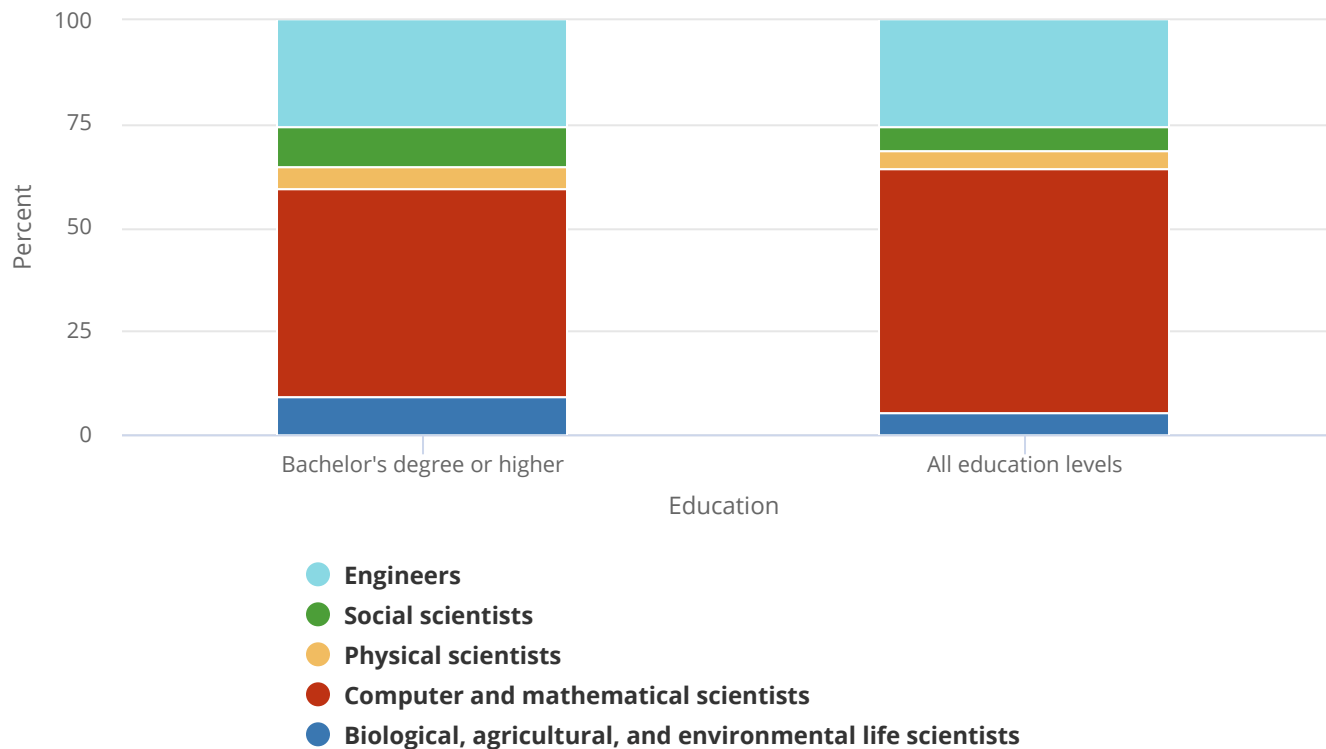
The STW includes individuals who are 25 years and older. The totals for at least one degree (at the bachelor's level or higher) in S&E field and highest degree in S&E field include individuals who are employed and those who are unemployed or out of the labor force. Values are rounded to the nearest 1,000. See Table S3-1 for more details.

Source(s)

Census Bureau, American Community Survey (ACS), 2017, Public Use Microdata Sample (PUMS); National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

FIGURE 3-1

Employment in S&E occupations, by broad occupational category: 2017

Source(s)

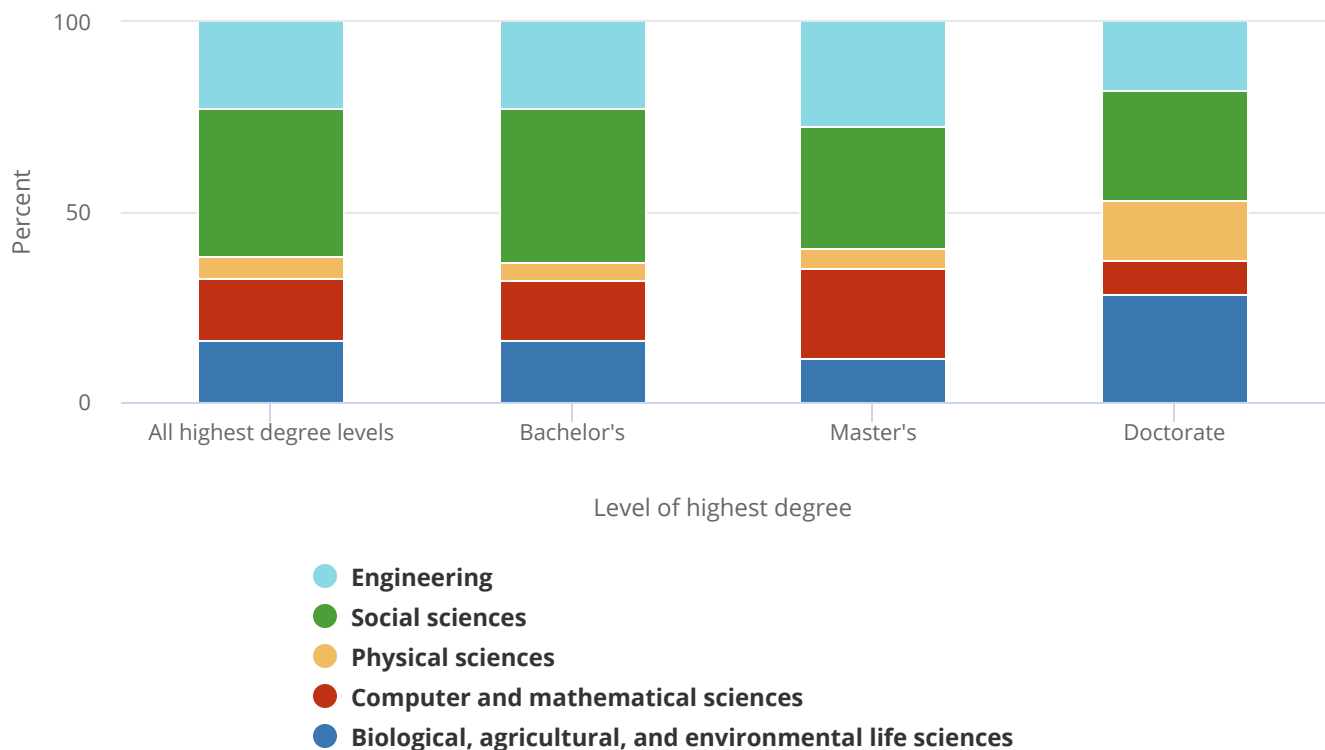
National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017; Bureau of Labor Statistics, Occupational Employment Statistics (OES) Survey, 2017.

Science and Engineering Indicators

S&E degree holders outnumber those currently employed in S&E occupations. In 2017, social sciences and engineering were the most common degree fields overall, while the life sciences fields were also prominent fields of study for doctorate holders (Figure 3-2). A majority of S&E highest degree holders (61%) reported that their job was either closely or somewhat related to their field of highest degree (Table S3-1). About a third (35%) of these individuals were employed in occupations not categorized as S&E, suggesting 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.

FIGURE 3-2

S&E degrees among college graduates, by field and level of highest degree: 2017

**Note(s)**

All highest degree levels includes professional degrees not shown separately.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

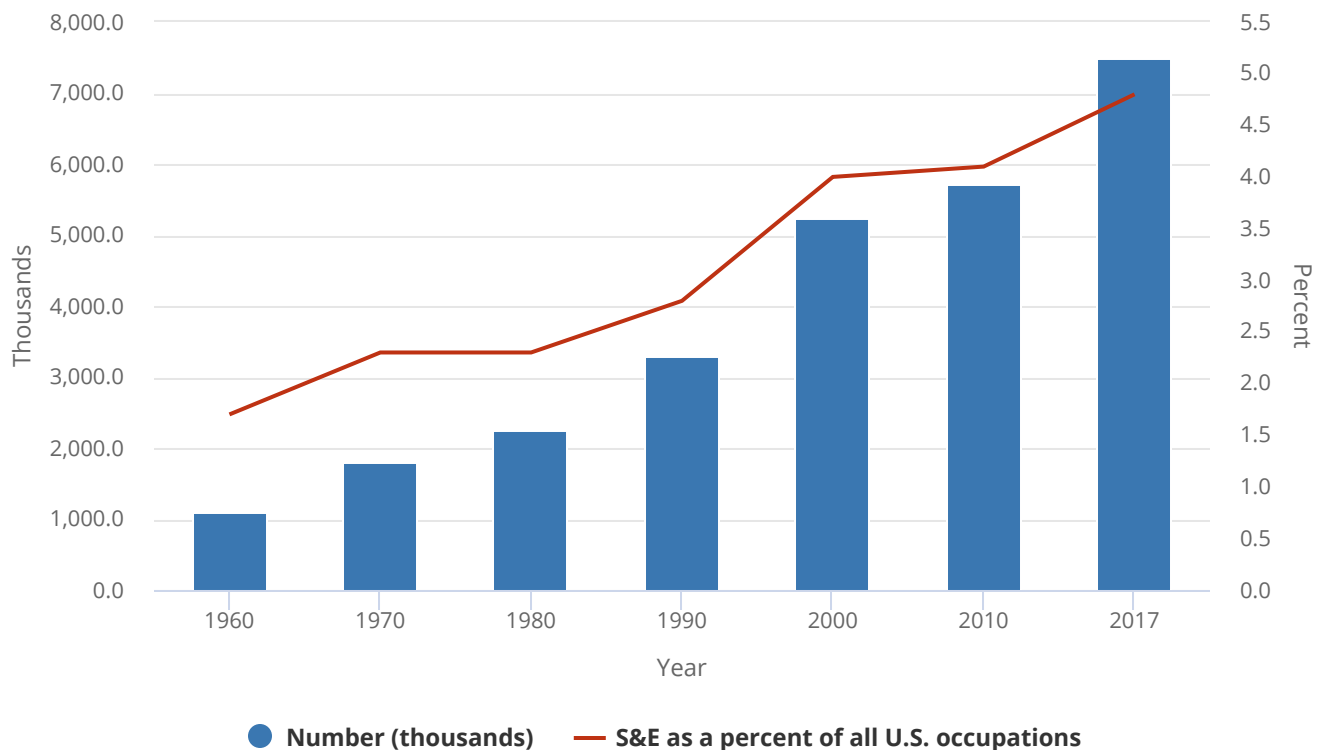
Science and Engineering Indicators

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 21 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 3-1); this figure is three times as large as the nearly 7 million college graduates employed in S&E occupations.

The S&E workforce has grown faster over time than the overall workforce. Census data show that employment in S&E occupations (at all education levels) grew from about 1.1 million in 1960 to about 7.5 million in 2017 (**Figure 3-3**). This represents a compound average annual growth rate of 4%, compared to a 2% rate for total employment during this period. S&E occupational employment as a share of total employment nearly tripled (see **Technical Appendix** for a list of occupations included). From NCSSES data, the total number of S&E highest degree holders employed in the United States grew at a 3.5% compound annual growth rate (from 8.9 million to 14.5 million) between 2003 and 2017. All broad S&E degree fields exhibited growth (**Figure 3-4**). See sidebar **Projected Growth of Employment in S&E Occupations** for BLS data on occupational projections for the period 2016–26.

FIGURE 3-3

Individuals employed in S&E occupations in the United States: Selected years, 1960–2017

**Note(s)**

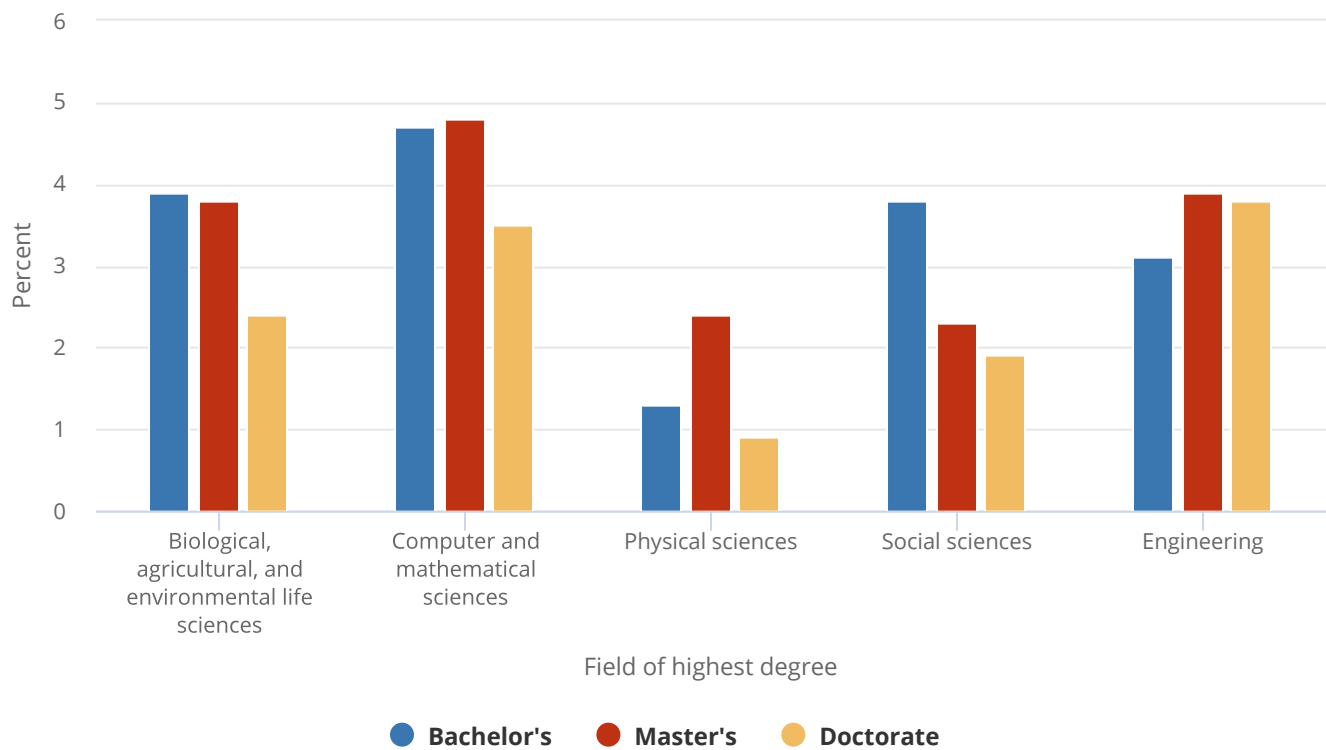
Data include individuals at all education levels.

Source(s)

Census Bureau, Decennial Census, 1960–2000; Minnesota Population Center, Integrated Public Use Microdata Series, International: Version 7.1, Minneapolis, MN: IPUMS (2018); and American Community Survey (ACS), 2010, 2017, Public Use Microdata Sample (PUMS).

FIGURE 3-4

Compound annual growth rate in the total number of employed individuals with highest degree in S&E, by field and level of highest degree: 2003–17



Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

A number of factors have contributed to the growth in the S&E workforce 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.

SIDEBAR

Projected Growth of Employment in S&E Occupations

According to Bureau of Labor Statistics (BLS) projections, the faster growth in S&E employment relative to overall employment is expected to continue through the 2016–26 period (13% versus 7%) (Table 3-A; Figure 3-A).^{*} In addition, occupations such as computer and mathematical scientists and health care practitioners and technicians, which employ the most workers in S&E and S&E-related occupations (4.2 million and 8.8 million workers, respectively), are expected to grow the most between 2016 and 2026.

TABLE 3-A

Bureau of Labor Statistics projections of employment and job openings in S&E and other selected occupations: 2016–26

(Thousands)

Occupation	BLS National Employment Matrix 2016 estimate	BLS projected 2026 employment	Occupational openings, 2016–26, annual average	10-year growth in total employment (%)
Total, all occupations	156,063.8	167,582.3	18,742.0	7.4
All S&E	6,952.6	7,825.3	591.5	12.6
Computer and mathematical scientists (excluding computer programmers, including logisticians)	4,248.7	4,882.3	364.7	14.9
Engineers, including ship engineers and sales engineers	1,765.8	1,911.0	136.1	8.2
Life scientists	325.4	358.0	32.4	10.0
Physical scientists	278.2	305.3	28.0	9.7
Social and related scientists (excluding historians)	334.5	368.7	30.3	10.2
S&E-related occupations				
S&E managers	956.6	1,088.4	88.0	13.8
S&E technicians and technologists, except computer programmers	1,125.2	1,203.7	113.5	7.0
Computer programmers	294.9	273.6	15.5	-7.2
Health care practitioners and technicians	8,751.5	10,088.1	625.1	15.3
Selected other occupations				
Lawyers	792.5	857.5	40.7	8.2
Postsecondary teachers	1,871.4	2,108.3	172.4	12.7

BLS = Bureau of Labor Statistics.

Note(s)

Estimates of current and projected employment for 2016–26 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.

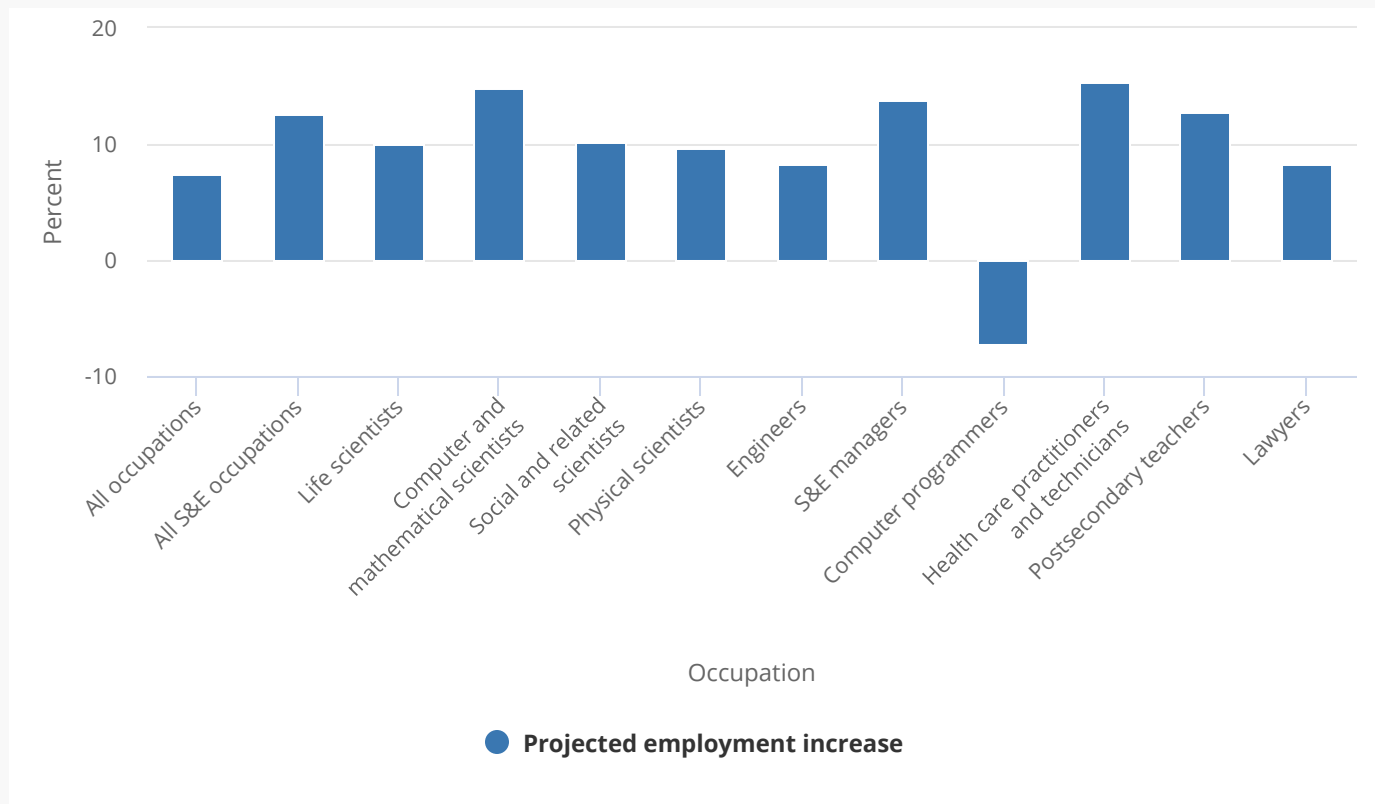
Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2016–26 BLS Employment Projections. See Table S3-1.

Science and Engineering Indicators

FIGURE 3-A

Projected increases in employment for S&E and other selected occupations: 2016–26

**Note(s)**

The computer and mathematical scientists category excludes computer programmers and mathematical technicians and includes logisticians. The social and related scientists category excludes historians. The engineers category includes ship engineers and sales engineers.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2016–26 Bureau of Labor Statistics Employment Projections.

Science and Engineering Indicators

Employment projections are dependent on assumptions about labor markets and overall economic activity and are difficult to forecast long in advance. In addition, technological and other innovations will influence demand for workers in specific occupations. BLS routinely evaluates the accuracy of the employment projections and recently found that their projections for 2006, 2008, and 2010 performed relatively well in comparison to other agency projections and to other models (Byun, Henderson, and Toossi 2015). 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 use their training.

The occupation groups of computer and mathematical scientists and health care practitioners and technicians are each projected to grow 15% from 2016 to 2026 (**Table 3-A; Figure 3-A**). These occupation groups are also expected to have the largest numbers of job openings (projected annual averages of about 365,000 and 625,000, respectively).[†] Projected growth of engineers and occupations in life, physical, and social sciences is smaller (8% to 10%), but still exceeds the growth for all occupations (7%) (**Table 3-A; Figure 3-A**). In contrast, BLS projects a loss of employment for computer programmers[‡] and slow growth in employment for S&E technicians and technologists relative to all S&E

and health care occupations. The projected decline in employment of computer programmers follows a long-term decline in employment in this occupation since the early 2000s (BLS *OES 1999–2019*). Several studies have projected declines in demand for computer programmers in the United States and suggested as a possible reason the ability of companies to offshore these activities to countries where wages are lower (see Levine 2012 for a review).

The proportion of total employment in S&E occupations and in the broad S&E categories is projected to change little between 2016 and 2026. S&E occupations and health care occupations, for example, comprise approximately 5% and 6%, respectively, of all occupations in 2016 and in the projected 2026 estimates. Computer and mathematical scientists comprise nearly two-thirds of S&E occupations in 2016 (61%) and 2026 (62%).

* To project occupational openings, the Bureau of Labor Statistics (BLS) calculates an estimate of separations caused by workers exiting the labor force, due to retirement or other reasons, and separations caused by workers transferring to different occupations. Projections of separations are combined with projections of employment change to determine occupational openings. This estimate of openings does not count workers who change jobs but remain in the same occupation. For more information, see <https://www.bls.gov/emp/documentation/separations.htm> (accessed 28 February 2019).

† 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.

‡ For more information, see <https://www.bls.gov/ooh/computer-and-information-technology/computer-programmers.htm> (accessed 14 May 2019).

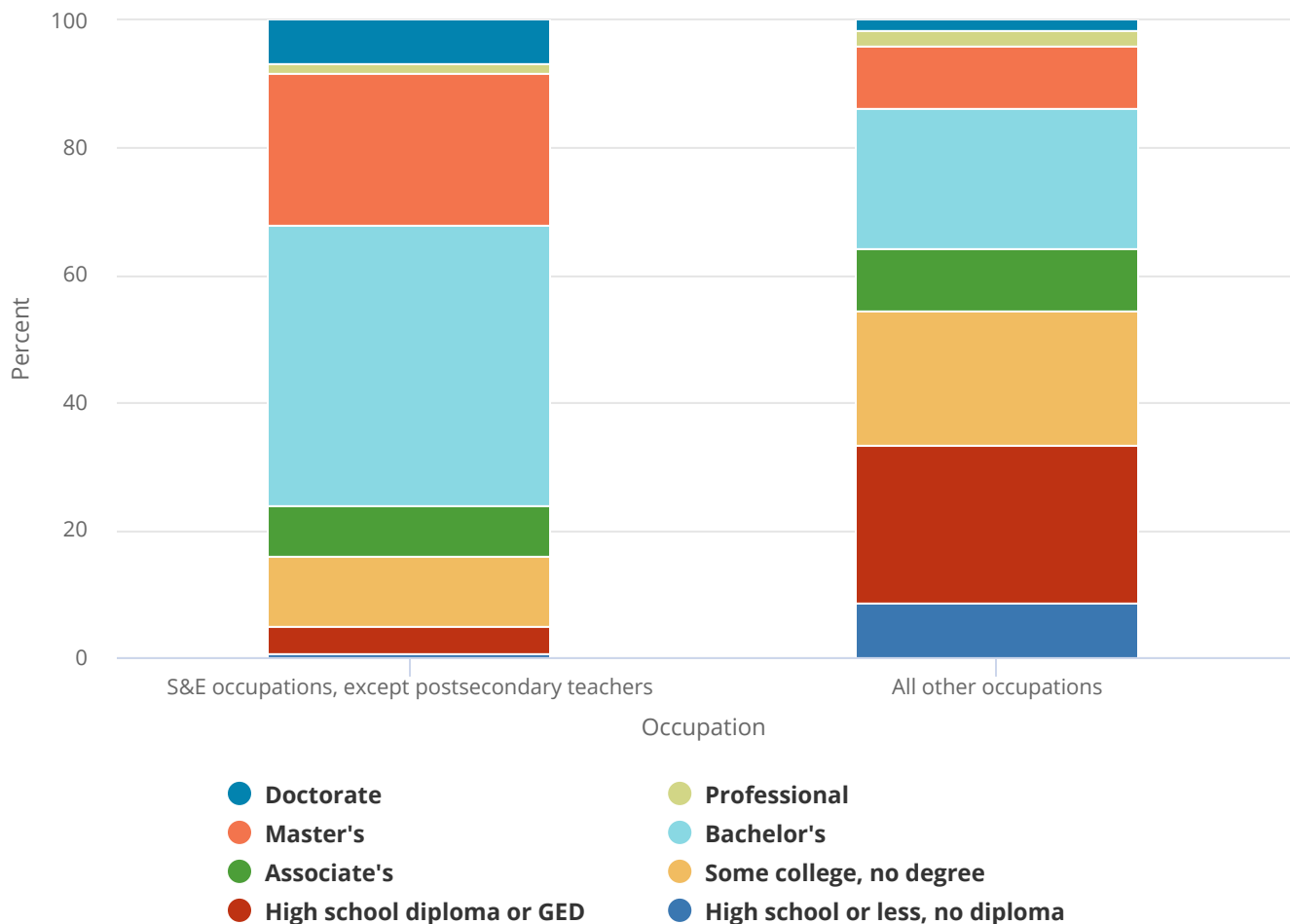
U.S. S&E Workforce: Relationship between Education and Occupation

Educational Background of Workers in S&E Occupations

Workers in S&E occupations have undertaken more education than the general workforce. The majority (76%) of workers in S&E occupations hold a bachelor's or higher degree compared to 36% of workers in all other occupations (**Figure 3-5**).² In addition, most (82%) college graduates working in S&E occupations have an S&E degree at the bachelor's level or higher (**Table 3-2**). This suggests that S&E training is the usual pathway into S&E occupations. However, the prevalence of having an S&E degree or a degree in the same broad field as one's S&E occupation varies across the broad occupation groups. For example, among computer and mathematical scientists, less than one-half (45%) have at least a bachelor's degree in the same broad field and about one-fifth (20%) do not have a degree in any S&E or S&E-related field of study. In contrast, between 71% and 82% of life scientists, physical scientists, social scientists, and engineers have at least one degree at the bachelor's or higher level in their respective broad field of study.

FIGURE 3-5

Educational attainment, by type of occupation: 2017



GED = General Equivalency Diploma.

Source(s)

Census Bureau, American Community Survey (ACS), 2017, Public Use Microdata Sample (PUMS).

TABLE 3-2

Educational background of college graduates employed in S&E occupations, by broad S&E occupational category: 2017

(Percent)

Educational background	All S&E occupations	Biological, agricultural, and environmental life scientists	Computer and mathematical scientists	Physical scientists	Social scientists	Engineers
Total (number)	6,769,000	610,000	3,419,000	366,000	646,000	1,728,000
At least one S&E degree	81.9	91.5	75.3	94.5	76.6	91.0
At least one S&E degree in field	60.8	76.9	44.8	75.5	70.9	82.4
Highest degree in field	54.8	68.2	40.2	59.3	60.5	75.9
All degrees in S&E	71.0	75.3	66.0	86.1	50.9	83.1
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	13.7	2.3	20.4	3.6	20.6	4.1

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 Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

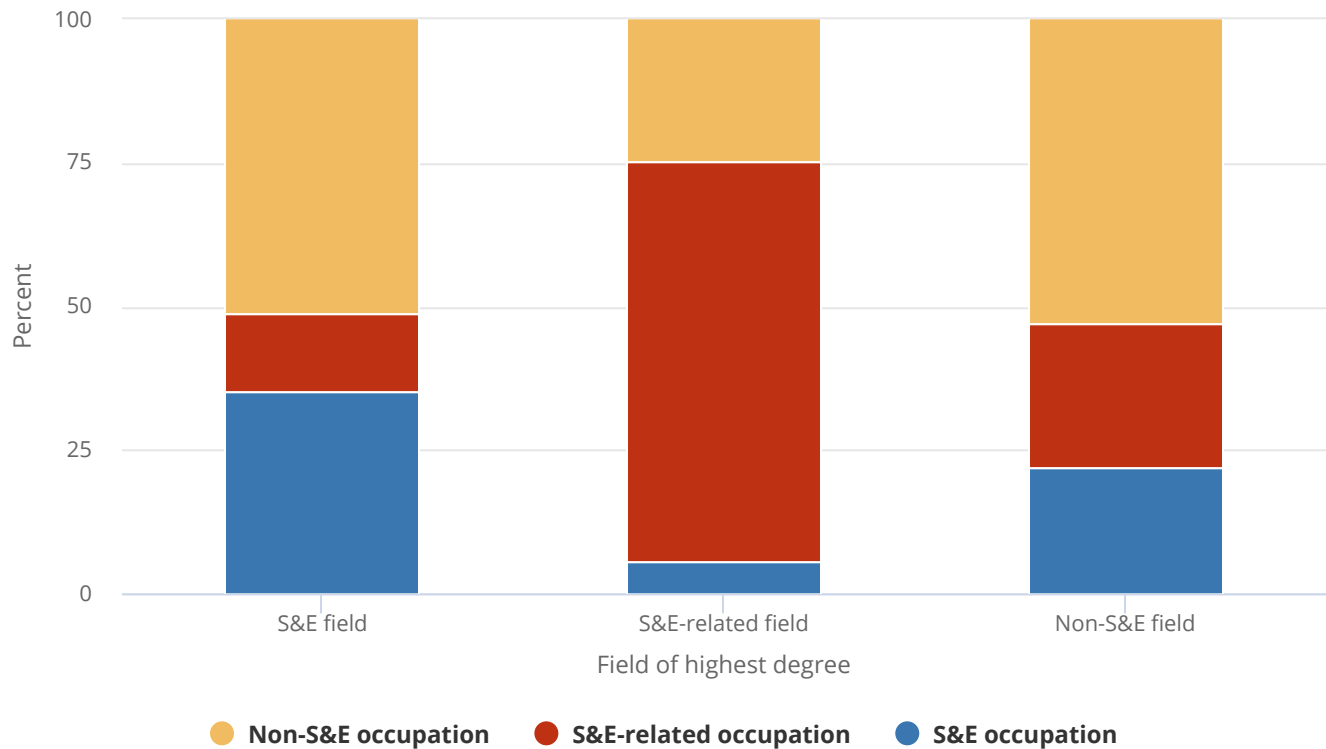
Science and Engineering Indicators

Distribution of S&E Degree Holders by Occupation

Although working in an S&E occupation often requires an S&E degree, many S&E highest degree holders pursue careers in other areas. About a third of S&E highest degree holders (35%) work in S&E occupations, while the rest work in S&E-related (14%) or non-S&E occupations (51%). In contrast, at least half of S&E-related or non-S&E highest degree holders each are employed in S&E-related and non-S&E occupations, respectively (**Figure 3-6**).

FIGURE 3-6

Distribution of scientists and engineers within occupation types, by broad field of highest degree: 2017

**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 Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

Most S&E highest degree holders not working in S&E occupations (69%) reported that their occupations were closely or somewhat related to their highest degrees (Table 3-3). In addition to S&E occupations, occupation groups in which relatively large numbers of S&E highest degree holders are employed include management-related occupations (1.5 million workers), non-S&E managers (1.2 million workers), and sales and marketing (1.0 million workers) (Table S3-2). Among S&E highest degree holders in non-S&E management and management-related occupations, 71% indicate that their jobs are related to their S&E degree.

TABLE 3-3

Relationship of highest degree to job among S&E highest degree holders not in S&E occupations, by degree level: 2017

(Percent)

Highest degree	Degree related to job		
	Closely	Somewhat	Not
All degree levels	35.2	33.5	31.3
Bachelor's	29.5	34.7	35.8
Master's	52.3	30.3	17.4
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)

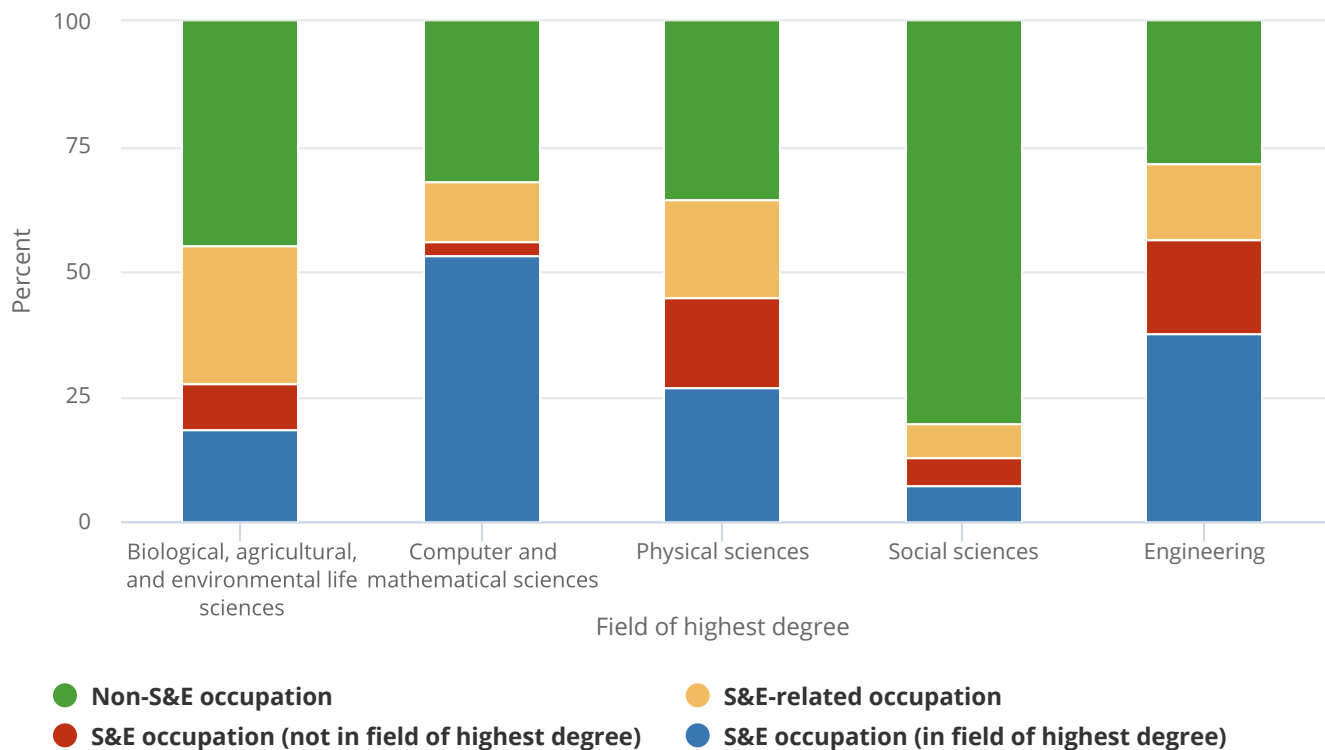
National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017, and the Survey of Doctorate Recipients (SDR), 2017.

Science and Engineering Indicators

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. Those with a highest degree in computer and mathematical sciences and engineering tend to work in occupations that are more related to their fields of study. Individuals with social sciences degrees, in contrast, work primarily in non-S&E occupations (80%) (Figure 3-7). Additionally, S&E doctorates tend to work in S&E occupations, whereas the link between S&E field of study and S&E occupation is less salient at the bachelor's and master's degree levels (Figure 3-8). For information on certifications and licenses, see sidebar **Certifications and Licenses**.

FIGURE 3-7

Occupational distribution of S&E highest degree holders, by field of highest degree: 2017

**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.

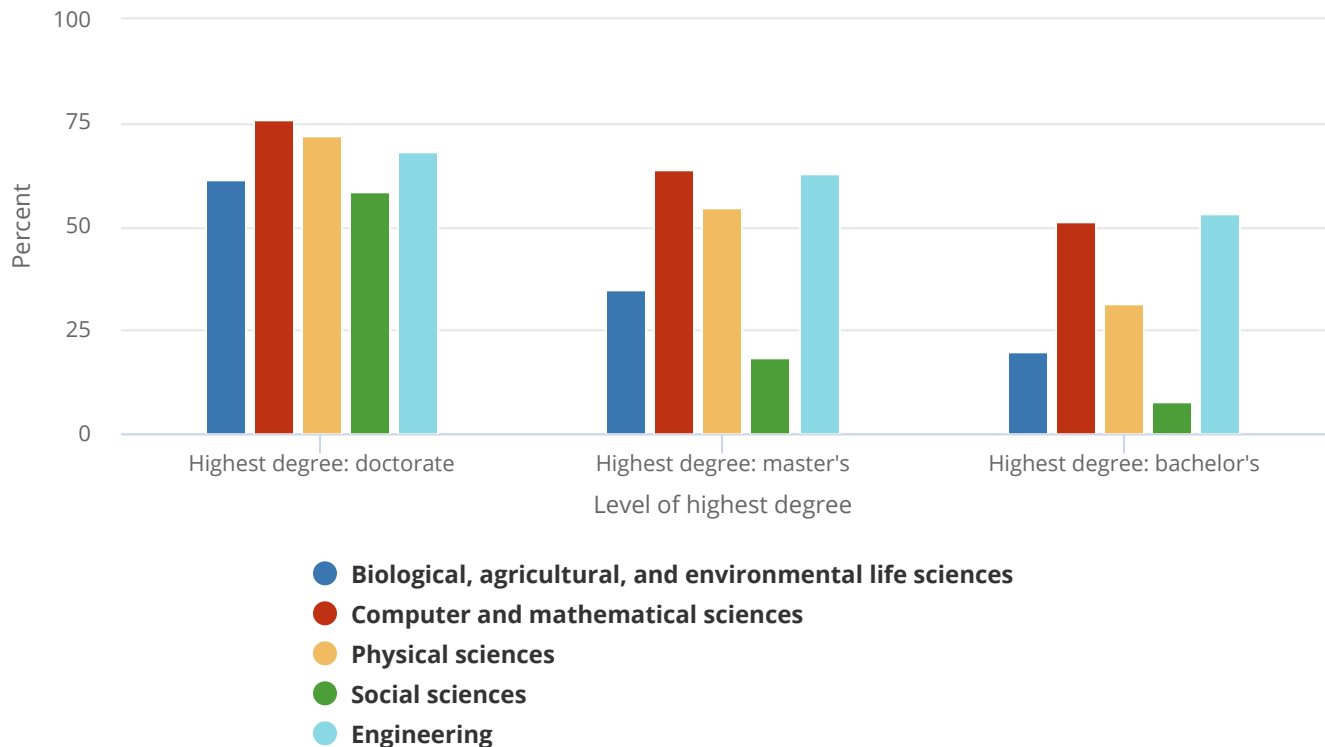
Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

FIGURE 3-8

S&E degree holders working in S&E occupations, by level and field of S&E highest degree: 2017

**Note(s)**

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

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

SIDEBAR

Certifications and Licenses

Community colleges and certification and license programs often serve as a starting point or as a supplement to traditional 4-year degrees in science, technology, engineering, and mathematics (STEM)-focused workforce development (NASSEM 2016). Certifications and licenses generally are associated with an occupation, technology, or industry, and recognize professionals who meet established knowledge, skill, and competency standards necessary to perform a specific job (Finamore and Foley 2017). Certifications are issued by a nongovernmental body, whereas licenses are awarded by a government agency and convey legal authority to work in an occupation (BLS 2019).

Certifications and licenses are obtained at all educational levels. However, they are more prevalent among those with a bachelor's degree and above. In 2018, among all workers 25 years or older, 8% of those with no high school diploma and 15% of those with a high school diploma (no college) held a certification or license; in comparison, 26% of those with some college or an associate's degree and 36% of those with a bachelor's degree or above held a certification or license (BLS *CPS 2018: Table 51*). The unemployment rate for individuals with a certification or license was lower, ranging from 1% for those at the bachelor's degree or higher to 3% for those with less than a high school diploma compared to 3% and 6%, respectively, for those without a certification or license (BLS *CPS 2018: Table 50*).

College-educated workers in S&E occupations (24%) were less likely to hold a certification or license than those in S&E-related occupations (77%) or non-S&E occupations (38%). The specific occupations in which workers with a bachelor's degree and higher had the highest certification or license prevalence rates were legal occupations (94%), science and engineering precollege teachers (91%), health occupations (89%), and other education-related occupations (84%) (Finamore and Foley 2017).

For information on community colleges, including 2-year degree awards, and minority-serving institutions (MSIs), see *Indicators 2020* report "Higher Education in Science and Engineering." Also, see NASEM 2019 for additional information on MSIs and their role in preparing a STEM-ready workforce.

S&E Workers in the Economy

Employment Sectors

Scientists and engineers perform their work and make their contributions across all sectors of the economy, including the business, education, and government sectors. Comprised mostly of for-profit businesses, but also including nonprofit organizations and the self-employed, the business sector (or “industry”) employed the most scientists and engineers in 2017 (71%) (Table 3-4). The education sector, including private and public institutions, employed another 18%—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 since the early 1990s. As the number of workers in S&E occupations doubled from 1993 to 2017, the proportion in the business sector—including that in for-profit businesses and nonprofit organizations—increased slightly (Table S3-4).

TABLE 3-4

Employment sector of scientists and engineers, by broad occupational category and degree field: 2017

(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)	27,273,000	14,501,000	6,769,000	8,271,000	12,233,000
Business or industry	71.2	73.1	72.2	71.0	70.8
For-profit businesses	53.3	59.5	63.8	46.5	52.2
Nonprofit organizations	11.8	7.5	5.3	20.0	9.9
Self-employed, unincorporated businesses	6.1	6.0	3.1	4.5	8.8
Education	18.0	15.4	16.2	21.3	17.2
4-year institutions	7.9	8.3	13.0	7.2	5.7
2-year and precollege institutions	10.2	7.2	3.2	14.1	11.5
Government	10.6	11.5	11.6	7.8	12.0
Federal	4.7	5.2	6.1	3.8	4.6
State or local	5.9	6.3	5.5	4.0	7.5

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)

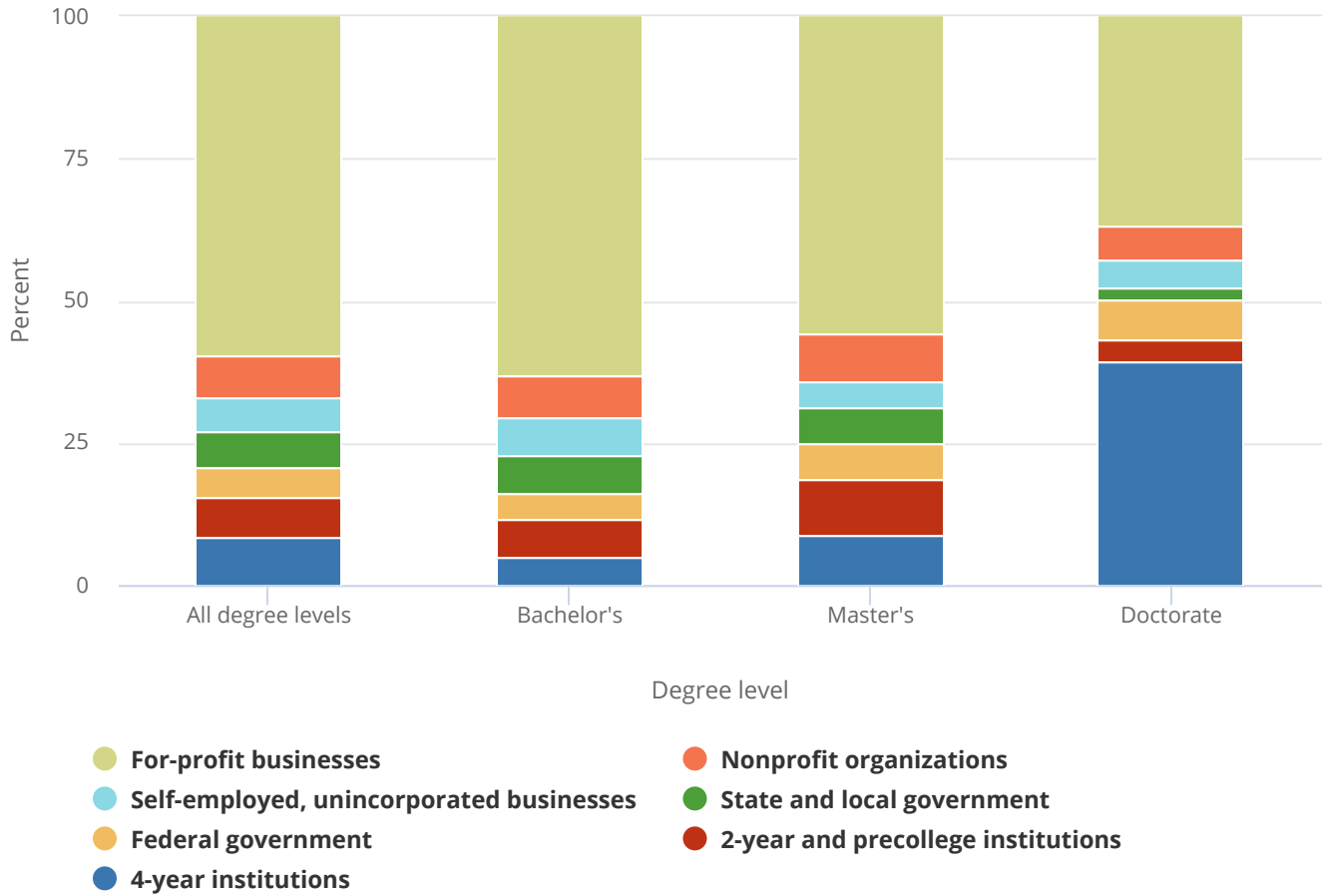
National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

Some differences exist in the concentration of particular groups of S&E workers across employment sectors (Table 3-4; Figure 3-9; Table S3-5, Table S3-6). The business sector, including for-profit and nonprofit businesses and the self-employed, and the education sector including precollege, 2-year and 4-year institutions, are both prominent employers of S&E doctorate holders, while the education sector is a less prominent employer for other degree levels and overall (Figure 3-9). The for-profit business sector is a larger employer of engineers and computer and mathematical scientists relative to the remaining occupations, while 4-year academic institutions employ a larger share of life, physical, and social scientists relative to engineers and computer and mathematical scientists (Figure 3-10).

FIGURE 3-9

S&E highest degree holders, by degree level and employment sector: 2017



Note(s)

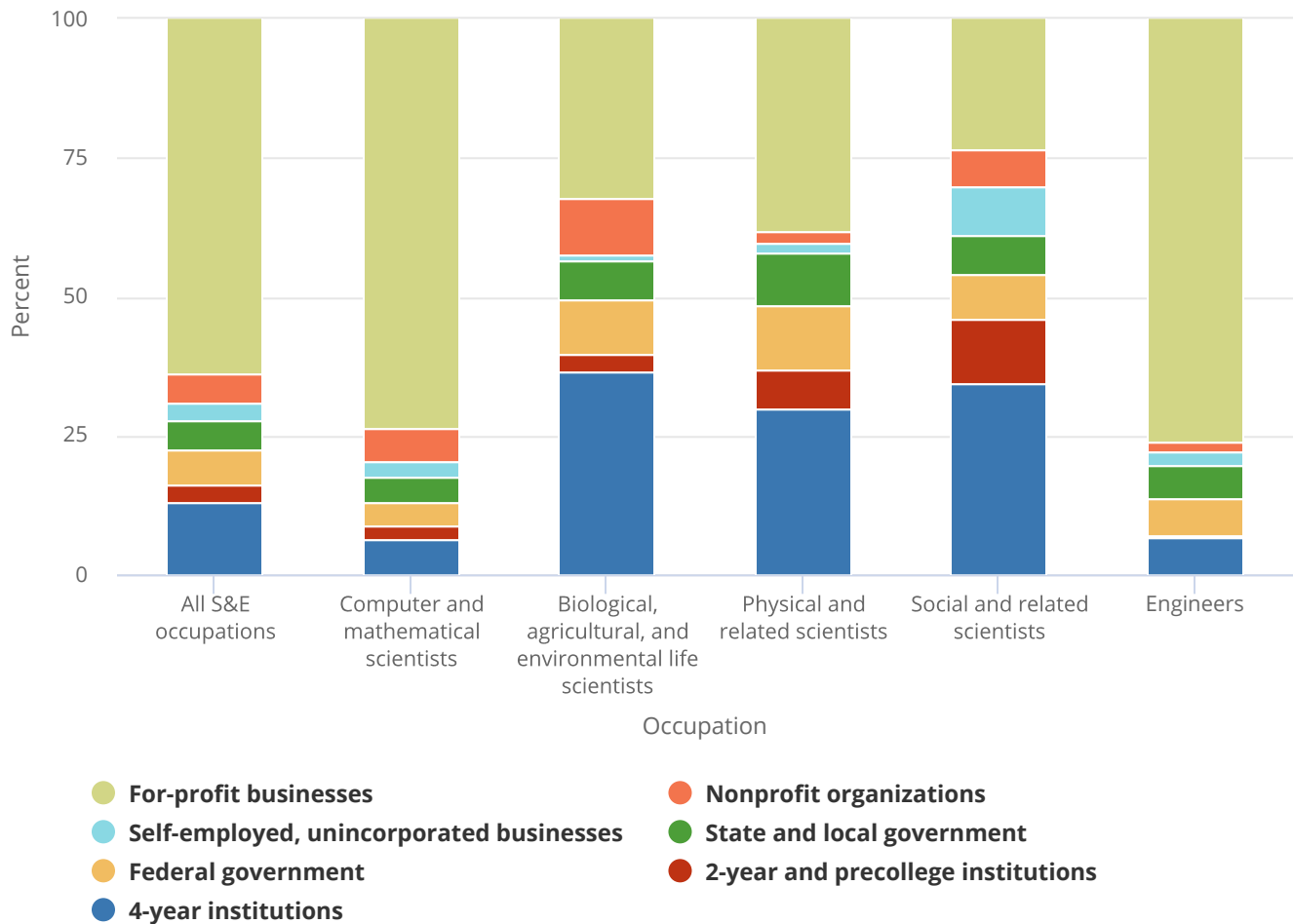
All degree levels includes professional degrees not shown separately.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

FIGURE 3-10

Broad S&E occupational categories, by employment sector: 2017

**Note(s)**

Percentages may not add to 100% because of rounding.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

In 2017, over 4.7 million scientists and engineers (17%) reported being self-employed in either an unincorporated or incorporated business, professional practice, or farm (Table S3-5).³ Those working in S&E-related or non-S&E occupations reported higher levels of self-employment (16% and 22%, respectively) than those working in S&E occupations (11%).

S&E employment in the United States also varies by geography: a small number of geographic areas accounts for a considerable proportion of S&E jobs. For example, the 20 metropolitan areas with the largest S&E employment account for 42% of nationwide employment in S&E jobs, compared to about 31% of employment in all occupations (Table 3-5). The New York-Jersey City-White Plains, NY-NJ and the Washington-Arlington-Alexandria, DC-VA-MD-WV metropolitan divisions have the largest numbers of workers in S&E occupations in 2017. 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).

TABLE 3-5

Metropolitan areas with largest number of workers in S&E occupations: May 2017

(Number)

Metropolitan area	Workers employed		Metropolitan workforce in S&E occupations as percentage of national total in S&E occupations
	All occupations	S&E occupations	
U.S. total	142,549,250	6,889,020	100
New York-Jersey City-White Plains, NY-NJ Metropolitan Division	6,693,930	303,080	4
Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Division	2,519,220	273,310	4
Los Angeles-Long Beach-Glendale, CA Metropolitan Division	4,430,840	184,310	3
San Jose-Sunnyvale-Santa Clara, CA	1,089,070	179,220	3
Chicago-Naperville-Arlington Heights, IL Metropolitan Division	3,662,390	173,730	3
Seattle-Bellevue-Everett, WA Metropolitan Division	1,647,350	172,730	3
Boston-Cambridge-Newton, MA NECTA Division	1,839,740	162,520	3
Houston-The Woodlands-Sugar Land, TX	2,929,400	159,400	2
Dallas-Plano-Irving, TX Metropolitan Division	2,491,590	157,640	2
Atlanta-Sandy Springs-Roswell, GA	2,619,440	153,360	2
San Francisco-Redwood City-South San Francisco, CA Metropolitan Division	1,116,390	122,890	2
Minneapolis-St. Paul-Bloomington, MN-WI	1,932,310	122,380	2
Denver-Aurora-Lakewood, CO	1,443,130	109,380	2
Phoenix-Mesa-Scottsdale, AZ	1,980,010	106,750	1
Warren-Troy-Farmington Hills, MI Metropolitan Division	1,231,590	100,220	1
San Diego-Carlsbad, CA	1,433,340	97,560	1
Baltimore-Columbia-Towson, MD	1,360,320	92,640	1
Anaheim-Santa Ana-Irvine, CA Metropolitan Division	1,616,210	90,700	1
Austin-Round Rock, TX	996,540	80,860	1
Oakland-Hayward-Berkeley, CA Metropolitan Division	1,138,240	74,640	1

Note(s)

The data exclude metropolitan statistical areas where S&E proportions were suppressed. Larger metropolitan areas are broken into component metropolitan divisions. Ranking is based on the estimated number of workers in S&E occupations. Differences between any two areas may not be statistically significant.

Source(s)

Bureau of Labor Statistics, special tabulations (2018) of the May 2017 Occupational Employment Statistics Survey.

Science and Engineering Indicators

Industry Employment

Industries vary in their proportions of S&E workers. In 2017, four industry groups with the largest numbers of S&E workers—professional, scientific, and technical services; manufacturing; educational services; and government—accounted for about 65% of industry S&E employment, compared with 31% of total employment (Table 3-6).

TABLE 3-6

Employment in S&E occupations, by major industry: May 2017

(Number)

Industry	Workers employed		Industry workforce in S&E occupations (%)
	All occupations	S&E occupations	
U.S. total	142,549,250	6,889,020	4.8
Agriculture, forestry, fishing, and hunting	424,020	1,980	0.5
Mining	591,130	40,140	6.8
Utilities	552,270	61,130	11.1
Construction	6,903,100	73,570	1.1
Manufacturing	12,299,600	953,900	7.8
Wholesale trade	5,845,580	247,400	4.2
Retail trade	16,009,120	48,320	0.3
Transportation and warehousing	5,792,400	46,640	0.8
Information	2,800,500	589,320	21.0
Finance and insurance	5,857,390	374,320	6.4
Real estate, rental, and leasing	2,147,230	19,350	0.9
Professional, scientific, and technical services	8,850,270	2,179,830	24.6
Management of companies and enterprises	2,326,030	327,980	14.1
Administrative and support and waste management and remediation	9,108,260	265,420	2.9
Educational services	13,042,580	699,520	5.4
Health care and social assistance	20,208,050	230,110	1.1
Arts, entertainment, and recreation	2,370,160	12,720	0.5
Accommodation and food services	13,617,690	4,920	0.0
Other services (except federal, state, and local government)	4,141,910	53,430	1.3
Federal, state, and local government (OES designation)	9,661,980	659,000	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 (2018) of the May 2017 OES Survey.

Science and Engineering Indicators

S&E employment intensity, defined by an industry's S&E employment as a proportion of its total employment, also varied by industry. Industries with low 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. Those with high S&E employment intensity include information and utilities, among others (Table 3-6).

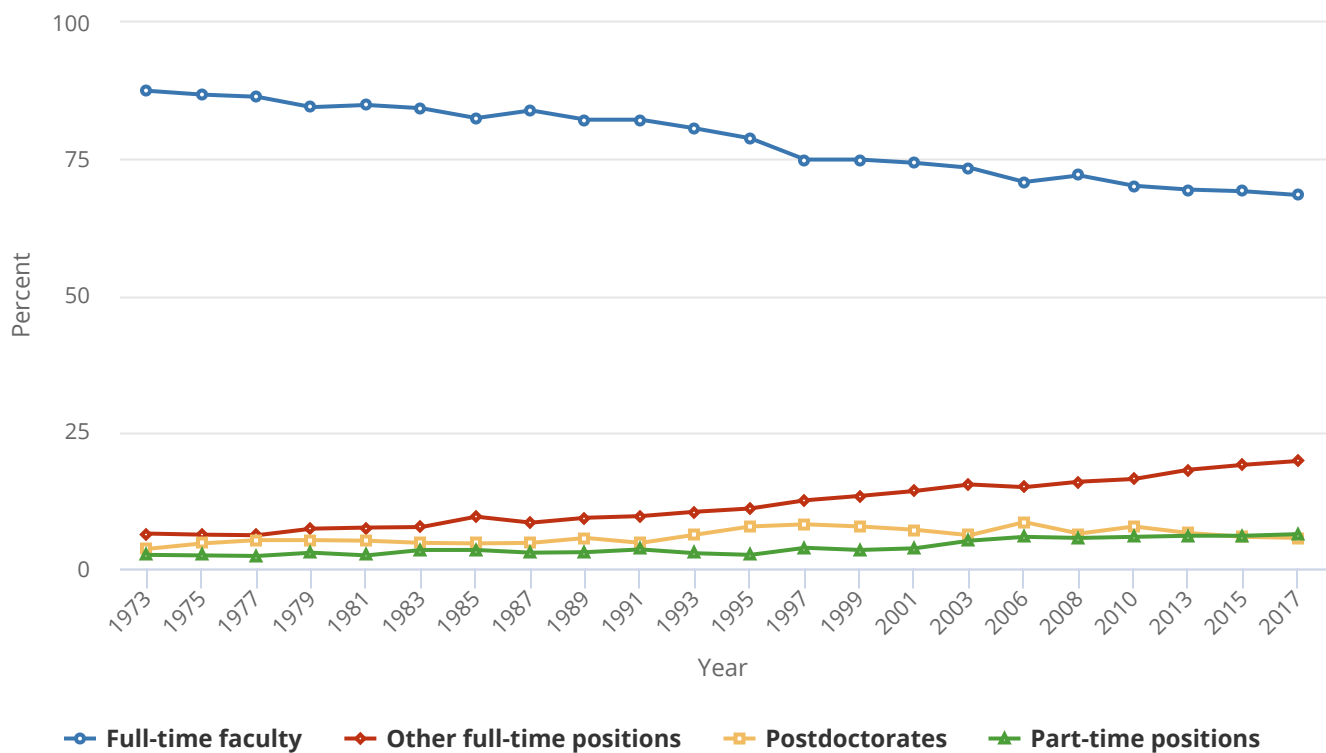
Academic Employment of Science, Engineering, and Health Doctorate Holders

As noted earlier, the education sector is a large employer of scientists and engineers with doctoral degrees; the academic doctoral workforce plays an important role in training the next generation of scientists and engineers and advancing the nation's basic research enterprise. In 2017, according to the Survey of Doctorate Recipients (SDR), there were about 390,000 science, engineering, and health (SEH) doctorate holders employed in the nation's universities and colleges. At the doctoral level, health sciences are also included in S&E fields of study as these data at the doctoral level correspond to

the doctor's research/scholarship degree level, which are research-focused degrees. The majority of the academic doctoral workforce (about 327,000) received their doctorate in the United States, while the remainder received their doctorate abroad. The majority of SEH doctorate holders are employed as full-time faculty (including tenured and tenure-track positions); however, as a proportion of all academically employed SEH doctorate holders, those employed as full-time faculty have been in steady decline for four decades, decreasing from about 90% in the early 1970s to less than 70% in 2017 (Figure 3-11; Table S3-7).⁴ In addition, SEH doctorate holders with tenured positions accounted for approximately 54% of all academically employed SEH doctorate holders in 1997 and declined to 45% in 2017. The proportion of those in tenure-track positions also declined in share, while the proportion in positions outside of the tenure system increased from 1997 to 2017.

FIGURE 3-11

SEH doctorate holders employed in academia, by type of position: 1973–2017

**Note(s)**

Academic employment is limited to U.S. doctorate holders employed at 2- or 4-year colleges or universities, medical schools, and university research institutes. Full-time faculty includes full, associate, and assistant professors. Other full-time positions include positions such as research associates, adjunct appointments, instructors, lecturers, and administrative positions. Part-time positions exclude those held by students or retired people. Percentages may not add to 100% because of rounding.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, Survey of Doctorate Recipients (SDR).

Science and Engineering Indicators

The overall distribution of SEH doctorate holders among for-profit businesses and 4-year educational institutions has also shifted. In 1993, nearly half of SEH doctorate holders (45%) were employed by universities and 4-year colleges, while 31% were employed by private, for-profit businesses (NCSES *SDR 1993*: Table 20). By 2017, these percentages were closer, with 39% in 4-year educational institutions and 35% in for-profit businesses (NCSES *SDR 2017*: Table 42).

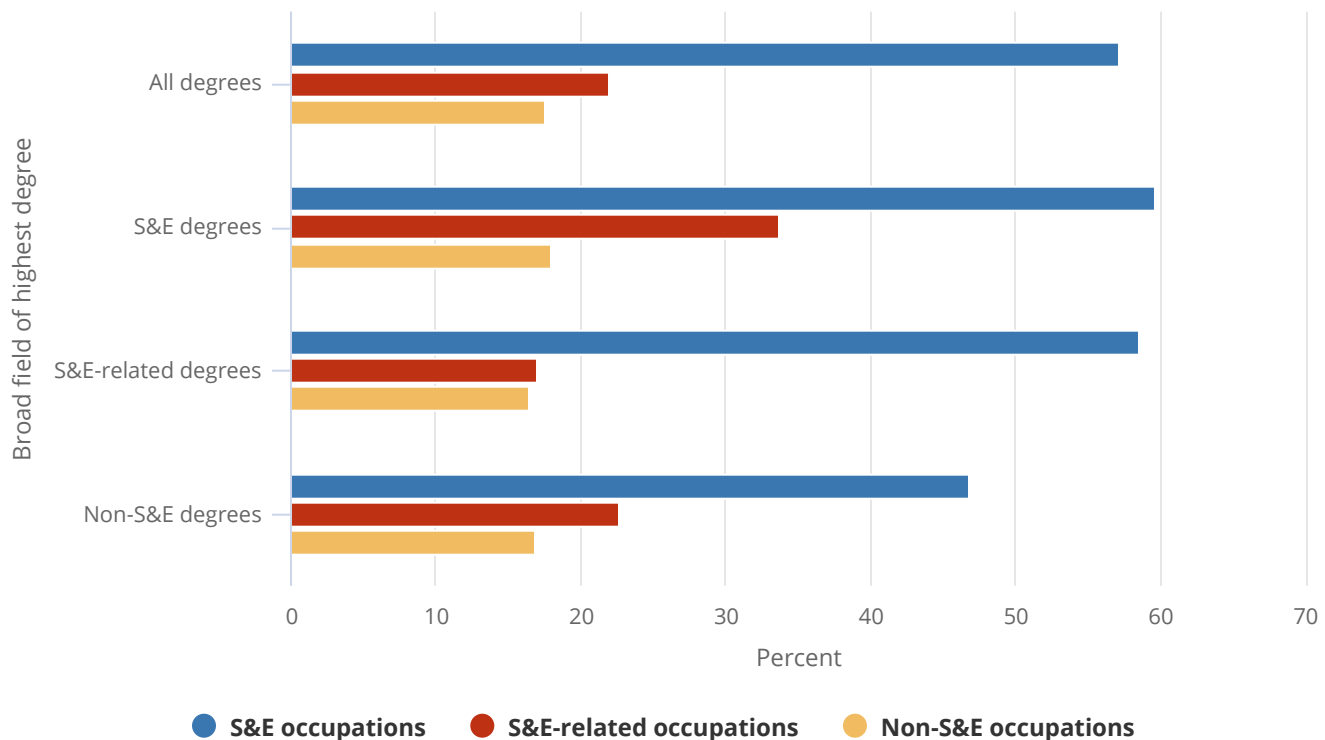
The SEH doctoral academic workforce is engaged primarily in research and teaching. In 2017, nearly identical shares of U.S.-trained doctorate holders reported that research or teaching was their primary work activity—approximately 40% each (see Table S3-8). Historically, this was not the case: the 1973 share of these doctorate holders engaged in teaching as a primary work activity (62%) far exceeded the share engaged primarily in research (26%). Federal research support holds a prominent role for academically employed SEH doctorate holders. In 2017, about 40% of them had received federal research support in the previous year (Table S3-9).

Scientists and Engineers Performing Research and Development

R&D creates new types of goods and services that contribute to economic productivity and growth and enhance living standards. *R&D workers* are defined here as those who reported basic research, applied research, design, or development⁵ 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 This analysis includes R&D workers in all sectors (including business, education, and government). The majority of people in S&E occupations (57%) are R&D workers, and so are considerable proportions of those in S&E-related (22%) and non-S&E occupations (18%) (Figure 3-12), suggesting that R&D-based work activities are prevalent in various types of jobs. In general, S&E doctorate holders indicated higher rates of R&D activity than those with a bachelor's or master's degree as their highest degree (Table 3-7).

FIGURE 3-12

Employed scientists and engineers with R&D activity, by broad field of highest degree and broad occupational category: 2017



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 Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

TABLE 3-7

R&D activity rate of scientists and engineers employed in S&E occupations, by broad occupational category and highest degree level: 2017

(Percent)

Highest degree level	Biological, agricultural, and environmental life scientists	Computer and mathematical scientists	Physical scientists	Social scientists	Engineers
All degree levels	78.2	48.7	68.0	47.4	67.7
Bachelor's	73.0	46.8	59.1	52.3	65.1
Master's	75.8	48.9	71.4	41.3	69.0
Doctorate	86.2	73.3	81.2	55.7	85.3

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 Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

S&E Labor Market Conditions

Indicators of labor market conditions (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. This section suggests that labor market outcomes are relatively favorable for scientists and engineers, although they vary by occupational categories and training level.

Unemployment

Unemployment rates among scientists and engineers tend to be lower than the rates for the labor force as a whole: an estimated 2.7% of scientists and engineers were unemployed compared to 4.9% of the entire U.S. labor force in February 2017 (Table 3-8).⁷ Workers in S&E occupations have historically experienced lower annual unemployment rates than the overall labor force (Figure 3-13).⁸ Rates, however, varied across occupational categories. Additionally, advanced degree holders were generally less vulnerable to unemployment than those with a bachelor's as their highest degree (Table 3-8).⁹

TABLE 3-8

Unemployment rates of scientists and engineers, by level of highest degree and broad occupational category: Selected years, 2003–17

(Percent)

Degree and occupation	2003	2006	2008	2010	2013	2015	2017
All scientists and engineers	3.2	2.5	3.1	4.3	3.8	3.3	2.7
Highest degree level							
Bachelor's	3.4	2.9	3.5	4.9	4.2	4.0	3.1
Master's	3.4	2.3	2.9	4.1	3.7	2.8	2.6
Professional	1.9	1.1	1.8	2.7	2.3	1.1	1.0
Doctorate	2.3	1.6	2.0	2.6	2.3	2.6	2.4
Occupation							
Computer and mathematical scientists	3.7	2.5	3.0	3.7	3.1	2.7	2.5
Biological, agricultural, and environmental life scientists	2.4	2.2	2.4	3.7	3.3	4.1	4.2
Physical and related scientists	2.8	2.3	3.0	3.3	4.5	3.2	2.1
Social and related scientists	1.6	2.5	2.1	2.3	3.3	3.6	3.0
Engineers	3.8	2.4	2.8	4.6	2.8	2.1	2.6
S&E-related occupations	2.0	1.5	1.9	2.5	2.2	1.8	1.9
Non-S&E occupations	3.8	3.0	3.9	5.6	5.0	4.3	3.0

Note(s)

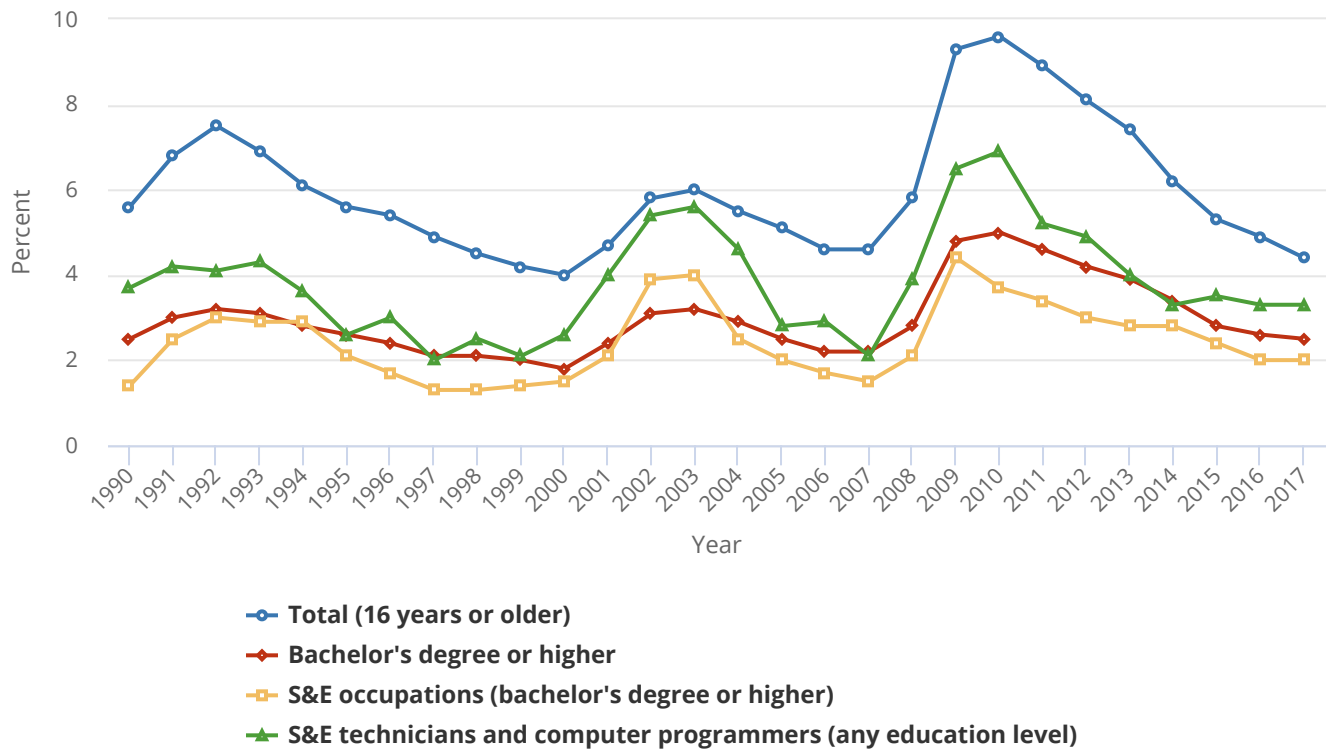
Scientists and engineers include those with one or more S&E or S&E-related degrees at the bachelor's level or higher or those who have only a non-S&E degree at the bachelor's level or higher and are employed in an S&E or S&E-related occupation. For data on unemployment rates by occupation, calculations assume that unemployed individuals are seeking further employment in their most recent occupation.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), 2003, 2006, 2008, 2010, 2013, and the National Survey of College Graduates (NSCG), 2015, 2017.

FIGURE 3-13

Unemployment rate, by selected groups: 1990–2017

**Note(s)**

Please see the Science and Engineering Labor Force Technical Appendix for definitions of S&E occupations and S&E technicians and computer programmers.

Source(s)

National Bureau of Economic Research, Merged Outgoing Rotation Group files, 1990–2017; Bureau of Labor Statistics, Current Population Survey (CPS).

Science and Engineering Indicators

Working Involuntarily Out of One's Field of Highest Degree

Working outside of one's chosen field of study 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, including labor market conditions such as availability of suitable work or for career and personal reasons (Stenard and Sauermann 2016). Those who reported that they did so because suitable work was not available in their degree field are referred to as involuntarily out-of-field (IOF) workers, and their number relative to all employed individuals is the IOF rate. In 2017, about 7.5% of S&E highest degree holders reported working involuntarily out of their field (Table 3-9).

TABLE 3-9

S&E highest degree holders who are working involuntarily out of field, by S&E degree field: Selected years, 2003–17

(Percent)

S&E degree field	2003	2006	2008	2010	2013	2015	2017
Highest degree in S&E field	7.8	8.1	7.1	8.4	8.3	7.9	7.5
Biological, agricultural, and environmental life sciences	10.1	9.7	10.1	10.1	9.4	10.4	8.5
Computer and mathematical sciences	4.9	5.7	4.5	5.1	4.1	4.0	4.4

TABLE 3-9

S&E highest degree holders who are working involuntarily out of field, by S&E degree field: Selected years, 2003–17

(Percent)

S&E degree field	2003	2006	2008	2010	2013	2015	2017
Physical sciences	8.8	8.6	7.1	8.2	8.3	9.3	8.7
Social sciences	10.1	10.6	9.2	11.3	11.8	11.4	11.0
Engineering	4.2	4.5	3.6	4.9	4.6	3.2	3.6

Note(s)

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.

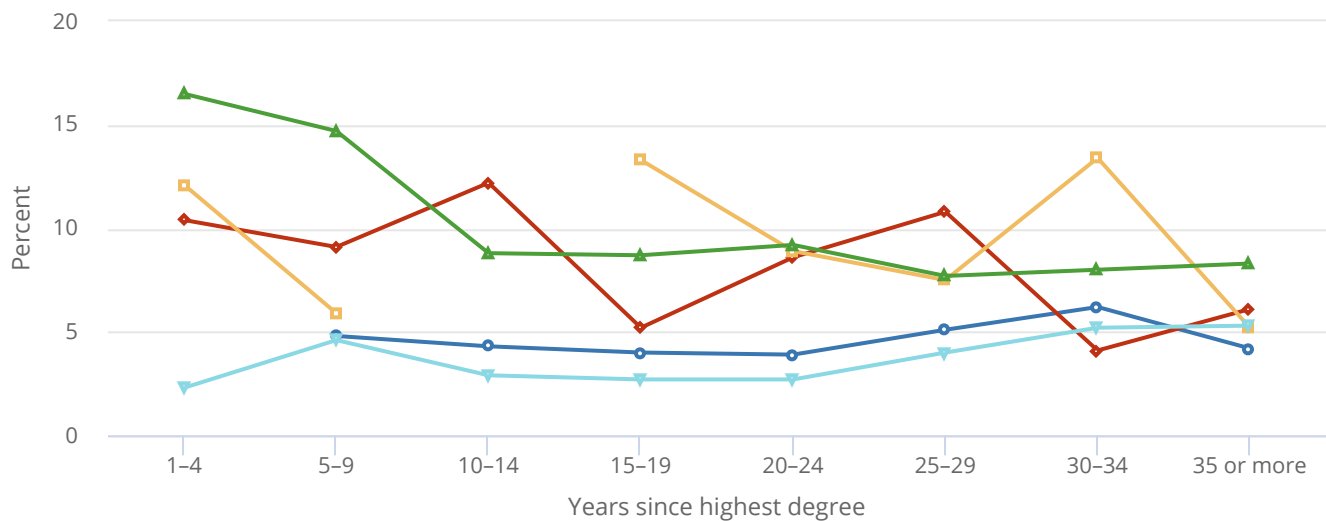
Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), 2003–13, and the National Survey of College Graduates (NSCG), 2015, 2017.

Science and Engineering Indicators

Similar to other labor market outcomes, IOF rates vary by degree levels and S&E fields of study (Table 3-9). Those with a highest degree in engineering or computer and mathematical sciences have lower IOF rates than those with a highest degree in physical, life, or social sciences. This pattern generally persists across most of the career cycle (Figure 3-14). Additionally, scientists and engineers with advanced degrees are less likely to work involuntarily out of field than those with bachelor's degrees only. In 2017, IOF rates for scientists and engineers with highest degrees at the bachelor's, master's, and doctorate levels were 8%, 4%, and 2%, respectively.

FIGURE 3-14

S&E highest degree holders working involuntarily out of field, by field of and years since highest degree: 2017

- Computer and mathematical sciences
- ◇— Biological, agricultural, and environmental life sciences
- Physical sciences
- ▲— Social sciences
- ▽— Engineering

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 Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

Earnings

Individuals in S&E occupations earn considerably more than the overall workforce. The median annual salary in 2017 in S&E occupations (regardless of education level or field) was \$85,390, which is more than double the median for all U.S. workers (\$37,690) (Table 3-10).¹⁰ This reflects the high level of formal education and technical skills associated with S&E occupations. Median S&E salaries rose at about the same rate (1.8%) as that for all U.S. workers (2.0%) from 2014 to 2017. Salaries varied across occupational categories. 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 3-10).

TABLE 3-10

Annual salaries in science, technology, and related occupations: May 2014–May 2017

(Current dollars)

Occupation	Mean			Median		
	Annual salaries in 2014	Annual salaries in 2017	Compound annual growth rate 2014–17 (%)	Annual salaries in 2014	Annual salaries in 2017	Compound annual growth rate 2014–17 (%)
All U.S. employment	47,230	50,620	2.3	35,540	37,690	2.0
STEM occupations	85,530	91,430	2.2	78,730	83,400	1.9
S&E occupations	85,980	91,510	2.1	80,920	85,390	1.8
Computer and mathematical scientists	83,750	89,780	2.3	79,230	84,420	2.1
Life scientists	81,300	86,290	2.0	71,950	74,650	1.2
Physical scientists	85,140	89,560	1.7	76,390	79,270	1.2
Social scientists	75,320	82,410	3.0	68,910	74,180	2.5
Engineers	94,250	98,820	1.6	89,090	92,590	1.3
Technology occupations	82,300	88,940	2.6	67,650	71,870	2.0
S&E-related occupations	76,200	82,730	2.8	62,600	66,540	2.1
Health-related occupations	77,570	82,650	2.1	62,980	66,290	1.7
Registered nurses	69,790	73,550	1.8	66,640	70,000	1.7
Dentists, general	166,810	199,980	6.2	149,540	190,840	8.5
Family and general practitioners	186,320	208,560	3.8	180,180	198,740	3.3
Other S&E-related occupations	82,400	87,530	2.0	74,500	77,790	1.5
Non-STEM occupations	42,380	45,320	2.3	32,390	34,530	2.2
Chief executives	180,700	196,050	2.8	173,320	183,270	1.9
General and operations manager	117,200	123,460	1.7	97,270	100,410	1.1

TABLE 3-10

Annual salaries in science, technology, and related occupations: May 2014–May 2017

(Current dollars)

Occupation	Mean			Median		
	Annual salaries in 2014	Annual salaries in 2017	Compound annual growth rate 2014–17 (%)	Annual salaries in 2014	Annual salaries in 2017	Compound annual growth rate 2014–17 (%)
Education administrators, postsecondary	101,910	107,670	1.8	88,390	92,360	1.5
Management analysts	90,860	93,440	0.9	80,880	82,450	0.6
Financial analysts	92,250	99,430	2.5	78,620	84,300	2.4
Lawyers	133,470	141,890	2.1	114,300	119,250	1.4
Technical writers	71,950	74,440	1.1	69,030	70,930	0.9

STEM = science, technology, engineering, and mathematics.

Note(s)

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)

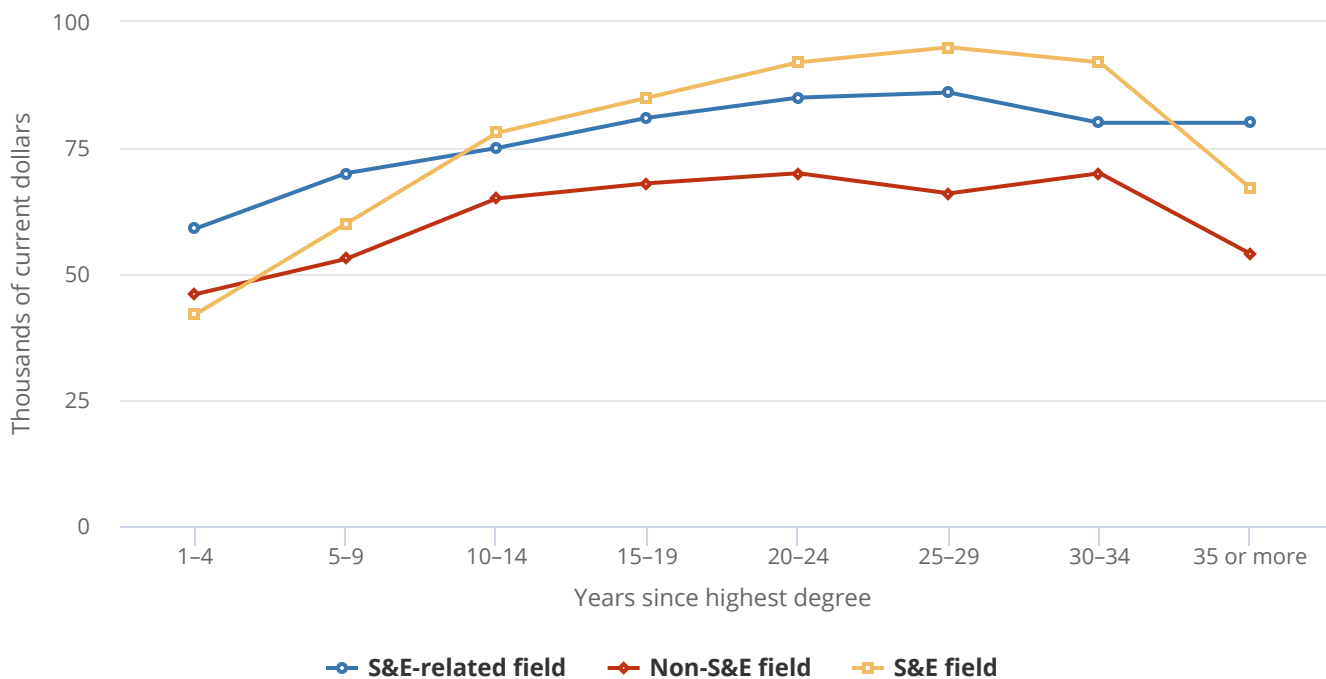
Bureau of Labor Statistics, special tabulations (2015 and 2018) of the May 2014 and May 2017 OES Survey.

Science and Engineering Indicators

The earning premium associated with an S&E or S&E-related degree compared to a non-S&E degree is present across most career stages (Figure 3-15). Earnings also vary by degree levels (Figure 3-16) with master's and doctoral degree holders earning more at all stages of the career cycle relative to bachelor's degree holders.

FIGURE 3-15

Median salaries for employed, college-educated individuals, by broad field of and years since highest degree: 2017



Note(s)

See Science and Engineering Labor Force **Technical Appendix** for classification of S&E, S&E-related, and non-S&E degree fields.

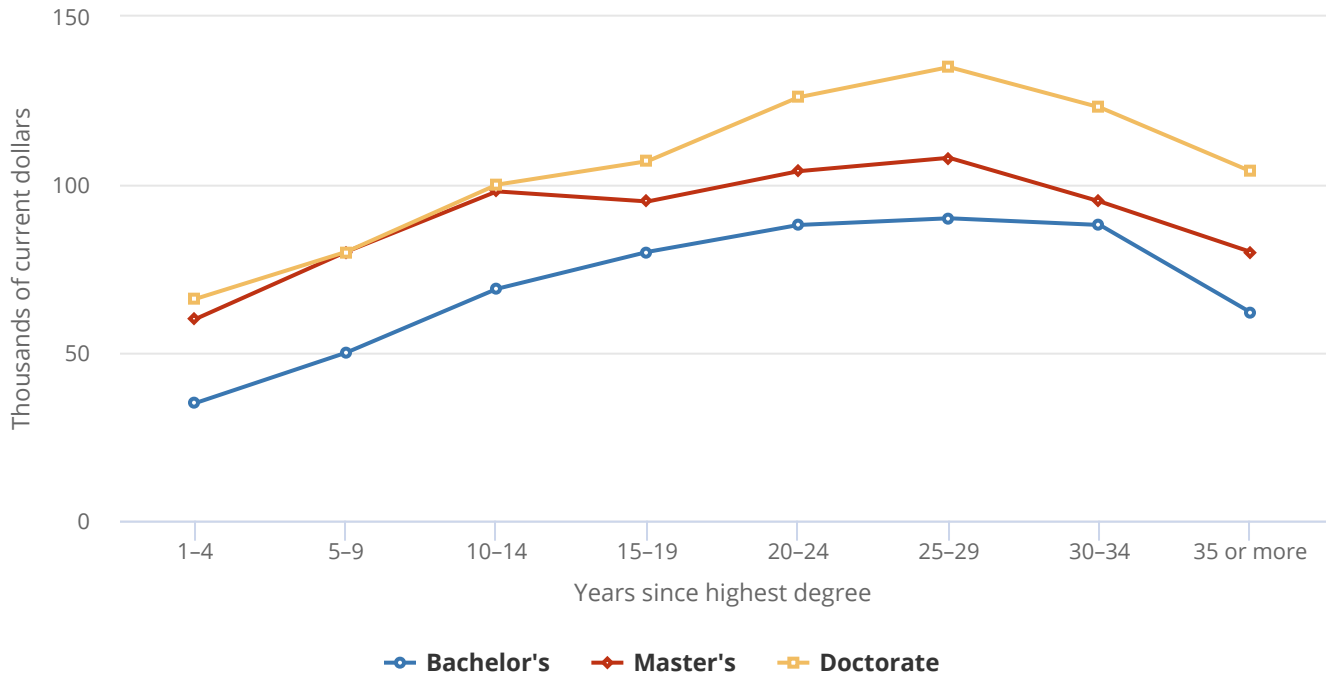
Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

FIGURE 3-16

Median salaries for S&E highest degree holders, by level of and years since highest degree: 2017

**Source(s)**

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

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 labor market conditions for more current entrants to the labor market. Compared with experienced S&E workers, recent S&E graduates—those between 1 and 5 years since receiving their highest degree—more often bring knowledge about emerging fields and state-of-the-art-skills to the labor market. From the National Survey of College Graduates, among the 27 million scientists and engineers employed in February 2017, 2.7 million were recent S&E degree recipients.

Recent S&E graduates may experience different labor market outcomes than more established graduates, and this experience differs between degree levels and broad fields. In 2017, recent graduates had a higher unemployment rate (4.5%) (Table 3-11) than all scientists and engineers (2.7%) (Table 3-8). Also, an estimated 9.9% of the recent S&E graduates indicated working involuntarily out of field (Table 3-11), compared to 7.5% of all S&E highest degree holders (Table 3-9).

TABLE 3-11

Labor market indicators for recent S&E degree recipients up to 5 years after receiving degree, by level and field of highest degree: 2017

(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	4.5	5.1	3.9	1.7	5.1	4.3
Bachelor's	5.0	6.3	2.6	s	5.6	5.4
Master's	3.2	s	s	s	3.8	s
Doctorate	2.8	s	s	s	s	s
Involuntarily out-of-field rate (%)						
All degree levels	9.9	10.4	3.1	10.5	16.7	1.9
Bachelor's	12.8	13.2	s	15.3	19.6	2.5
Master's	4.0	4.1	1.2	s	8.7	1.2
Doctorate	0.6	s	s	s	s	s
Median annual salary (\$)						
All degree levels	43,000	34,000	70,000	37,000	36,000	68,000
Bachelor's	37,000	32,000	55,000	32,000	33,000	63,000
Master's	62,000	41,000	80,000	39,000	42,000	79,000
Doctorate	70,000	55,000	108,000	64,000	70,000	90,000

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 2012 to February 2016. 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 Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

The number of science, engineering, and health (SEH) doctorates who received their doctorate within the past 3 years (recent SEH doctorates) has risen between 2006 and 2017 albeit inconsistently across the broad SEH fields (Table S3-10). For example, the number of computer and information sciences doctorates rose since 2006 and those in psychology declined over this period. Like other recent graduates as well as the overall workforce, trends in labor market outcomes such as unemployment and IOF rates vary across doctoral fields (Table S3-10). Earnings vary by field as well as by position type and employment sector. For example, salaries for SEH doctorates who received their doctorate within the past 5 years ranged from \$49,000 for postdoctoral positions in 4-year institutions to \$104,000 for those employed in the business sector (Table 3-12). Each sector, however, exhibited substantial internal variation by SEH field of training.

TABLE 3-12

Median salaries for recent SEH doctorate recipients up to 5 years after receiving degree, by field of degree and employment sector: 2017

(Current dollars)

Field of doctorate	All sectors	Education				2-year or precollege institutions	Government	Business or industry
		4-year institutions			Postdoc			
		All positions	Tenured or tenure-track position					
All SEH fields	80,000	60,000	74,000	49,000	59,000	83,000	104,000	

TABLE 3-12

Median salaries for recent SEH doctorate recipients up to 5 years after receiving degree, by field of degree and employment sector: 2017

(Current 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			
Biological, agricultural, and environmental life sciences	59,000	50,000	72,000	48,000	55,000	65,000	85,000
Computer and information sciences	124,000	81,000	86,000	65,000	s	119,000	138,000
Mathematics and statistics	87,000	66,000	75,000	59,000	59,000	89,000	118,000
Physical sciences	77,000	54,000	65,000	49,000	55,000	81,000	100,000
Psychology	72,000	62,000	65,000	49,000	69,000	88,000	80,000
Social sciences	71,000	65,000	71,000	47,000	59,000	93,000	100,000
Engineering	100,000	69,000	84,000	50,000	48,000	100,000	110,000
Health	82,000	69,000	74,000	47,000	88,000	95,000	105,000

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 Center for Science and Engineering Statistics, National Science Foundation, Survey of Doctorate Recipients (SDR), 2017.

Science and Engineering Indicators

Postdoctoral Positions

A significant number of 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, government, industry, or nonprofit setting.¹¹ 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.

The estimated number of postdocs varies depending on the data source used. No single data source measures the entire population of postdocs.¹² NCSES's 2017 Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS) reports that 64,733 doctorates were employed as postdocs and conducting research in SEH fields at U.S. academic institutions and their affiliated research centers and hospitals (NCSES *GSS 2017: Table 2-1*). This is a slight increase from 2014 (63,593). Over half (55%) of these postdocs are temporary visa holders.

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 (Table S3-11).¹³ Salaries for this population vary by field of doctorate, and the median salary for postdocs (\$49,000) was just over half the median salary for individuals in non-postdoc positions (\$86,000) (Table 3-13).

TABLE 3-13

Median salaries for recent SEH doctorate recipients in postdoc and non-postdoc positions up to 5 years after receiving degree: 2017

(Current dollars)

Field of doctorate	All positions	Postdocs	Non-postdocs
All SEH	74,000	49,000	86,000
Biological, agricultural, and environmental life sciences	54,000	48,000	72,000
Computer and information sciences	129,000	66,000	130,000
Mathematics and statistics	88,000	57,000	99,000
Physical sciences	70,000	50,000	84,000
Psychology	66,000	49,000	70,000
Social sciences	70,000	49,000	72,000
Engineering	95,000	51,000	100,000
Health	76,000	47,000	85,000

SEH = science, engineering, and health.

Note(s)

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

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, Survey of Doctorate Recipients (SDR), 2017.

Science and Engineering Indicators

Of the nearly 65,000 academic postdoc positions in SEH fields, women held 40% of them in 2017 (NCSES *GSS 2017: Table 2-1*). Among postdocs in engineering, however, the proportion of women was lower (22%) and the proportion of temporary visa holders was higher (66%) than the overall SEH shares. The majority of academic postdocs (62%) in 2017 were supported by research grants; the rest were supported by fellowships, traineeships, or other mechanisms (NCSES *GSS 2017: Table 3-6*).

The Skilled Technical Workforce

The pervasiveness of science and technology in the economy has changed the nature of work for individuals at all education levels, including those who have a high school diploma or an associate's degree or similar level qualification, rather than a bachelor's degree. The skilled technical workforce (STW) consists of individuals who use science, technology, engineering, and mathematics (STEM) knowledge and skills in their jobs and have some high school, high school diploma, some college, associate's degree, or similar levels of educational attainment.

The STW is important to U.S. economic competitiveness. Businesses cite the availability of STEM workers as critical to their ability to compete globally, yet regularly express difficulty in finding workers to fill these jobs. The STW also plays an important role in advancing our national security. Industries that are critical to our national security and defense—including aerospace, advanced manufacturing, information technology, health care, and cybersecurity—rely on availability of these workers (NASEM 2017).

Demographics of the Skilled Technical Workforce

In 2017, over 17 million people worked as skilled technical workers, defined here as workers in occupations that employ significant levels of S&E expertise and technical knowledge and whose educational attainment is less than a bachelor's degree (Table 3-14).¹⁴ In this section, nationally representative data from the American Community Survey (ACS) are used to provide an analysis of demographic and employment trends among the STW (age 25 and older) in the United States (see this report's **Technical Appendix** for more details). The data show that skilled technical jobs provide solid career opportunities for a significant part of the U.S. workforce.

The STW accounts for a considerable portion of U.S. employment (13% of the workforce age 25 and older) (Table 3-14). This workforce is made up primarily of men—only 28% of skilled technical workers are women. In contrast, the overall U.S. workforce (age 25 and older) is about half women and half men. The racial and ethnic distribution of the STW is largely similar to the overall workforce (Table 3-14). Compared to the overall workforce, Asians¹⁵ account for a smaller share of the STW (4% versus 6%), and so do foreign-born individuals (16% of STW, compared with 18% of the overall workforce).

TABLE 3-14

Total and skilled technical workforce age 25 and older, by gender, race, ethnicity, and foreign born: 2017

(Number and percent)

Characteristic	Total workforce	Skilled technical workforce
All employment	135,349,000	17,003,000
Sex		
Male	52.92	72.40
Female	47.08	27.60
Race and ethnicity		
Asian	6.20	3.53
Black or African American	11.23	10.05
Hispanic or Latino	16.45	18.01
White	63.57	65.99
All others	2.55	2.43
Foreign born	18.50	16.20

Note(s)

Values do not include those employed in military occupations. Hispanic may be any race; race categories exclude Hispanic origin. All employment numbers are rounded to the nearest 1,000.

Source(s)

Census Bureau, American Community Survey (ACS), 2017, Public Use Microdata Sample (PUMS).

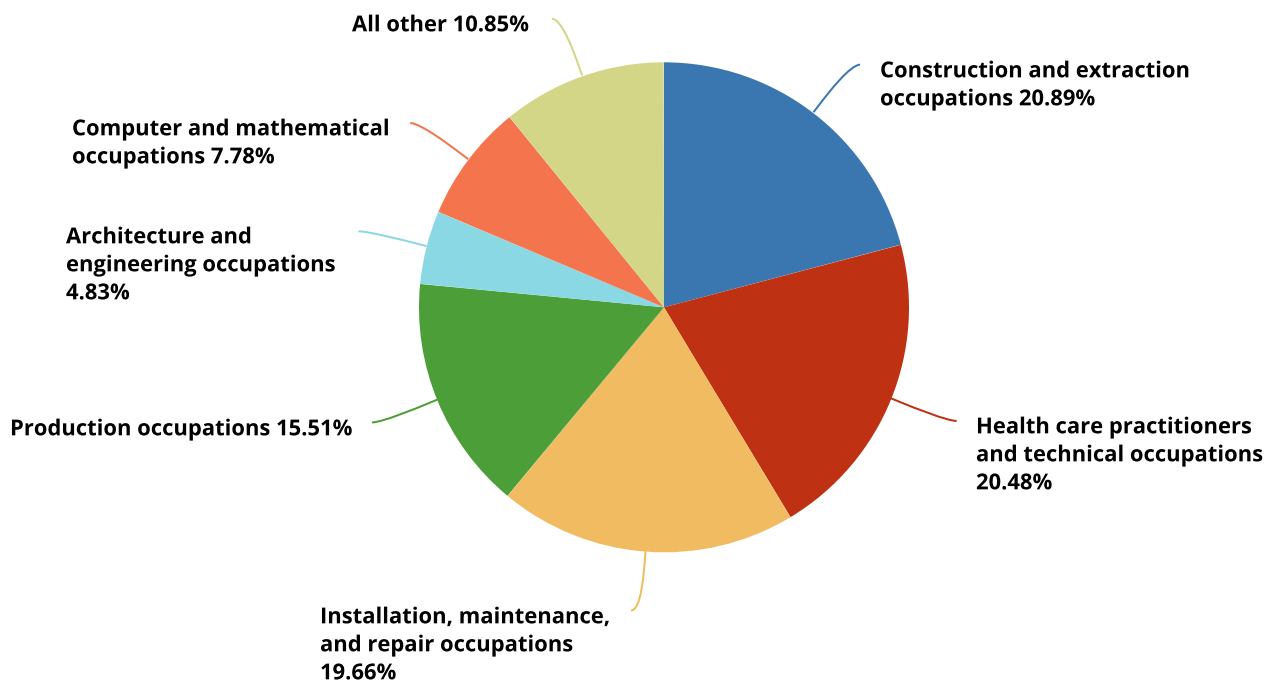
Labor Market Trends of the Skilled Technical Workforce

Skilled technical occupations provide higher paying jobs that have lower unemployment rates than the remaining occupations for workers with less than a bachelor's degree. In 2017, the median salary of skilled technical workers (\$45,000) was significantly higher and the unemployment rate was lower (3%) compared to workers with less than a bachelor's degree in all other occupations (\$29,000 and 5%).

Employment of skilled technical workers was concentrated in four broad occupational categories. Occupations of the STW include S&E and S&E-related occupations, but also those that require significant technological skills and expertise, but do not necessarily require a bachelor's degree for entry (for a full list of occupations included here see **Technical Appendix**). Nearly two-thirds of the STW were employed in occupations in construction and extraction (21%); health care (20%); and installation, maintenance, and repair (20%). Another 16% were employed in production occupations (**Figure 3-17**).

FIGURE 3-17

Skilled technical workers, by occupation: 2017



Note(s)

Values do not include those employed in military occupations.

Source(s)

Census Bureau, American Community Survey (ACS), 2017, Public Use Microdata Sample (PUMS).

STW employment was concentrated in three broad industries: construction, manufacturing, and medical industries. In total, these three industry groups accounted for nearly 60% of STW employment, compared with 30% of all employment (Table 3-15). STW employment intensity, defined by an industry's STW employment as a proportion of its total employment, was highest in construction (36%); mining, quarrying, and oil and gas extraction (35%); and utilities (29%).

TABLE 3-15

Employment of the skilled technical workforce, by major industry: May 2017

(Number)

Industry	Workers employed		STW as a percent of all occupations (%)
	All occupations	STW	
U.S. total – all industries	135,348,542	17,002,829	12.6
Construction	9,348,965	3,389,527	36.3
Mining, quarrying, and oil and gas extraction	678,302	240,037	35.4
Utilities	1,231,070	356,987	29.0
Manufacturing	14,393,604	3,325,677	23.1
Military	315,564	70,949	22.5
Medical	16,507,728	3,354,391	20.3
Information	2,800,784	368,782	13.2
Other services, except public administration	6,725,564	850,137	12.6
Public administration	6,752,910	729,062	10.8
Wholesale trade	3,698,339	297,082	8.0
Professional, scientific, and management, and administrative, and waste management services	16,316,563	1,309,555	8.0
Transportation and warehousing and utilities	6,527,537	445,869	6.8
Retail trade	13,219,102	901,438	6.8
Arts, entertainment, and recreation, and accommodation and food services	9,901,617	495,309	5.0
Finance and insurance, and real estate, and rental and leasing	9,556,066	439,018	4.6
Agriculture, forestry, fishing, and hunting	1,669,255	56,783	3.4
Social assistance	3,082,982	76,243	2.5
Educational services	12,622,590	295,983	2.3

STW = skilled technical workforce.

Note(s)

Industries are defined by the North American Industry Classification System (NAICS). The American Community Survey does not cover employment among self-employed workers and employment in private households. Values do not include those employed in military occupations.

Source(s)

Census Bureau, American Community Survey (ACS), 2017, Public Use Microdata Sample (PUMS).

Science and Engineering Indicators

The STW provides valuable expertise in key industries such as the medical industry, construction, and manufacturing. Overall, the occupations available to those workers with S&E and technological knowledge and abilities provide a viable career path for those with a high school diploma, an associate's degree, some college, or similar qualification. The STW is another pathway to an overall well-paying and secure career. Gender discrepancies remain, but racial and ethnic groups are well-represented in this workforce indicating a diverse workforce, which may contribute positively to growth and innovation.

Demographic Trends of the S&E Workforce

As researchers and policymakers increasingly emphasize the need for expanding S&E capabilities in the United States, demographic groups that are not as represented in S&E as they are in the general population may be seen as an underutilized source of capacity building in S&E. This lower representation signals a lack of diversity in the workplace, which may negatively impact 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, and 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. See sidebar **College-Educated Individuals with a Military Background** for more information on veterans and workers with a military background.

SIDEBAR

College-Educated Individuals with a Military Background

Since 2017, the National Center for Science and Engineering Statistics (NCSES) has been obtaining data on veteran status among those with a bachelor's or higher-level degree. According to the most recent estimates (as of February 2017) of the 61 million college graduates in the United States, approximately 3.7 million had served on active duty in the United States Armed Forces in the past and another 241,000 were currently serving on active duty (Milan 2018). This section analyzes veterans with a bachelor's degree or higher, who served on active duty in the past; the analysis does not include those who are currently on active duty or in the Reserves or National Guard.

Relative to nonveterans, veterans were more likely to be older, male, and have a disability. About three-quarters of veterans and nonveterans were white. There was a higher share of black veterans (13%) than nonveterans (7%). Among female veterans, 28% were black and 14% were Hispanic compared to 9% each among nonveteran women. Veteran women were also younger than male veterans with median ages of 49 and 63, respectively.

Current data on the college-educated veteran workforce reveals that many veterans are not working in S&E or S&E-related occupations nor have they received training in S&E or S&E-related fields of study. Among the 2.4 million employed veterans, a large number worked in non-S&E occupations (1.6 million), followed by S&E-related (426,000) and S&E occupations (358,000). About one-third of veterans were not in the labor force and 85,000 were unemployed. Most veterans with a bachelor's or higher-level degree (57%) had earned their highest degree in a non-S&E field, followed by nearly a third in S&E and 12% in an S&E-related field.

However, this is not the case across all demographic categories. Female veterans were more likely to work in S&E-related occupations (28%) or have a highest degree in an S&E-related field of study (25%) relative to nonveteran women (19% and 16%, respectively).

Most veterans find their veteran financial assistance for education and community college courses valuable toward their future education and career paths. Over half (53%) had used financial assistance from the Veterans Educational Assistance Act (GI Bill) to fund their undergraduate education. In addition, many had attended community college courses (57%); among them, 27% did so "to earn credits for a bachelor's degree."

Veterans (15%) were more likely to work in the federal government system relative to nonveterans (3%). However, the for-profit business sector remained a large employer of both veterans and nonveterans with over half of each (53%) working in for-profit businesses.

Women in the S&E Workforce

The number of women in S&E occupations or with S&E degrees has doubled over the past two decades (Table 3-16). Despite these gains, the latest data show that women are underrepresented in general in S&E, with notable exceptions. In 2017, women constituted 29% of workers in S&E occupations—up from 23% in 1993—relative to over half (52%) of the college-educated workforce overall. Among S&E degree holders, women represented 40% of employed individuals—up from 34% in 1993—with a highest degree in S&E (Figure 3-18).

TABLE 3-16

Racial and ethnic distribution of employed female scientists and engineers in S&E occupations and with S&E highest degrees: 1995 and 2017

(Percent)

Race and ethnicity	Women in S&E occupations		Women with S&E highest degrees	
	1995	2017	1995	2017
Total (number)	714,000	1,966,000	2,391,000	5,771,000
American Indian or Alaska Native	0.3	0.3	0.3	0.4
Asian	9.8	20.8	7.2	14.9
Black or African American	5.6	8.5	7.9	8.7
Hispanic or Latino	2.9	7.8	3.8	10.0
Native Hawaiian or Other Pacific Islander	NA	0.3	NA	0.2
White	81.3	60.4	80.8	63.4
More than one race	NA	1.9	NA	2.4

NA = not available.

Note(s)

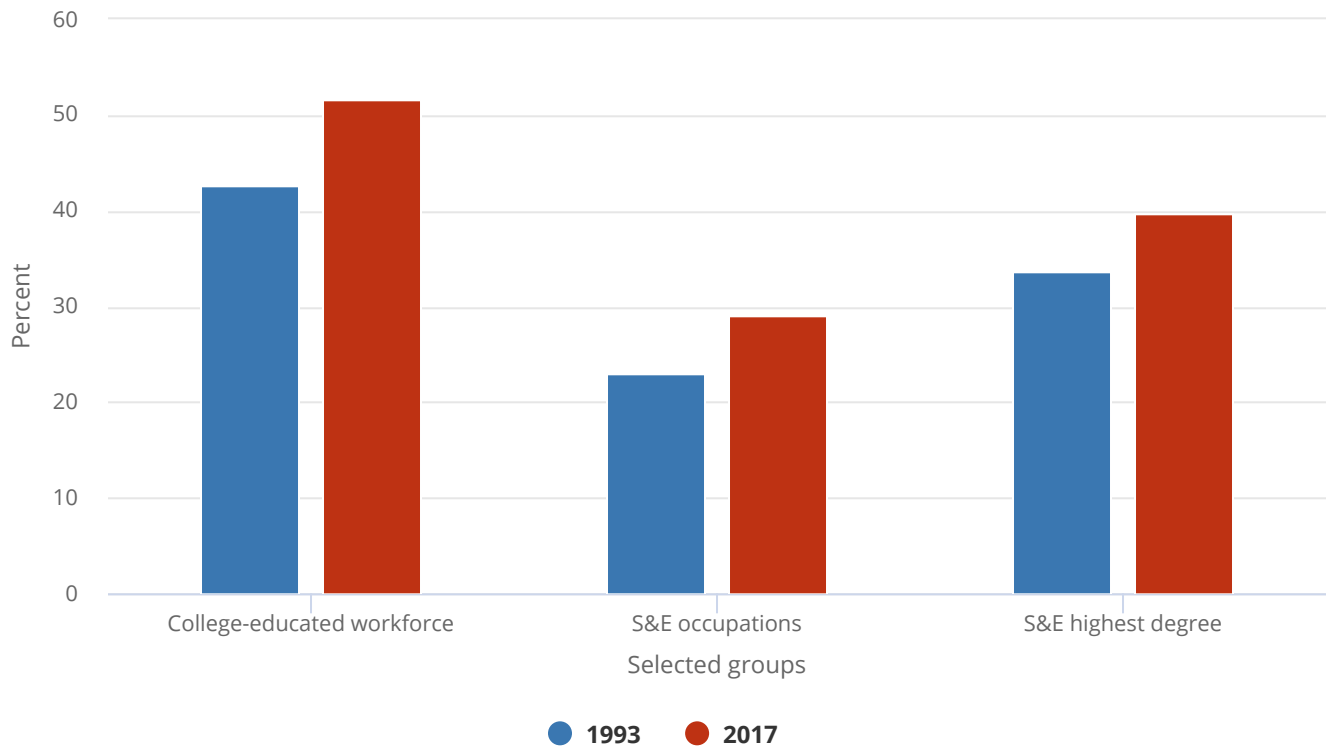
Hispanic may be any race; race categories exclude Hispanic origin. In 1993, respondents could not classify themselves in more than one racial and ethnic category, and Asian included Native Hawaiian and Other Pacific Islander. Scientists and engineers includes those with one or more S&E or S&E-related 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 Center for Science and Engineering Statistics, National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), 1995, and the National Survey of College Graduates (NSCG), 2017.

FIGURE 3-18

Women in the workforce and in S&E: 1993 and 2017

**Source(s)**

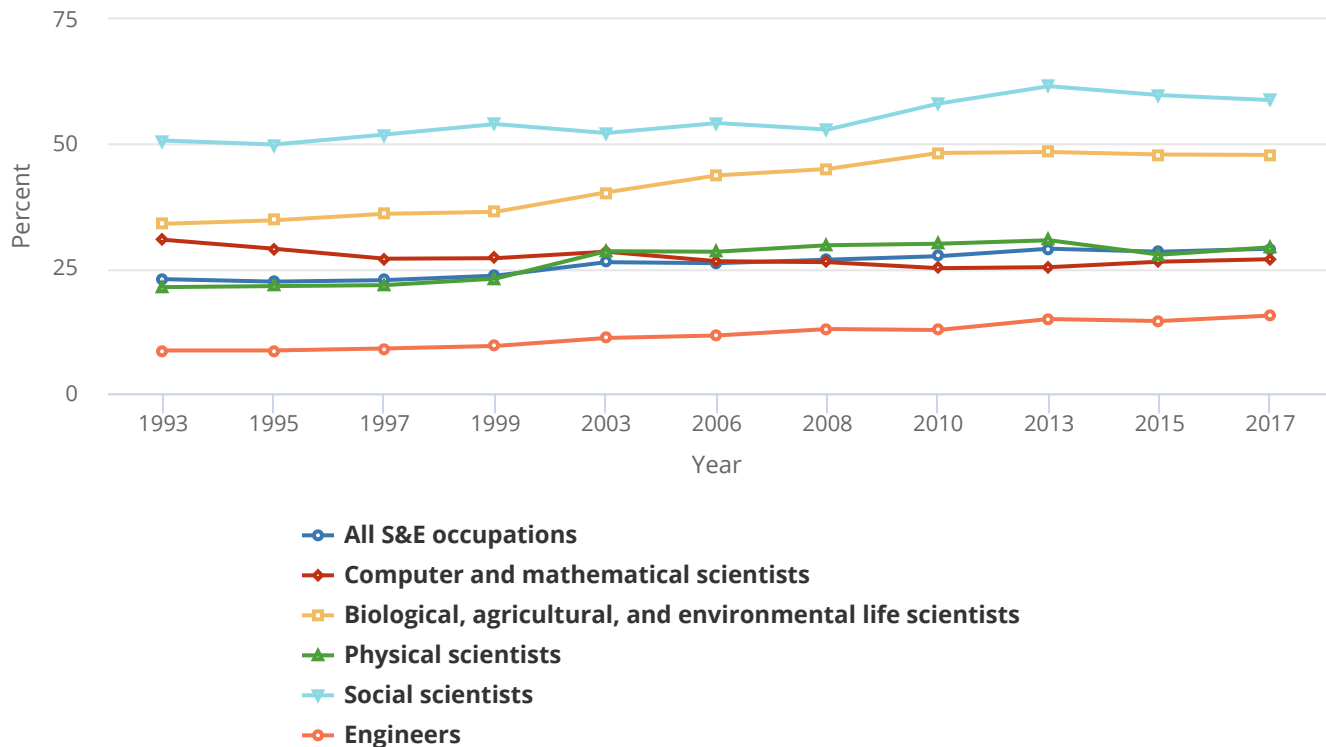
National Center for Science and Engineering Statistics, National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), 1993, and the National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

Women make up over 34% of all scientists (engineers excluded), although representation varies across the broad fields. Women account for approximately 48% and 59% of life scientists and social scientists, respectively, and nearly 30% of physical scientists and computer and mathematical scientists (Figure 3-19; Table S3-12). Notably, while 59% of social scientists are female, occupations within social sciences varied widely: women accounted for 21% of economists and 69% of psychologists. About 16% of engineers are women, ranging from about 7% of mechanical engineers to 25% of chemical engineers (Figure 3-19; Table S3-12).

FIGURE 3-19

Women in S&E occupations: 1993–2017

**Note(s)**

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

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, SESTAT, 1993–2013, and the National Survey of College Graduates (NSCG), 2015–17.

Science and Engineering Indicators

In contrast to jobs in S&E occupations, a majority of jobs in S&E-related occupations (58%) are held by women (Table S3-12). Women comprise 71% of health-related occupations. Women in health occupations are employed 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-related occupations. In contrast, among diagnosing and treating practitioners, women accounted for 44% of workers in these occupations.

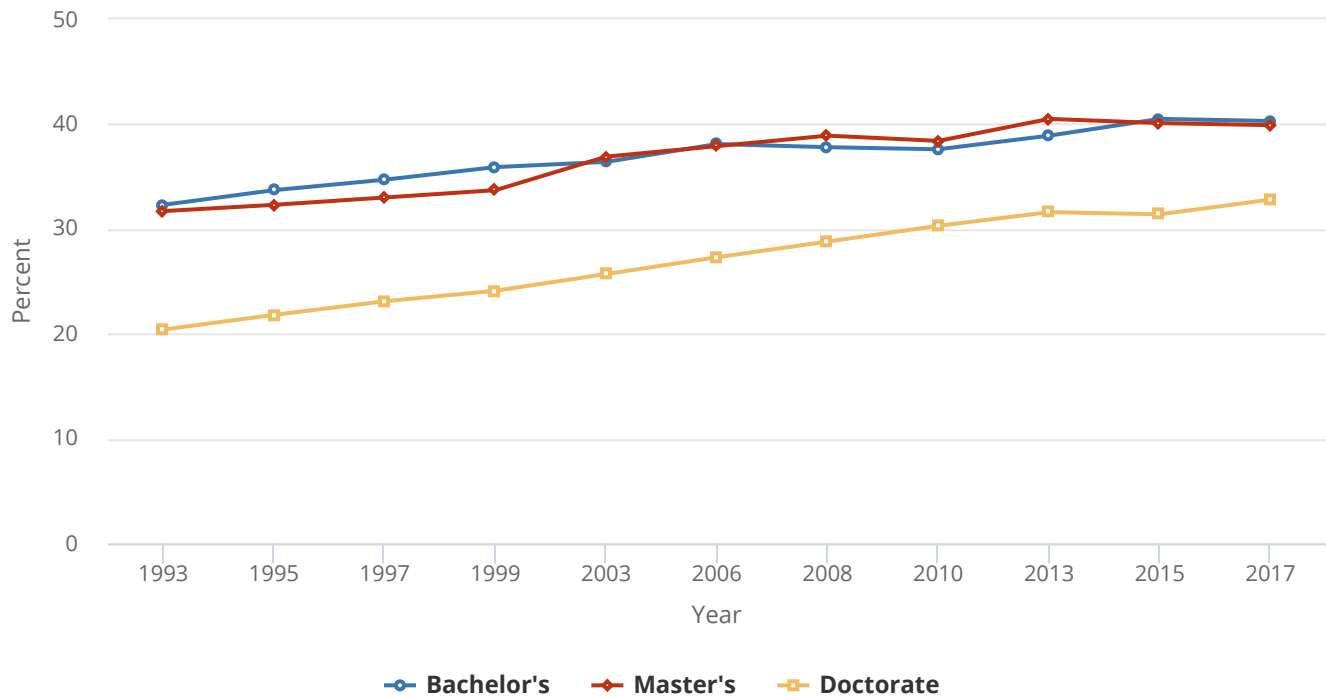
Since the early 1990s, the representation of women has grown in most S&E occupations with some notable exceptions. For example, the percentage of women in engineering occupations nearly doubled during the period of 1993 to 2017 from 9% to 16%. In the case of computer and mathematical sciences, while the number of women tripled in this new, rapidly growing and changing field, they did not increase as much as the number of men. The result has been an overall decline in the proportion of women, from 31% in 1993 to 27% in 2017 (Figure 3-19). 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 31% in 2017.

Women are a larger share of S&E highest degree holders than of S&E occupations. In 2017, women constituted 40% of employed S&E highest degree holders—up from 34% in 1993 (Figure 3-18). 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 (Table S3-13).

The proportion of female S&E highest degree holders has risen at the bachelor's, master's, and doctoral degree levels over the past two decades (Figure 3-20). However, female S&E highest degree holders are underrepresented at all degree levels relative to the proportion of women in the college-educated population (52%).

FIGURE 3-20

Employed female scientists and engineers with highest degree in S&E, by degree level: 1993–2017



Note(s)

Employment may be in an S&E, S&E-related, or non-S&E occupation. 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 Center for Science and Engineering Statistics, National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), 1993–2013, and the National Survey of College Graduates (NSCG), 2015–17.

Science and Engineering Indicators

The number of female doctorate holders employed in academia grew rapidly over time (more than doubling between 1997 and 2017) and faster than the number of men (16%) (Table S3-14). Women accounted for 38% of S&E doctorates employed in academia in 2017, up from 25% in 1997, and accounted for 32% of full-time senior faculty (including full professors and associate professors) in 2017, up from 17% in 1997. Gender differences in the doctoral academic workforce vary across disciplines (Table S3-14).

Minorities in the S&E Workforce

Underrepresentation of certain racial and ethnic groups has long 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. Blacks, Hispanics, and American Indians or Alaska Natives together make up a greater share of the general population than they do of those receiving S&E degrees or working in S&E occupations. In contrast, whites and Asians tend to comprise about the same or greater portions of S&E degree holders and workers than their proportions of the general population would suggest.

While blacks, Hispanics, American Indians or Alaska Natives, Asians, and Native Hawaiians or Other Pacific Islanders are minorities relative to whites in the general population, they are not necessarily “underrepresented minorities” in S&E (Table 3-17). For example, Asians are over-represented in S&E relative to their proportion of college-degree holders and the general population. At 20% and 16% of the S&E occupations and degree holders, respectively, Asians comprise a much larger proportion of these groups than their proportion of the general population (6%). The proportions of white S&E workers and degree holders are similar to their proportion in the general population—they comprise a little over two-thirds of each of these groups (Table 3-17). The proportion of blacks and Hispanics in both science and engineering groups is less than 10% each relative to their 12% and 16% of the general population, respectively. Between 1995 and 2017, the representation of Asians and Hispanics in S&E has increased considerably while the shares of white scientists and engineers has declined; the representation of black scientists and engineers has risen slightly (Table 3-18).

TABLE 3-17

Racial and ethnic distribution of U.S. residents, and of employed individuals in S&E occupations, with S&E degrees, and with college degrees: 2017

(Percent)

Race and ethnicity	S&E occupations	S&E highest degree holders	College degree holders	U.S. residential population ^a
Total (number)	6,769,000	14,501,000	48,223,000	238,771,628
American Indian or Alaska Native	0.2	0.3	0.3	0.6
Asian	19.8	15.7	9.3	5.8
Black or African American	5.6	6.7	7.9	11.9
Hispanic or Latino	7.5	8.6	8.9	15.6
Native Hawaiian or Other Pacific Islander	0.3	0.3	0.3	0.2
White	65.0	66.4	71.4	64.1
More than one race	1.6	2.0	2.0	1.9

^a Age 21 and older.**Note(s)**

Hispanic may be any race; race categories exclude Hispanic origin.

Source(s)

Census Bureau, American Community Survey (ACS), 2017, Public Use Microdata Sample (PUMS); National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

TABLE 3-18

Racial and ethnic distribution of employed scientists and engineers in S&E occupations and with S&E highest degrees: 1995 and 2017

(Percent)

Race and ethnicity	S&E occupations		S&E highest degrees	
	1995	2017	1995	2017
Total (number)	3,186,000	6,769,000	10,115,000	14,501,000
American Indian or Alaska Native	0.3	0.2	0.3	0.3
Asian	9.6	19.8	6.7	15.7
Black or African American	3.4	5.6	5.2	6.7
Hispanic or Latino	2.8	7.5	3.2	8.6
Native Hawaiian or Other Pacific Islander	NA	0.3	NA	0.3
White	83.9	65.0	84.5	66.4
More than one race	NA	1.6	NA	2.0

NA = not available.

Note(s)

Hispanic may be any race; race categories exclude Hispanic origin. In 1995, respondents could not classify themselves in more than one racial and ethnic category, and Asian included Native Hawaiian and Other Pacific Islander. Scientists and engineers includes 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 Center for Science and Engineering Statistics, National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), 1995, and the National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

Representation of workers in certain S&E occupations varied by race and ethnicity (Table S3-15, Table S3-16). Asians had a large presence in computer and engineering occupations, accounting for about a third of computer software engineers, software developers, computer hardware engineers, computer and information research scientists, and postsecondary teachers in engineering. Hispanics had a relatively large presence among psychologists (15%), political scientists (33%), postsecondary teachers in computer science (13%), and industrial engineers (17%). Blacks had high representation rates among computer systems analysts (13%), computer support specialists (14%), and network and computer systems administrators (14%) relative to their representation in S&E occupations overall.

Among S&E highest degree holders, the shares of racial and ethnic groups vary similarly across degree fields, as they do in occupations (Table 3-19, Table S3-20). Compared to most other broad S&E fields, Asians have higher representation rates among those with degrees in engineering and in computer and mathematical sciences; blacks have higher representation rates among those with degrees in computer and mathematical sciences and in social sciences; Hispanics have lower representation rates among those with degrees in computer and mathematical sciences. Whites represent smaller segments of degree holders in engineering and computer and mathematical sciences than in life, physical, and social sciences. In the academic workforce, underrepresented minorities (blacks, Hispanics, and American Indians or Alaskan Natives) constituted 9.3% of total academic doctoral employment and 9.0% of full-time faculty positions in 2017, up from about 6% of both these positions in 1997 (Table S3-18).

TABLE 3-19

Racial and ethnic distribution of employed individuals with S&E highest degree, by field of highest degree: 2017

(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)	14,501,000	2,290,000	2,567,000	814,000	5,336,000	3,494,000
American Indian or Alaska Native	0.3	0.6	0.2	s	0.4	0.3
Asian	15.7	13.4	23.3	15.8	7.6	24.1
Black or African American	6.7	5.3	8.1	4.7	8.6	4.0
Hispanic or Latino	8.6	7.6	5.8	6.1	10.4	9.2
Native Hawaiian or Other Pacific Islander	0.3	0.1	0.3	s	0.3	0.3
White	66.4	70.3	60.5	71.6	70.5	60.8
More than one race	2.0	2.6	1.9	1.4	2.2	1.3

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

Note(s)

Hispanic may be any race; race categories exclude Hispanic origin. Percentages may not add to 100% because of rounding.

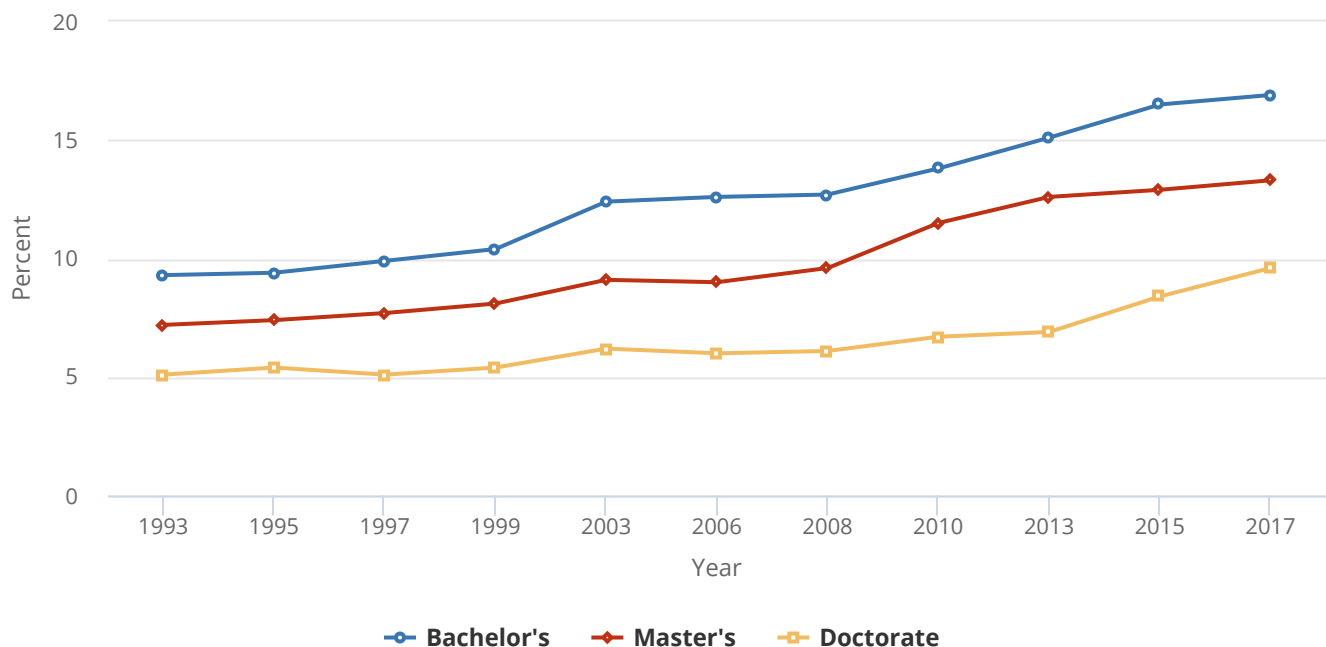
Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

The percentage of underrepresented minorities in S&E has grown at all degree levels since 1993 (Figure 3-21). The number of underrepresented minorities with S&E highest degrees at the bachelor's, master's, and doctoral degree levels quadrupled in recent decades.¹⁶

FIGURE 3-21

Employed underrepresented minorities with highest degree in S&E, by degree level: 1993–2017

Note(s)

Underrepresented minorities include blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), 1993–2013, and the National Survey of College Graduates (NSCG), 2015–17.

Science and Engineering Indicators

Salary Differences for Women and Racial and Ethnic Minorities

Women and racial and ethnic minorities generally receive less pay than their male and white or Asian counterparts (Table 3-20; Table S3-19, Table S3-20). Differences in average age, work experience, academic training, sector and occupation of employment, and other characteristics can make direct comparison of salary statistics misleading. Degree areas with lower salaries generally have higher concentrations of women and racial and ethnic minorities. Disproportionately larger shares of degree holders in life and social sciences work in occupations not categorized as S&E, and the salaries for these occupations are generally lower than for other S&E occupations. 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, 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 degree completion. Because of the rapid increase of the number of females 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.

TABLE 3-20

Median annual salary among S&E highest degree holders working full time, by sex, race, and ethnicity: 1995, 2003, and 2017

(Current dollars)

Characteristic	1995	2003	2017
All	44,000	60,000	80,000
Sex			
Female	34,000	45,000	60,000
Male	49,000	68,000	90,000
Race and ethnicity			
American Indian or Alaska Native	s	48,000	67,000
Asian	45,000	64,000	90,000
Black or African American	35,000	48,000	56,000
Hispanic or Latino	38,000	50,000	65,000
Native Hawaiian or Other Pacific Islander	NA	56,000	83,000
White	45,000	60,000	80,000
More than one race	NA	50,000	75,000

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; race categories exclude Hispanic origin.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), 1995, 2003, and the National Survey of College Graduates (NSCG), 2017.

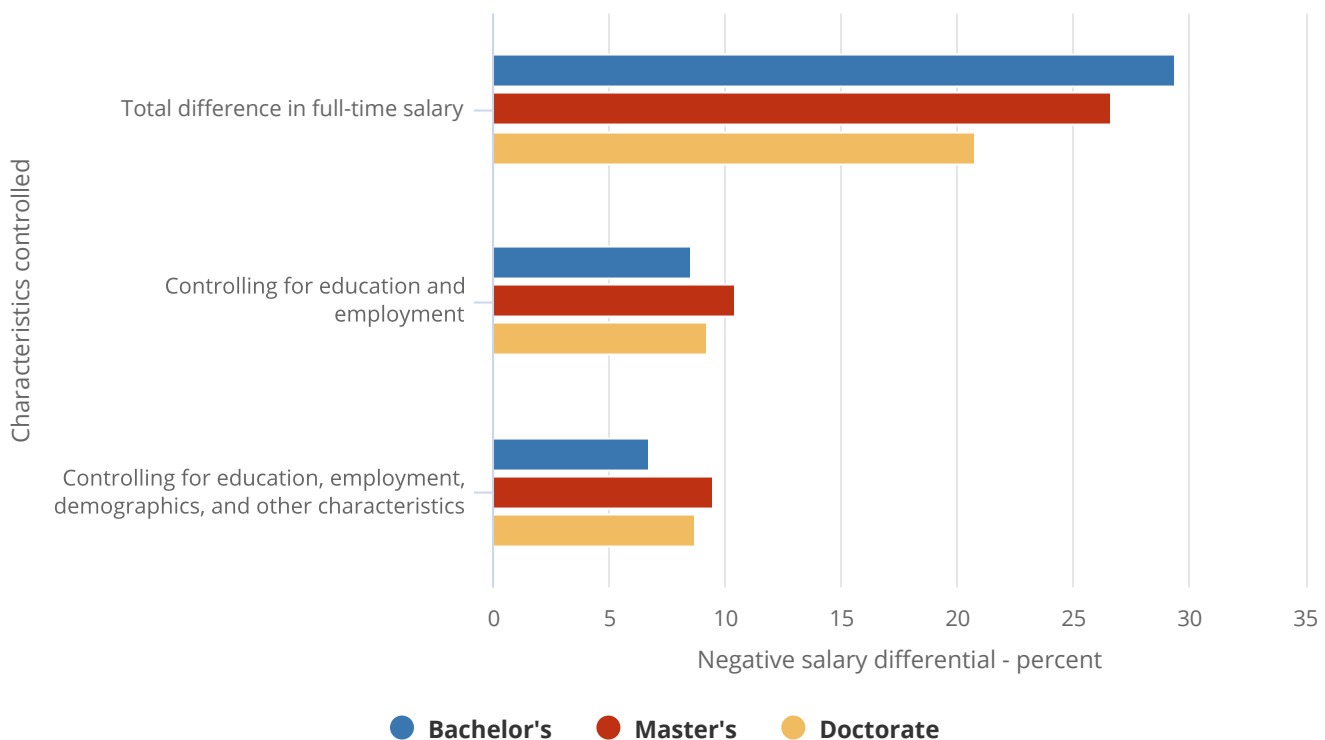
Science and Engineering Indicators

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. 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 these differences. The models used here estimate 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. Also included are data related to salary differences between Asians and whites, and individuals in the remaining race and ethnic categories (American Indians or Alaska Natives, blacks, Hispanics, Native Hawaiians or Other Pacific Islanders, and those reporting more than one race).¹⁷

Controlling for the effects of differences in field of highest degree, degree-granting institution, field of occupation, employment sector, and experience,¹⁸ the estimated salary difference between men and women narrows by more than half relative to the total difference in full-time salary (Figure 3-22). However, after controlling for these effects, a salary differential remains. Women earn 9% less than men among S&E highest degree holders at the bachelor's or doctoral level and 10% less at the master's level. Compared with whites and Asians (controlling for education and employment), S&E highest degree holders in other racial and ethnic groups working full time earn 10% and 5% less at the bachelor's and master's degree levels, respectively (Figure 3-23).¹⁹

FIGURE 3-22

Estimated salary differences between women and men with highest degree in S&E employed full time, controlling for selected characteristics, by degree level: 2017



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, 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, controlling for education, employment, 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.

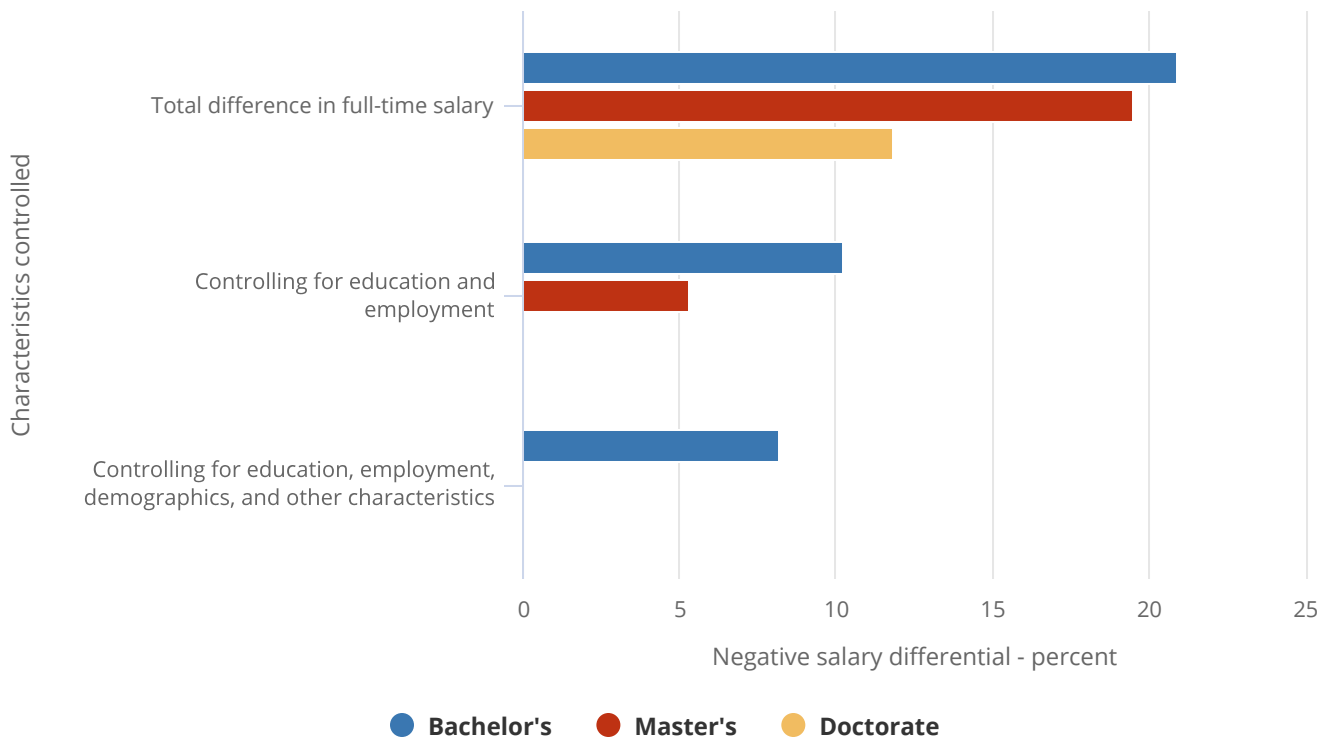
Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017, and the Survey of Doctorate Recipients (SDR), 2017.

Science and Engineering Indicators

FIGURE 3-23

Estimated salary differences between whites and Asians and all other races and ethnicities employed full time with highest degree in S&E, controlling for selected characteristics, by degree level: 2017

**Note(s)**

The estimates for doctorates in the "controlling for education and employment" and for doctorates and master's degrees in the "controlling for education, employment, demographics, and other characteristics" categories are not statistically significant at the 90% confidence level and have been suppressed. 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, then transformed into percentage difference. Minorities include American Indians or Alaska Natives, blacks or African Americans, Hispanics or Latinos, Native Hawaiians or Other Pacific Islanders, and those reporting more than one race. Hispanic may be any race; race categories exclude Hispanic origin. 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, controlling for education, employment, 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 Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017, and the Survey of Doctorate Recipients (SDR), 2017.

Science and Engineering Indicators

Salaries vary by factors beyond education, occupation, and experience.²⁰ Salaries also differ across regions, partly reflecting differences in the cost of living across geographic areas. However, adding such measures as well as personal and family characteristics to education, occupation, and experience results in marginal changes in the estimated salary differences between men and women, and among racial and ethnic groups,²¹ compared with estimates that account for education, occupation, and experience alone. Women's adjusted salary differentials remain at all degree levels (**Figure 3-22**), while the adjusted salary difference among racial and ethnic groups remain at the bachelor's degree level (**Figure 3-23**).²²

The analysis of salary differences suggests that attributes related to human capital (i.e., 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 salary differences between demographic groups.

Readers should keep in mind that the interaction between demographic attributes and those related to human capital are complicated and may impact labor market outcomes. The regression analysis addresses major factors that affect differences in earnings but does not attempt to cover all possible sources of difference (for more detailed discussions, see Blau and Kahn 2017; Ceci and Williams 2011; Mincer 1974; Polachek 2008; and Xie and Shauman 2003).

Immigration and the S&E Workforce

The industrialized nations of the world have long benefited from the inflow of foreign-born scientists and engineers and the S&E skills and knowledge they bring. In the United States, a large proportion of S&E workers are foreign born, and both the number and proportion of foreign-born S&E workers have risen over time (Table 3-21).²³ In 2017, foreign-born individuals accounted for 30% of workers (with a bachelor's or higher-level degree) in S&E occupations compared to less than one-fifth of the overall population (18%) and of all college graduates (17%).²⁴

TABLE 3-21

Foreign-born workers in S&E occupations, by education level: 1993, 2003, 2013, and 2017

(Percent)

Education	1993	2003		2013		2017	
	SESTAT	SESTAT	ACS	NSCG	ACS	NSCG	ACS
All college educated	15.8	22.6	25.1	26.5	27.7	29.5	29.1
Bachelor's	11.4	16.4	18.2	18.9	19.8	21.6	21.1
Master's	20.7	29.4	30.7	34.3	37.1	39.2	39.4
Doctorate	26.8	36.4	38.3	41.4	43.6	43.1	44.7

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); National Center for Science and Engineering Statistics, National Science Foundation, SESTAT and NSCG.

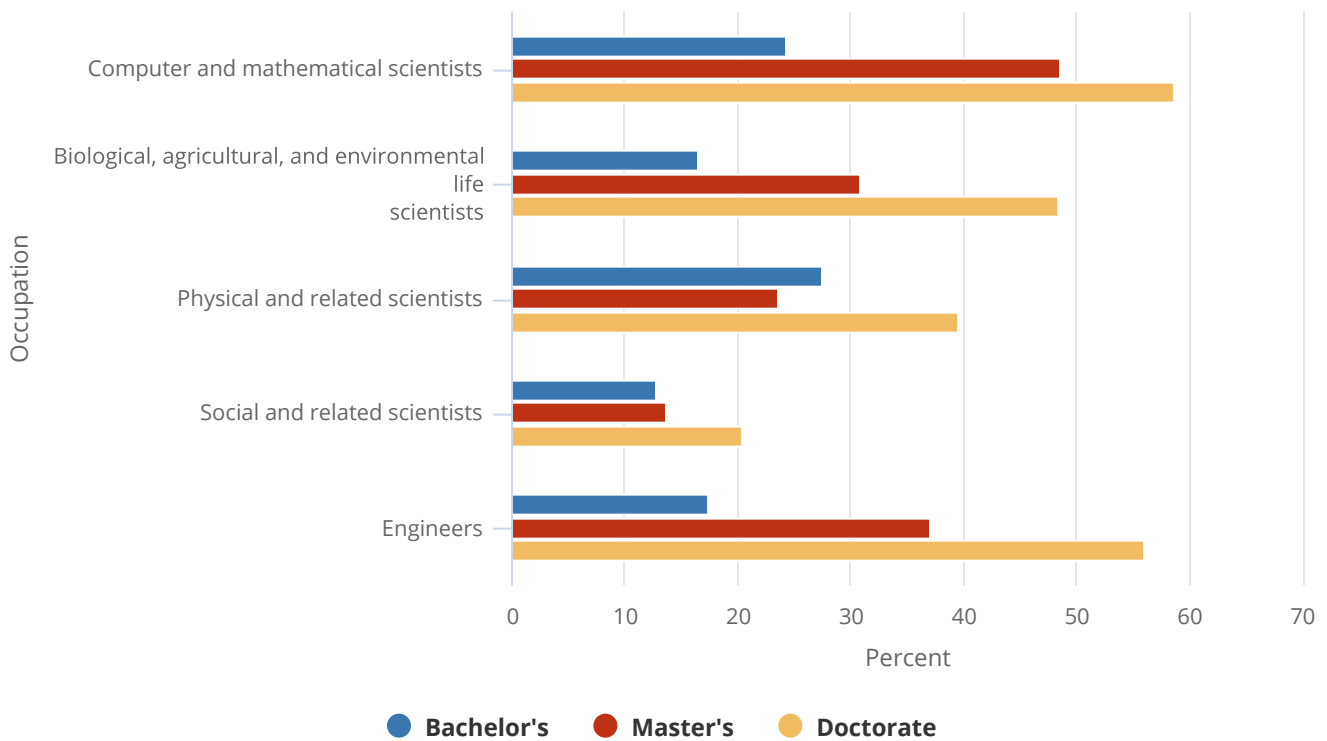
Science and Engineering Indicators

Characteristics of Foreign-Born Scientists and Engineers

Foreign-born workers employed in S&E occupations tend to have higher levels of education than those born in the United States. Among individuals employed in S&E occupations, 17% of foreign-born workers have a doctorate, compared to 9% 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 3-24). In 2017, foreign-born S&E doctorate holders comprised nearly a third of the U.S.-trained academic doctoral workforce (30%) (Table S3-21). In terms of demographic groups, Asians were a greater percentage (60%) of foreign-born workers in S&E occupations relative to 3% of U.S. native-born workers in S&E occupations. The opposite was true for whites who were a lower percentage (24%) of foreign-born workers in S&E occupations relative to 82% of native-born workers in these occupations (Table S3-22).

FIGURE 3-24

Foreign-born scientists and engineers employed in S&E occupations, by highest degree level and broad S&E occupational category: 2017



Source(s)

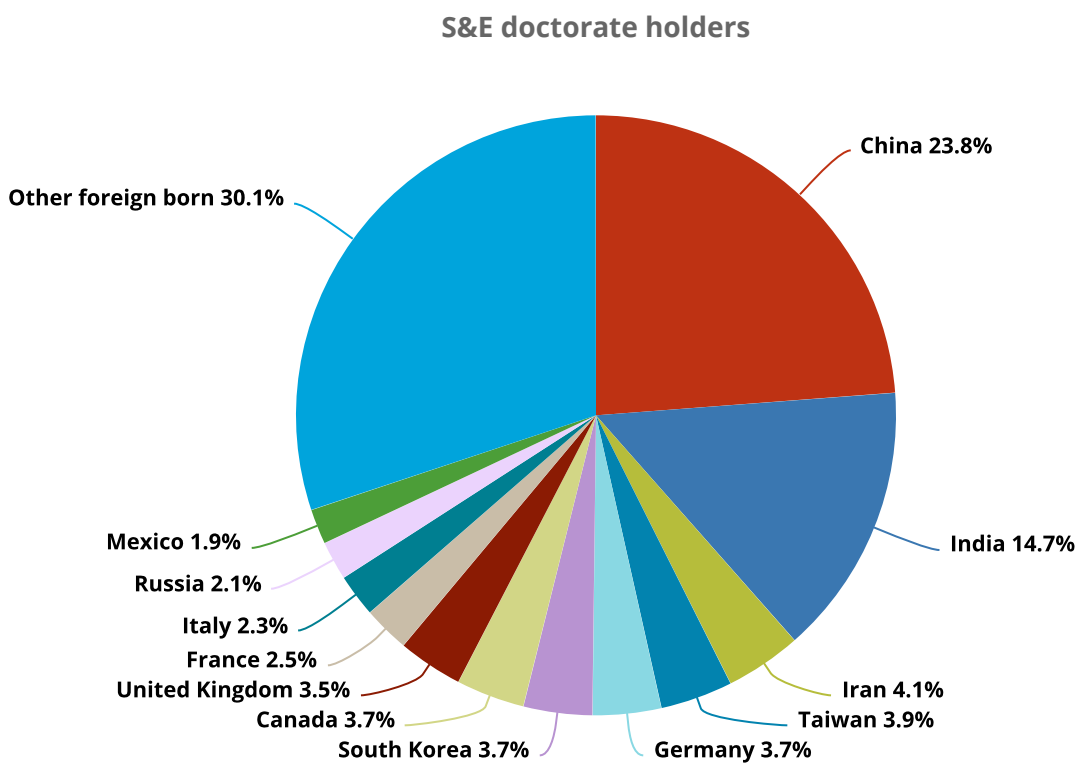
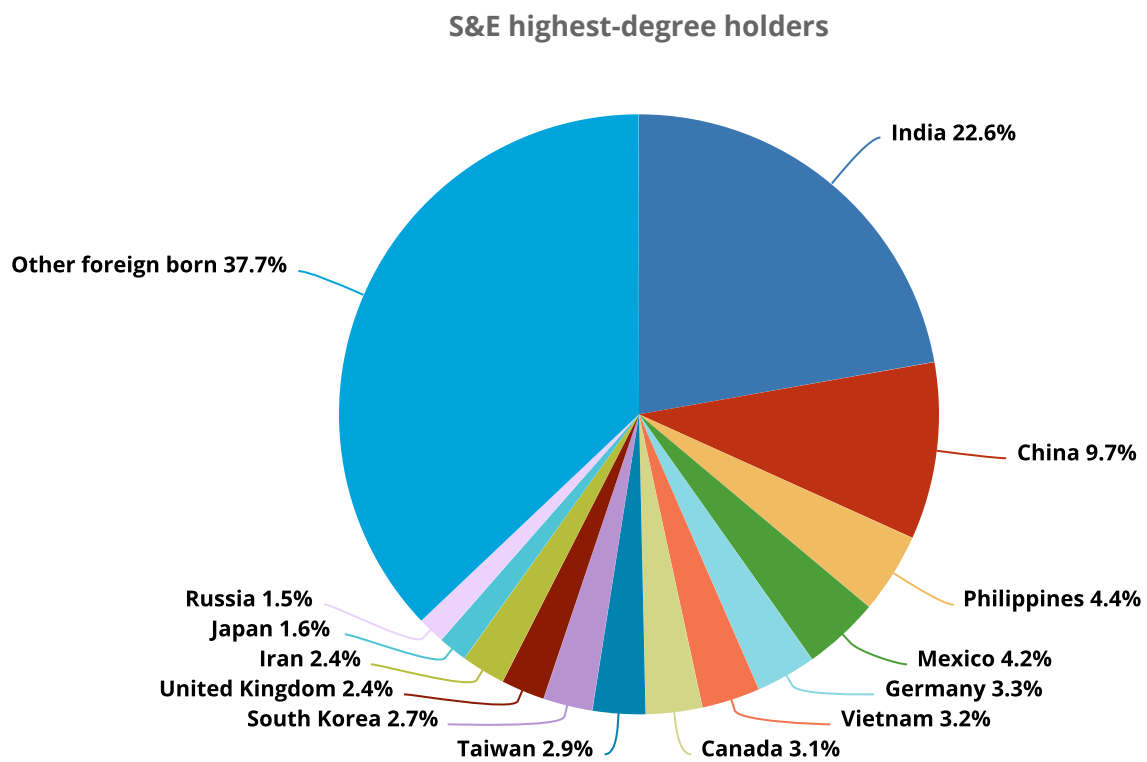
National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

Science and Engineering Indicators

In 2017, half of the foreign-born individuals in the United States with an S&E highest degree were from Asia, with India (23%) and China (10%) as the leading countries of origin (Figure 3-25). For the foreign-born holders of S&E doctorates, however, China provided a higher proportion (24%) than India (15%) (Figure 3-25). 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 3-25

Foreign-born individuals with highest degree in S&E living in the United States, by place of birth: 2017



Source(s)

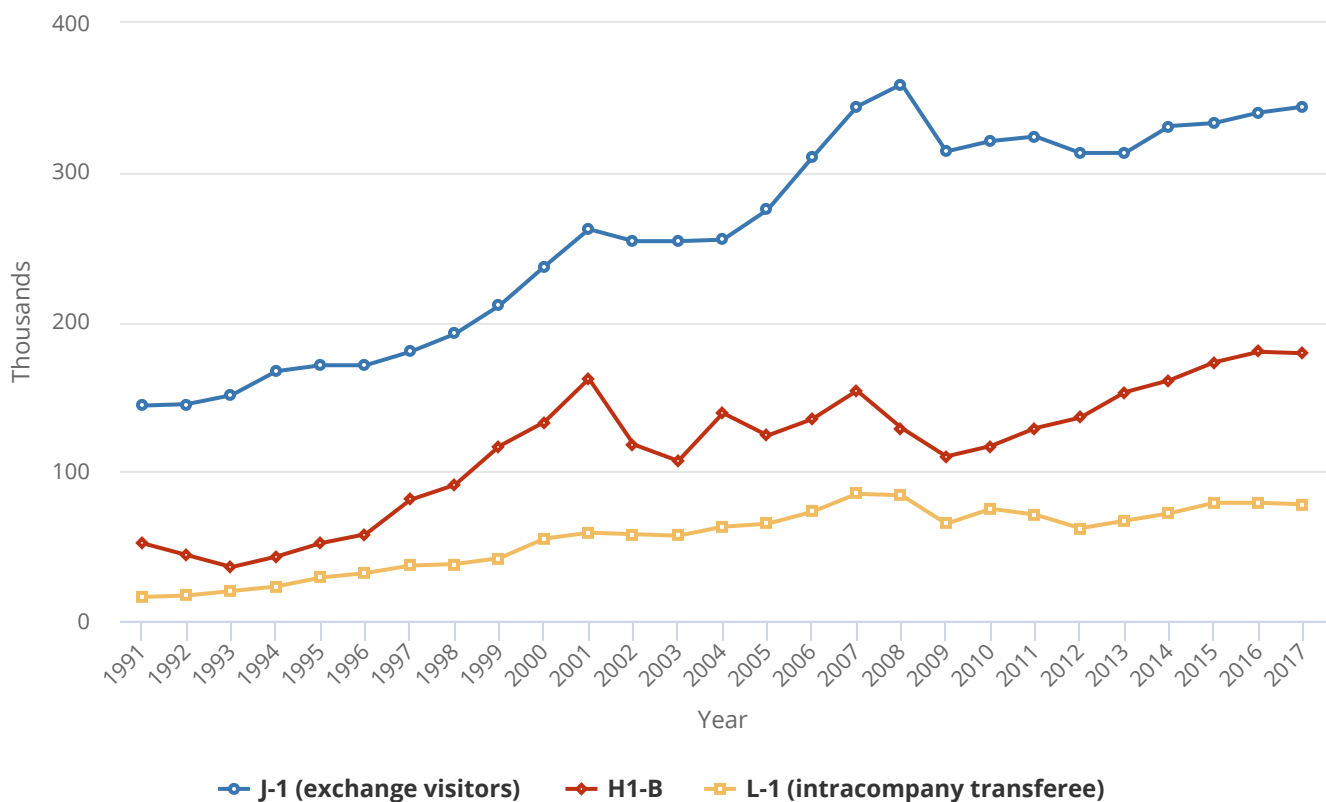
National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates (NSCG), 2017.

New Foreign-Born Workers

The number of temporary work visas issued for high-skill workers, such as researchers, faculty and scholars, or doctorate holders, for example, provides an indication of how many new immigrant workers are entering the U.S. labor force.²⁵ After several years of growth, the largest classes of these temporary visas declined during the 2007–09 economic downturn and then increased post-recession (Figure 3-26).²⁶ H-1B visas²⁷ account for a significant proportion of foreign-born, high-skill workers employed by U.S. firms on temporary visas. In 2017, the United States issued about 179,000 H-1B visas, up 63% from the recent low in 2009 (110,000). The majority of H-1B visa recipients work in S&E or S&E-related occupations with computer-related occupations accounting for 62% of new H-1B visas issued in FY 2017 (DHS/USCIS *FY17 H-1B Workers*: Table 8A).²⁸ 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). H-1B visa recipients tend to possess a bachelor's or higher-level degree (DHS/USCIS *FY17 H-1B Workers*: Table 7). In FY 2017, 63% of new H-1B visa recipients were from India, and 14% were from China (DHS/USCIS *FY17 H-1B Workers*: Table 4A).

FIGURE 3-26

Temporary work visas issued in categories with many high-skill workers: FYs 1991–2017



Note(s)

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

Source(s)

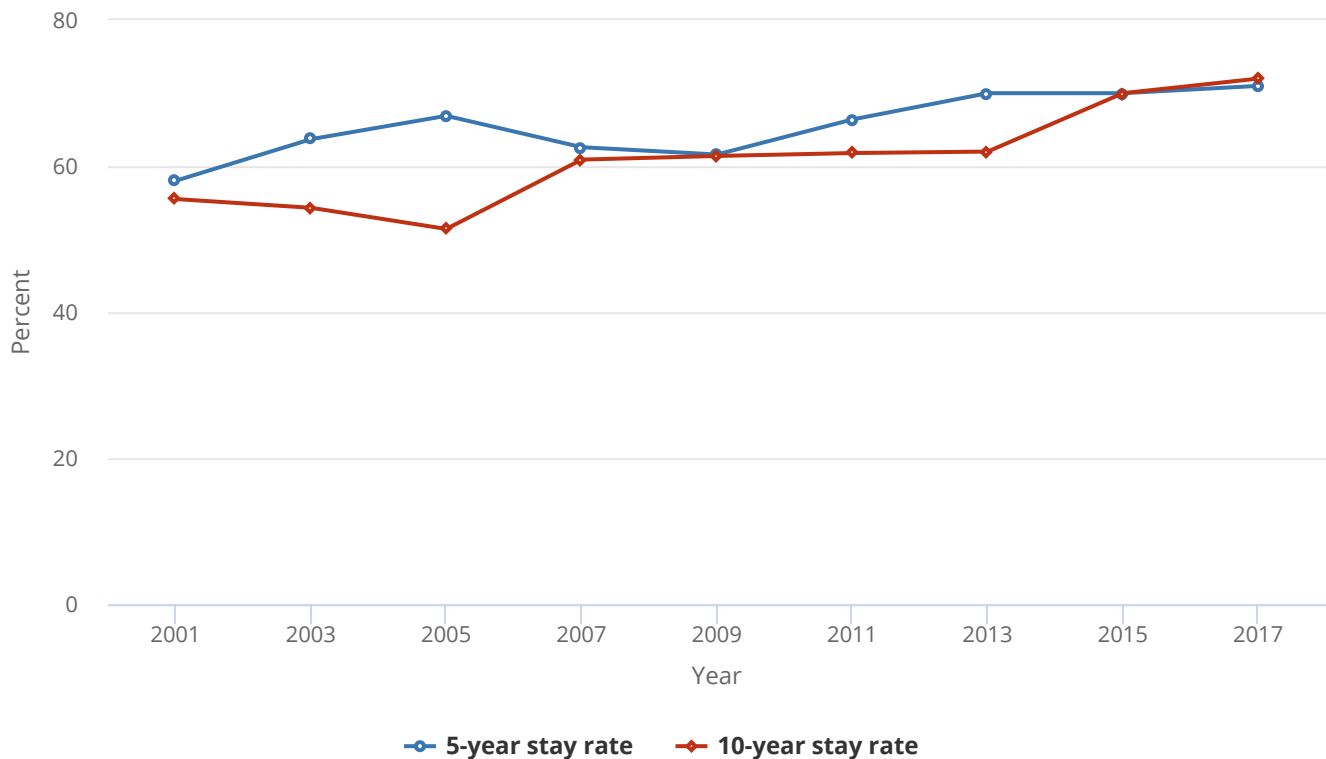
U.S. Department of State, Nonimmigrant Visa Issuances by Visa Class and by Nationality, and Nonimmigrant Visas by Individual Class of Admission.

“Stay Rates” of U.S. S&E Doctorate Recipients

Most foreign-born noncitizen recipients of U.S. S&E doctorates remain in the United States for subsequent employment. Among temporary visa holders who received their S&E doctoral degrees approximately 5 and 10 years prior to 2017, nearly three-quarters remained in the United States in 2017—71% and 72%, respectively (Figure 3-27). These rates are referred to as “stay rates” and 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.²⁹

FIGURE 3-27

Stay rates for U.S. S&E doctoral degree recipients with temporary visas at graduation: 2001–17



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 (2001–11); National Center for Science and Engineering Statistics, National Science Foundation, Survey of Doctorate Recipients (SDR), 2013–17.

Science and Engineering Indicators

Stay rates vary by place of citizenship. Students from China and India, the two largest source countries for U.S. S&E doctoral degree recipients on temporary visas, have relatively high stay rates (Table 3-22). Stay rates also vary somewhat by field of degree: doctoral recipients in the social sciences have lower stay rates than other broad S&E fields of study (Table 3-23).

TABLE 3-22

Temporary visa holders receiving S&E doctorates in 2011–13 and 2006–08 who were in the United States in 2017, by region, country, or economy of citizenship at time of degree

(Number and percent)

Region, country, or economy of citizenship	2011–13 foreign doctorate recipients	5-year stay rate (%)	2006–08 foreign doctorate recipients	10-year stay rate (%)
Total	39,250	71	38,000	72
China (including Hong Kong)	11,000	83	13,000	90
India	7,700	83	6,450	83
South Korea	3,100	57	3,350	44
West Asia	4,600	68	2,750	59
Europe	3,500	71	3,950	69
North and South America	3,750	56	3,350	55
All other countries	5,550	51	5,150	50

Note(s)

Detail may not add to total because of rounding.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, Survey of Doctorate Recipients (SDR), 2017.

Science and Engineering Indicators

TABLE 3-23

Temporary visa holders receiving S&E doctorates in 2011–13 and 2006–08 who were in the United States in 2017, by S&E degree field

(Number and percent)

Degree field	2011–13 foreign doctorate recipients	5-year stay rate (%)	2006–08 foreign doctorate recipients	10-year stay rate (%)
Total	39,250	71	38,000	72
Biological, agricultural, health, and environmental life scientists	9,250	74	9,400	73
Computer and mathematical scientists	5,400	78	5,100	75
Physical sciences	6,150	67	6,400	71
Social scientists	4,900	52	4,100	47
Engineering	13,500	75	13,000	77

Note(s)

Detail may not add to total because of rounding.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, Survey of Doctorate Recipients (SDR), 2017.

Science and Engineering Indicators

The 5- and 10-year stay rates have increased since 2001, with a temporary decline during the economic recession of 2007–09 (Figure 3-27). These rates are calculated every 2 years for the individuals graduating 5 and 10 years earlier, respectively. Although the overall trend was upward, this varied by country of citizenship at the time of degree. In particular, the two largest source countries for S&E doctorates, China and India, saw a decline in their respective 5-year stay rates from 93% and 90% in 2003 to 84% and 85% in 2013; the rates remained stable from 2013 through 2017 (Table S3-23). The 5-year stay rate for Europe increased from 63% in 2003 to 71% in 2017. South Korea increased from 36% in 2003 to 57% in 2017.³⁰

In addition to 5-year and 10-year stay rates, there are data on the period immediately after graduation, a pivotal point that can substantially affect long-term career trajectories. At the time that they receive their doctorates, foreign-born students (including those on temporary and permanent visas) 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 non-postdoc job) the following year.³¹ Consistent with 5-year and 10-year stay rates, 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 immediately after graduation (Table S3-24). In the 2014 to 2017 graduating cohort, 77% of foreign-born noncitizen recipients of U.S. S&E doctorates planned to stay in the United States, and 46% had either accepted an offer of a postdoc or other employment or were continuing employment in the United States. The overall rising trend over time and the trends by degree fields largely follow those of 5- and 10-year stay rates (Table S3-24). For information on international labor force estimates, see sidebar **Global S&E Labor Force**.

SIDEBAR**Global S&E Labor Force**

The rising emphasis on developing S&E expertise and technical capabilities is 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). Highly skilled S&E workers have become increasingly mobile and nations have adapted their immigration policies to make it easier for these valued workers to relocate and work in their countries. 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 business establishment surveys of industry that provide basic information about workers in S&E occupations or on workers with training in S&E disciplines. Additionally, although surveys that collect workforce data are conducted in many Organisation for Economic Co-operation and Development (OECD) member countries, they do not cover several countries—including Brazil and India—that have high and rising levels of science and technology capability, and they do not provide fully comparable data for China.

OECD data covering substantial, internationally comparable segments of the S&E workforce provide strong evidence of its widespread, although 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.

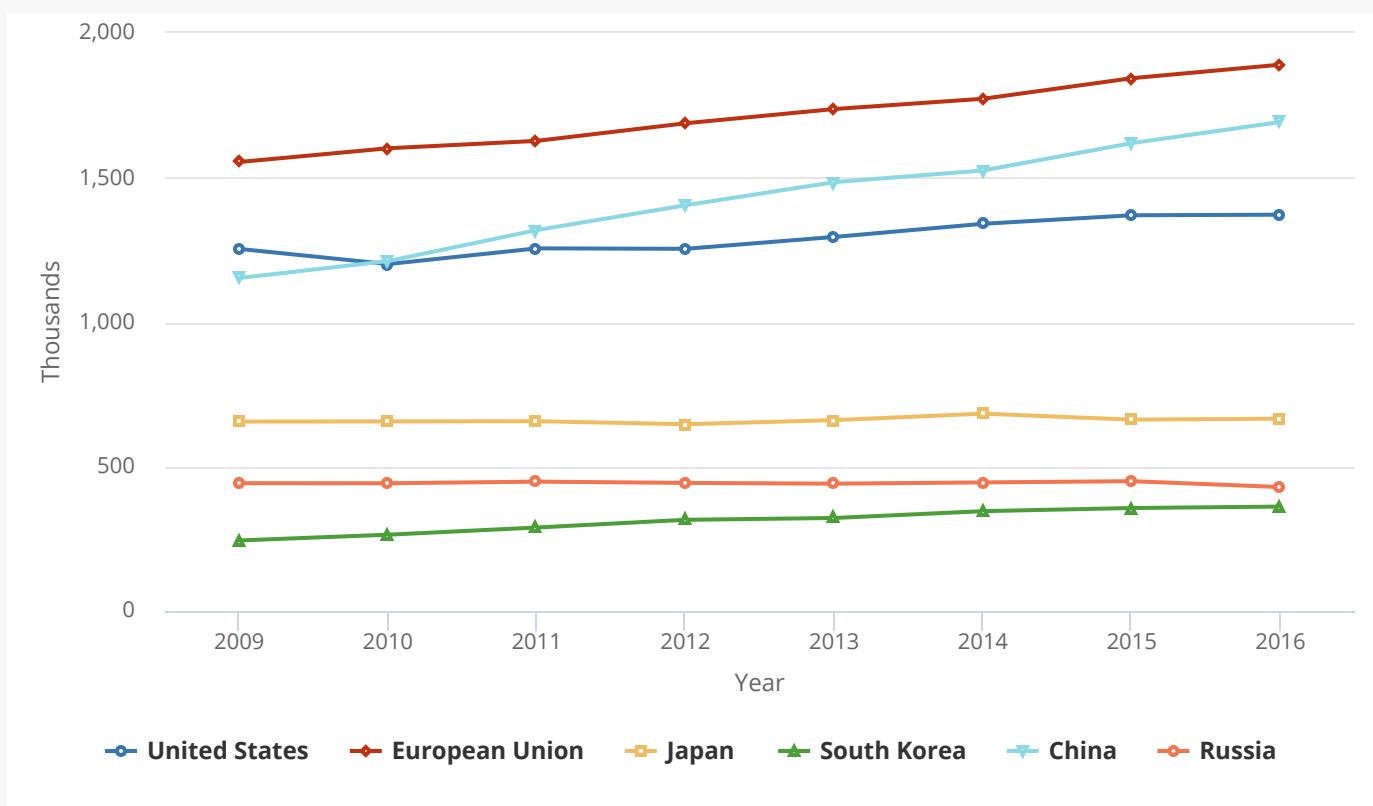
OECD reports an estimated increase in the number of researchers in its member countries from 4.1 million in 2009 to 4.8 million in 2016. OECD also publishes estimates for seven nonmember economies, including China and Russia. Adding these seven to the OECD member total for 2016 yields a worldwide estimate of 7.2 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, although not shown here, 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 the end of the recession in 2009 (**Figure 3-B**). China and South Korea both reported nearly 50% more researchers in 2016 than in 2009. The United States and the EU experienced steady growth but at a lower rate; the number of researchers grew 9% in the United States and 22% in the EU between 2009 and 2016. Exceptions to the overall worldwide trend include Japan (which experienced a relatively small change of about 2%) and Russia (which experienced a decline; see also Gokhberg and Nekipelova [2002]).

FIGURE 3-B

Estimated number of researchers in selected regions, countries, or economies: 2009–16

**Note(s)**

Researchers are full-time equivalents.

Source(s)

Organisation for Economic Co-operation and Development, Main Science and Technology Indicators, 2018/2 (2019).

Science and Engineering Indicators

Conclusion

Workers with S&E expertise are integral to the creation of new products and processes. They advance basic scientific knowledge and transform these advances into tangible and useful goods and services through their innovative ideas and ability. The use of S&E expertise is widespread in the United States with credentials ranging from high school diplomas to doctorates, individuals with S&E training make significant contributions to the S&E enterprise and throughout the economy. Although S&E workers are employed throughout the economy, they are primarily employed in the for-profit business sector. However, 4-year academic institutions continue to also be primary employers of S&E doctorate holders. The skilled technical workforce provides valuable expertise in key industries such as the medical industry, construction, and manufacturing. Across all sectors and industries, S&E workers and skilled technical workers tend to have favorable labor market outcomes relative to non-S&E workers, including higher salaries and lower unemployment rates.

Many suggest that a nation's workforce diversity is associated with increased innovative capacity. Women and some racial and ethnic minorities are underrepresented in S&E overall; however, representation levels vary by occupational category and field of degree. In addition, the representation of these groups in S&E occupations and with S&E degrees has increased in recent decades.

Foreign-born people account for a considerable share of S&E employment in the United States (nearly 30%). Foreign-born noncitizens comprise a large proportion of S&E doctorate holders; the bulk of these students remain in the United States after graduation, indicating that their contributions to the U.S. economy continue well after their training in U.S. institutions ends.

In today's dynamic marketplace, where information flows rapidly and technology is always evolving, labor market conditions change fast. Many 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 policy-relevant information needed to understand the dynamic S&E landscape in the United States and globally.

Glossary

Definitions

European Union (EU): The EU comprises 28 member nations: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, 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, OECD 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 36 countries headquartered in Paris, France. The member countries are Australia, Austria, Belgium, Canada, Chile, Czechia, Estonia, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, 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.

Skilled technical workforce (STW): Workers in occupations that use significant levels of S&E expertise and technical knowledge and whose educational attainment is less than a bachelor's degree.

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

EU: European Union

FY: fiscal year

IOF: involuntarily out-of-field

NCSES: National Center for Science and Engineering Statistics

NSB: National Science Board

NSCG: National Survey of College Graduates

NSF: National Science Foundation

OECD: Organisation for Economic Co-operation and Development

OES: Occupational Employment Statistics

R&D: research and development

S&E: science and engineering

SDR: Survey of Doctorate Recipients

SED: Survey of Earned Doctorates

SEH: science, engineering, and health

SESTAT: Scientists and Engineers Statistical Data System

STEM: science, technology, engineering, and mathematics

STW: skilled technical workforce

USCIS: U.S. Citizenship and Immigration Services

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Notes

- 1 Most of the detailed data presented in this report are from the National Survey of College Graduates (NSCG). Individuals with associate's degrees as their highest degrees are not included in the NSCG survey sample. Therefore, they are not included in references to "degrees" or "degree holders" in the context of this report, unless otherwise specified.
- 2 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. National Science Foundation (NSF) surveys of scientists and engineers and some BLS surveys collect data on postsecondary teachers by field.
- 3 The data on self-employment from the National Survey of College Graduates (NSCG) include those who report being self-employed or employed by a business owner in an unincorporated or incorporated business, professional practice, or farm. As a result, the data may capture 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).
- 4 Those with faculty rank may conduct research (e.g., research faculty, scientist, associate, fellow, postdoc) and hold an administrative position (e.g., president, provost, chancellor) or teach (e.g., teaching and adjunct faculty).
- 5 From *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development* (https://read.oecd-ilibrary.org/science-and-technology/frascati-manual-2015/concepts-and-definitions-for-identifying-r-and-d_9789264239012-4-en#page3, accessed 19 February 2019), the term *R&D* covers three types of activities: basic research, applied research, and experimental development. Here the term *R&D* includes the activity of design.
- 6 The other 10 activities are used to define 4 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 The unemployment rate for scientists and engineers was estimated using data from the NCSES National Survey of College Graduates. The BLS civilian unemployment rate for people ages 16 years or older, not seasonally adjusted, is available at <https://data.bls.gov/timeseries/LNU04000000> (accessed 15 November 2018). Seasonally adjusted rates are available at <https://data.bls.gov/timeseries/LNS14000000> (accessed 22 July 2019).
- 8 The Current Population Survey is the source of the official U.S. unemployment rate.
- 9 At the doctorate level, 2015 and 2017 differed from earlier years shown here. The SESTAT data incorporated data from the SDR, which correspond to the doctor's research/scholarship degree level and are research-focused degrees. The NSCG data used for 2015 and 2017 cover all doctorates regardless of type.
- 10 All earnings reported are in current dollars.
- 11 Although the formal job title is often *postdoc fellowship* or *research associate*, titles vary among organizations. This report 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.
- 12 Three NSF surveys—the Survey of Doctorate Recipients (SDR), the Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS), and the Early Career Doctorates Survey (ECDS)—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—academia, industry, and government—whereas the GSS and the ECDS cover both U.S.- and foreign-trained doctorate holders in academia and federally funded research and development centers, which may be run by for-profit or nonprofit

businesses, and the National Institutes of Health (NIH) Intramural Research Program, which is in the government sector. Therefore, postdocs in the industry and government sectors may be missed. 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). Because the SDR covers only U.S.-trained individuals, it substantially undercounts postdoctoral researchers, most of whom were trained outside the United States. To present more complete counts of postdoctoral researchers, this report uses counts from the GSS, which include foreign-trained postdocs employed in U.S. higher education institutions.

13 These data are from the Survey of Earned Doctorates (SED), which is administered to individuals receiving research doctoral degrees from all accredited U.S. institutions.

14 See the **Technical Appendix** for more information on the methods used to define these additional occupations and the total list of occupations included in the STW.

15 The U.S. Office of Management and Budget (OMB) set standards for the collection of data on race and ethnicity. NCSES uses the OMB standards and guidelines to define Asians and Native Hawaiians or Other Pacific Islanders. These are two distinct racial groups, and the report analyzes them separately. OMB defines “Asian” as *A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian Subcontinent, including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam* and “Native Hawaiian or Other Pacific Islander” as *A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands*. For more information on how NCSES defines racial and ethnic groups according to OMB guidelines, see <https://nces.nsf.gov/pubs/nsf19304/technical-notes> (accessed 23 May 2019).

16 Minority-serving institutions (MSIs) play a prominent role in training black and Hispanic scientists and engineers. In 2016, approximately 15% and 46% of S&E bachelor’s degrees earned by blacks and Hispanics, respectively, are from historically black colleges and universities and high Hispanic enrollment institutions (NCSES *WMPD 2019: Table 5-8 and 5-9*). Between 2013 and 2017, about 37% of Hispanic doctoral graduates earned their bachelor’s degree from high-Hispanic enrollment institutions, and a quarter of blacks earned their bachelor’s degree from historically black colleges and universities.

17 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 2017 and in whites and Asians relative to all other races and ethnicities, respectively. 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 gender and race and ethnicity because the former addresses differences in mean earnings rather than median earnings.

18 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 categories), years since highest degree, and years since highest degree squared.

19 The estimates for doctoral degrees in the “controlling for education and employment” category and for doctoral degrees and master’s degrees in the “plus demographics and other characteristics” category are not statistically significant at the 90% confidence level

20 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.

- 21** 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 Census Bureau divisions), and whether either parent holds a bachelor's or higher-level degree. The gender regression controls for racial and ethnic minority status, and the race and ethnicity regression controls for gender.
- 22** The estimates for doctoral degrees in the "controlling for education and employment" category and for doctoral degrees and master's degrees in the "plus demographics and other characteristics" category are not statistically significant at the 90% confidence level.
- 23** 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 places of birth. When interpreting data on foreign-born workers, the range of individuals in this category should be kept in mind.
- 24** All college graduates and overall population data are for employed individuals ages 25 or older from NCSES calculations using ACS 2017 Public Use Microdata Sample data.
- 25** 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.
- 26** The J-1 exchange visitor visa is used for many different skill levels.
- 27** The H-1B program allows companies in the United States to temporarily employ foreign workers in occupations that require the theoretical and practical application of a body of highly specialized knowledge and a bachelor's degree or higher (or its equivalent) in the specific specialty. H-1B specialty occupations may include such fields as science, engineering, and information technology.
- 28** However, precise counts of H-1B visas issued to individuals in these occupations cannot be obtained because the U.S. Citizenship and Immigration Services does not classify occupations with the same taxonomy used by NSF.
- 29** 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 stay rate. For example, 10-year and 5-year stay rates in 2017 refer to the proportion of 2007 and 2012 graduating cohorts, respectively, who reported living in the United States in 2017. 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 pooled proportion of the 2006, 2007, and 2008 cohorts who reported living in the United States in 2017.
- 30** Stay rates from 2001 to 2011 are from Finn (2014) and are based on data obtained from the U.S. Social Security Administration. Stay rates for 2013, 2015, and 2017 are calculated using data from the Survey of Doctorate Recipients. They are based on an average from 3-year cohorts to reduce the error of the estimates.
- 31** This question is part of the Survey of Earned Doctorates (SED), which is administered to individuals receiving research doctoral degrees from all accredited U.S. institutions. For information on the SED, see <https://www.nsf.gov/statistics/srvydoctorates/>. The information on plans to stay or definite commitments to stay reflects intentions in 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.

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