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Labor Force

The STEM Labor Force of Today: Scientists, Engineers, and Skilled Technical Workers

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Executive Summary

Key takeaways:

- By including workers of all educational backgrounds and the wide variety of occupations that require significant science, technology, engineering, and mathematics (STEM) knowledge and expertise, the STEM workforce represented 23% of the total U.S. workforce in 2019.
- A little over half of STEM workers do not have a bachelor's degree and work primarily in health care (19%), construction trades (20%), installation, maintenance, and repair (21%), and production occupations (14%).
- Unemployment was lower among the STEM labor force (2%) compared to the non-STEM labor force (4%) in 2019, and this pattern persisted even during the COVID-19 pandemic.
- In 2019, STEM workers had higher median earnings ($55,000) than non-STEM workers ($33,000).
- Women are about 34% of STEM workers, representing 44% of those with a bachelor's degree or higher and 26% of those without a bachelor's degree.
- Although Blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives represent 30% of the employed U.S. population, they are 23% of the STEM workforce due to underrepresentation of these groups among STEM workers with a bachelor's degree or higher.
- Foreign-born workers accounted for 19% of the STEM workforce and 45% of a subset of STEM workers (i.e., mathematical and computer scientists, physical scientists, life scientists, social scientists, and engineers) with doctoral degrees in 2019.

Individuals in the STEM workforce make important contributions to improving a nation's living standards, economic growth, and global competitiveness. They fuel a nation's innovative capacity through their work in research and development (R&D) and in other technologically advanced activities, collectively referred to as the science and engineering (S&E) enterprise. The goal of this report is to provide information about the STEM workforce that enables insight into how the U.S. S&E enterprise is positioned to meet the needs of and compete in an increasingly technologically advanced economy, both nationally and internationally.

For this cycle, the report integrates two major components of the STEM workforce: workers with a bachelor's degree or higher and workers without a bachelor's degree, also referred to as the skilled technical workforce (STW). The inclusion of the STW recognizes the importance of these workers in adapting and maintaining new processes and technologies that are integral to the U.S. S&E enterprise and the increasing use of these skills across a broad range of occupations. As such, the STEM workforce described in this report includes occupations that have historically been known to require STEM skills and expertise (e.g., life sciences, physical sciences, engineering, mathematics and computer sciences, social sciences, and health care) as well as occupations that are not typically considered STEM fields but that do, in fact, require STEM skills (e.g., installation, maintenance and repair, construction trades, and production occupations). This major shift in the broad understanding of the STEM workforce more than doubles the number of workers classified as part of the STEM workforce by including 16 million workers with at least a bachelor's degree and 20 million without a bachelor's degree.

Workers in STEM occupations experience lower rates of unemployment and higher salaries than those in non-STEM occupations, and employment in many STEM occupations is expected to grow. However, this projected growth may be unevenly distributed across the United States: 20 metropolitan areas employ disproportionately more workers at all education levels in life sciences, physical sciences, engineering, mathematics and computer sciences, and social sciences. STEM workers with a bachelor's degree or higher are employed proportionately more in coastal states, whereas STEM workers without a bachelor's degree, the STW, are proportionately more in states in the South and Midwest regions of the United States.

Like their non-STEM counterparts, most STEM workers with a bachelor's degree or higher are employed by the business sector, reflecting the dominance of this sector among employers. However, this is not the case for STEM doctorate holders. In 2019, 4-year academic institutions (39%) and for-profit businesses (35%) employed similar proportions of those with doctoral degrees in a STEM field, although the 4-year academic institution share has declined since 1993 (45%). In academia, doctorate holders are shifting from faculty to nonfaculty positions and from teaching as a primary activity to R&D as a primary activity. In addition, full-time faculty as a percentage of all doctoral academic employment has been in steady decline for four decades, decreasing from about 90% in the early 1970s to 70% in 2019.

Typically, workers with a bachelor's degree or higher in STEM occupations often have a degree in a STEM field. However, many workers with a STEM education background pursue careers outside of STEM, indicating the applicability of STEM skills and expertise across a broad range of occupations. For example, STEM degree holders are employed in large numbers (more than 1 million in each) as financial or personnel specialists, executive-level managers or education administrators, and sales and marketing workers. In addition, about 70% of STEM degree holders who worked in occupations outside of STEM reported that their occupation was closely or somewhat related to their degree field. Overall, only 37% of workers with their highest degree in computer and mathematical sciences, life sciences, physical sciences, social sciences, or engineering worked in occupations classified as scientists or engineers. In contrast, 71% of workers with their highest degree in a health-related field, STEM education field, or technology or technical field worked in occupations related to these degree fields.

Less information is available regarding the education and training pathways for STEM workers without a bachelor's degree, which include associate's degrees, certificate programs, apprenticeships, certifications, and licenses. However, STEM workers without a bachelor's degree earn associate's degrees and hold certifications and licenses at higher rates than their non-STEM counterparts.

Although data about workers without a bachelor's degree in STEM are limited, several key findings are evident by comparing the two components of the STEM workforce, in particular, information relevant to broadening participation for historically underrepresented groups: women, Blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives. The proportion of women with a bachelor's degree or higher in the STEM workforce is greater than those without a bachelor's degree in STEM. Women in the STEM workforce with at least a bachelor's degree exceeded their 50% representation within the U.S. employed population in some STEM occupations. For example, among health care workers with a bachelor's degree or higher, women were 70% of the workforce in 2019; within health care, however, women tended to be employed in the lower-paying occupations.

The number and proportion of workers from an underrepresented race or ethnicity have increased within the STEM workforce with Hispanic or Latino workers mostly closing the gap in representation. Although those from certain races or ethnicities are underrepresented among STEM workers with a bachelor's degree or higher, the degree to which they are underrepresented varies across STEM occupations. In 2019, Blacks or African Americans were 12% of the employed U.S. population. However, Blacks or African Americans represented 6% of workers with a bachelor's degree or higher who were classified as computer and mathematical scientists but represented 13% of computer network architects and 17% of information security analysts. Similarly, Hispanic or Latino Americans were comparable to or proportionately more than their representation in the U.S. employed population in several occupations in the social sciences. Many factors can contribute to the uneven concentration of underrepresented minority races or ethnicities across STEM occupations, and further research is needed to understand the barriers to broadening participation among them.

In addition to Americans born in the United States, a substantial proportion of the STEM workforce is foreign born, making up 23% of this workforce with a bachelor's degree or higher. Foreign-born workers are particularly concentrated among those at the doctorate level who work as computer and mathematical scientists, engineers, and life scientists. China and India are the leading birthplaces for foreign-born STEM doctorate holders in the United States. Many U.S.-trained foreign-born doctorate holders in STEM fields (i.e., mathematics and computer sciences, physical sciences, life sciences, social sciences, and engineering) on temporary visas expect to remain within the United States a least a year after receiving their degrees. Many of these noncitizen doctorate recipients become permanent residents or U.S. citizens. Thus, immigration represents a key component to building the capacity of the U.S. STEM workforce.

The U.S. STEM workforce is large and diverse in occupations, education level, and nationality. Although STEM workers generally have better labor market outcomes compared to non-STEM workers, these benefits are unevenly distributed across region, sex, race, or ethnicity. While participation by historically underrepresented groups has grown, these groups continue to be less well represented, which may impede the innovative capacity of the U.S. S&E enterprise. Broadening participation in STEM and ensuring equitable distribution of benefits from STEM fosters the development of a robust STEM workforce, which is critical for improving the nation’s living standards, providing economic growth, and maintaining global competitiveness.

Introduction

This report provides an analytical overview of the U.S. science, technology, engineering, and mathematics (STEM) labor force,[1] which is comprised of employed and unemployed workers. Analysis is based on various data sources, including education and workforce surveys conducted by the National Center for Science and Engineering Statistics (NCSES). These surveys cover most occupations in the STEM labor force with a bachelor's degree or higher. Data from the U.S. Census Bureau and the Bureau of Labor Statistics (BLS) are also used to analyze the STEM workforce at all education levels, providing analysis of the STEM workforce as defined by those with at least a bachelor's degree and those without. Topics covered in this report include the definition, size, and growth of the STEM workforce as well as the relationship between training and occupation. Salary and unemployment rates provide information on the position of STEM workers in the economy and their labor market conditions. An examination of the demographic makeup of the STEM labor force and the role of foreign-born STEM workers concludes the report.

Most of the data presented in this report are from 2019 and, therefore, do not reflect the impact of the current COVID-19 pandemic. However, there is a sidebar that examines monthly unemployment rates of the STEM and non-STEM workforces for selected months in 2020.

U.S. STEM Workforce: Definition, Size, and Growth

New advancements and discoveries in science and technology, such as quantum technologies, space exploration, and medical vaccines, are rapidly changing the world of work and, as a result, continue to challenge the traditional framework used to define the U.S. STEM labor force. The constant stream of innovative technologies that improve work activities, such as automation and artificial intelligence, further disrupt and blur the growing boundaries of the science & engineering (S&E) enterprise. Those who work in the S&E enterprise fuel the nation's innovative capacity through their work in research and development (R&D) and other technologically advanced activities. As a range of workers with STEM knowledge and skills becomes increasingly central to innovation and economic growth, a new definition of the STEM workforce that encompasses the "diversity and inclusivity of science and engineering is vital to the future of the S&E enterprise and crucial to maintain the broad public support for S&E" (NSB 2019a:6). This report continues to measure employed workers with a bachelor's degree or higher in S&E and S&E-related occupations and workers with S&E or S&E-related degrees. It also broadens the definition of STEM workers to include workers with at least a bachelor's degree and workers without a bachelor's degree.

In past *Science and Engineering Indicators* reports, the focus was on a subset of the STEM workforce with a bachelor's degree or higher who work primarily in STEM occupations, such as computer, life, physical, and social scientists and engineers (i.e., S&E occupations). Analyses also included workers in health care and S&E managerial occupations (i.e., S&E-related occupations). These reports introduced a limited analysis of the skilled technical workforce (STW), which includes occupations that require a high level of knowledge in a technical domain but do not require a bachelor's degree. While not defined as the STW at the time, the ***Indicators 2016*** and ***Indicators 2018*** reports analyzed workers in S&E and S&E-related occupations without a bachelor's degree. The *Indicators 2020* **"Science and Engineering Labor Force"** report expanded the analysis to include STEM workers in middle-skill occupations such as construction, extraction, and production. While middle-skill occupations include STEM and non-STEM workers, the usage of "middle-skill occupations" generally refers only to STEM workers in the context of this report. However, these reports did not provide a framework that included the STW within the STEM workforce, primarily because one had not yet been developed.

In recent years, several organizations and researchers—including the National Academies of Sciences, Engineering, and Medicine (NASEM 2017), the National Science Board (NSB 2015, 2019a), and NCSES (2020a), among others—have recognized that workers with less than a bachelor's degree who have S&E skills and technical expertise are integral to the overall R&D capabilities of the U.S. STEM labor force. Although U.S. workforce experts may know these STEM workers as middle-skill workers (Carnevale et al. 2018; Fuller et al. 2014; Holzer and Lerman 2007; NASEM 2017), this report identifies them as the STW. To provide a more calibrated understanding of the U.S. STEM labor force, this report introduces a comprehensive definition of the STEM workforce that explicitly integrates the STW with STEM workers with a bachelor's degree or higher.

The discussion that follows in this section will address three primary goals. First, this section will explain the expanded definition of the STEM workforce and delineate how this definition departs from the narrower definition of the U.S. S&E labor force that was the focus of prior *Indicators* reports. Second, the most recent statistics on the size and growth of the U.S. STEM workforce will be discussed. This discussion will include both the new, expanded definition of the STEM workforce and also the S&E workforce definition used in past *Indicators* reports. NCSES collects data on S&E workers with a bachelor's degree or higher that offer unique insight into this important segment of the STEM workforce, and these analyses of the S&E workforce continue even as the report is evolving to include the expanded STEM workforce definition. The third and final goal is to lay a foundation for future reports to explore themes relevant to the expanded U.S. STEM workforce. As new data become available, future research will become more inclusive of all workers who inform, support, and advance the U.S. S&E enterprise.[2]

A Traditional Definition: S&E Workers in the STEM Workforce

Past and current *Indicators* analyses focus on a subset of the STEM workforce: individuals with at least a bachelor's degree working in S&E occupations. S&E occupations encompass five major categories: (1) computer and mathematics scientists; (2) biological, agricultural, and environmental life scientists; (3) physical scientists; (4) social scientists, and (5) engineers.[3] Analyses of workers who also utilize science and technological expertise may include those employed in S&E-related occupations, including doctors, nurses, engineering managers, computer programmers, and biological technologists.

To provide a comprehensive understanding of U.S. workers utilizing STEM skills and knowledge at the bachelor's degree level or higher, past *Indicators* reports primarily focused on those in S&E occupations with at least a bachelor's degree, with a degree in an S&E field of study or those who use a bachelor's degree level of S&E expertise in their job. Data on these S&E skills and knowledge provide insights on the R&D and technology impact of these workers, the education and training required to support the workers in S&E, and the pervasiveness of S&E skills, regardless of occupation type. The category of scientists and engineers includes individuals who have an S&E or S&E-related degree or work in an S&E or S&E-related occupation; it yields the largest number of S&E workers with a bachelor's degree or higher in this report. Collectively, these approaches have been used by *Indicators* to define and analyze the S&E workforce with a bachelor's degree or higher.

NCSES's National Survey of College Graduates (NSCG) and the Survey of Doctorate Recipients (SDR) provide detailed data on those with a bachelor's degree or higher in S&E and S&E-related occupations or with S&E and S&E-related degrees and those in the workforce with science, engineering, or health (SEH) research doctorates, respectively. The NSCG and SDR collect education and occupation data on adults up to age 75. The NSCG (NCSES 2021b) focuses on adults with a bachelor's degree or higher living in the United States, whereas the SDR (NCSES 2021d) focuses on U.S.-trained S&E doctorate recipients living in the United States and abroad. To classify the occupations, this *Indicators* report continues to use the NCSES Taxonomy of Occupations. (See NCSES *NSCG 2017*: **Technical Table A-1** for taxonomy.)[4] The NCSES occupation taxonomy does not allow middle-skill occupations to be identified separately from non-STEM occupations. Hence, analysis based on NSCG or SDR data in this report will continue to focus on workers in S&E, S&E-related, and non-S&E occupations, the latter of which include middle-skill and non-STEM occupations.

Focusing narrowly on workers with a bachelor's degree or higher who are employed in S&E occupations, this S&E workforce definition yields about 6.6 million–7.5 million workers, depending on the data source (**Table LBR-1**).[5] This estimate almost quadruples to nearly 29 million when using another definition for scientists and engineers, which includes those who have an S&E or S&E-related degree or work in an S&E or S&E-related occupation. Nearly 20 million individuals attained their highest degree—a bachelor's, master's, professional, or doctoral degree—in an S&E field.

Table LBR-1

Measures and size of U.S. S&E workforce with a bachelor's degree or higher: 2019

(Number)

Measure	Individuals
Scientists and engineers	
S&E or S&E-related occupation or degree	28,627,000
Occupation	
Employed in S&E occupations (NSCG)	7,466,000
Employed in S&E occupations (ACS)	6,559,000
Education	
At least one degree in S&E field	25,859,000
Highest degree in S&E field	19,662,000
Job requires S&E technical expertise at bachelor's level	
In one or more S&E fields	21,767,000
Engineering, computer science, mathematics, or natural sciences	16,000,000

Table LBR-1

Measures and size of U.S. S&E workforce with a bachelor's degree or higher: 2019

(Number)

Measure	Individuals
Social sciences	5,767,000

ACS = American Community Survey; NSCG = National Survey of College Graduates.

Note(s):
The data source is NSCG unless otherwise noted. The NSCG estimate of the number of workers in S&E occupations includes postsecondary teachers of S&E fields, and the ACS estimate excludes them. The totals for at least one degree in S&E field and highest degree in S&E field include individuals who are employed and those who are unemployed and out of the labor force. Scientists and engineers are individuals under the age of 76 with a bachelor's degree or higher, are living in the United States, and have an S&E or S&E-related degree or occupation.

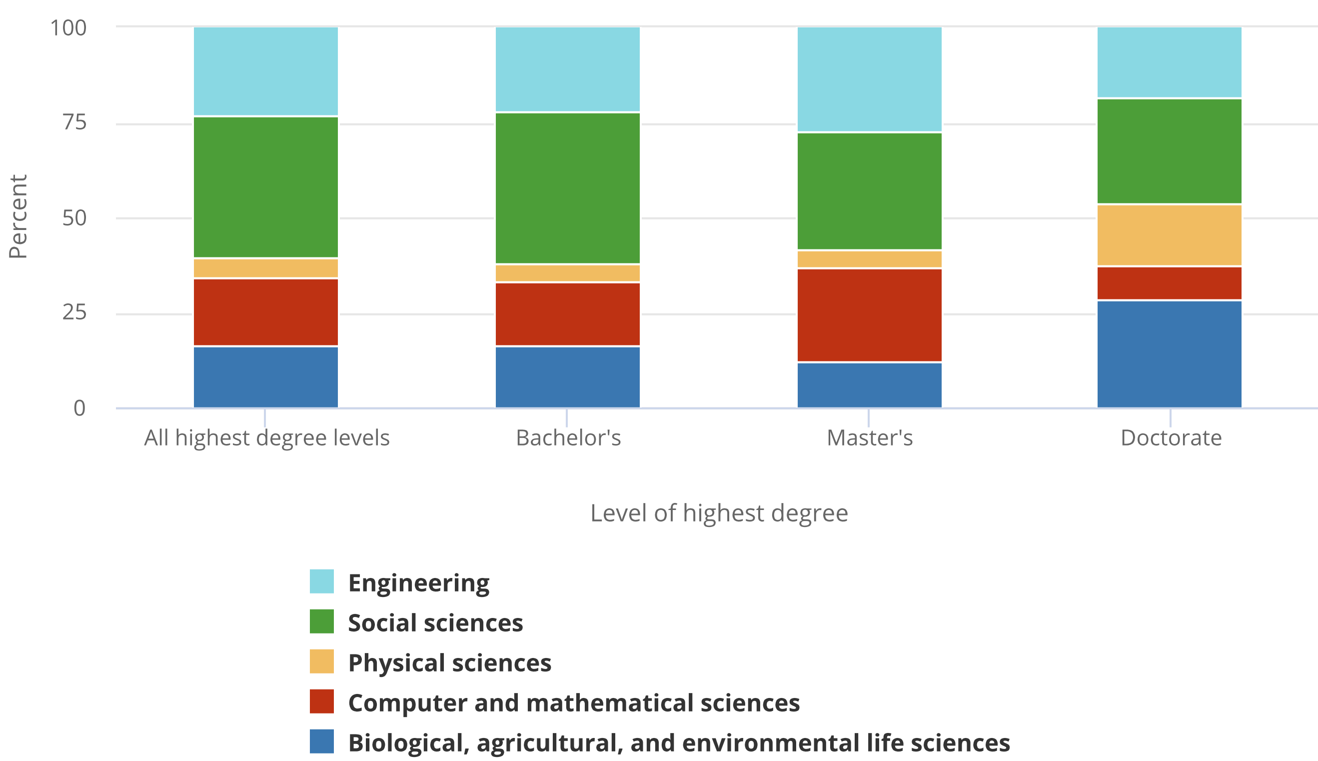
Source(s):
National Center for Science and Engineering Statistics, NSCG, 2019; U.S. Census Bureau, ACS, 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

Based on the NCSES's (2021a) 2019 NSCG, S&E degree holders outnumber those currently employed in S&E occupations. (See NCSES *SDR 2019*: **Technical Table A-1** for Taxonomy of Disciplines.) In 2019, social sciences and engineering were the most common degree fields overall, whereas the life sciences and social sciences fields were prominent fields of study for doctorate holders (**Figure LBR-1**).

Figure LBR-1

Individuals with their highest degree in S&E, by field and level of highest degree: 2019



Note(s):
All highest degree levels include professional degrees not shown separately.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

The extensive use of S&E expertise in the workplace is also evident from the number of workers with a bachelor's degree or higher who indicate that their job requires technical expertise at the bachelor's degree level in S&E fields. Among workers with a bachelor's degree or higher, regardless of occupation or degree type, almost 22 million reported that their jobs required at least this level of technical expertise in one or more S&E fields (**Table LBR-1**). This estimate is almost three times as large as the 7.5 million college graduates employed in S&E occupations.

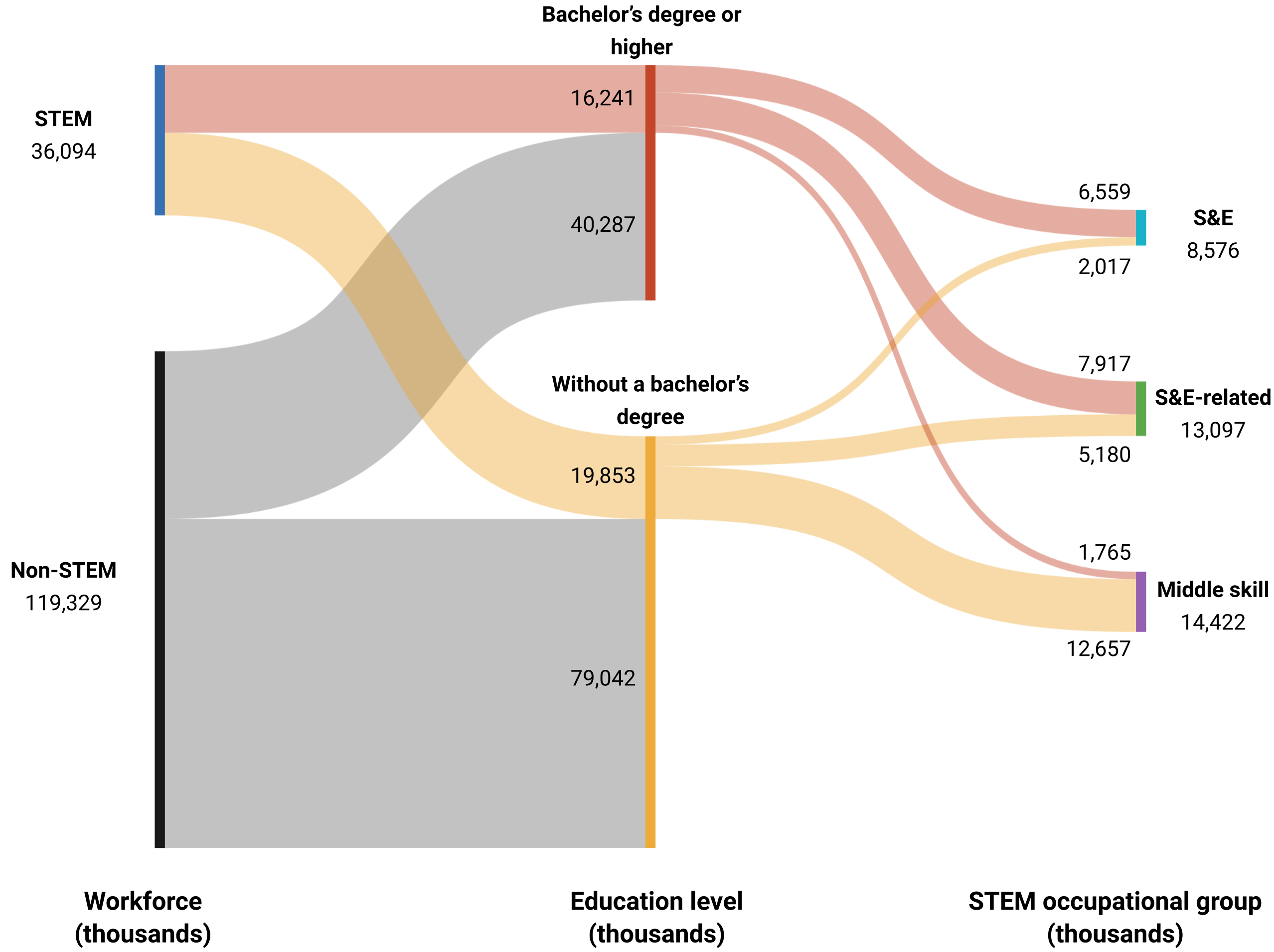
Understanding workers with a bachelor's degree or higher in S&E occupations has been instrumental in describing the STEM workforce; however, the increasing prevalence of advanced technologies in the workplace has raised the importance of understanding workers in occupations that also require significant STEM expertise but do not require a bachelor's degree. These occupations, referred to as *middle-skill occupations* or, in the context of this report, *middle-skill occupations in STEM*, are critical in adapting and maintaining new processes and technologies that are integral to the U.S. S&E enterprise. The expanded definition of the U.S. STEM workforce introduced here recognizes the increasing use of these skills across a broad range of STEM occupational groups—S&E, S&E-related, and middle-skill occupations—by workers at all education levels.

A New Expanded Definition of the STEM Workforce

The effect of expanding the STEM workforce definition to include individuals at all education levels and in middle-skill occupations is a major change for this report. According to the U.S. Census Bureau's (2020a) 2019 American Community Survey (ACS), the number of STEM workers in middle-skill occupations is nearly the same as the number of workers in S&E and S&E-related occupations combined. Most of the nearly 20 million STEM workers without a bachelor's degree work in middle-skill occupations (12.7 million), followed by S&E-related occupations (5.2 million) and S&E occupations (2 million) (**Figure LBR-2**). Most of the middle-skill occupations are held by nearly 13 million STEM workers who make up the STW. Of the more than 16 million STEM workers with a bachelor's degree or higher, most work in S&E or S&E-related occupations.

Figure LBR-2

U.S. workforce, by STEM occupational group and education level: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. The STEM workforce without a bachelor's degree is also known as the skilled technical workforce (STW). S&E occupations include computer and mathematical scientists; biological, agricultural, and environmental life scientists; physical scientists; social scientists; and engineers. S&E-related occupations include health-related occupations (e.g., health practitioners and health technicians); S&E managers; S&E teachers; and S&E technologists. Middle-skill occupations include those in construction and extraction; installation, maintenance, and repair; production; and other middle-skill occupations. Middle-skill occupations include the STW and STEM workers with a bachelor's degree or higher. Numbers are rounded to the nearest 1,000.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

This report builds on the methodology used by NASEM to identify middle-skill occupations (NASEM 2017).[6] The methodology is derived from a skills-based data set of self-reported information provided by workers on how heavily they rely on certain knowledge domains to conduct their work. Middle-skill occupations are those in which STEM workers scored highly in selected STEM knowledge domains such as biology, engineering and technology, and computers and electronics, among others, and in which greater than 50% of the workers did not have a bachelor's degree.

By most federal STEM taxonomies, the middle-skill occupations are not categorized as STEM fields or occupations.[7] While middle-skill occupations have been used to describe the STW in previous editions of this report, these occupations are new in the context of classifying them as part of the STEM workforce.[8] Occupations in this STEM occupational group include aircraft mechanics and service technicians, first-line supervisors of construction trades and extraction workers, and heavy vehicle and mobile equipment service technicians and mechanics, among others (Table SLBR-1). Thus, the STEM workforce described in this report not only includes occupations that are historically known to require S&E skills and expertise (e.g., life sciences, physical sciences, engineering, mathematics and computer sciences, social sciences, and health care) but also occupations that require STEM skills but are not historically considered STEM occupations (e.g., installation, maintenance, and repair; construction trades; and production occupations).

Moving forward, *Indicators* reports will continue to provide information on workers with a bachelor's degree or higher in S&E and S&E-related occupations as has been done in previous reports for continuity and the important insight that can be gleaned from such analyses. Much of the analysis in this report focuses on these workers. Despite current data limitations, information on middle-skill occupations and the STW will be presented, when possible, to provide insight of the expanded STEM workforce introduced in this report.

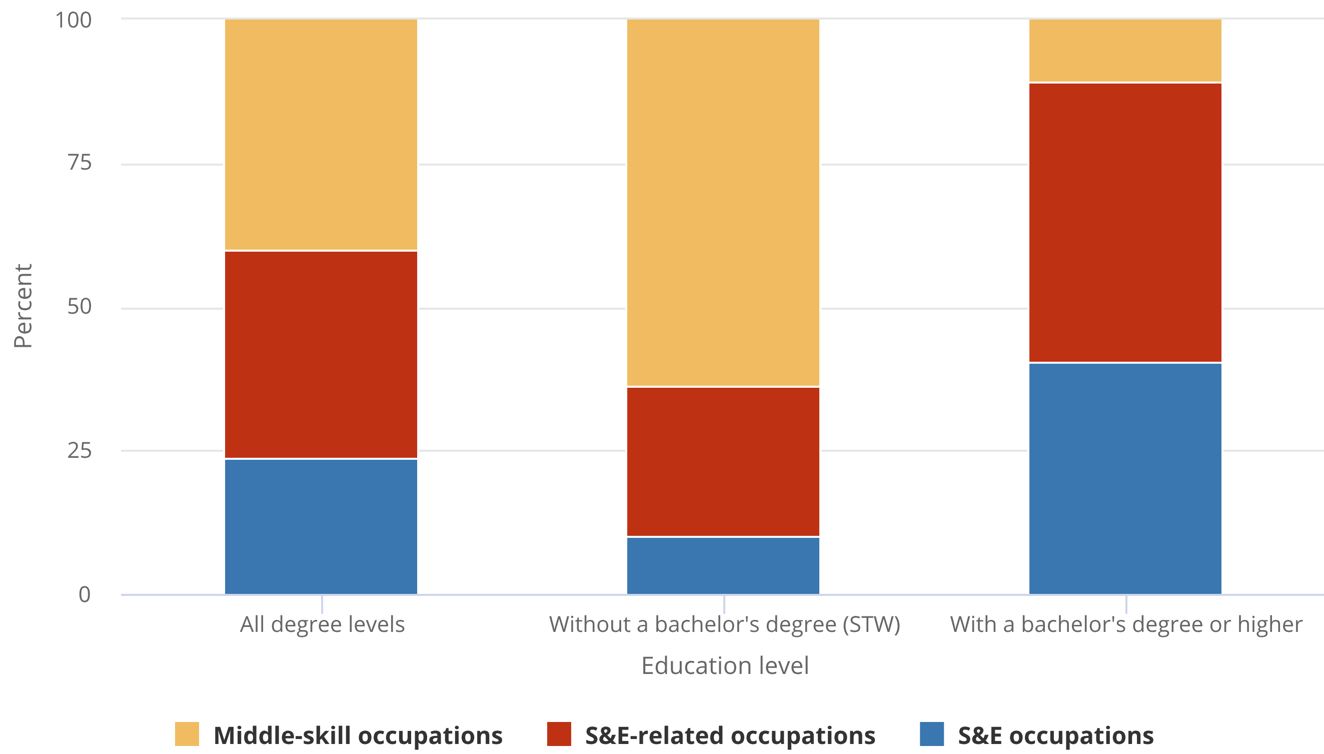
Size of the STEM Workforce

The size of the STEM workforce greatly increases with the inclusion of middle-skill occupations and workers without a bachelor's degree relative to the S&E workforce definitions used in prior *Indicators* reports that focused primarily on S&E workers with a bachelor's degree or higher. In 2019, the ACS showed approximately 6.6 million workers with a bachelor's degree or higher in S&E occupations (**Figure LBR-2**; Table SLBR-1). However, with the definition of the STEM workforce expanded to include workers without a bachelor's degree who are employed in S&E, S&E-related, and middle-skill occupations (i.e., the STW), there are approximately 36 million STEM workers, representing 23% of the total U.S. workforce. Within this expanded STEM workforce, 55% of workers do not have a bachelor's degree (STW), and 45% of workers have a bachelor's degree.

On examination of the STEM workforce by education, a clear difference emerges among the occupations pursued by those with at least a bachelor's degree and those without a bachelor's degree. Among STEM workers with a bachelor's degree or higher, most (89%) are employed in S&E or S&E-related occupations that typically require a bachelor's degree for entry (**Figure LBR-3**; Table SLBR-1). These workers are employed predominantly (73%) in three broad occupational categories: (1) health practitioner and technical occupations, (2) computer and mathematical occupations, and (3) architecture and engineering occupations (Table SLBR-1). Within these broad occupational categories, the principal detailed occupations include registered nurses (2.2 million), software developers (1.4 million), physicians (894,000), other engineers (492,000), and computer and information systems managers (486,000).

Figure LBR-3

Employment in STEM occupations, by occupational category and education level: 2019



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

While a majority of STEM workers with a bachelor's degree or higher are employed in S&E or S&E-related occupations, nearly two-thirds (64%) of the STW are employed in middle-skill occupations that do not require a bachelor's degree for entry (**Figure LBR-3**; Table SLBR-1). The remaining 36% of the STW is employed in S&E occupations that normally require a bachelor's degree for entry or in S&E-related occupations. About 74% of the STW is employed in four broad occupational categories: (1) construction trades; (2) installation, maintenance, and repair workers; (3) health care practitioners and technical occupations; and (4) production occupations (Table SLBR-1). Like STEM workers with a bachelor's degree, one of the common roles for the STEM workers without a bachelor's degree (STW) is registered nurses (1.2 million). Other principal detailed occupations among the STW include carpenters (1.2 million), miscellaneous production workers (1.2 million), and electricians (872,000)

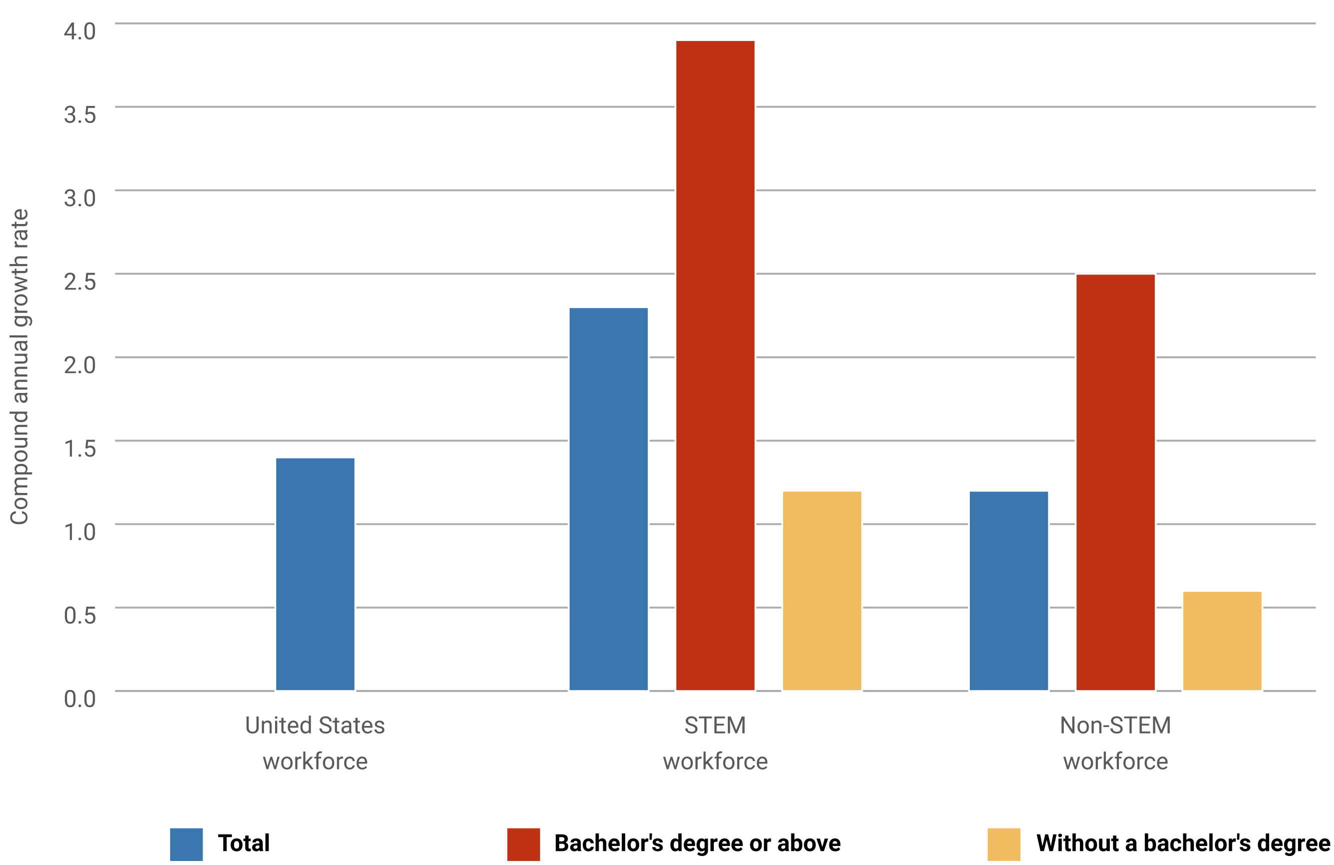
As the data show, health care-related occupations are popular among STEM workers with a bachelor's degree or higher as well as the STW. These occupations are projected to grow faster than most other occupations in the next 10 years, and there are many opportunities in these occupations that do not require a bachelor's degree for entry. (See sidebar **Projected Growth of Employment in STEM Occupations**.)

Growth of the STEM Workforce

As scientific and technical expertise becomes increasingly critical for sustained economic growth, occupations that require this expertise can also be expected to grow. (For future projections of employment in STEM occupations for 2019–29, see sidebar **Projected Growth of Employment in STEM Occupations**.) Using the expanded definition of the U.S. STEM workforce, the ACS shows that employment in these occupations grew by 2.3% annually between 2010 and 2019, outpacing the 1.4% annual growth in total U.S. employment (**Figure LBR-4**). Those with a bachelor's degree or higher within the STEM workforce experienced the greatest employment growth during this time (3.9%), followed by their non-STEM counterparts (2.5%). A similar trend is observed for workers without a bachelor's degree; the STW saw higher employment growth (1.2%) than non-STEM workers without a bachelor's degree (0.6%).

Figure LBR-4

Growth rate of employed adults in the United States, by workforce and degree level: 2010–19



STEM = science, technology, engineering, and mathematics.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

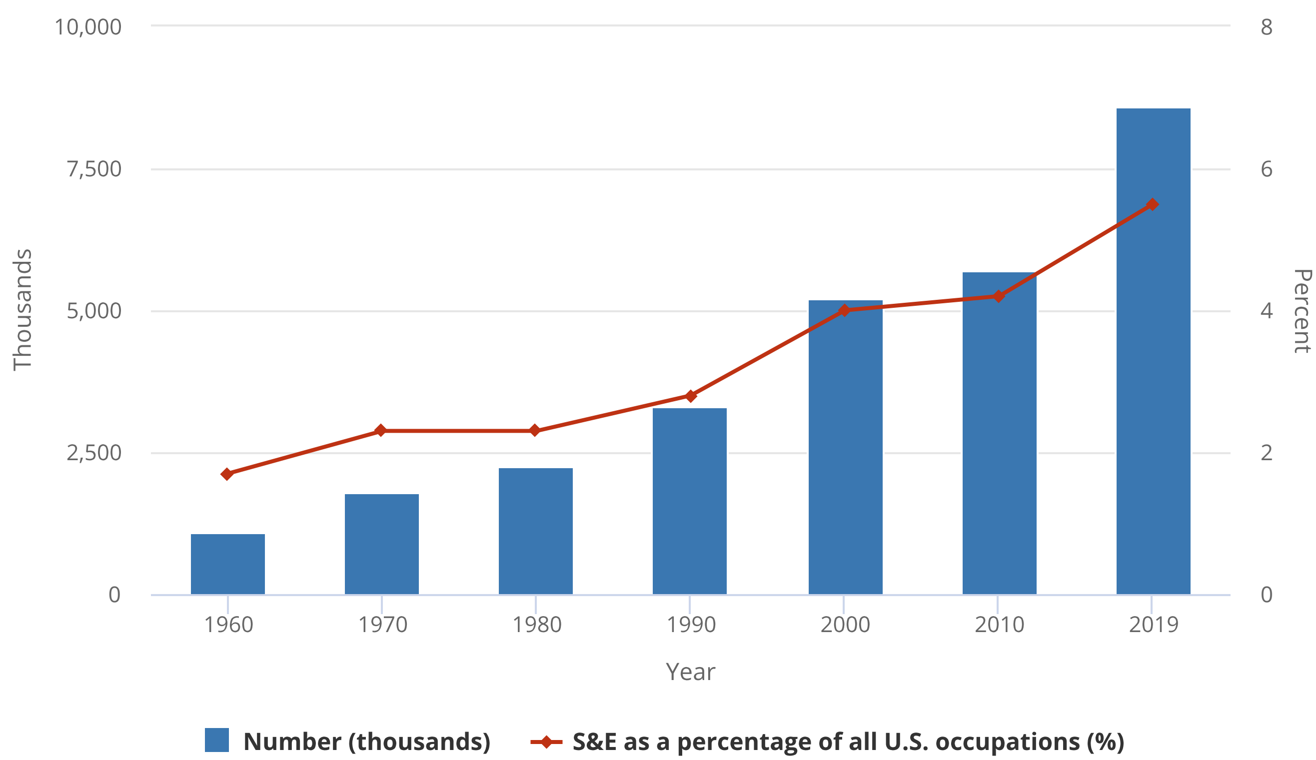
Science and Engineering Indicators

The composition of the total workforce has slowly shifted away from non-STEM employment to STEM employment. Between 2010 and 2019, the proportion of non-STEM employment declined roughly 2 percentage points (Table SLBR-2). However, over three-quarters of the total U.S. workforce were non-STEM workers between 2010 and 2019, while the STEM workforce was less than a quarter of the workforce in these years.

The long-run dynamics of workers in STEM occupations are important to identify because they may provide insight on workforce trends that could affect U.S. economic competitiveness in STEM-intensive industries. To understand these dynamics within the STEM workforce, a subset of workers in S&E occupations at all education levels was evaluated using U.S. Census Bureau data from 1960 to 2019. Employment in these selected S&E occupations grew from about 1.1 million in 1960 to about 8.6 million in 2019, with a compound annual growth rate of 4%, compared to a 1% rate for total employment during this period (**Figure LBR-5**). As a proportion of total U.S. employment, these occupations more than tripled, increasing from 1.7% in 1960 to 5.5% in 2019. Workers with their highest degree in an S&E field similarly grew an average of 3.4% between 2003 and 2019 (**Figure LBR-6**).

Figure LBR-5

Individuals employed in S&E occupations in the United States: Selected years, 1960–2019



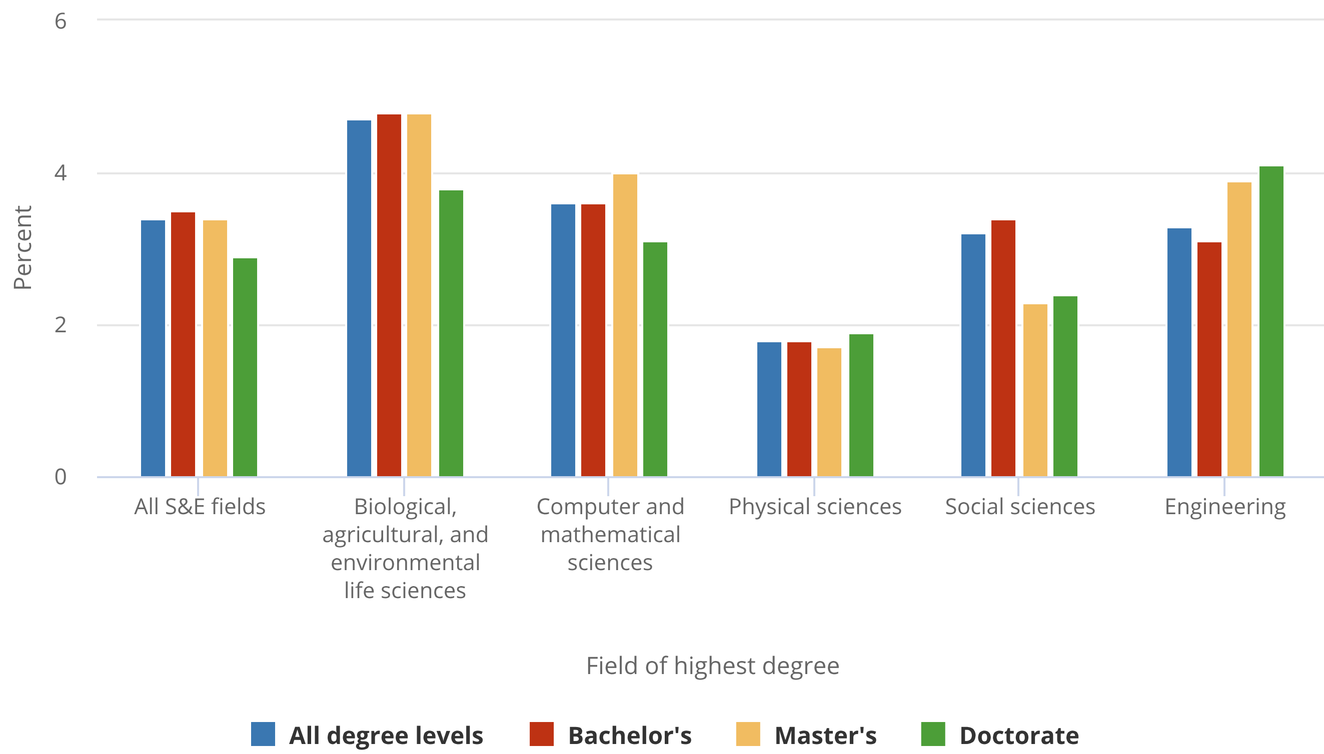
Note(s):
Data include individuals ages 16–75 at all education levels.

Source(s):
U.S. Census Bureau, Decennial Census, 1960–2000, and American Community Survey (ACS), 2010, 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

Figure LBR-6

Compound annual growth rate in the total number of employed individuals with highest degree in S&E, by field and level of highest degree: 2003–19



Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

SIDEBAR

Projected Growth of Employment in STEM Occupations

According to Bureau of Labor Statistics (BLS) (2020a) projections, which were developed prior to the COVID-19 pandemic of 2020, S&E employment is expected to grow faster than overall employment through the 2019–29 period (10% vs. 4%) (**Table LBR-A**). S&E managers, computer and mathematical scientists, and health care practitioners and technicians are expected to grow the most—at 18%, 13%, and 9%, respectively—from 2019 to 2029 (**Table LBR-A**).* The 2019–29 projections do not include the impact of the COVID-19 pandemic and response efforts. However, a recent report presents alternate scenarios for selected occupations subject to higher levels of uncertainty as a result of potential structural changes related to the pandemic (Ice, Rieley, and Rinde 2021).

Table LBR-A

Bureau of Labor Statistics projections of employment and job openings in S&E and other selected occupations: 2019–29

(Thousands)

Occupation	BLS National Employment Matrix 2019 estimate	BLS projected 2029 employment	10-year growth in total employment (number)	10-year growth in total employment (%)
Total, all occupations	162,795.6	168,834.7	6,039.1	3.7
S&E occupations	7,659.7	8,391.1	731.4	9.5
Computer and mathematical scientists (excluding computer programmers, including logisticians)	4,791.6	5,402.3	610.7	12.7
Engineers (including ship engineers and sales engineers)	1,883.3	1,956.4	73.1	3.9
Life scientists	344.8	361.4	16.6	4.8
Physical scientists	276.6	291.4	14.8	5.4
Social and related scientists (excluding historians)	363.4	379.6	16.2	4.5
S&E managers	1,389.7	1,639.5	249.8	18.0
S&E technicians and technologists, except computer programmers	1,339.9	1,351.0	11.1	0.8
Computer programmers	213.9	193.8	-20.1	-9.4
Healthcare practitioners and technicians	9,133.7	9,967.3	833.6	9.1
Construction and extraction workers	3,862.7	4,013.0	150.3	3.9
Installation, maintenance, and repair workers	5,119.2	5,217.7	98.5	1.9
Production workers	2,543.8	2,433.7	-110.1	-4.3
Lawyers	813.9	846.3	32.4	4.0
Postsecondary teachers	1,721.5	1,849.7	128.2	7.4

BLS = Bureau of Labor Statistics.

Note(s):
Estimates of current and projected employment for 2019–29 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 Center for Science and Engineering Statistics (NCSES); numbers in the table are based on the sum of BLS projections for occupations that NCSES includes in the respective categories.

Source(s):
Bureau of Labor Statistics, special tabulations (2020) of the 2019–29 Employment Projections.

Science and Engineering Indicators

In contrast, BLS projects the largest loss of employment for computer programmers (a decline of more than 9%) and production workers (a decline of more than 4%) (BLS 2021). 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), which may relate to offshoring these activities to countries where wages are lower (see Levine for a review). The manufacturing sector is expected to lose the most of any sector over the projected decade. Factors contributing to the loss of jobs in this sector include the adoption of new productivity-enhancing technologies, such as robotics, and international competition (BLS 2020d).

The 2019–29 projections do not include the impact of the COVID-19 pandemic and response efforts. The BLS employment projections are developed using historical data. Here, the projections cover the time period through 2019; therefore, all input data precede the pandemic. The projections are long-term and intended to capture structural change in the economy, not cyclical fluctuations. As such, they are not intended to capture the impact of the recession that began in February 2020. However, beside the immediate recessionary impact, the pandemic may cause structural changes to the economy that would not be captured here.

* 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.

STEM Pathways: Degree Attainment, Training, and Occupations

Education and training are fundamental to building the capacity of the STEM workforce. There are multiple pathways into the STEM workforce. These pathways include taking courses in STEM and career technical education at the secondary level (for more details, see the *Indicators 2022* report "Elementary and Secondary STEM Education"), postsecondary education through attainment of 2- and 4-year degrees or certificates (for more details, see the forthcoming *Indicators 2022* report "Higher Education in Science and Engineering"), or the acquisition of certifications or licenses (NASEM 2017). Not all STEM degree holders work in STEM occupations, and the degree to which STEM-capable workers enter and remain in the STEM workforce has implications for the U.S. S&E enterprise.

This section describes the STEM workforce based on the prevalence of degree attainment, certifications, and licenses among these workers. It also presents data on the level and type of degree attained by workers with a bachelor's degree or higher in a subset of STEM occupations—that is, S&E and S&E-related occupations. (See the **Glossary** section for definitions of S&E occupations and S&E-related occupations.) The extent to which individuals with degrees in S&E or S&E-related fields (see the **Glossary** section for definitions of S&E fields and S&E-related fields) work in S&E and S&E-related occupations is also examined, as is the use of S&E expertise across occupations. The primary data source for the analysis of STEM workers with a bachelor's degree or higher, NCSES's NSCG, does not allow for workers in middle-skill occupations to be identified separately from those in non-STEM occupations. (See the **Glossary** section for definitions of middle-skill occupations and non-STEM occupations.) Hence, workers with a bachelor's degree or higher in non-S&E occupations include those in middle-skill and non-STEM occupations. (See the **Glossary** section for definition of non-S&E occupations.)

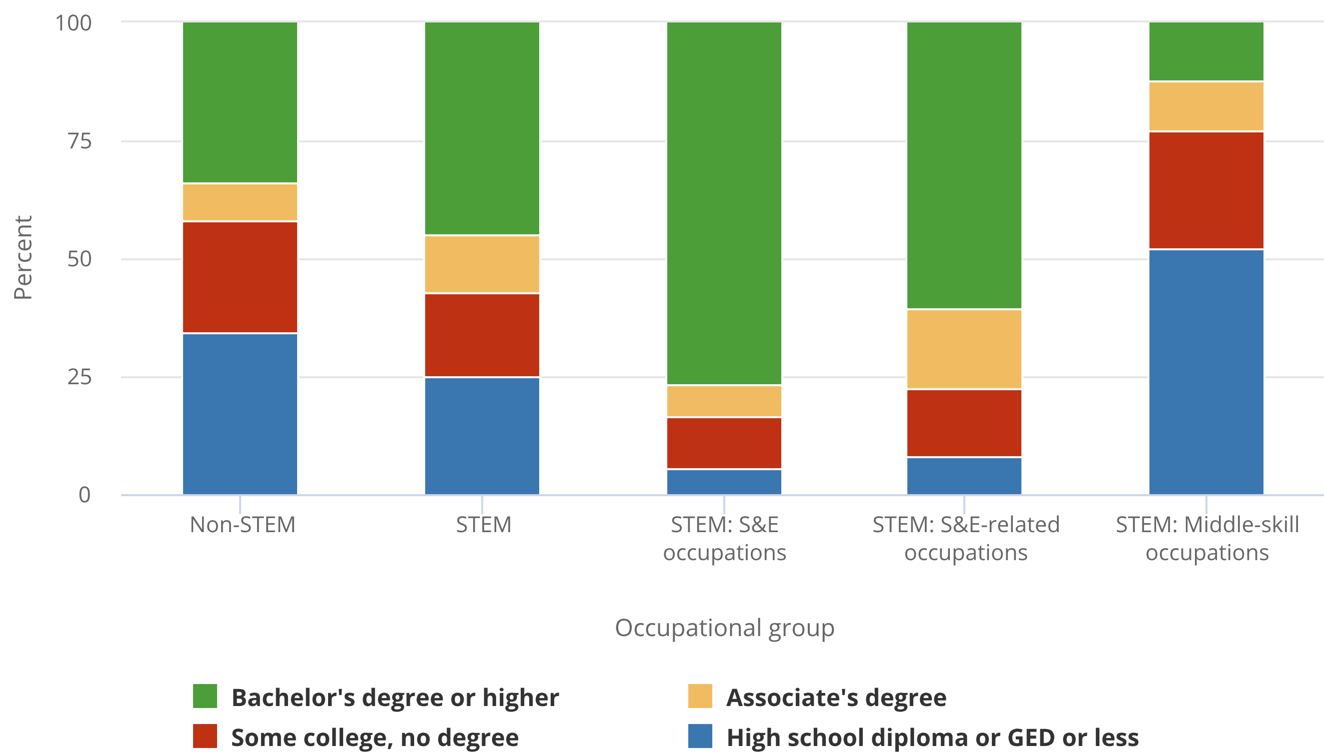
Education and Training of Workers in STEM

Degree Attainment

A 4-year degree is one of the primary pathways for STEM workers. More STEM workers than non-STEM workers have a bachelor's degree or higher. Based on the U.S. Census Bureau's (2020a) 2019 ACS, approximately 45% of STEM workers hold a bachelor's degree or higher, compared to 34% of workers in non-STEM occupations (**Figure LBR-7**). Within the STEM workforce, most workers in S&E occupations (76%) and S&E-related occupations (60%) hold a bachelor's degree or higher. In contrast, only 12% of workers in middle-skill occupations hold a bachelor's degree or higher.

Figure LBR-7

Educational attainment of workers, by workforce, occupational group, and degree level: 2019



GED = General Equivalency Diploma; STEM = science, technology, engineering, and mathematics.

Note(s):
Data include individuals ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

Among STEM workers with a bachelor's degree or higher, most workers in S&E and S&E-related occupations have a degree in an S&E or S&E-related field. Based on the 2019 NSCG, 76% of workers with a bachelor's degree or higher in S&E occupations have their highest degree in an S&E field, and another 11% have at least one degree (but not the highest) in an S&E or S&E-related field (**Table LBR-2**). Similarly, 60% of workers with a bachelor's degree or higher in S&E-related occupations have their highest degree in an S&E-related field. In addition, almost one-quarter of S&E-related workers have their highest degree in an S&E field of study.

Table LBR-2

Educational background of employed adults with bachelor's degree or higher, by major occupation: 2019

(Percent)

Occupation	Total (number)	Highest degree in S&E field and working in degree field	Highest degree in S&E field but not working in degree field	Highest degree in S&E-related field	A degree in S&E or S&E-related field but not highest	No degrees in S&E or S&E-related fields
S&E occupations	7,466,000	56.8	19.6	5.7	5.1	12.8

Table LBR-2

Educational background of employed adults with bachelor's degree or higher, by major occupation: 2019

(Percent)

Occupation	Total (number)	Highest degree in S&E field and working in degree field	Highest degree in S&E field but not working in degree field	Highest degree in S&E-related field	A degree in S&E or S&E-related field but not highest	No degrees in S&E or S&E-related fields
Computer and mathematical scientists	3,774,000	42.0	28.1	4.9	5.1	20.0
Biological, agricultural, and environmental life scientists	698,000	69.8	13.1	11.0	2.6	3.5
Physical scientists	409,000	60.2	31.2	s	2.7	1.8
Social scientists	663,000	67.6	4.3	6.7	8.5	12.9
Engineers	1,921,000	76.9	8.4	5.4	5.2	4.2
S&E-related occupations	8,893,000	0.0	24.0	59.7	4.8	11.6
Non-S&E occupations	34,165,000	0.0	22.0	5.0	8.9	64.1

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

STEM = science, technology, engineering, and mathematics.

Note(s):
Workers in non-S&E occupations are those with a bachelor's degree or above in non-STEM and middle-skill occupations. Percentages may not add to 100% because of rounding.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

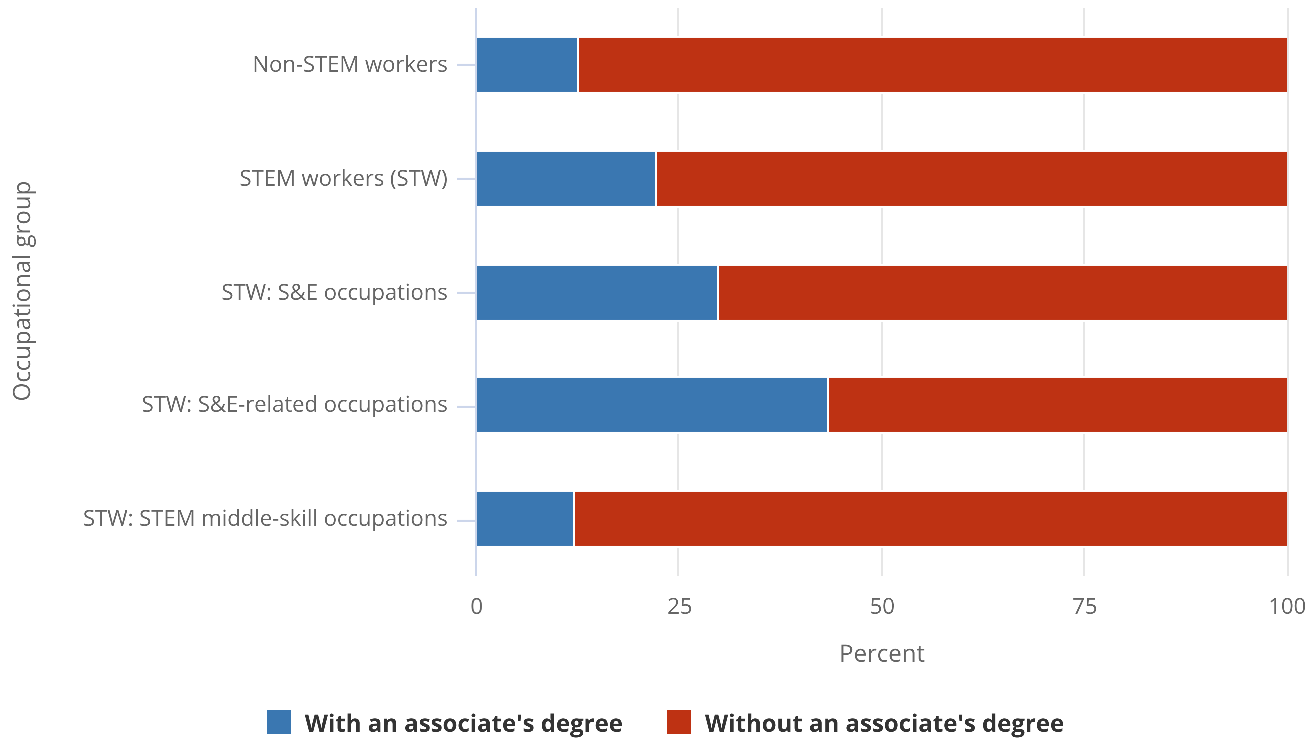
Science and Engineering Indicators

Except for computer and mathematical scientists, most workers with a bachelor's degree or higher in S&E occupations have their highest degree in the same broad field as that of their occupation (**Table LBR-2**). Among computer and mathematical scientists, 42% have their highest degree in a mathematical or computer science field, and 20% do not have a degree in any S&E or S&E-related field of study. In contrast, between 60% and 77% of life scientists, physical scientists, social scientists, and engineers have their highest degree in their respective broad field of study.

Associate's degrees are another pathway to the STEM workforce, and about a quarter of associate's degrees awarded in 2019 were in S&E or S&E technology degree fields. (See forthcoming *Indicators 2022* report "Higher Education in Science and Engineering" for more details on associate's degree completions.) Compared to non-STEM workers without a bachelor's degree, associate's degrees are more prevalent among their STEM counterparts, but this varies among STEM occupational groups. Based on the 2019 ACS, 22% of the STW has an associate's degree, which is higher than the 13% of non-STEM workers without a bachelor's degree (**Figure LBR-8**). Within the STW, S&E-related workers, which are primarily in the health care fields, have an associate's degree (44%) at a greater proportion than workers in S&E (30%) or STEM middle-skill (12%) occupations.

Figure LBR-8

Workers with less than a bachelor's degree, by workforce, occupational group, and associate's degree attainment: 2019



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. Percentages may not add to 100% because of rounding.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

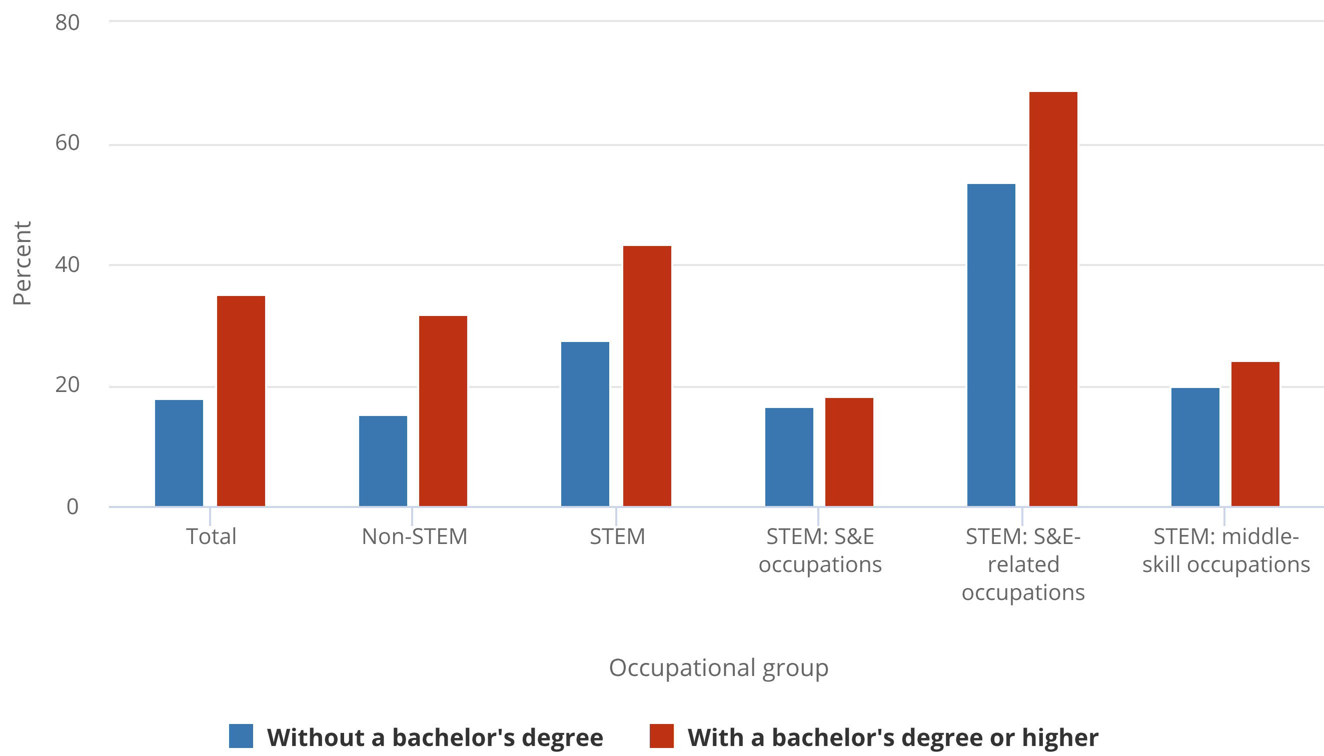
Certifications and Licenses

A college degree is not the only pathway to a STEM career; other options for acquiring the skills needed to enter the STEM workforce include obtaining a certificate, certification, or license in a STEM area. These credentials are generally 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). Certificates are offered by a wide range of institutions but mostly by community colleges. Although data on STEM certificate completions are available in the forthcoming *Indicators 2022* report “Higher Education in Science and Engineering,” less information is available on the certificate rates among workers in STEM occupations.[9] Hence, this section focuses on certification and licensing by STEM workers.

Although workers at all education levels obtain certifications and licenses, they are more prevalent among workers with a bachelor's degree or higher, both within STEM occupations and in non-STEM occupations (**Figure LBR-9**). Based on the BLS 2019 Current Population Survey (CPS) (Flood et al. 2020), 35% of workers with a bachelor's degree or higher held a certification or license compared to 18% of workers without a bachelor's degree. Among STEM workers, 43% with a bachelor's degree or higher held a certification or license compared to 28% without a bachelor's degree; for non-STEM, the proportions were 32% and 15%, respectively.

Figure LBR-9

Workers with certifications and licenses, by workforce, occupational group, and degree attainment: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

Source(s):
Flood S, King M, Rodgers R, Ruggles S, Warren JR, Integrated Public Use Microdata Series (IPUMS), Current Population Survey: Version 7.0 , IPUMS, 2020, https://doi.org/10.18128/D030.V7.0.

Science and Engineering Indicators

Among the STEM workforce, workers in S&E-related occupations held certifications and licenses at the highest proportions, both for those with and without a bachelor's degree (69% and 53%, respectively), followed by workers in STEM middle-skill occupations (24% with a bachelor's degree or higher, 20% without) and workers in S&E occupations (18% with a bachelor's degree or higher, 16% without). Health care occupations make up the bulk of S&E-related occupations and likely account for the high prevalence of certifications and licenses among STEM workers in S&E-related occupations (Table SLBR-1).

For workers with a bachelor's degree or higher holding certifications and licenses, the 2019 NSCG shows that credentials are primarily related to their work; only a small proportion, about 3% to 6%, hold certifications or licenses not related to their occupations (Table SLBR-3). These credentials are most prevalent among workers in S&E-related occupations, with 74% of workers in S&E-related occupations holding certifications and licenses related to their work, which corresponds to the high proportion of health-related occupations in the S&E-related broad occupational group. For S&E-related workers, the primary areas of certifications and licenses include nurse; health care practitioner, provider, and specialist; and other health care–related areas. Certifications and licenses are less prevalent among workers in S&E occupations, with approximately 22% holding credentials related to their work. The primary areas for S&E workers were different, including engineering, engineering technician and engineering technologist, computer networking administration and security, and project management, quality control, operations, and support (Table SLBR-3).

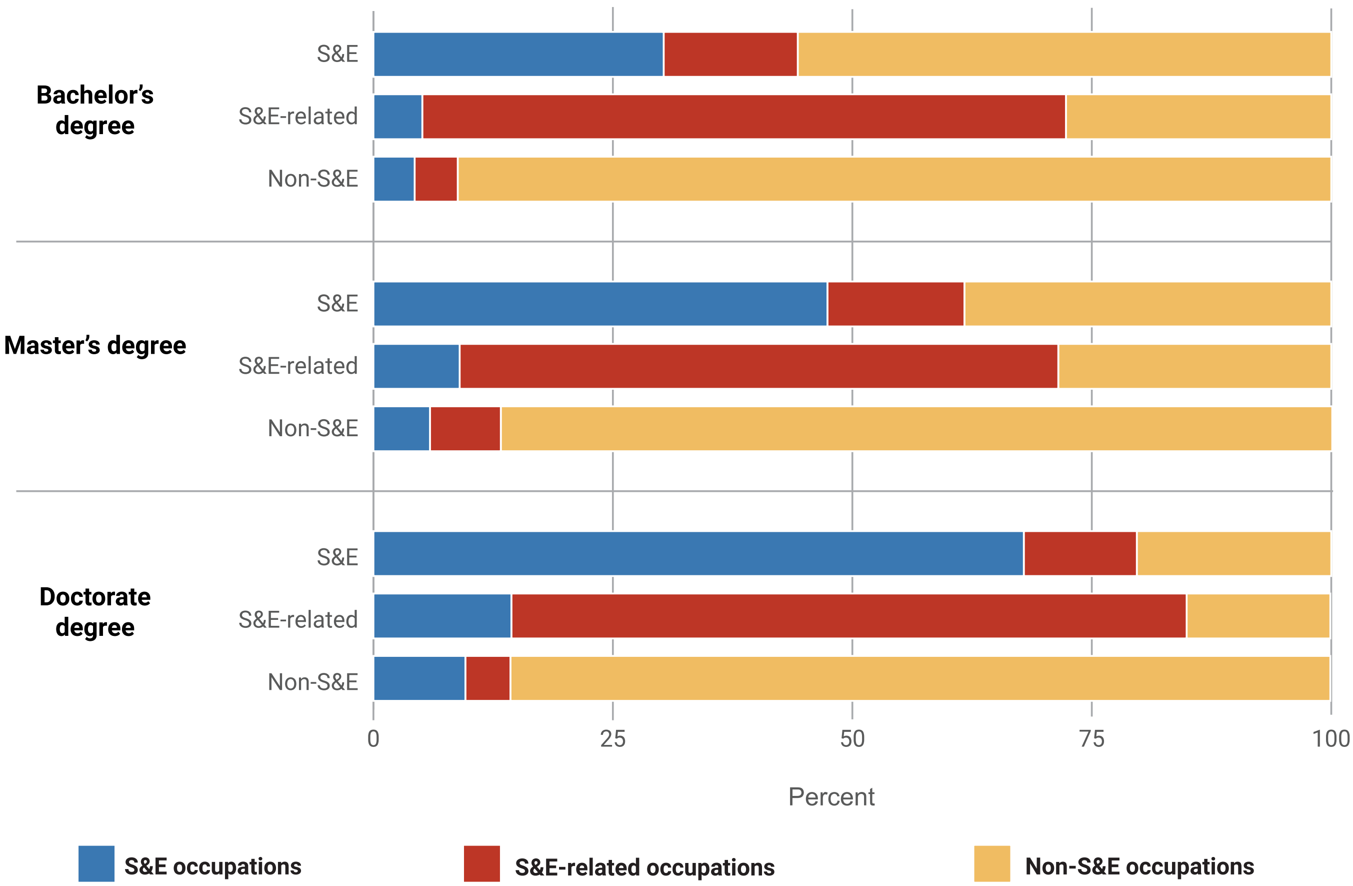
Application of STEM Skills and Expertise by Non-S&E Workers

Although workers with at least a bachelor's degree in STEM occupations often have an S&E degree or S&E-related degree, individuals with their highest degree in S&E or S&E-related fields may also pursue careers in other areas. Based on the 2019 NSCG, 37% of those with their highest degree in an S&E field worked in S&E occupations; the rest worked in S&E-related occupations (14%) or non-S&E occupations (49%) (Table SLBR-4). Compared to S&E highest degree holders, individuals whose highest degree is in an S&E-related field (71%) are employed at greater proportions in occupations aligned with their broad field of degree.

The extent to which individuals hold their highest degree in an S&E field and work in S&E occupations varies by level and field of degree. Workers with their highest degree in computer and mathematical sciences (56%) and engineering (40%) fields work the most in occupations in their major fields of study. In contrast, individuals with social sciences degrees (80%) work primarily in non-S&E occupations (Table SLBR-4). Additionally, individuals with doctorate degrees in S&E fields tend to work in S&E occupations, whereas the link between S&E field of study and S&E occupation is weaker at the bachelor's and master's degree levels (**Figure LBR-10**).

Figure LBR-10

Workers with a bachelor's degree or higher in each broad field of highest degree and degree level, by broad occupation: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Individuals may have degrees in more than one S&E degree field. Middle-skill occupations are excluded because the data source does not allow for the separation of middle-skill occupations from non-STEM occupations. Non-S&E occupations include middle-skill and non-STEM occupations.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Occupation is not the only measure of the use of STEM training in a profession. Many individuals who hold their highest degree in S&E work in occupations related to their degrees, even though those occupations are not technically categorized as S&E. Most workers with their highest degree in an S&E field who are not working in S&E occupations (69%) reported that their occupations were closely or somewhat related to their highest degrees (Table SLBR-5). A similar relationship holds for workers with their highest degree in S&E-related fields not working in S&E-related occupations. This relationship is stronger as degree level increases.

S&E highest degree holders not working in S&E occupations report being employed in a wide variety of additional roles, including many that require leadership skills. In addition to S&E occupations, occupations in which relatively large numbers of S&E highest degree holders are employed include S&E-related occupations (2.1 million), such as health care practitioners or S&E managers, technicians, and technologists (Table SLBR-4). Other workers are employed in non-S&E occupations, including management-related occupations (1.7 million), such as financial or personnel specialists; non-S&E managers (1.2 million), such as executive-level managers or education administrators; and sales and marketing (1.0 million), which includes insurance and business services or sales of industrial machines, equipment, or supplies. The use of S&E expertise has become quite prevalent throughout today's economy, regardless of occupation type. Approximately 53% of workers in jobs that are not categorized as S&E occupations state that their jobs require S&E technical expertise at the bachelor's level.

STEM Labor Market Conditions and the Economy

Indicators of labor market conditions and salaries provide information on economic rewards and the overall attractiveness of STEM careers. Data suggest that labor market outcomes are generally favorable for workers in STEM occupations compared to workers in non-STEM occupations. Despite variation by occupation and level of education, workers in STEM occupations tend to have higher salaries and lower unemployment rates than their non-STEM counterparts.

This section examines the unemployment, working involuntarily part time or in a position not in one's degree field, salary, and distribution of STEM workers throughout the U.S. economy. It also presents data on the labor market outcomes of workers with a bachelor's degree or higher in a subset of STEM occupations—that is, S&E and S&E-related occupations. (See the **Glossary** section for definitions of S&E occupations and S&E-related occupations.) The primary data source for the analysis of STEM workers with a bachelor's degree or higher, NCSES's NSCG, does not separately identify workers in middle-skill occupations from those in non-STEM occupations. (See the **Glossary** section for definitions of middle-skill occupations and non-STEM occupations.) Hence, workers with a bachelor's degree or higher in non-S&E occupations include those in middle-skill and non-STEM occupations. (See the **Glossary** section for definition of non-S&E occupations.)

Unemployment

The unemployment rate is a long-standing key labor market indicator used to measure the performance of the labor market and the strength of the economy (ILO 2019). The unemployment rate is defined as the proportion of the labor force—people who are either working or actively looking for work—who are not working (BLS 2020b). People who are not looking for a job, such as a stay-at-home parent, are not included in the labor force.

Many factors contribute to unemployment. *Frictional unemployment* causes the unemployment rate to be nonzero and is the result of temporary transitions in workers' lives, such as when a worker moves to a new city and must find a job or a recent college graduate enters the job market (Dubina 2017). *Structural unemployment* can be caused by a mismatch in worker skills and available jobs, such as occurs in industries undergoing technological advancements. *Seasonal unemployment* is caused by different industries or parts of the labor market being available during different seasons or times of the year, such as agricultural jobs during the fall, when crops are harvested, or retail sales jobs during the winter holiday season. *Cyclical unemployment* is caused by declining demand and is usually associated with times of recession in the business cycle.

Although the COVID-19 pandemic was not part of the business cycle, it caused short-term unemployment similar to cyclical unemployment. The long-term, structural impact of the crisis has yet to be determined. Beginning around April 2020, unemployment rose in the United States as many businesses, and society in general, shut down or self-quarantined to prevent the rapid spread of COVID-19. However, unemployment rates differed by occupation and level of education. (See sidebar **STEM and Non-STEM Unemployment in the Time of COVID-19**.)

SIDEBAR

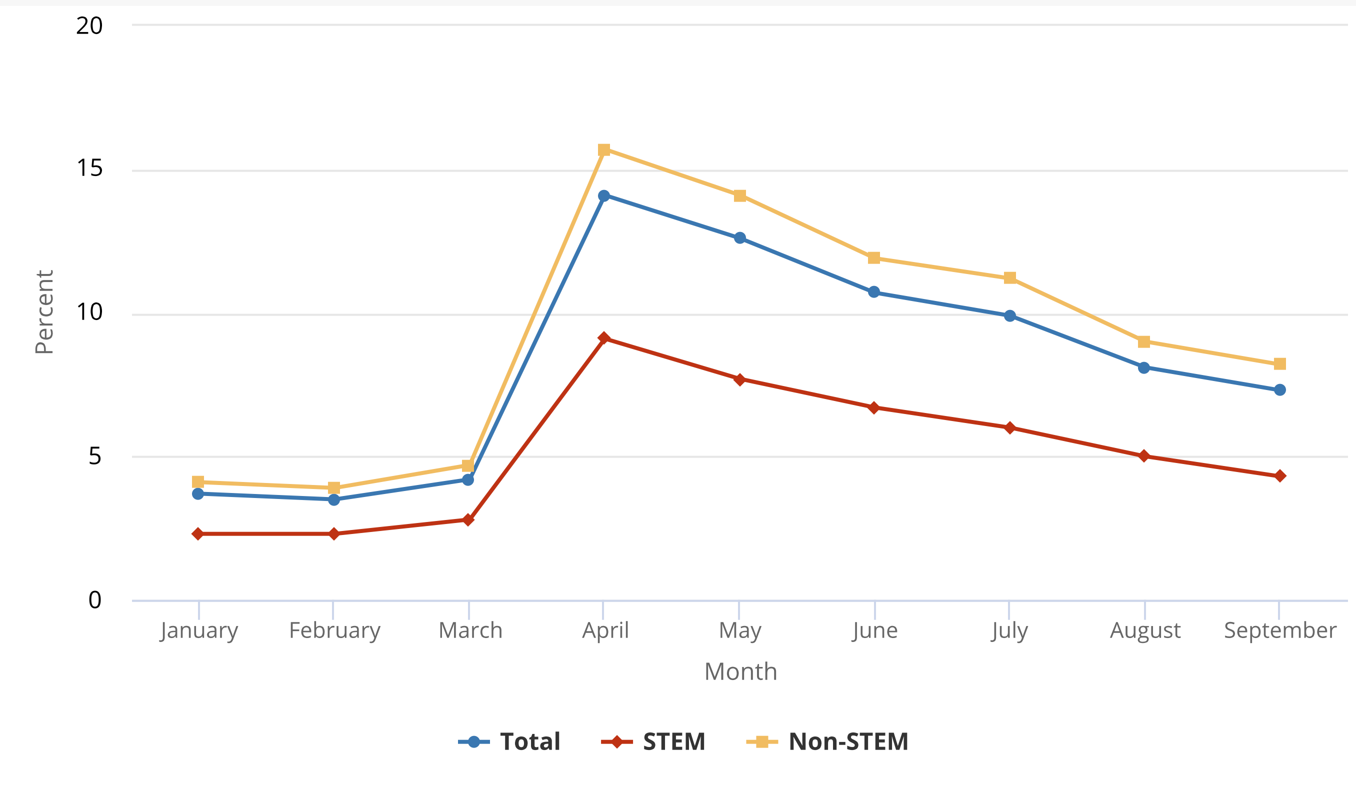
STEM and Non-STEM Unemployment in the Time of COVID-19

In 2020, the world experienced a pandemic caused by the novel coronavirus and its associated illness, COVID-19. The extremely contagious nature of the virus and the severity of its symptoms, resulting in death in some cases, led to widespread stay-in-place orders in the United States and many countries around the world to prevent the spread of the disease. In response to the stay-in-place orders, many businesses, including stores and restaurants, temporarily shut down, people worked from home, and children finished the school year online. Unemployment rates rose dramatically in a very short period;* however, these rates differed by occupation, and workers in science, technology, engineering, and mathematics (STEM) occupations tended to fare better during the crisis than their counterparts in non-STEM occupations. Based on monthly unemployment rates from the Bureau of Labor Statistics' 2020 Current Population Survey (CPS) (Flood et al. 2020), this sidebar examines the impact of the pandemic on unemployment rates by occupation group.

While unemployment rates spiked between March and April of 2020 and remained high compared to their pre-pandemic levels, unemployment rates for those in the STEM labor force (16–75 years old) were well below those of the non-STEM labor force (**Figure LBR-A**). STEM unemployment jumped from about 3% in March to 9% in April of 2020 but remained lower than the double-digit rates experienced by those in non-STEM occupations. Between March and April, the non-STEM unemployment rate increased from about 5% to 16%, remained in the double-digit range through July 2020, and declined to under 10% in August and September 2020.

Figure LBR-A

Monthly unemployment rates, by workforce: 2020



STEM = science, technology, engineering, and mathematics.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. Data are not seasonally adjusted.

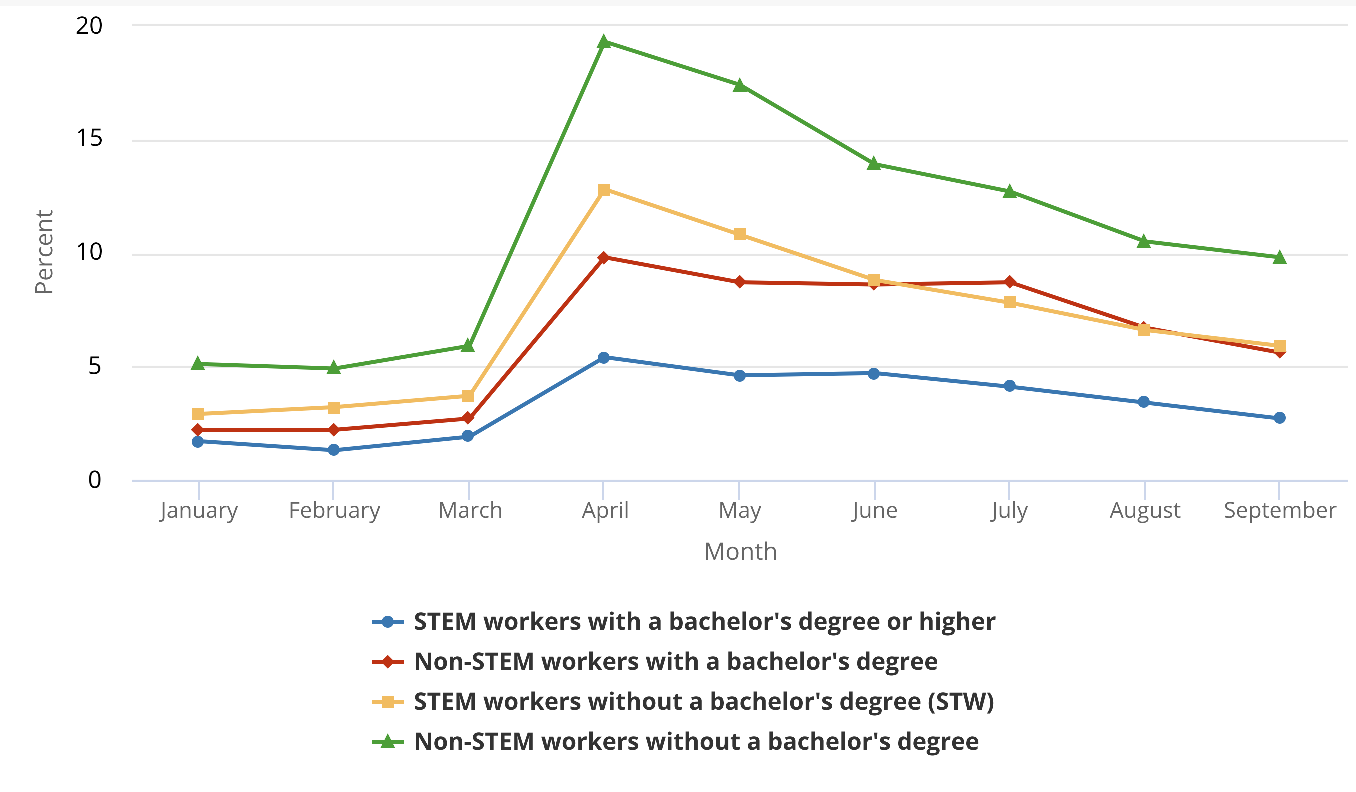
Source(s):
Flood S, King M, Rodgers R, Ruggles S, Warren JR, Integrated Public Use Microdata Series (IPUMS), Current Population Survey: Version 7.0 (2020), IPUMS, 2020, https://doi.org/10.18128/D030.V7.0.

Science and Engineering Indicators

Except for non-STEM workers without a bachelor's degree, all other segments of the labor force had unemployment rates below 5% before April 2020 (**Figure LBR-B**). The unemployment rate for those with at least a bachelor's degree in the STEM labor force never rose above 6% during the pandemic period from April through September. In contrast, all other groups reached close to double-digit unemployment at their peak. However, the STEM labor force without a bachelor's degree fared much better than their non-STEM counterparts. The unemployment rate for the STEM labor force without a bachelor's degree peaked at 13% in April, whereas the unemployment rate for their non-STEM counterparts without a bachelor's degree peaked at 19%. Although unemployment rates have declined for all groups, the non-STEM labor force without a bachelor's degree continues to face severe unemployment rates, reaching 10% in September 2020. Thus, employment for the STEM labor force, regardless of education level, was more secure than that for the non-STEM labor force during this period of the pandemic. However, it is important to note that some preliminary analysis suggests that the COVID-19 pandemic has disproportionately affected women more than men in the STEM workforce (Andersen et al. 2020; Myers et al. 2020).

Figure LBR-B

Monthly unemployment rates, by workforce and educational level: 2020



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. Data are not seasonally adjusted.

Source(s):
Flood S, King M, Rodgers R, Ruggles S, Warren JR, Integrated Public Use Microdata Series (IPUMS), Current Population Survey: Version 7.0 (2020), IPUMS, 2020, https://doi.org/10.18128/D030.V7.0.

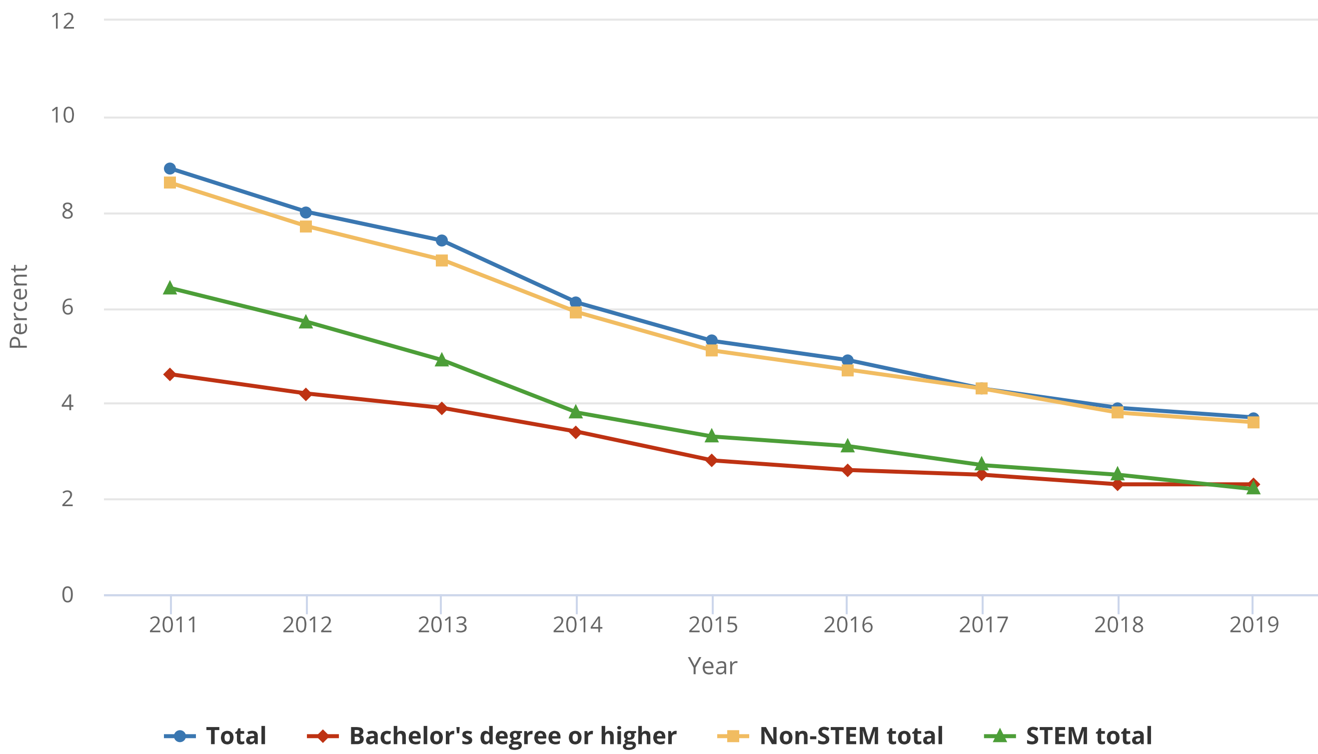
Science and Engineering Indicators

* See **https://www.bls.gov/covid19/employment-situation-covid19-faq-april-2020.htm** for more information on the rise of unemployment in April 2020. Accessed 11 November 2020.

The STEM labor force has historically experienced lower annual unemployment rates than the overall labor force (**Figure LBR-11**).[10] The BLS CPS (Flood et al. 2020) shows that although all groups experienced relatively high unemployment rates following the Great Recession (2007–2009), the unemployment rate for the STEM labor force was consistently less than that for the total and non-STEM labor forces.[11] By 2019, unemployment rates declined for all broadly defined occupational groups but were lowest for the STEM labor force (2.2%) and for those with a bachelor's degree or higher (2.3%). Unemployment was highest for workers in the total (3.7%) and non-STEM labor forces (3.6%).

Figure LBR-11

Unemployment rate in each workforce: 2011–19



STEM = science, technology, engineering, and mathematics.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. Unemployment rates for total and those with a bachelor's degree or higher do not include responses without an occupation.

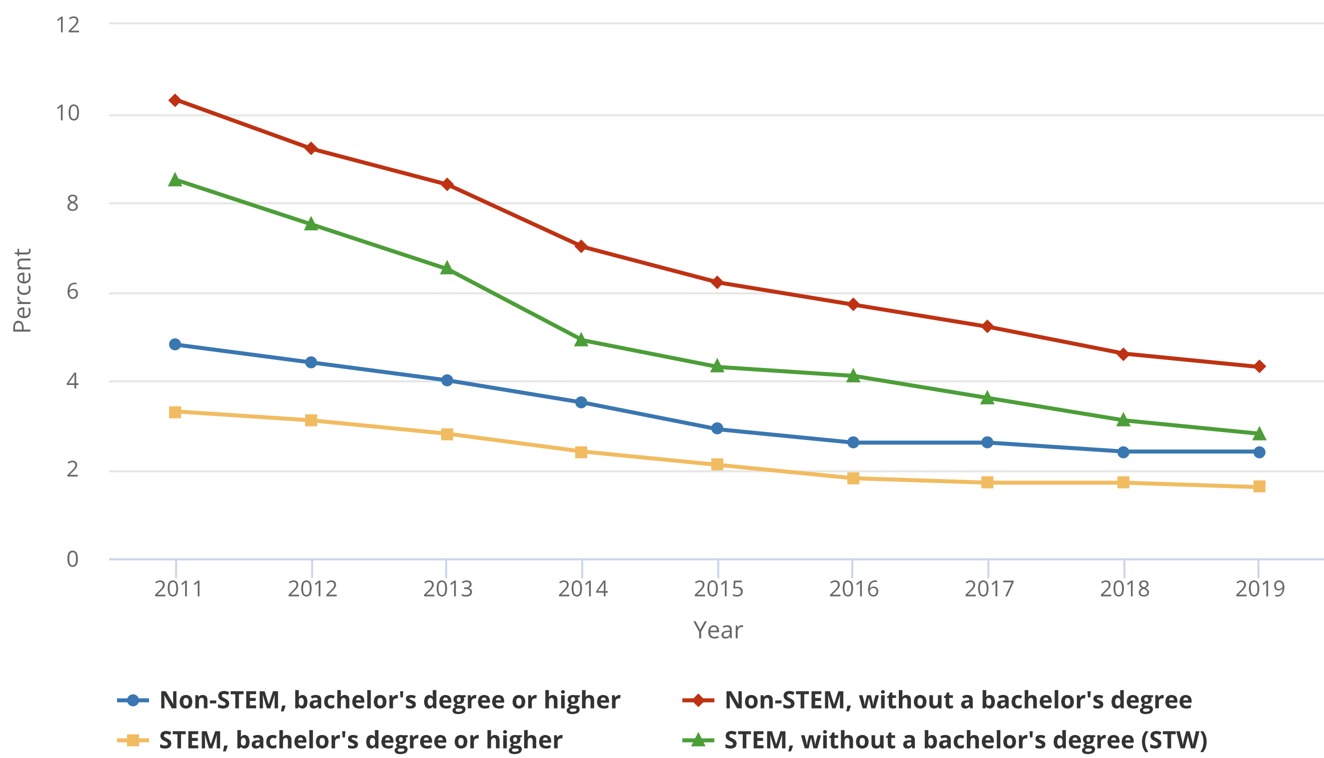
Source(s):
Flood S, King M, Rodgers R, Ruggles S, Warren JR, Integrated Public Use Microdata Series (IPUMS), Current Population Survey: Version 7.0 [2011–19], IPUMS (2020), https://doi.org/10.18128/D030.V7.0.

Science and Engineering Indicators

On average, the STEM labor force at all education levels experienced lower unemployment rates compared to their non-STEM counterparts. The STEM labor force with a bachelor's degree or higher had lower rates throughout the decade than the non-STEM labor force with a bachelor's degree (**Figure LBR-12**). The NSCG further indicates that unemployment rates for the labor force with a bachelor's degree or higher varied within major occupational categories in S&E and by degree levels. For example, individuals with their highest degree at the doctoral or professional level were generally less vulnerable to unemployment than those with a bachelor's as their highest degree (Table SLBR-7).[12] The STEM labor force without a bachelor's degree also had lower rates than their non-STEM counterparts. By 2019, 2.8% of the STEM labor force without a bachelor's degree, or the STW, were unemployed compared to 4.3% of non-STEM labor force without a bachelor's degree, indicating the relative strength of jobs requiring technical skills and expertise (**Figure LBR-12**).

Figure LBR-12

Unemployment rate in each workforce, by degree attainment: 2011–19



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. Unemployment rates for total and those with a bachelor's degree or higher do not include responses without an occupation.

Source(s):
Flood S, King M, Rodgers R, Ruggles S, Warren JR, Integrated Public Use Microdata Series (IPUMS), Current Population Survey: Version 7.0 [2011–19], IPUMS (2020), https://doi.org/10.18128/D030.V7.0.

Science and Engineering Indicators

Working Involuntarily Part Time or Out of One's Field of Highest Degree

Working involuntarily out of field (IOF) or involuntarily part time (IPT) can sometimes indicate underutilization of labor and can be viewed as one indicator of economic inefficiencies that arise from labor market stress. Individuals work outside of their highest degree field or part time for a variety of reasons. Labor market conditions, such as availability of suitable work or career and personal reasons, influence these employment choices (NSB 2016; NSB 2018; Stenard and Sauermann 2016). Those who reported working outside of the field of their highest degree because suitable work in their degree field was not available are referred to as IOF workers, and their number compared to all employed individuals is the IOF rate.

Another dimension of labor underutilization is working part time because full-time employment was not available. The IPT rate is the number of workers working part time because full-time work was unavailable compared to all employed individuals.[13] The IOF rate applies only to workers with a bachelor's degree or higher, whereas the IPT rate applies more generally to all workers regardless of educational attainment. However, the IOF and IPT rates discussed in this report are only for workers with a bachelor's degree or higher reported in the 2019 NSCG.

In 2019, about 4% of S&E highest degree holders were IPT, and 7% were IOF. Although the IPT rates have been fairly stable since 2010, the IOF rates have declined (Table SLBR-8). Similar to other labor market outcomes, IOF rates vary by degree levels and S&E fields of study. Those with their highest degree in engineering or computer and mathematical sciences have lower IOF rates than those with their highest degree in physical, life, or social sciences. Additionally, those with their highest degree in engineering have a lower IPT rate than all other fields. For all S&E highest degree holders, the IOF rate and IPT rate are generally stable across most of the career cycle (**Figure LBR-13**).

Figure LBR-13

S&E highest degree holders working involuntarily part time and out of field, by years since highest degree: 2019

Note(s):
The IPT rate is the proportion of all employed individuals with a bachelor's degree or higher who reported working part time because a full-time job was not available. The IOF rate is the proportion of all employed individuals with a bachelor's degree or higher who reported working in a job not related to their field of highest degree because a job in that field was not available.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

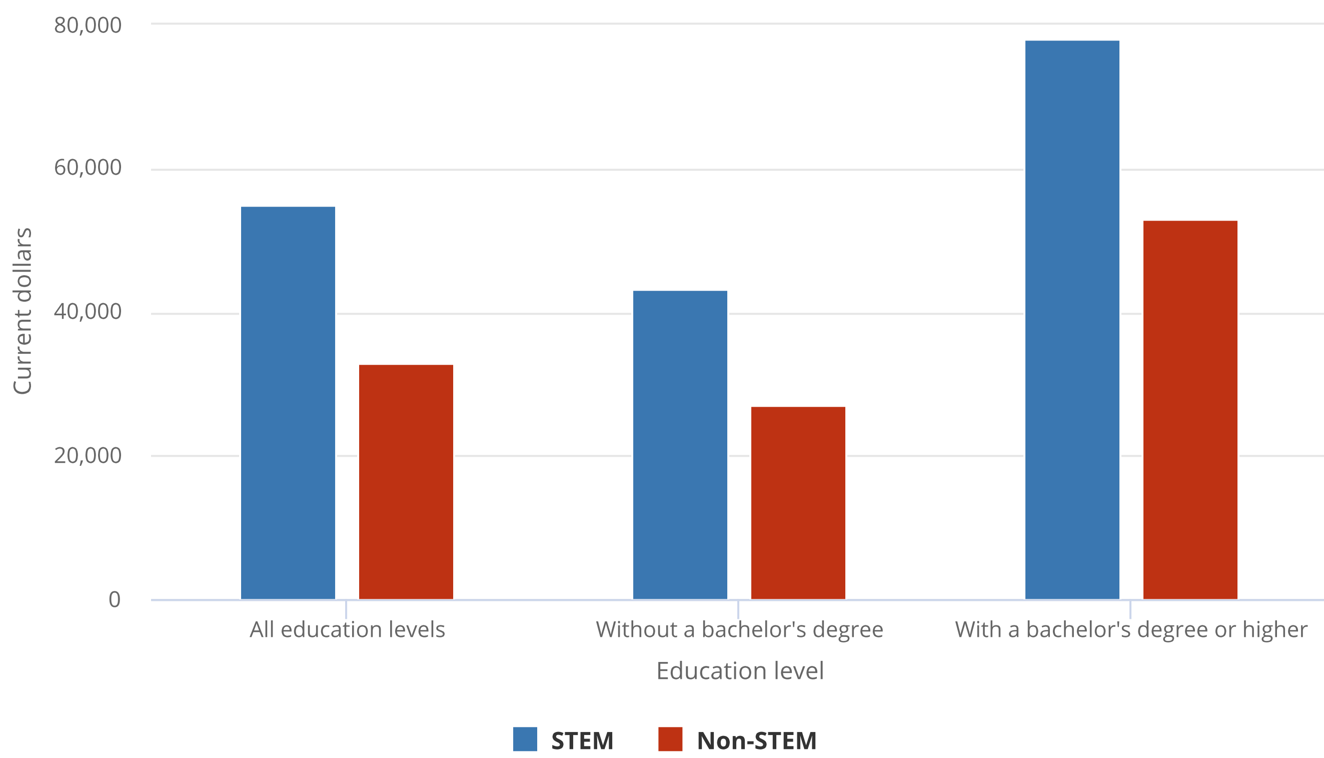
Science and Engineering Indicators

Earnings

The wages that people earn fuel the economy and give workers the ability to support themselves and their families. STEM workers have higher median salaries than their non-STEM counterparts ($55,000 compared to $33,000) (**Figure LBR-14**). Data from the ACS show that this pattern holds regardless of education level. STEM workers with a bachelor's degree or higher have a median salary that is 47% greater than that of non-STEM workers with a bachelor's degree or higher. The STW earns 60% more at the median than non-STEM workers without a bachelor's degree.

Figure LBR-14

Median salaries, by workforce and education level: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

Across all educational levels, the BLS (2017, 2020c) Occupational Employment Statistics (OES) show that workers in S&E occupations earn considerably more than the overall workforce. The median annual salary in 2019 for all workers in S&E occupations (regardless of education level or field) was $88,720, which is more than double the median for all U.S. workers ($39,810) (**Table LBR-3**).[14] This reflects the high level of formal education and technical skills associated with S&E occupations.

Table LBR-3

Annual salaries in S&E and S&E-related occupations: 2016–19

(Current dollars and annual growth rate)

Occupation	Mean			Median		
	Annual salaries in 2016	Annual salaries in 2019	Compound annual growth rate 2016–19 (%)	Annual salaries in 2016	Annual salaries in 2019	Compound annual growth rate 2016–19 (%)
Total, all occupations	49,630	53,490	2.3	37,040	39,810	2.0
S&E occupations	89,750	94,930	2.1	83,900	88,720	1.8
Computer and mathematical scientists	87,890	93,620	2.3	82,780	103,900	2.1
Life scientists	84,660	90,240	2.0	73,270	78,960	1.2
Physical scientists	88,220	92,100	1.7	78,210	81,800	1.2
Social scientists	81,070	86,290	2.1	73,060	77,200	1.9
Engineers	97,170	101,370	1.4	91,430	94,850	1.2
S&E-related occupations (except S&E managers, technicians, and technologists)	81,140	85,560	1.8	65,050	70,040	2.5
S&E managers, technicians, and technologists	86,390	96,030	3.6	70,070	76,860	3.1
Health-related workers	81,070	85,460	1.8	64,820	69,810	2.5
Registered nurses	72,180	77,460	2.4	68,450	73,300	2.3
Dentists, general	173,860	178,260	0.8	153,900	155,600	0.4
Family and general practitioners	200,810	213,270	2.0	190,490	205,590	2.6
Other S&E-related workers	85,280	90,900	2.2	76,310	80,960	2.0
Non-S&E occupations	44,450	47,960	2.6	33,840	36,750	2.8
Chief executives	194,350	193,850	-0.1	181,210	184,460	0.6
General and operations managers	122,090	123,030	0.3	99,310	100,780	0.5
Education administrators, postsecondary	105,770	112,400	2.0	90,760	95,410	1.7
Management analysts	91,910	95,560	1.3	81,330	85,260	1.6
Lawyers	139,880	141,890	0.5	118,160	122,960	1.3
Technical writers	73,160	76,860	1.7	69,850	72,850	1.4

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. Non-S&E occupations include middle-skill and non-STEM occupations. Other S&E-related workers include actuaries, architects (except naval), postsecondary architecture teachers, and cartographers and photogrammetrists.

Source(s):
Bureau of Labor Statistics, special tabulations (2017 and 2020) of the 2016 and 2019 OES Survey.

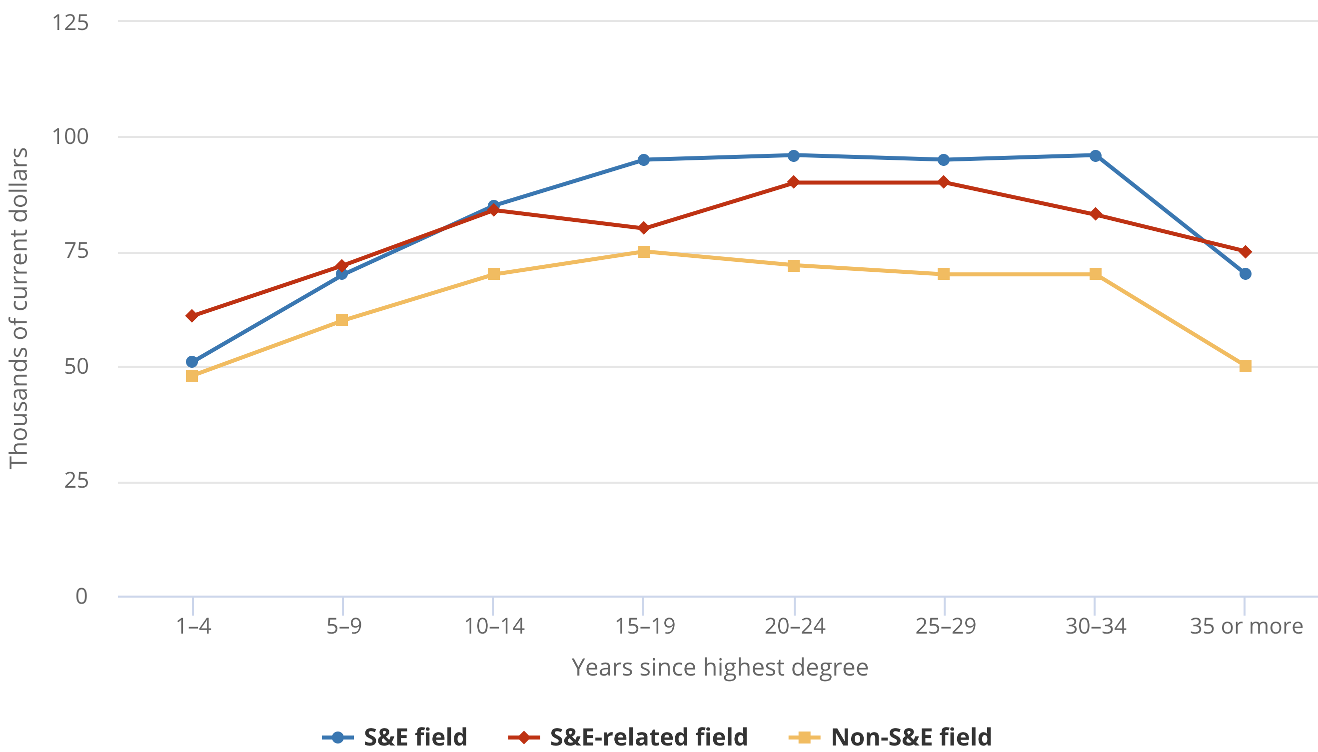
Science and Engineering Indicators

Salaries of S&E and S&E-related workers varied across detailed occupational categories. Among workers in S&E occupations, those in computer and mathematical science had the highest median salaries in 2019 at $103,900 (**Table LBR-3**). Salaries for workers in S&E-related occupations displayed similar patterns of higher earnings compared 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 from a median of $73,300 to $205,590.

Across broad degree fields reported in the NSCG, workers with an S&E or S&E-related degree earn more across most career stages compared to workers with a non-S&E degree (**Figure LBR-15**). This earning premium, as measured by median salaries, varies by degree level with S&E master's and doctoral degree holders earning more at nearly all stages of the career cycle compared to bachelor's degree holders (**Figure LBR-16**). Additionally, the earnings premium of doctoral degree holders remains high at the end of the career cycle, whereas bachelor's degree or master's degree holders have mostly decreased earnings at the end of the career cycle.

Figure LBR-15

Median salaries for workers with a bachelor's degree or higher, by broad field of degree and years since highest degree: 2019

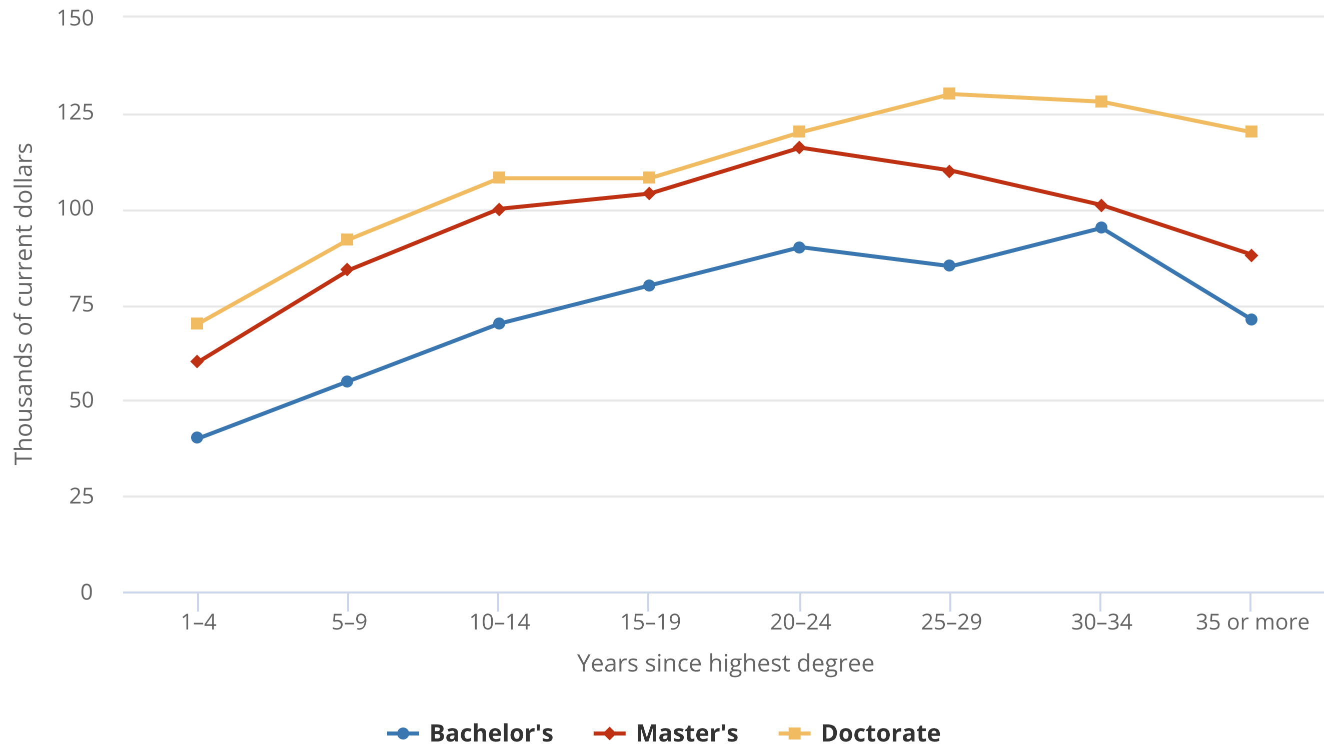


Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Figure LBR-16

Median salaries of S&E highest degree holders, by degree level and years since highest degree: 2019



Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Recent Graduates

The current economy is marked by rapid information flow and development of new knowledge, products, and processes. Thus, demand for certain skills and abilities may change fast. The employment outcomes of recent graduates—defined in this section as those between 1 year and 5 years since receiving their highest degree—are an important indicator of labor market conditions for more current entrants to the labor market.

Recent S&E graduates experience different labor market outcomes from more established graduates, and this experience differs between degree levels and broad fields. In 2019, the NSCG shows that recent S&E graduates had a higher unemployment rate (4.2%) (Table SLBR-9) than all scientists and engineers (2.6%) (Table SLBR-7). However, the IOF rate was approximately the same for recent S&E graduates (7.1%) (Table SLBR-9) compared to all S&E highest degree holders (6.9%) (Table SLBR-8).

Unemployment and IOF rates for recent doctoral recipients (up to 3 years after receiving a doctorate) vary across SEH fields (Table SLBR-10).[15] For example, according to NCSES's (2021c) SDR, 2019 unemployment among doctorates in life sciences was 1.4%, and it was 3.7% among those with doctorates in the social sciences. In addition, social sciences doctorates also had a relatively high IOF rate (4.0%) compared to engineering doctorates (1.7%).

Earnings of recent SEH doctorates vary by field as well as by position type and employment sector. For example, median salaries for SEH doctorates who received their doctorate within the past 5 years ranged from $51,000 for postdoctoral positions in 4-year institutions to $110,000 for those employed in the business sector (**Table LBR-4**). Although each sector exhibited substantial internal variation by SEH field of training, those working in business or industry were the most highly paid within an SEH field.

Table LBR-4

Median salaries for recent SEH doctorate recipients up to 5 years after receiving degree, by field of degree and employment sector: 2019

(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	Postdoctoral position			
All SEH fields	85,000	64,000	80,000	51,000	62,000	90,000	110,000
Biological, agricultural, and environmental life sciences	66,000	55,000	80,000	50,000	52,000	70,000	92,000
Computer and information sciences	135,000	85,000	93,000	57,000	s	109,000	159,000
Mathematics and statistics	91,000	64,000	72,000	59,000	63,000	109,000	139,000
Physical sciences	80,000	58,000	74,000	52,000	51,000	79,000	109,000
Psychology	80,000	66,000	69,000	53,000	70,000	91,000	96,000
Social sciences	78,000	70,000	79,000	56,000	61,000	99,000	106,000
Engineering	105,000	74,000	87,000	51,000	73,000	100,000	119,000
Health	84,000	72,000	75,000	49,000	77,000	100,000	106,000

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, Survey of Doctorate Recipients (SDR), 2019.

Science and Engineering Indicators

Postdoctoral Positions

For many SEH doctoral recipients, a postdoctoral appointment (generally known as a *postdoc*) is the first position held in the STEM workforce after receiving their doctorate. Postdoc positions are defined as temporary, short-term positions intended primarily for acquiring additional training in an academic, government, industry, or nonprofit setting.[16] Individuals in postdoc positions often perform cutting-edge research and receive valuable training (Dorenkamp and Weiss 2018).

In many SEH fields, faculty positions and nonacademic positions require postdoctoral experience (Sauermann and Roach 2016). However, the extent to which a postdoc appointment is part of an individual's career path varies greatly across SEH fields. The Survey of Earned Doctorates (SED) shows that postdocs have historically been more common in life sciences and physical sciences than in other fields, such as social sciences and engineering (Table SLBR-11) (NCSES 2020b). Based on the 2019 SDR, salaries for this population up to five years after receiving their doctorate vary by field of doctorate, and the median salary for postdocs ($53,000) was just over half the median salary for individuals in non-postdoc positions ($94,000) (**Table LBR-5**).

Table LBR-5

Median salaries for recent SEH doctorate recipients in postdoctoral and non-postdoctoral positions up to 5 years after receiving degree: 2019

(Current dollars)

Field of doctorate	All positions	Postdoctoral positions	Non-postdoctoral positions
All SEH	85,000	53,000	94,000
Biological, agricultural, and environmental life sciences	66,000	52,000	82,000
Computer and information sciences	135,000	65,000	138,000
Mathematics and statistics	91,000	60,000	102,000
Physical sciences	80,000	55,000	93,000
Psychology	80,000	53,000	82,000
Social sciences	78,000	57,000	79,000
Engineering	105,000	55,000	109,000
Health	84,000	50,000	90,000

SEH = science, engineering, and health.

Note(s):
Data include graduates from 19 months to 60 months before the survey reference date. Salaries are rounded to the nearest $1,000.

Source(s):
National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR), 2019.

Science and Engineering Indicators

The estimated number of postdocs varies depending on the data source used. No single data source measures the entire population of postdocs.[17] NCSES's (2021e) 2019 Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS) reports that 66,247 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 2019*: **Table 2-1**). This is a 2% increase from 2017, when there were 64,783 postdocs in SEH fields (NCSES *GSS 2018*: **Table 2-1**).

Women and temporary visa holders are highly represented in the SEH postdocs. Of the 66,247 academic postdoc positions in SEH fields in 2019, women accounted for 41% (NCSES *GSS 2019*: **Table 2-1**). Over half of these postdocs are temporary visa holders. Among postdocs in engineering, however, the proportion of women was only 24%, and the proportion of temporary visa holders was 68% (NCSES *GSS 2019*: **Table 1-2c** and **Table 1-3c**).[18]

Employment Sectors

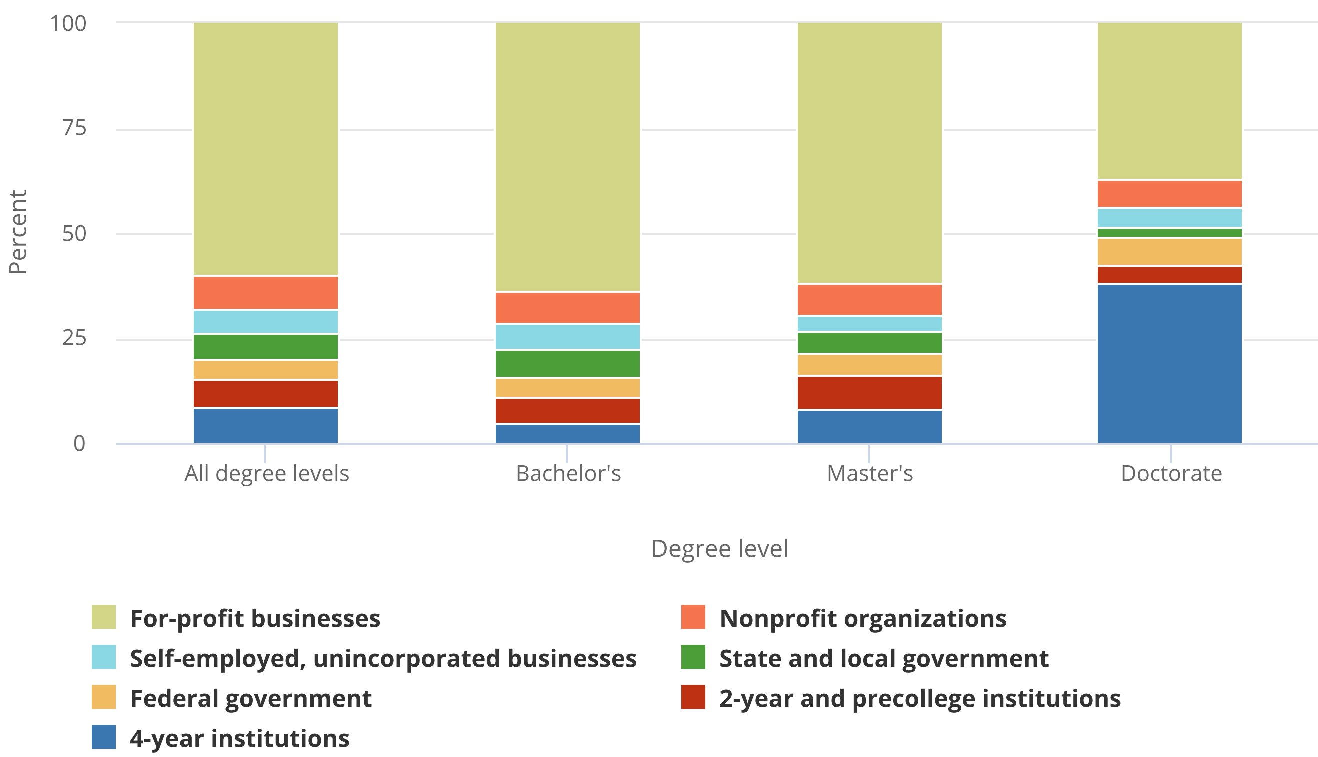
STEM workers and those with education or training in STEM make contributions across all sectors of the economy, including in the business, education, and government sectors. Data from the 2019 NSCG show that the business sector employs nearly three-fourths of workers with a bachelor's degree or higher in S&E or S&E-related occupations or with their highest degree in S&E or S&E-related fields. The dominance of the business sector in employment extends to all workers with a bachelor's degree or higher, regardless of type of occupation (Table SLBR-12).

The education sector, including private and public institutions, is the second largest employer of scientists and engineers (18%). However, among scientists and engineers in the education sector, workers in S&E occupations or with their highest degrees in S&E fields are employed in the education sector at lower proportions (15%–16%) compared to scientists and engineers overall. These differences are largely due to lower proportions of S&E workers and S&E highest degree holders in 2-year and precollege institutions. Sectoral employment of S&E highest degree holders and S&E workers has been quite stable since the early 1990s (Table SLBR-13).

Some differences exist in the concentration of particular groups of S&E workers across employment sectors (**Figure LBR-17**, Table SLBR-14, Table SLBR-15, Table SLBR-16). For-profit businesses employ 60% or more workers with an S&E highest degree at all degree levels except S&E doctorate holders. Only 37% of S&E highest degree holders at the doctorate level are employed by for-profit businesses, which is similar to the proportion employed by 4-year education institutions (38%) (**Figure LBR-17**).

Figure LBR-17

S&E highest degree holders, by degree level and employment sector: 2019



Note(s):
All degree levels include professional degrees not shown separately.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Geographic Distribution of the STEM Workforce

The availability of skilled workers is an important indicator of a region's population, productivity, and technological growth (Carlino, Chatterjee, and Hunt 2001; Glaeser and Saiz 2003). Spatial differences in access to a well-educated workforce and strong innovation sector can contribute to growing inequalities across American communities (Moretti 2013). The BLS (2020c) OES data, which include workers at all education levels, show that the number of STEM workers in S&E occupations varies by geography across the United States. (See forthcoming *Indicators 2022* report "Invention, Knowledge Transfer, and Innovation" for more details on geographic distribution of innovation activities.)

A small number of geographic areas account for a considerable proportion of STEM workers in S&E occupations. For example, 20 metropolitan areas account for 50% of workers in S&E occupations, whereas these same metropolitan areas account for 38% of employment in all occupations (Table SLBR-17). In addition, there are 20 metropolitan areas in which STEM workers employed in S&E occupations comprise 8%–23% of the total workforce compared to the national average of 5% (Table SLBR-18). (For a discussion of the percentage of STEM workers by state, see sidebar **Where the U.S. STEM Workers Are: 2019**.)

SIDEBAR

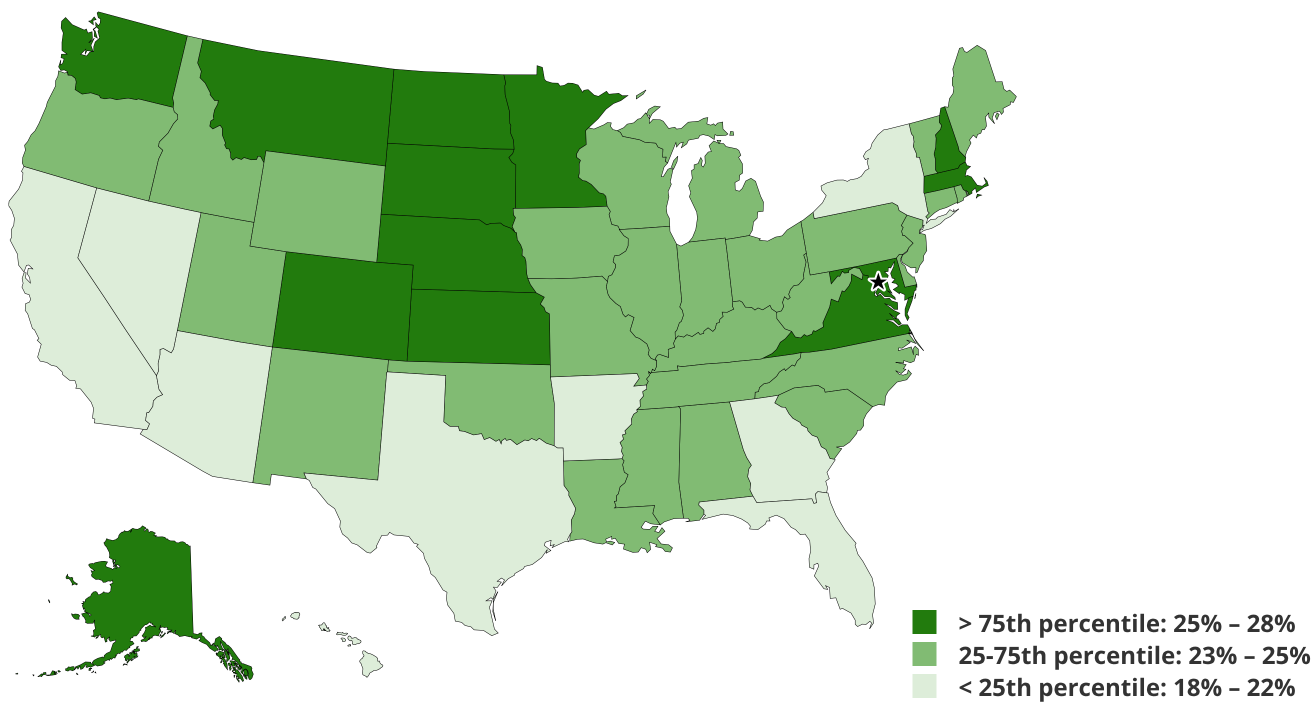
Where the U.S. STEM Workers Are: 2019

A state's capacity to support innovative activity can be measured by the extent to which it has a skilled workforce with the expertise required to conduct this type of work. This sidebar analyzes the percentage of the workforce in each of the 50 states that is in science, technology, engineering, and mathematics (STEM) occupations using data from the U.S. Census Bureau (2020a) 2019 American Community Survey (ACS).

In 2019, about 18 states, spread throughout all four regions defined by the U.S. Census Bureau, had about one-quarter of their workforce in STEM occupations.* Many of these states were in the Midwest, but several states outside the Midwest also had one-quarter of STEM workers (**Figure LBR-C**).

Figure LBR-C

Employment in STEM workforce, by state: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

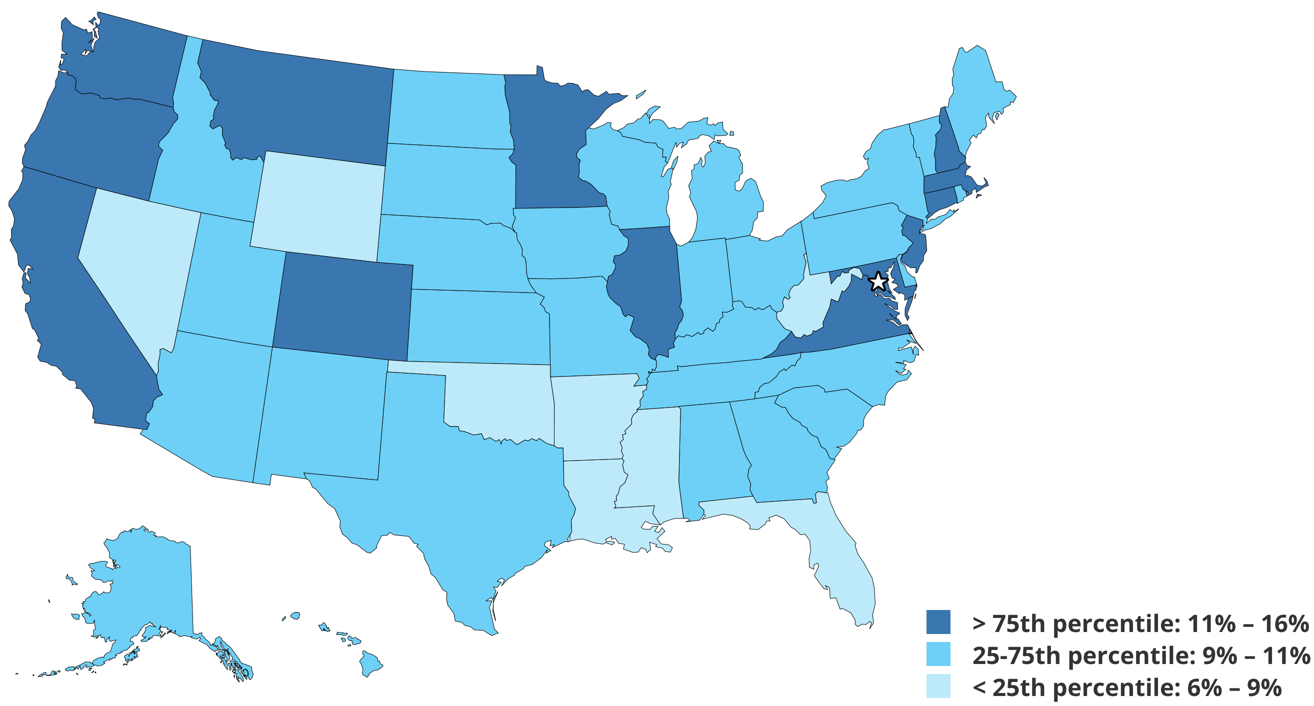
Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

States on the coasts and one state in the Midwest tended to have high proportions of workers with a bachelor's degree or higher in STEM relative to other states (**Figure LBR-D**). The District of Columbia, Massachusetts, Maryland, and Virginia had about 13% or more of these workers, with the highest proportion in the District of Columbia (16%). States in the Western region (Washington and Colorado) and Minnesota also had 13% of workers in STEM occupations with a bachelor's degree or higher. Nevada had the lowest percentage of STEM workers with a bachelor's degree or higher (6%).

Figure LBR-D

Employment of workers with a bachelor's degree or higher in STEM occupations, by state: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

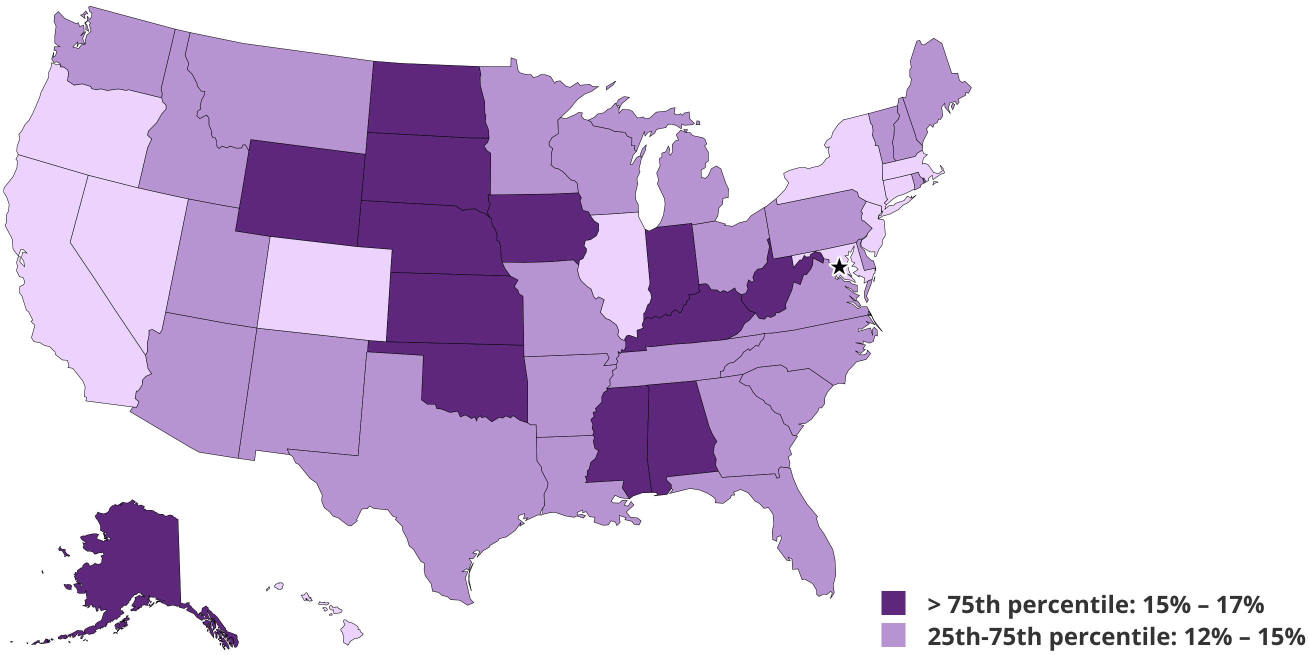
Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

While relatively high concentrations of STEM workers with a bachelor's degree or higher occurred in the coastal states, Southern and Midwest states had relatively high concentrations of STEM workers without a bachelor's degree —that is, the skilled technical workforce (STW). The percentage of STW ranged from about 4% to 17% by state overall. The bulk of the states with about 15% or more of their workers in the STW were in the Southern and Midwestern states (**Figure LBR-E**).

Figure LBR-E

Employment of STEM workers without a bachelor's degree (STW), by state: 2019



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. The STW comprises STEM workers without a bachelor's degree.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

The concentration of STEM workers across states varies by educational attainment. Those STEM workers with a bachelor's degree or higher tend to work in S&E or S&E-related occupations (**Figure LBR-2**) and are more concentrated in coastal states with high R&D intensity (see **Indicators State Data Tool**). Workers in the STW, who primarily apply their technical expertise in health care, production, construction and extraction, and installation, maintenance, and repair occupations, make up greater proportions of the workforce in states in the Midwest and Southern regions compared to other U.S. states.

* While the analyses presented in the text reflect statistically significant differences at the 90% confidence level or higher, not all of the percentages shown in the maps are statistically significantly different from each other.

Industry Employment

Across all education levels, the BLS (2020c) OES data show that industries employ S&E workers at various rates. In 2019, five industry groups with the largest numbers of workers in S&E occupations—information; professional, scientific, and technical services; manufacturing; educational services; and government—accounted for nearly three-quarters of industry S&E employment, compared with one-third of total employment (Table SLBR-19). (See the forthcoming *Indicators 2022* report "Production and Trade of Knowledge- and Technology-Intensive Industries" for more information about employment in these industries.)

The intensity of employment in S&E occupations, defined as the proportion of an industry's total employment in S&E occupations, also varied by industry. Industries with low S&E employment intensity (i.e., below the national average of 5%) 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, utilities, and management of companies and enterprises, among others (Table SLBR-19).

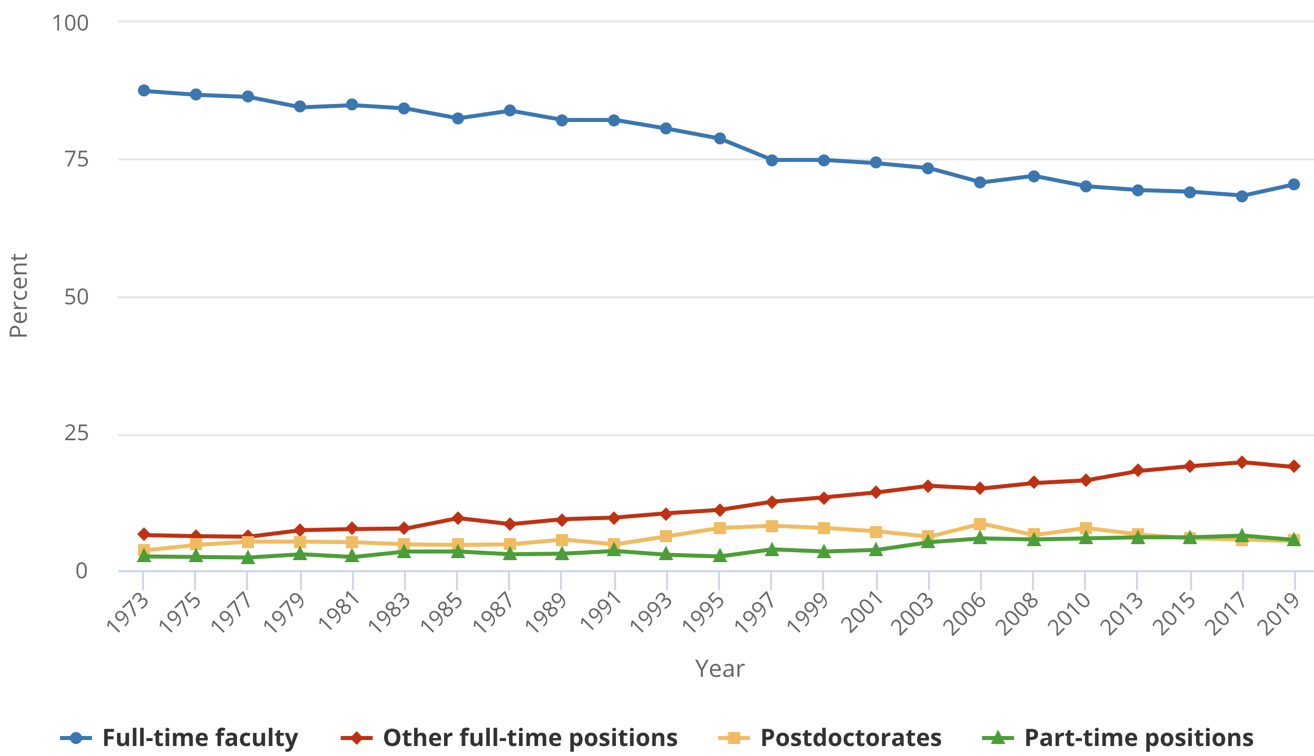
Based on the ACS, STW employment in 2019 was concentrated in three broad industries: construction, manufacturing, and medical industries. In total, these three industry groups accounted for 57% of STW employment, compared with 29% of employment across all industries (Table SLBR-20). STW employment intensity, defined by an industry's STW employment as a proportion of its total employment, was highest in construction (37%), military (35%), utilities (29%), mining (28%), and agriculture, forestry, fishing, and hunting (26%).

Academic Employment

As noted earlier, the education sector is a large employer of SEH doctorate recipients, and 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. The SDR shows that there were about 350,000 individuals in the academic doctoral workforce in 2019 who received their SEH doctorate in the United States. 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 70% in 2019 (**Figure LBR-18**; Table SLBR-21).[19]

Figure LBR-18

SEH doctorate recipients employed in academia, by type of position: 1973–2019



SEH = science, engineering, and health.

Note(s):
Academic employment is limited to U.S. doctorate recipients employed at 2- or 4-year colleges or universities, medical schools, and university research institutes. Full-time faculty include 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, Survey of Doctorate Recipients (SDR), 2019.

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 (SRS/NSF *SDR 1993*: **Table 20**). By 2019, these percentages were closer, with 39% in 4-year educational institutions and 35% in for-profit businesses (NCSES *SDR 2019*: **Table 42**).

The SEH doctoral academic workforce is engaged primarily in research and teaching. In 2019, nearly identical shares of U.S.-trained SEH doctorate holders working in academia reported that research or teaching was their primary work activity, or approximately 40% each (Table SLBR-22). 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 (24%). Federal research support holds a prominent role for academically employed SEH doctorate holders. In 2019, about 40% of them had received federal research support in the previous year (Table SLBR-23). (See the forthcoming *Indicators 2022* report, “Academic Research and Development” for more details on federal support of R&D conducted in academic institutions.)

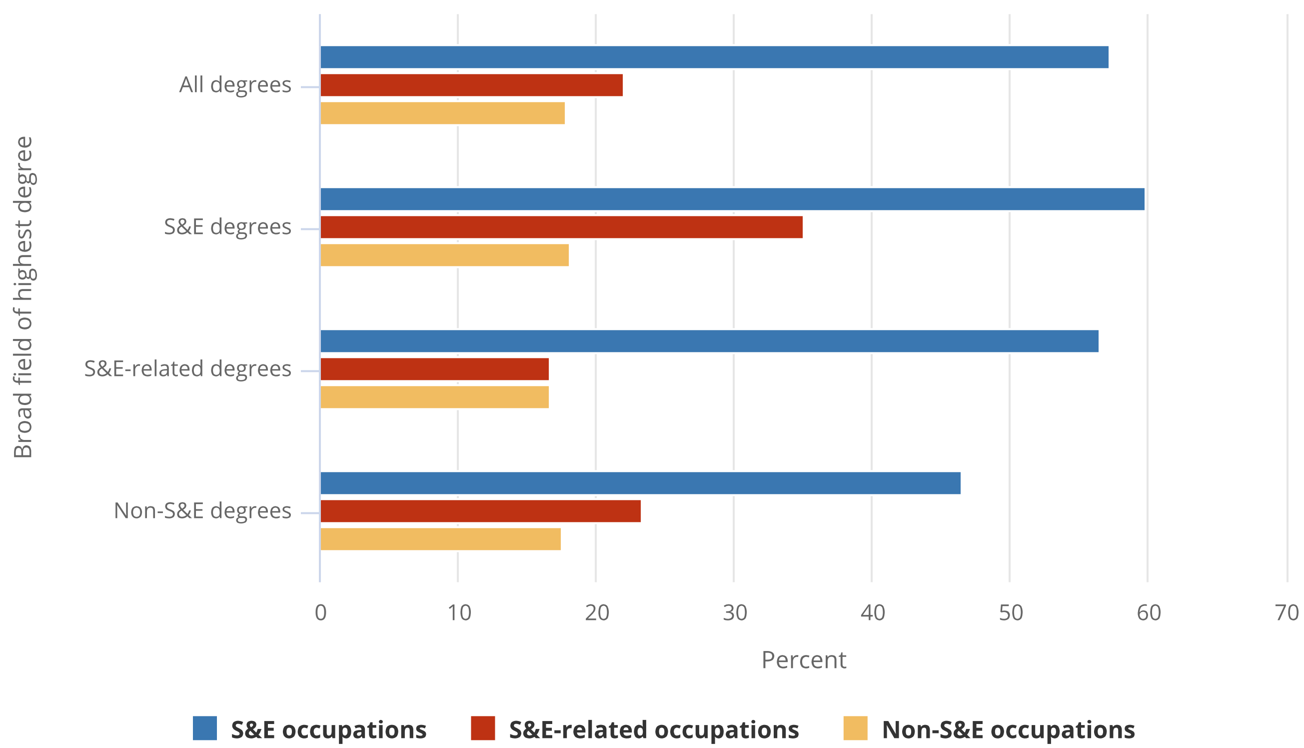
Research and Development Activities

R&D creates new types of goods and services that can contribute to economic and productivity growth and enhance living standards. This section uses the NSCG to examine the R&D activity of workers with a bachelor's degree or higher in S&E or S&E-related occupations. R&D or design activity is defined as the proportion of workers who reported basic or applied research, development, or design 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).[20]

The majority of workers with a bachelor's degree or higher in S&E occupations (57%) are engaged in R&D or design activity, as are considerable proportions of those in S&E-related (22%) and non-S&E occupations (18%) (**Figure LBR-19**), suggesting that R&D- and design-based work activities are prevalent in various types of jobs. With the exception of social scientists, doctorate holders in S&E occupations indicated higher rates of R&D or design activity than those with a bachelor's or master's degree as their highest degree (**Table LBR-6**). (See sidebar **Global S&E Labor Force** for a comparison of the researchers in selected countries.)

Figure LBR-19

Scientists and engineers with R&D and design activity, by broad field of highest degree and broad occupational category: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Scientists and engineers include adults up to 75 years old with an S&E or S&E-related degree or occupation. R&D and design activity refer to workers reporting basic research, applied research, development, or design as a primary or secondary work activity in their principal job (activities ranking first or second in work hours). Non-S&E occupations include middle-skill and non-STEM occupations.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Table LBR-6

R&D and design activity of scientists and engineers employed in S&E occupations, by broad occupational category and highest degree level: 2019

(Percent)

Highest degree level	Biological, agricultural, and environmental life scientists	Computer and mathematical scientists	Physical scientists	Social scientists	Engineers
All degree levels	74.4	47.8	71.3	53.9	67.6
Bachelor's	68.7	46.6	65.2	63.9	64.7
Master's	69.9	46.2	67.2	49.0	69.5
Doctorate	84.2	72.7	85.1	56.3	84.1

Note(s):
Scientists and engineers include adults up to 75 years old with an S&E or S&E-related degree or occupation. R&D and design activity refer to the share of workers reporting basic research, applied research, development, or design as a primary or secondary work activity in their principal job (activities ranking first or second in work hours). All degree levels include professional degrees not broken out separately.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

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 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.

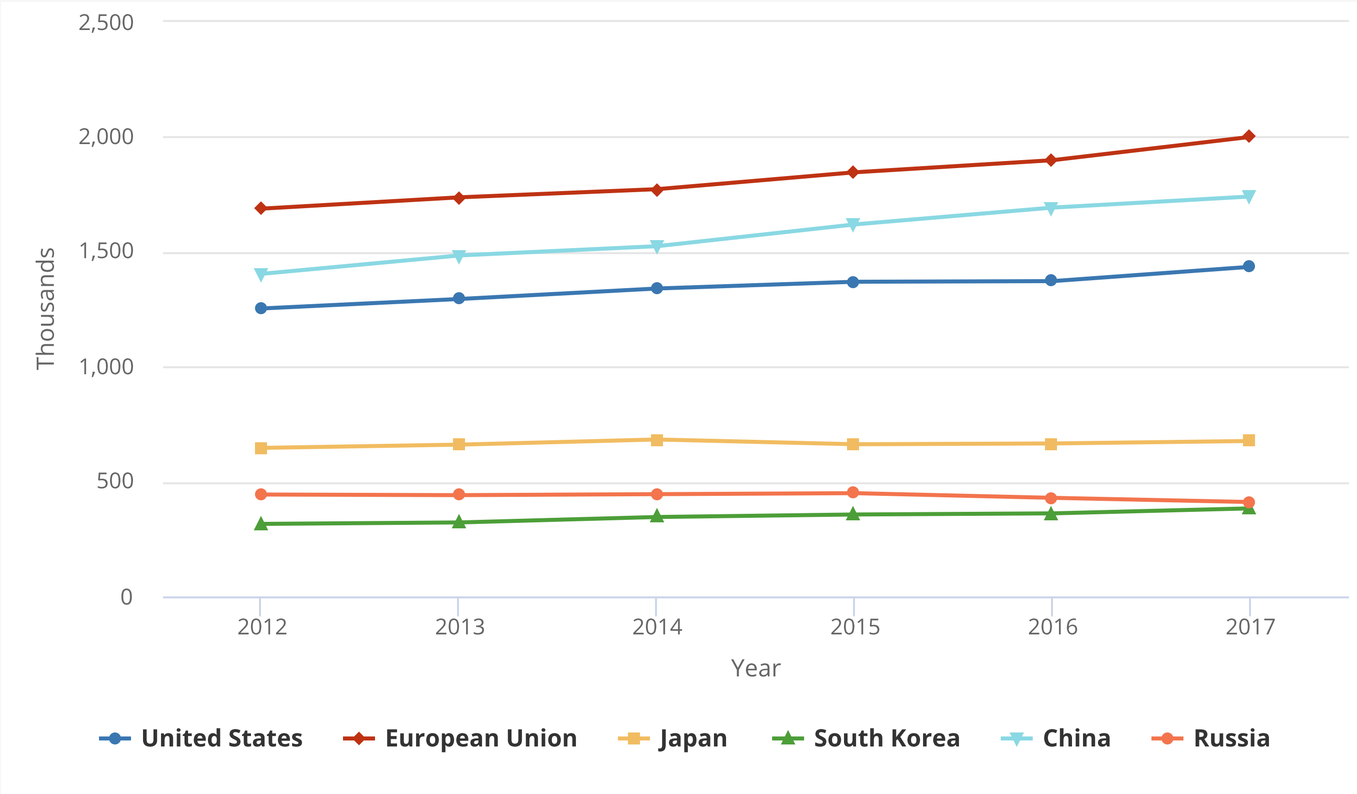
OECD data covering substantial, internationally comparable segments of the S&E workforce provide strong evidence of its widespread, although uneven, growth in the world's developed nations. OECD countries, which include most of the world's highly developed nations, compile data on researchers from establishment 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 2015:379). 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 4.4 million in 2012 to 5.1 million in 2017 (OECD 2020). OECD also publishes estimates for seven nonmember economies, including China and Russia. Adding these seven to the OECD member total for 2017 yields a worldwide estimate of 7.5 million researchers. However, numerous uncertainties affect this estimate, including (but not limited to) lack of coverage of countries with a 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 and Brazil) are omitted entirely from these totals. In addition, for some countries and regions, including the United States and the European Union (EU; see the **Glossary** section 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 2012 (**Figure LBR-F**). China and South Korea both reported at least 20% or more researchers in 2017 than in 2012. The United States and the EU experienced steady growth but at a lower rate; the number of researchers grew 15% in the United States and 19% in the EU between 2012 and 2017. Exceptions to the overall worldwide trend include Japan (which experienced a relatively small change of about 5%) and Russia (which experienced a decline; see also Gokhberg and Nekipelova (2002)).

Figure LBR-F

Estimated number of researchers in selected regions, countries, or economies: 2012–17



Note(s):
Researchers are full-time equivalents.

Source(s):
Organisation for Economic Co-operation and Development, Main Science and Technology Indicators, 2020/1 (August 2020).

Science and Engineering Indicators

Participation of Demographic Groups in STEM

Broadening participation in the U.S. STEM enterprise will lead to the expansion of STEM capabilities throughout the U.S. workforce and enhance the innovative capacity of the S&E enterprise in the United States (NSB 2020). Some demographic groups are represented to a lesser degree in STEM compared to the general population and may be seen as an underutilized source of talent for building the capacity of the S&E enterprise. Lower participation among certain demographic groups signals a lack of diversity in the workplace, which may negatively impact productivity, innovation, and entrepreneurship (Bell et al. 2019; Flabbi et al. 2019; Hsieh et al. 2019).

This section mostly focuses on sex, race or ethnicity, nativity, and citizenship of workers in STEM occupations by educational attainment. It also presents data on sex and race or ethnicity of workers with a bachelor's degree or higher in a subset of STEM occupations—that is, S&E and S&E-related occupations. (See the **Glossary** section for definitions of S&E occupations and S&E-related occupations.) The primary data source for the analysis of STEM workers with a bachelor's degree or higher, NCSES's NSCG, does not allow workers in middle-skill occupations to be identified separately from those in non-STEM occupations. (See the **Glossary** section for definitions of middle-skill occupations and non-STEM occupations.) Hence, workers with a bachelor's degree or higher in non-S&E occupations include those in middle-skill and non-STEM occupations. (See the **Glossary** section for non-S&E occupations.)

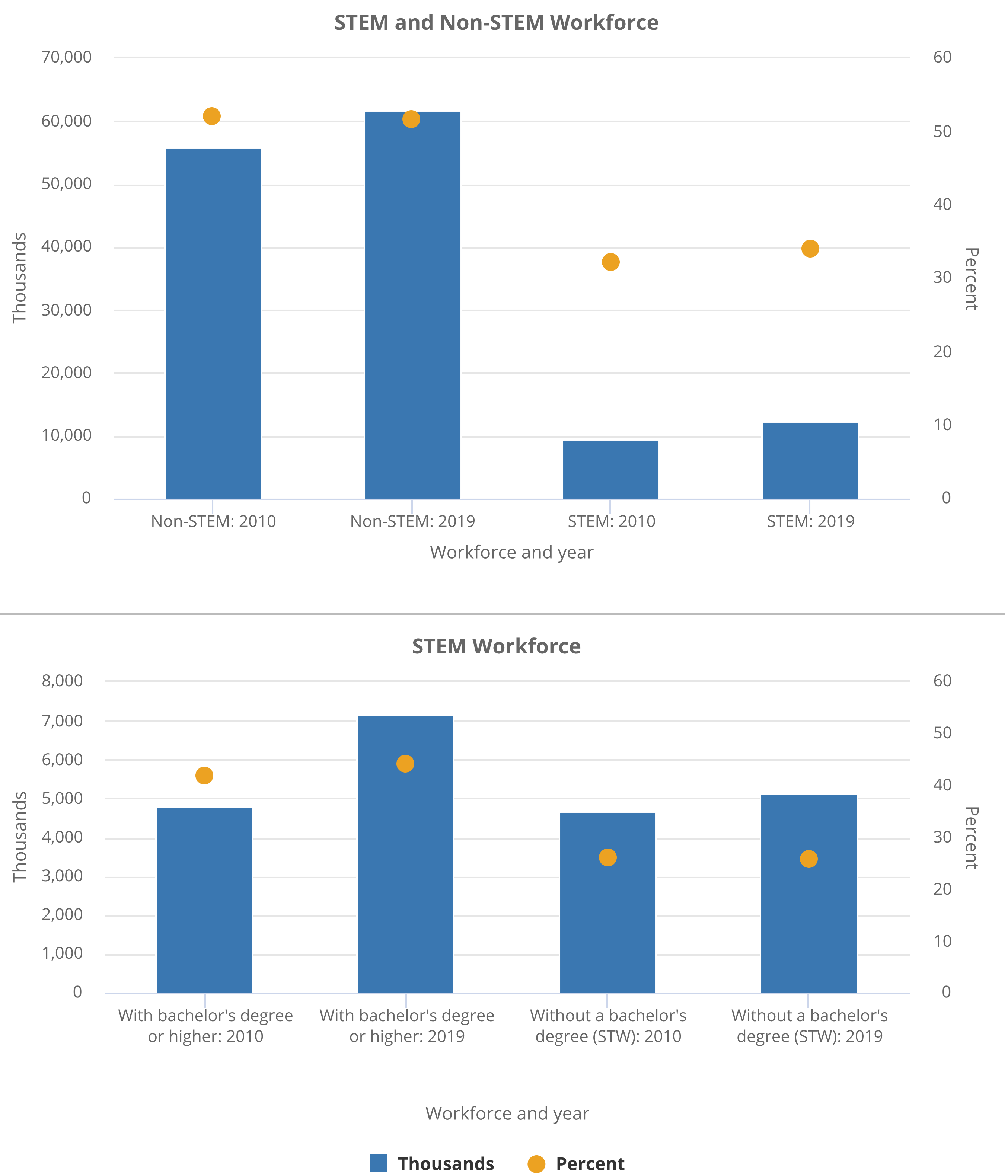
There is some limited analysis in this section on the demographic composition of the STW and of those with degrees in S&E and S&E-related fields. For more detailed analysis on the demographic composition of the STW and of those with degrees in S&E and S&E-related fields, see the NCSES report ***Women, Minorities, and Persons with Disabilities in Science and Engineering: 2021***.

Women in STEM

The representation of women in STEM varies across occupational groups and educational attainment. Based on the U.S. Census Bureau (2020a) 2019 ACS, women constituted 34% of the STEM workforce (12 million workers) but about 52% of the non-STEM workforce (62 million workers) (**Figure LBR-20**). Within STEM, women comprised 44% of workers with a bachelor's degree or higher (7 million workers) and 26% of those without a bachelor's degree, or in the STW (5 million workers) (**Figure LBR-20**).

Figure LBR-20

Employed women, by workforce: 2010 and 2019



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

Since 2010, the proportion of women in the U.S. STEM workforce increased with uneven growth across STEM occupational groups and educational attainment. Overall, women in the STEM workforce increased from 32% in 2010 to 34% in 2019, nearly all of which was related to an increase in the proportion of women with a bachelor's degree or higher in STEM, from 42% (5 million workers) in 2010 to 44% (7 million workers) in 2019. The proportion of women in the STW in 2010 and 2019 was 26% (5 million workers).

By 2019, the number of women with a bachelor's degree or higher working in S&E occupations almost tripled since 1993 and nearly doubled in S&E-related occupations since 2003, but the distribution of women in these occupations was uneven (**Table LBR-7**).[21] Data from the 2019 NSCG show that the proportion of women with a bachelor's degree or higher in S&E occupations grew from 23% in 1993 to 29% in 2019, still well below their representation of the workforce with a bachelor's degree or higher in 2019 (52%). In contrast, women with a bachelor's degree or higher worked proportionately more in S&E-related occupations in 2019 (57%).

Table LBR-7

Women with a bachelor's degree or above, by broad occupational group and highest degree: 1993, 2003, 2019

(Thousands and percent)

Occupational group and highest degree	Thousands			Percent		
	1993	2003	2019	1993	2003	2019
Workforce with a bachelor's degree or above	3,064	7,585	26,341	31	42	52
STEM occupations						
S&E	755	1,269	2,193	23	26	29
S&E-related	NA	2,948	5,109	NA	55	57
STEM highest degree						
S&E	2,025	3,426	6,132	31	36	40
S&E-related	NA	2,462	4,747	NA	56	64

NA = not available.

STEM = science, technology, engineering, and mathematics.

Note(s):
Middle-skill occupations are excluded because the data source does not allow for the separation of middle-skill occupations from non-STEM occupations. Percentages may not add to 100% because of rounding.

Source(s):
National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT), 1993 and 2003, and National Survey of College Graduates (NSCG), 2019.

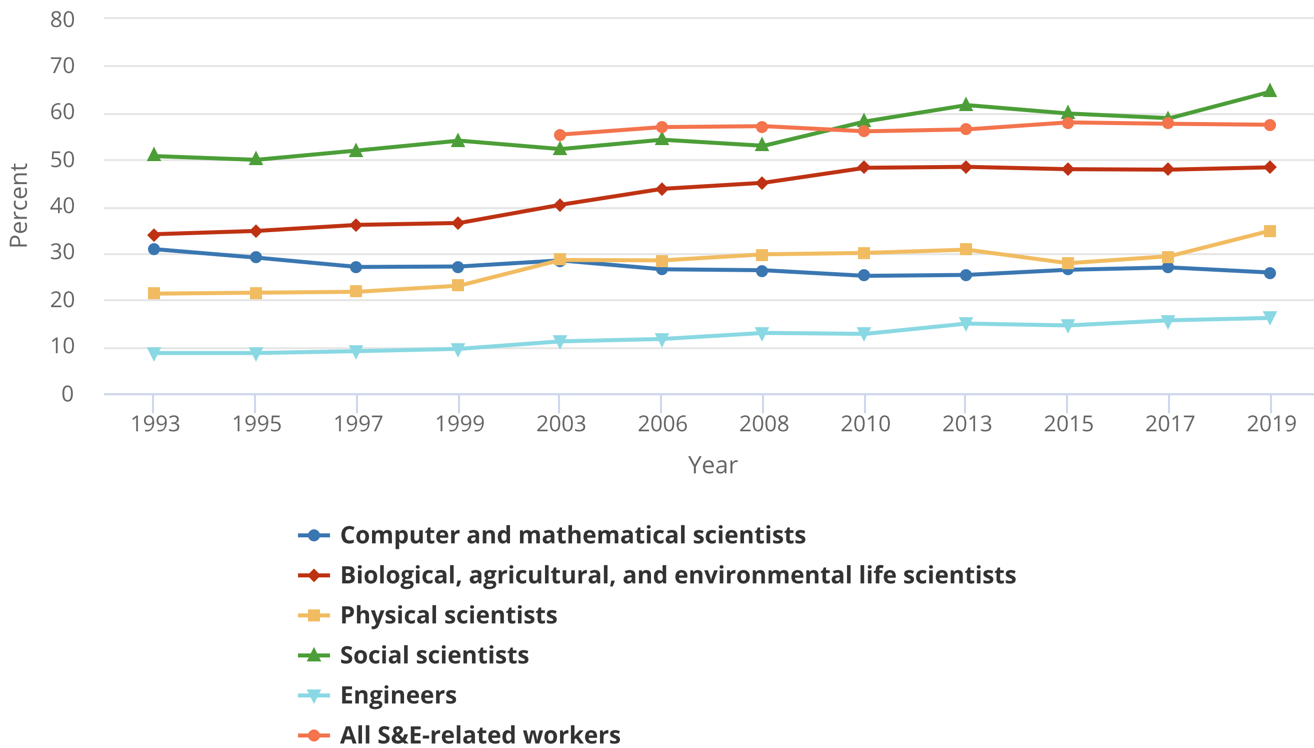
Science and Engineering Indicators

Within S&E-related occupations, women with a bachelor's degree or higher represented 70% of health care workers, the majority of which are nurse practitioners, pharmacists, registered nurses, dietitians, therapists, and physician assistants (Table SLBR-24). Compared to their representation among bachelor's degree holders overall, women also had higher representation among health technologists and technicians (66%), postsecondary teachers in health and related sciences (70%) and other health workers (70%). Among the higher salaried positions in health, such as family and general practitioners (**Table LBR-3**), women accounted for less than their proportion of the workforce with a bachelor's degree or higher (43%).

With the exception of computer and mathematical sciences, the proportion of women with a bachelor's degree or higher in the major occupational categories within S&E grew between 1993 and 2019, but women are unevenly distributed across them (**Figure LBR-21**). In 2019, women account for 48% of life scientists and 65% of social scientists but only 35% of physical scientists and 26% of computer and mathematical scientists. Representation of women is the lowest in engineering (16%) among the major occupational categories in S&E. Furthermore, the representation of women varies within these major occupational categories. For example, 65% of social scientists are women, and among the detailed occupations within the social sciences, women accounted for 24% of economists and 81% of psychologists (Table SLBR-24). The distribution of women among S&E degree fields mirrors the distribution of women among S&E occupations associated with those fields (Table SLBR-25).

Figure LBR-21

Women with a bachelor's degree or higher in S&E and S&E-related occupations: Selected years, 1993–2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Data are not available for all S&E-related workers for 1993–99. National estimates were not available from the Scientists and Engineers Statistical Data System (SESTAT) in 2001. Middle-skill occupations are excluded because the data source does not allow for the separation of middle-skill occupations from non-STEM occupations.

Source(s):
National Center for Science and Engineering Statistics, SESTAT, 1993–2013, and National Survey of College Graduates (NSCG), 2015–19.

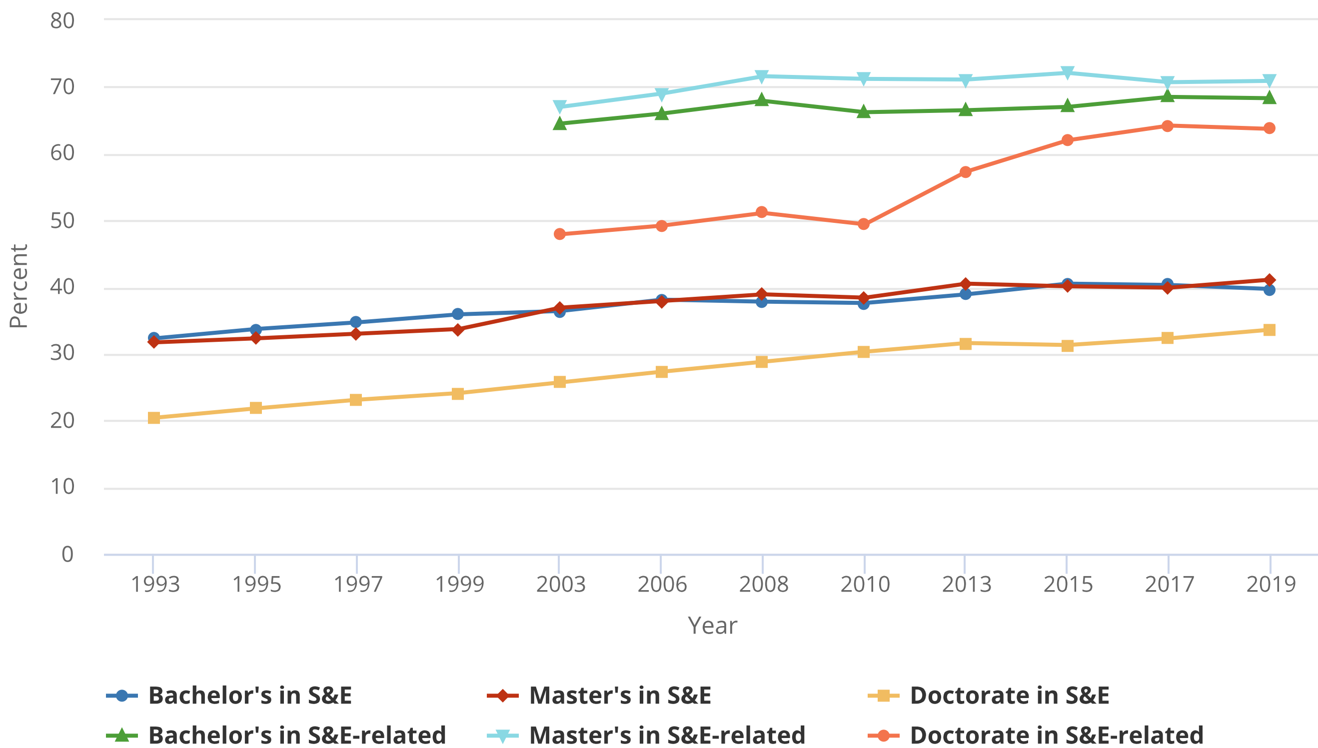
Science and Engineering Indicators

Within the SEH doctoral academic workforce, the number of women more than doubled between 1997 and 2019 and grew at a faster rate than men (Table SLBR-26). The 2019 SDR shows that women accounted for 39% of SEH doctorates employed in academia in 2019, up from 25% in 1997, and they accounted for 33% of full-time senior faculty (including full professors and associate professors) in 2019, up from 17% in 1997. The proportion of women in the doctoral academic workforce varies across disciplines (Table SLBR-26).

Compared to their representation in S&E and S&E-related occupations, women accounted for a greater proportion of individuals with highest degrees in S&E and S&E-related fields in 2019. The proportion of women holding their highest degree in S&E increased from 31% in 1993 to 40% in 2019, and a similar increase occurred with S&E-related highest degree holders (**Table LBR-7**). However, the proportion of working women with any level of S&E-related degree consistently exceeds that for the proportion of women with S&E degrees (**Figure LBR-22**). While female representation among employed S&E highest degree holders (40%) is below that of the workforce with a bachelor's degree or higher (52%), it is still higher than female representation in S&E occupations (29%). Hence, the underrepresentation of women in S&E occupations is only partially a result of low representation with an S&E or S&E-related educational background.

Figure LBR-22

Employed women with their highest degree in S&E and S&E-related fields, by degree level: Selected years, 1993–2019



Note(s):
Data are not available for S&E-related fields for 1993–99.

Source(s):
National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT), 1993–2013, National Survey of College Graduates (NSCG), 2015–19, and Survey of Doctorate Recipients (SDR), 2015–19.

Science and Engineering Indicators

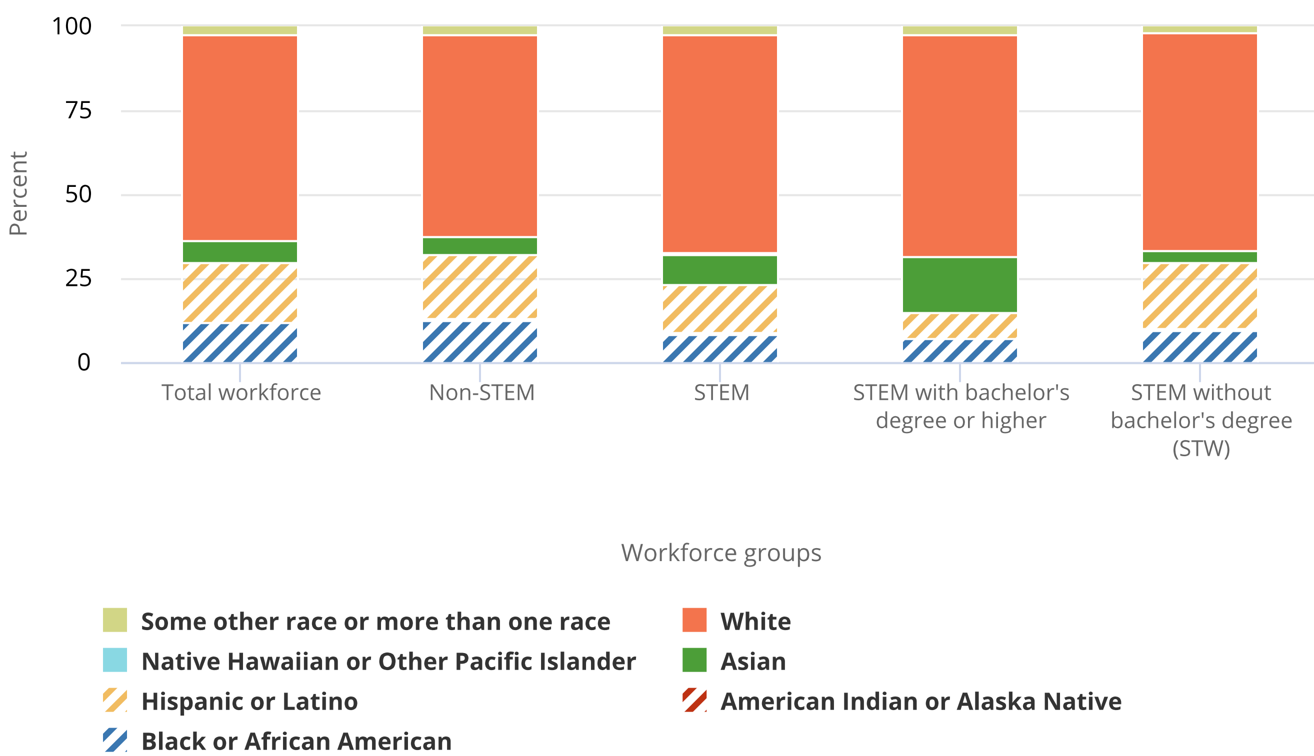
Representation of Race or Ethnicity in STEM

Underrepresentation of certain races and ethnicities has long been a focus of policymakers interested in the development and employment of diverse human capital to maintain the United States' global competitiveness in STEM. Blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives together make up a greater share of the general population than they do of those working in S&E occupations and with S&E degrees. These races and ethnicities are referred to as underrepresented minorities in this report. In contrast, Whites and Asians tend to comprise about the same or greater portions of S&E workers and S&E degree holders compared to their proportions of the general population.[22]

According to the U.S. Census Bureau (2020a) 2019 ACS, Asians and Whites represent a greater share of STEM (9% and 65%, respectively) compared to all Asians and all Whites in the U.S. workforce (6% and 61%, respectively) (**Figure LBR-23**). However, the representation of Asians in STEM is primarily driven by their representation among STEM workers with a bachelor's degree or higher (16%), whereas Asians are underrepresented among STEM workers without a bachelor's degree, or the STW (4%). In contrast, Whites represent a greater share of STEM workers with at least a bachelor's degree (66%) and of the STW (65%).

Figure LBR-23

Employed adults, by workforce, educational attainment, and race or ethnicity: 2019



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Black or African American, Hispanic or Latino, and American Indian or Alaska Native are underrepresented minority groups, shown in the striped areas. Data include ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. Hispanic or Latino may be any race; race categories exclude those of Hispanic or Latino origin. Percentages may not add to 100% because of rounding.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

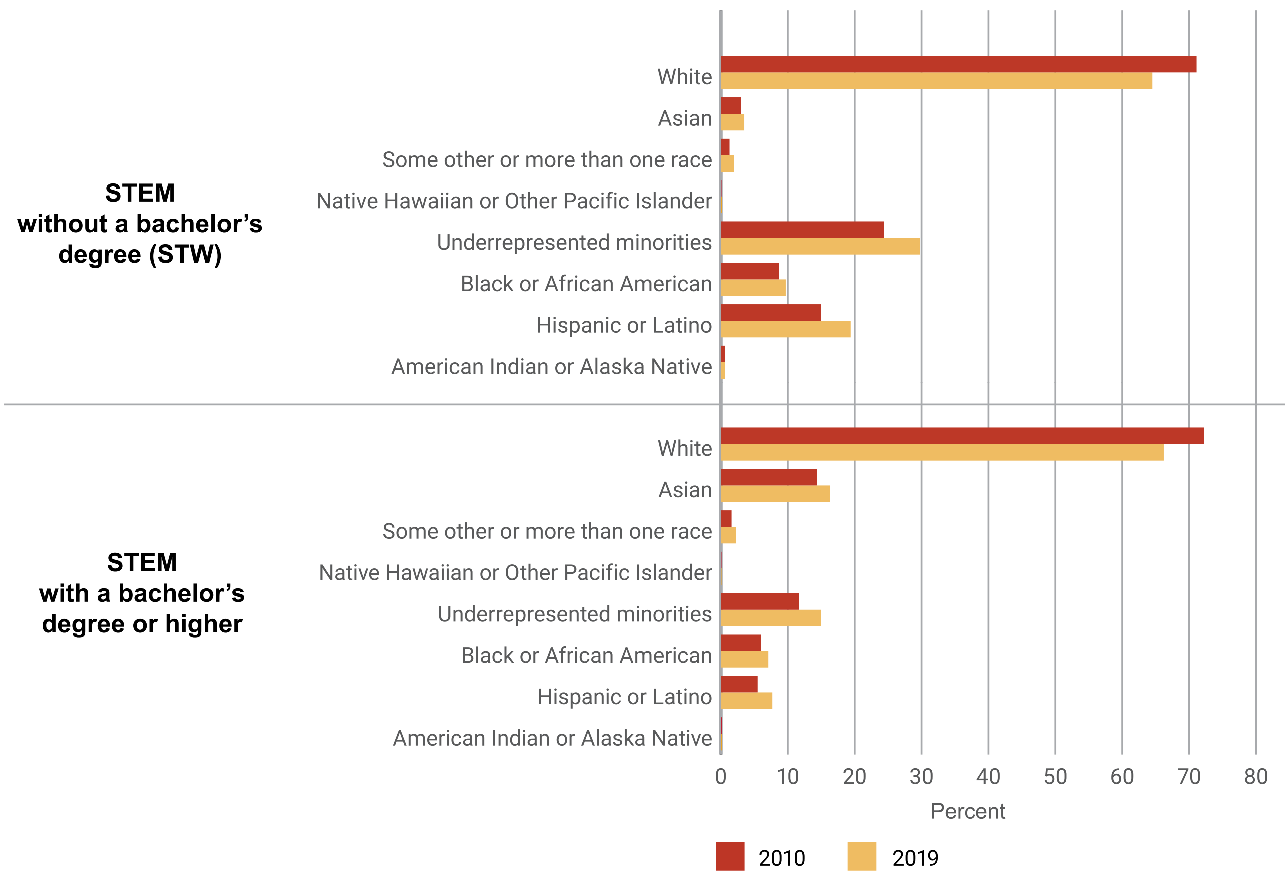
Science and Engineering Indicators

Hispanic or Latino and Black or African American workers are underrepresented in STEM, with the greater discrepancy being among those with a bachelor's degree or higher than those without a bachelor's degree. Hispanic or Latino workers make up 18% of the U.S. workforce but represent 14% of STEM workers. Similarly, Black or African American workers make up 12% of the U.S. working population but represent only 9% of STEM workers. In the STEM workforce with a bachelor's degree or higher, Hispanic or Latino workers represent 8% of the workforce, and Black or African American workers represent 7%. However, at 19% of the STW, Hispanic or Latino workers are more than their proportion of the working population. Black or African American workers are underrepresented at 10% in the STW.

The proportion of Black or African American and Hispanic or Latino workers increased in both the STEM workforce with at least a bachelor's degree and the STW between 2010 and 2019. In STEM, the number of Black or African Americans with a bachelor's degree or higher increased 67%, and those in the STW increased 24%. Similarly, Hispanic or Latino STEM workers grew 99% for those with a bachelor's degree or higher and 44% for those in the STW. Participation increased for these groups at a higher rate than White STEM workers with a bachelor's degree or higher and those in the STW. This resulted in an increase in the proportion of Black or African American workers in STEM with and without a bachelor's degree by approximately 1 percentage point in each and an increase in the proportion of Hispanic or Latino workers by 2 percentage points among those with a bachelor's degree or higher and 4 percentage points among those without a bachelor's degree (**Figure LBR-24**).

Figure LBR-24

STEM workforce, by degree level and race or ethnicity: 2010 and 2019



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school. Hispanic or Latino may be any race; race categories exclude those of Hispanic or Latino origin. Percentages may not add to 100% because of rounding.

Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

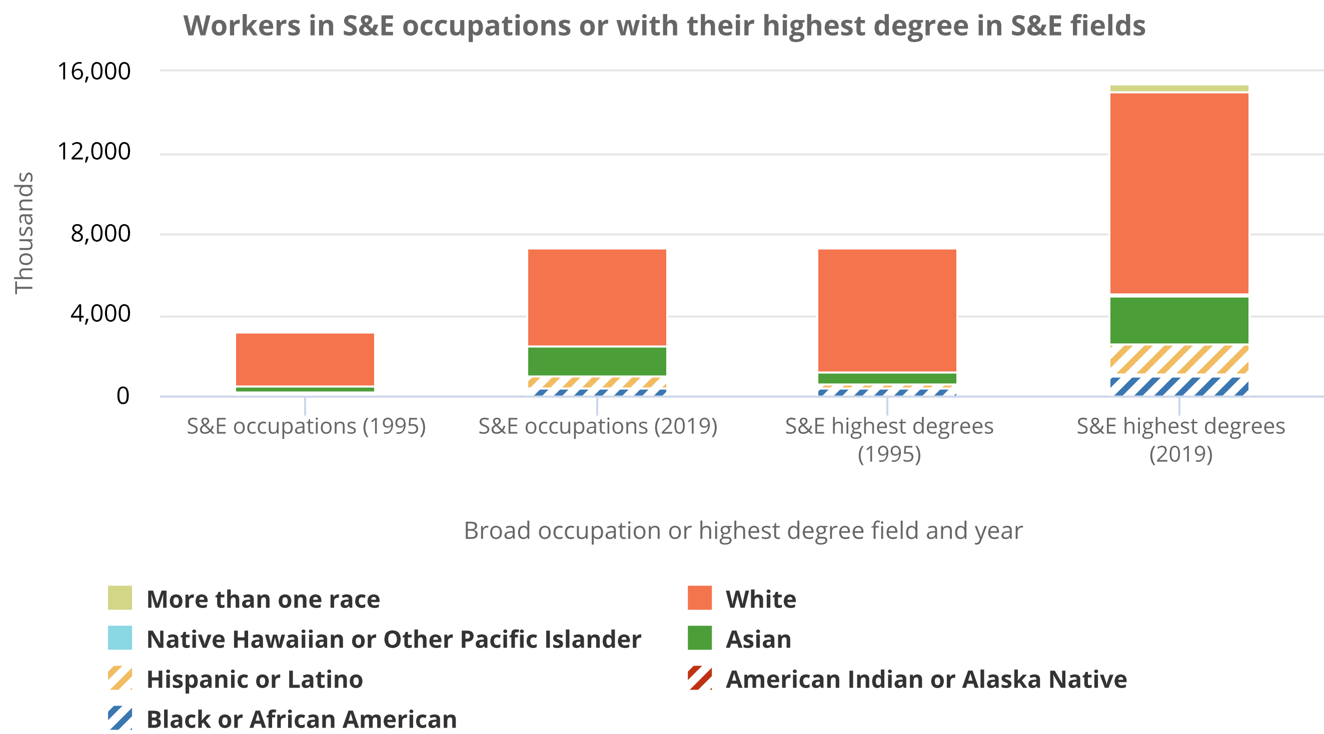
Science and Engineering Indicators

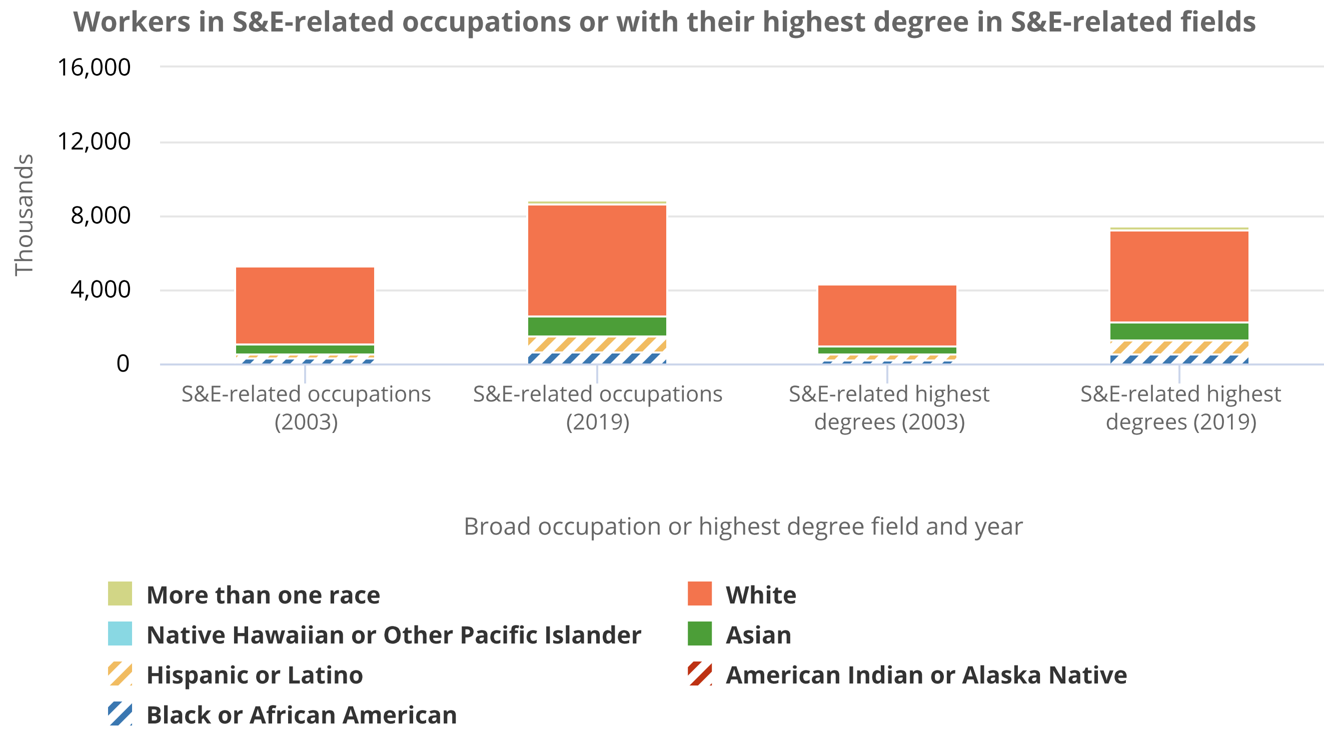
Among STEM workers with a bachelor's degree or higher, growth among races or ethnicities in S&E and S&E-related occupations was uneven. The NSCG shows that the number of Hispanics or Latinos working in S&E occupations sextupled between 1995 and 2019 and tripled for Blacks or African Americans (**Figure LBR-25**). A similar trend emerges among workers in these races or ethnicities with their highest degree in S&E fields. As a result, the representation of Hispanics or Latinos working in S&E occupations grew from 3% in 1995 to 8% in 2019 and holding their highest degree in

S&E fields grew from 3% to 9%. In contrast, during this same period, the proportion of Blacks or African Americans working in S&E occupations grew from 3% to 5%, and those holding their highest degree in S&E fields grew from 5% to 7%. In S&E-related occupations, Hispanic or Latino workers tripled, and Black or African workers more than doubled between 2003 and 2019, resulting in increased representation of both races or ethnicities (**Figure LBR-25**).

Figure LBR-25

Racial or ethnic distribution of workers with a bachelor's degree or higher, by broad occupation or highest degree field: Selected years, 1995, 2003, and 2019





Note(s):
Black or African American, Hispanic or Latino, and American Indian or Alaska Native are underrepresented minority groups, shown in the striped areas. Hispanic or Latino may be any race; race categories exclude those of Hispanic or Latino origin. In 1995, respondents could not classify themselves in more than one racial or ethnic category, and Asian included Native Hawaiian and Other Pacific Islander. Data are not available for Native Hawaiians or Other Pacific Islanders or more than one race for 1995. Data for American Indian or Alaska Native are suppressed for some years for reasons of confidentiality and/or reliability. Workers with a bachelor's degree or higher in middle-skill occupations are excluded from the analysis because the data source does not allow for analysis of these workers.

Source(s):
National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT), 1995 and 2003, and National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

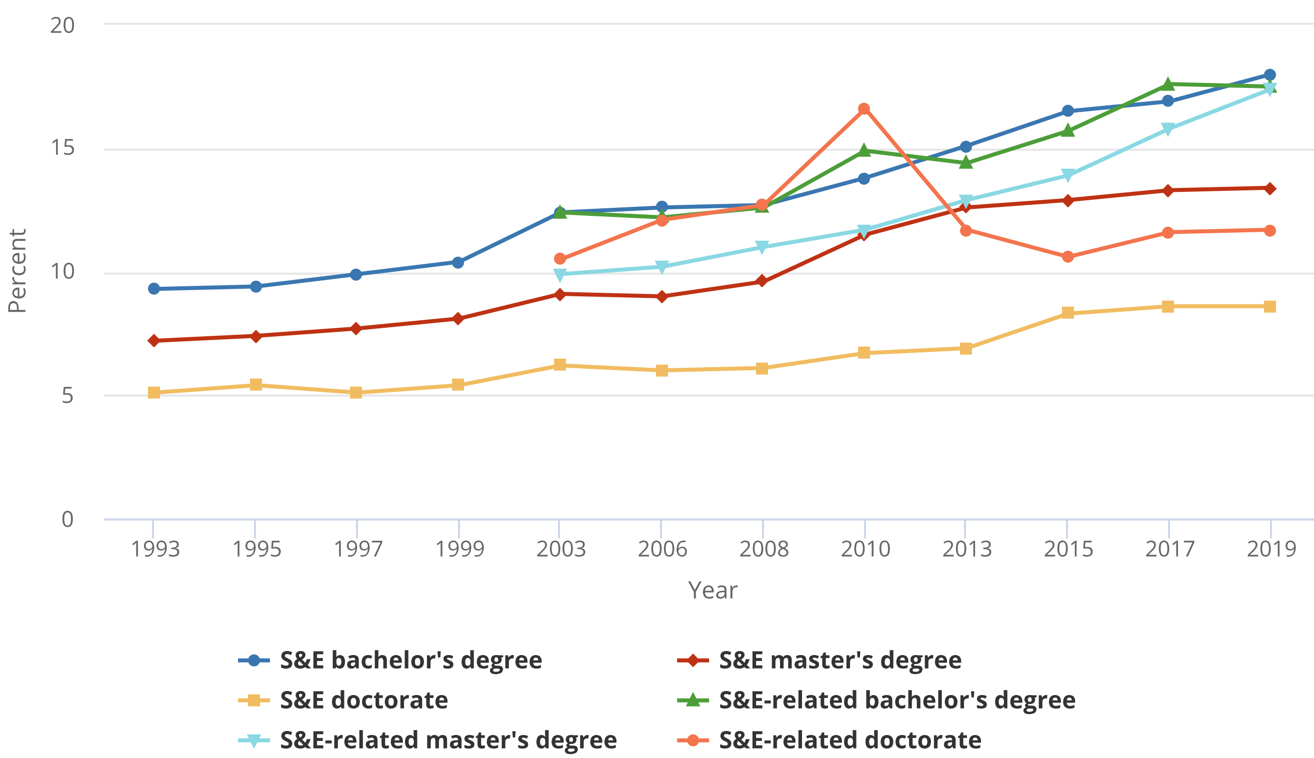
Although racial or ethnic representation among STEM workers with a bachelor's degree or higher has improved, there is wide variation in representation across detailed occupations within S&E. Compared to their share of S&E occupations overall (5%), Black or African American workers were proportionately higher among postsecondary teachers in the social and related sciences (9%), computer support specialists (10%), network and computer systems administrators (11%), and information security analysts (17%) (Table SLBR-27). Black or African American workers in S&E-related occupations (7% overall) were also more highly represented as medical and health services managers (13%), other health workers (14%), and electrical, electronic, and industrial and mechanical technicians (11%). Hispanics or Latinos, who are 8% of workers in S&E occupations overall, had a relatively large presence among social scientists (12%). Detailed occupational categories within S&E with relatively high concentration of Hispanics or Latinos include other social and related scientists (23%), civil, architectural, or sanitary engineers (10%), and industrial engineers (14%). Similar to Black or African American counterparts, Hispanic or Latino workers in S&E-related occupations (9% overall) were also more highly represented as biological and life sciences technologists and technicians (20%) and other engineering technologists and technicians (15%). Asian workers in S&E occupations (21%) have higher representation among computer and mathematical scientists (25%). The racial or ethnic groups of S&E highest degree holders vary in a manner similar to their occupation groups (Table SLBR-28).

Similar to the overall trends in the STEM workforce with a bachelor's degree or higher, underrepresented minorities have increased representation within the SEH doctoral academic workforce. The SDR shows that the proportion of underrepresented minorities in all academic positions and full-time faculty positions increased from 6% in 1997 to 9% in 2019 (Table SLBR-29). Among all academic positions in the SEH doctoral workforce (i.e., full-time faculty, postdocs, and other positions), underrepresented minorities had the highest representation in the social sciences (13%) and psychology (12%) degree fields and the lowest in computer and information sciences (6%), physical sciences (7%), and mathematics and statistics (7%).

With the exception of S&E-related doctorate degrees, the percentage of underrepresented minorities holding a highest degree in S&E and S&E-related fields has consistently increased across all degree levels in the past few decades (**Figure LBR-26**). The number of underrepresented minorities with their highest degree in S&E more than doubled across all degree levels since 1993. Similarly, underrepresented minorities with their highest degree in an S&E-related field doubled at the bachelor's level and tripled at the master's level since 2003. However, the number of underrepresented minorities with their highest degree in an S&E-related field at the doctorate level declined between 2003 and 2019.

Figure LBR-26

Employed underrepresented minorities with highest degree in S&E and S&E-related field, by degree level: 1993–2019



Note(s):
Underrepresented minorities include Blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives. Hispanic or Latino may be any race; race categories exclude Hispanic or Latino origin. Data are not available for all S&E-related fields for 1993–99.

Source(s):
National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT), 1993–2013, National Survey of College Graduates (NSCG), 2015–19, and Survey of Doctorate Recipients (SDR), 2015–19.

Science and Engineering Indicators

Salary Differences across Sex and Race or Ethnicity

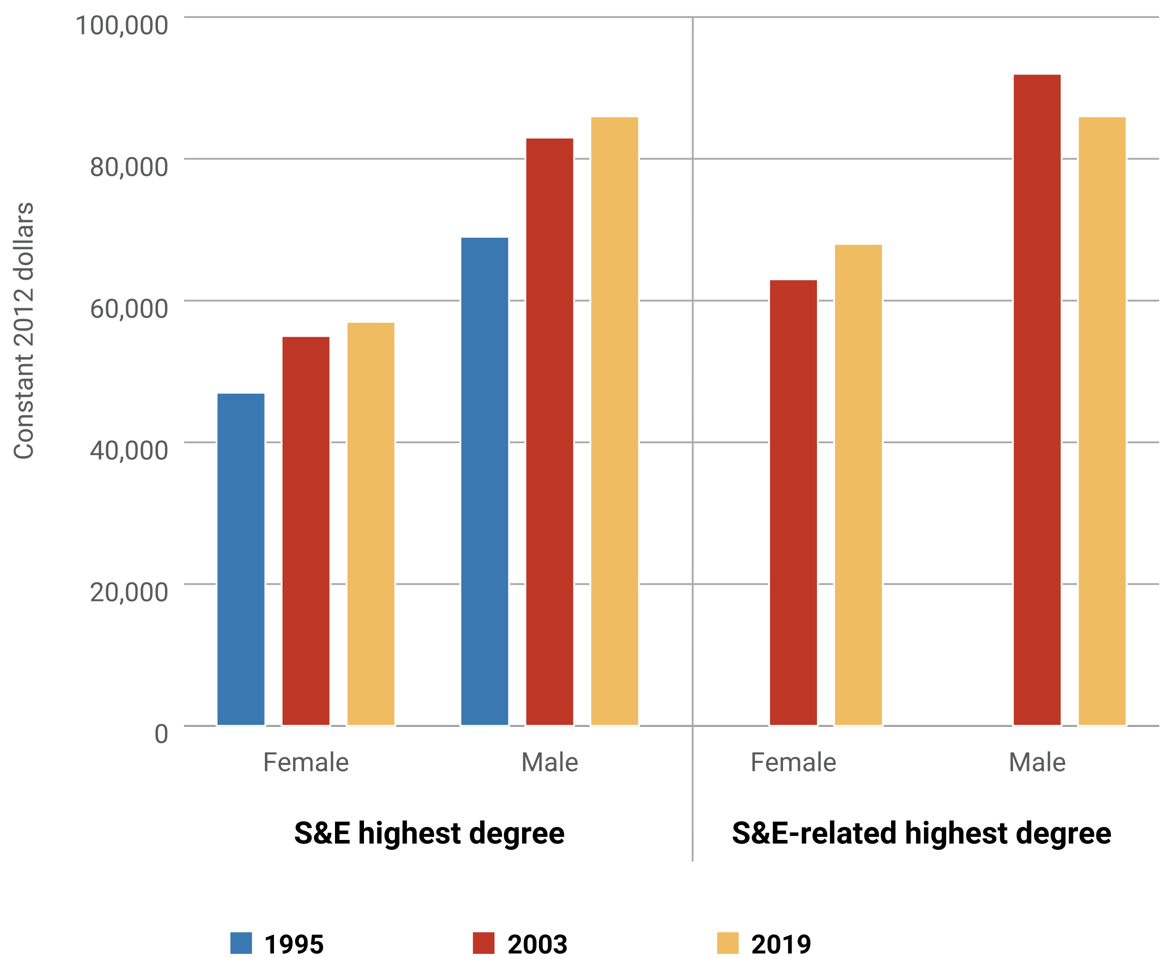
Persistent salary differences exist between men and women and across races or ethnicities. These differences can reflect myriad factors, including fields of education and occupation; employment sector; psychological factors (e.g., reluctance of women to negotiate); and discrimination (Blau and Kahn 2017; Pager and Shepherd 2008). Although the analysis presented in this section cannot attribute differences in salary between sex and race or ethnicity to such factors, examination of salary differences over time reveals whether differences are widening or shrinking.

Women with their highest degree in an S&E degree field working full-time generally receive less pay than their male counterparts across all major occupational groups. According to the NSCG, the 2019 median annual salary of men with their highest degree in S&E was about 50% higher than women (Table SLBR-30). However, this percentage wage difference was smaller for women with their highest degree in S&E working in S&E occupations (22%) compared to those working in S&E-related occupations (43%) and non-S&E occupations (45%).

To account for changes in the cost of living over time, nominal median salaries are deflated by the personal consumption expenditure price index (BEA 2020).[23] Constant dollar median salaries for S&E highest degree holders have increased for women from $47,000 in 1995 to $57,000 in 2019 and men from $69,000 to $86,000 (**Figure LBR-27**). Since 2003, constant dollar median salaries for S&E-related highest degree holders have increased for women from $63,000 to $68,000 in 2019 but have declined for men from $92,000 to $86,000.

Figure LBR-27

Median annual salaries of full-time workers with highest degrees in S&E or S&E-related fields, by sex: Selected years, 1995, 2003, and 2019



Note(s):
Salaries are deflated with the Bureau of Economic Analysis personal consumption expenditure price index (2020) and are rounded to the nearest $1,000. Full-time workers are those working 35 hours or more per week. Data are not available for all S&E-related fields for 1995.

Source(s):
National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT) 1995, 2003, and National Survey of College Graduates (NSCG), 2019.

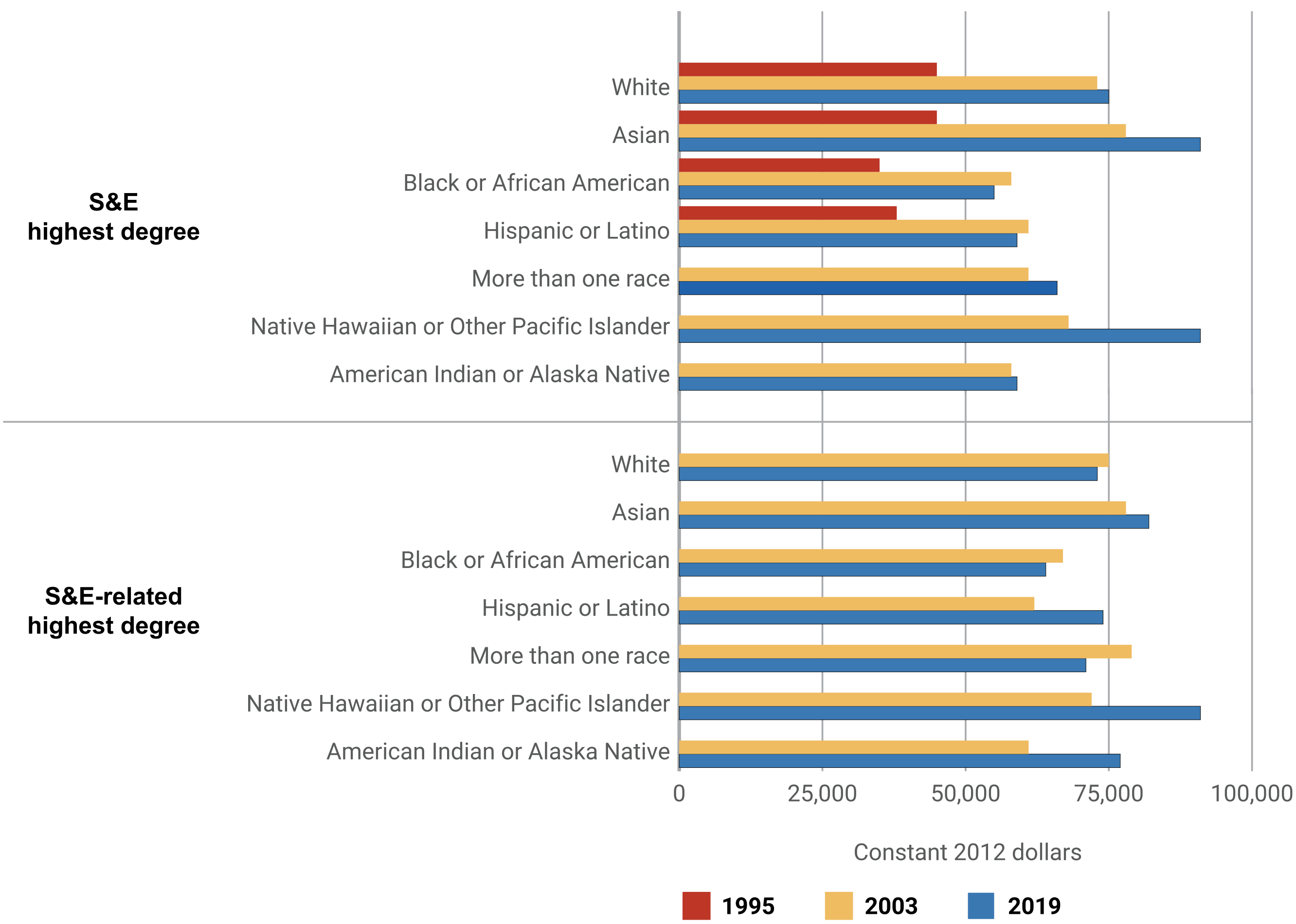
Science and Engineering Indicators

Salaries also vary across race or ethnicity for individuals with their highest degree in S&E fields. Median salaries of S&E highest degree holders ranged from $60,000 to $100,000 in 2019. Among full-time workers with their highest degree in an S&E field, the lowest median salaries ($60,000–$65,000) were for Black or African American, Hispanic or Latino, or American Indian or Alaska Native workers (Table SLBR-31). The highest earning workers in both degree groups were

Asians ($100,000) and Native Hawaiian or Other Pacific Islanders ($100,000). Between 1995 and 2003, constant dollar salaries grew for S&E highest degree holders who were Asian, Black or African American, Hispanic or Latino, and White (**Figure LBR-28**). Since 2003, constant dollar salaries of S&E highest degree holders have been flat across races or ethnicities, with the exception of Asians.

Figure LBR-28

Median annual salaries of full-time workers with highest degrees in S&E or S&E-related fields, by race or ethnicity: Selected years, 1995, 2003, and 2019



Note(s):
Salaries are deflated with the Bureau of Economic Analysis personal consumption expenditure price index (2020) and are rounded to the nearest $1,000. Hispanic or Latino may be any race; race categories exclude those of Hispanic or Latino origin. Data for 1995 include some individuals with multiple races in each category. Full-time workers are employed 35 hours or more per week. Data are not available for Native Hawaiians or Other Pacific Islanders or more than one race for 1995; data are not available for S&E-related fields for 1995. Data for American Indians or Alaska Natives are suppressed for 1995 for reasons of confidentiality and/or reliability.

Source(s):
National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT), 1995, 2003, and National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Differences in average age, work experience, academic training, sector and occupation of employment, and other characteristics can make direct comparison of salary statistics misleading. Lower salaries are generally concentrated in degree fields that have higher concentrations of women and racial or ethnic minorities. For example, among the major occupation categories, the highest paying positions in S&E in 2019 were in engineering and in mathematical and computer sciences, which are disproportionately held by men (Table SLBR-30). Statistical models can estimate the size of the salary difference between groups when various salary-related factors are considered. Previous statistical analysis on salary differences suggests that attributes related to human capital (e.g., knowledge and skills) rather than demographic attributes have a greater influence in explaining the salary differences observed among S&E highest degree holders by sex and race or ethnicity (NSB 2019b). Nonetheless, the analysis also shows that measurable differences in human capital do not entirely explain salary differences between demographic groups.

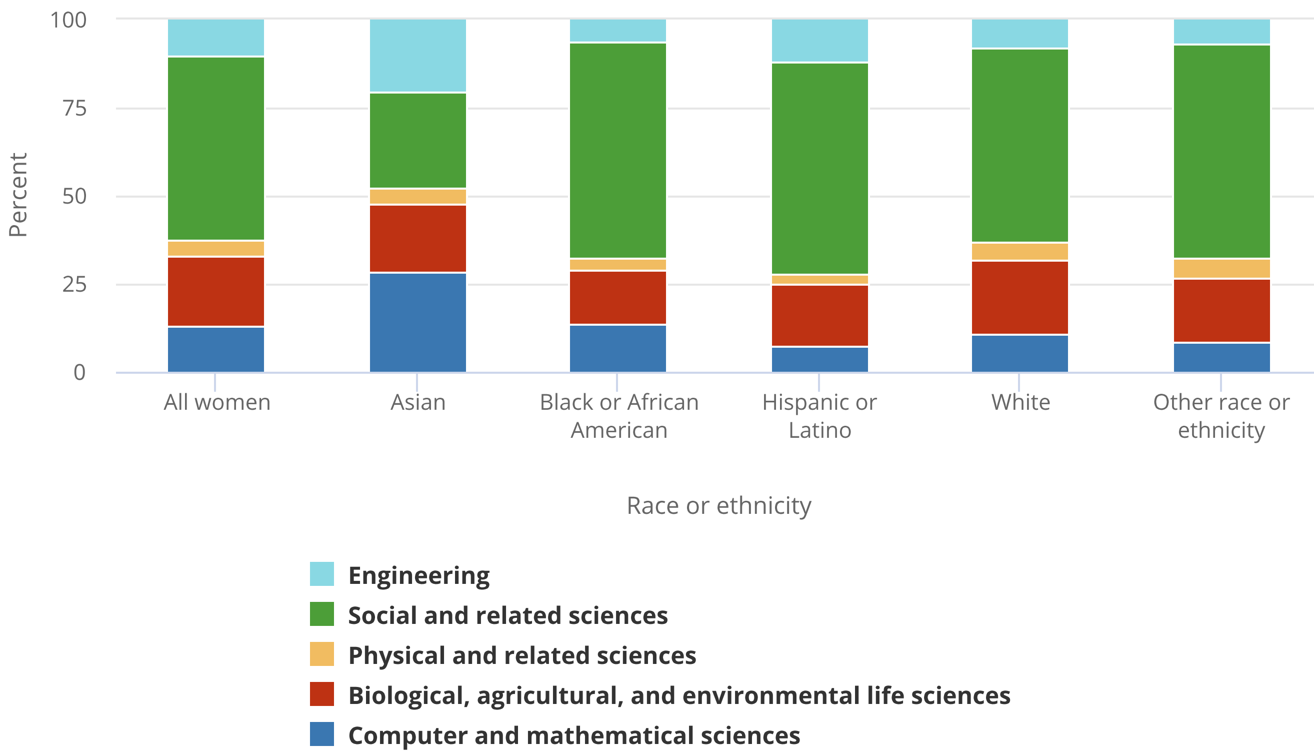
Intersectionality in STEM

Intersectionality describes a framework for understanding how multiple intersecting social identities (e.g., sex, race or ethnicity, sexual orientation, disability, and class) affect life outcomes in ways that are qualitatively and quantitatively different from the impact of a single social identity (Armstrong and Jovanovic 2015; Cole 2009).[24] Recent analysis shows that some intersecting social identities face compounded nonlinear discriminatory penalties in the labor market (Paul et al. 2018). In terms of the STEM workforce, educational pathways, representation, and earnings varied for intersecting identities based on sex and race or ethnicity (Hanson 2013; Martinez and Gayfield 2019).

In 2019, with the exception of Asian women, employed women with their highest degree in the social sciences were the majority (55%–62%) of each race or ethnicity among employed female S&E highest degree holders (**Figure LBR-29**). The remaining women, again in all races and ethnicities except Asian, were distributed across the other four broad fields, with the lowest proportion of each group holding degrees in physical sciences. In contrast, Asian women were more evenly distributed, with 20%–30% of Asian women having their highest degrees in computer and mathematical sciences, life sciences, social and related sciences, or engineering. Highest degree holders in the physical sciences were the smallest proportion of Asian, Hispanic or Latino, and White women (3%–5%).

Figure LBR-29

Employed women with highest degree in an S&E field, by race or ethnicity and field of degree: 2019



Note(s):
Hispanic or Latino may be any race; race categories exclude those of Hispanic or Latino origin. Other race or ethnicity includes American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, and more than one race. Percentages may not add to 100% because of rounding.

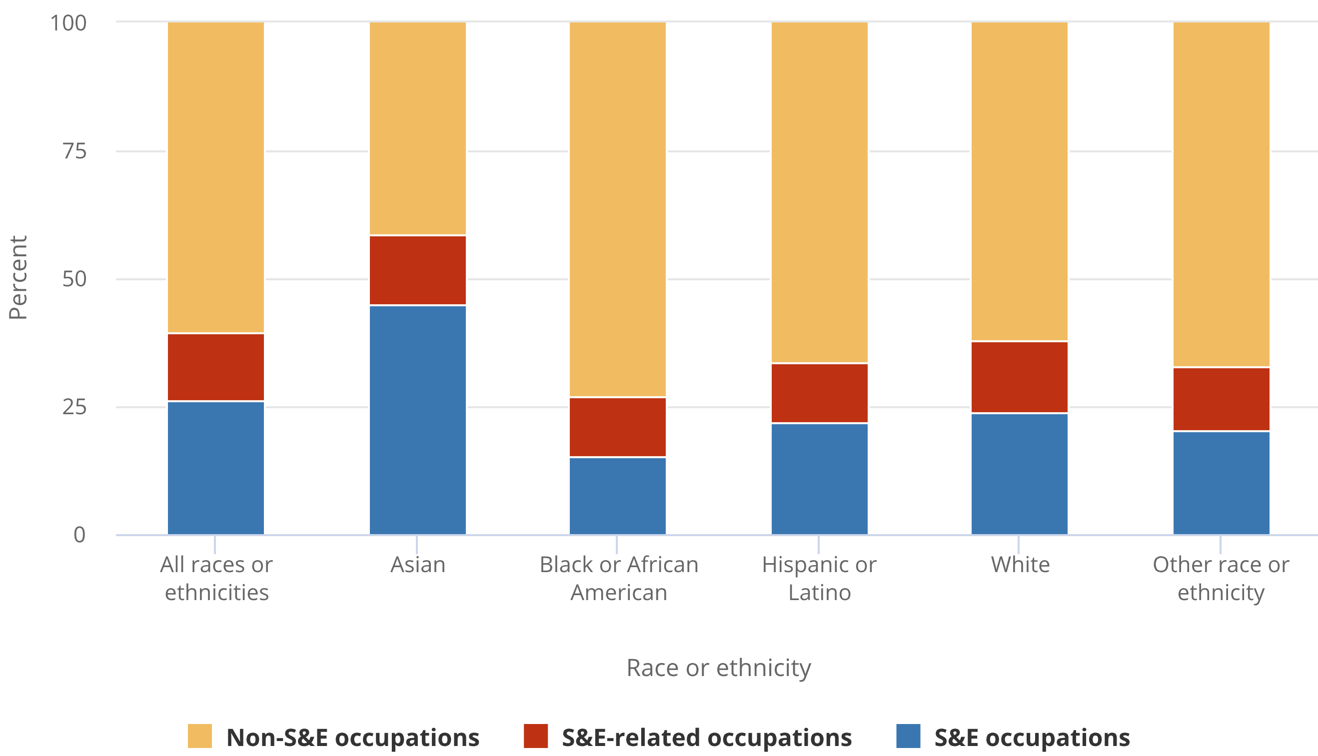
Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Female S&E highest degree holders tend to work proportionately less in S&E occupations (26%) compared to men (45%) (**Figure LBR-30**; Table SLBR-32). However, the extent to which women with their highest degree in an S&E field worked in S&E occupations varied by race or ethnicity. Among women with their highest degree in an S&E field, Asian women worked proportionately more in S&E occupations (45%) compared to White (24%), Hispanic or Latino (22%), other races or ethnicities (21%), and Black or African American women (15%) (**Figure LBR-30**).

Figure LBR-30

Employed women with their highest degree in an S&E field, by race or ethnicity and broad occupation: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Hispanic or Latino may be any race; race categories exclude those of Hispanic or Latino origin. Detail may not add to total because of rounding. Other race or ethnicity includes American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, and more than one race. Non-S&E occupations includes middle-skill and non-STEM occupations.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Although the majority of Black or African American women with their highest degree in an S&E field were in the social sciences (**Figure LBR-29**), only 6% of them worked in S&E occupations (Table SLBR-33). In contrast, Black or African American women with their highest degree in engineering and computer and mathematical sciences worked in S&E occupations at higher proportions (38% and 41%, respectively). Nearly three-fourths of Black or African American women with their highest degree in an S&E field (73%) worked in non-S&E occupations, primarily in management-related occupations (16%), social services (11%), and other non-S&E occupations (28%) (Table SLBR-34).

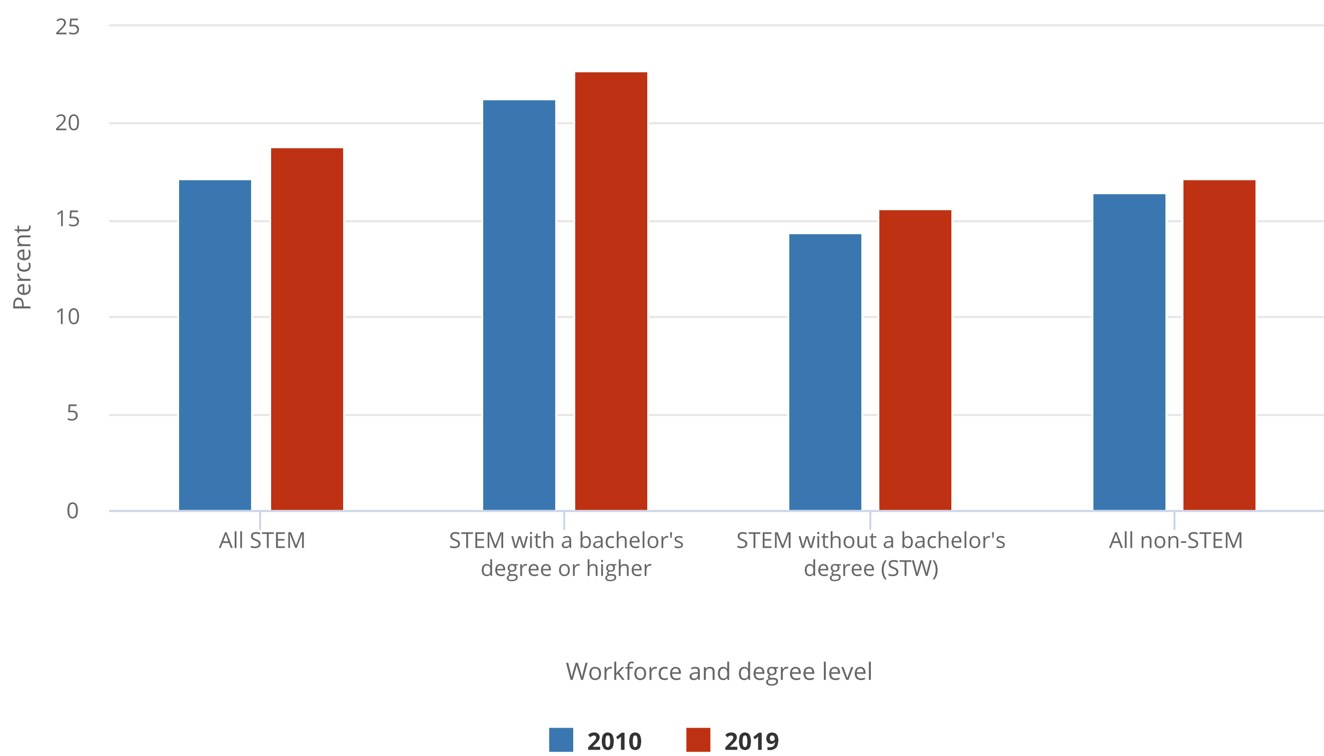
Foreign-Born Workers in STEM

The U.S. S&E enterprise has long benefitted from the S&E skills and knowledge of foreign-born STEM workers (Abramitzky and Boustan 2017; Kerr and Kerr 2017; Khanna and Lee 2019). Foreign-born workers are those born in countries other than the United States regardless of citizenship; a subset of foreign-born workers comprises noncitizens who are temporarily in the United States on visas or are permanent residents. U.S. policies on immigration and citizenship shape employers' access to this critical source of STEM talent (Kerr and Kerr 2020). Most of this section is based on 2019 data and does not reflect changes in immigration based on the COVID-19 pandemic or recent changes to immigration law after 2019 (DHS/USCIS 2020b; 2020c; DOL 2020b).

According to the U.S. Census Bureau's (2020a) 2019 ACS, a considerable proportion of STEM workers are foreign born, and both the number and proportion of foreign-born STEM workers rose between 2010 and 2019 (**Figure LBR-31**). In 2019, foreign-born workers accounted for 19% of the STEM workforce, increasing from 17% since 2010. Foreign-born workers with a bachelor's degree or higher comprise a larger share of the STEM workforce (23%) than those without a bachelor's degree (16%). Most foreign-born workers with a bachelor's degree or higher in S&E and S&E-related occupations are Asian or White, but the distribution of race or ethnicity of these workers varies by broad occupational category (Table SLBR-35).

Figure LBR-31

Foreign-born workers in STEM, by degree level: 2010 and 2019



STEM = science, technology, engineering, and mathematics; STW = skilled technical workforce.

Note(s):
Data include workers ages 16–75 and exclude those in military occupations or currently enrolled in primary or secondary school.

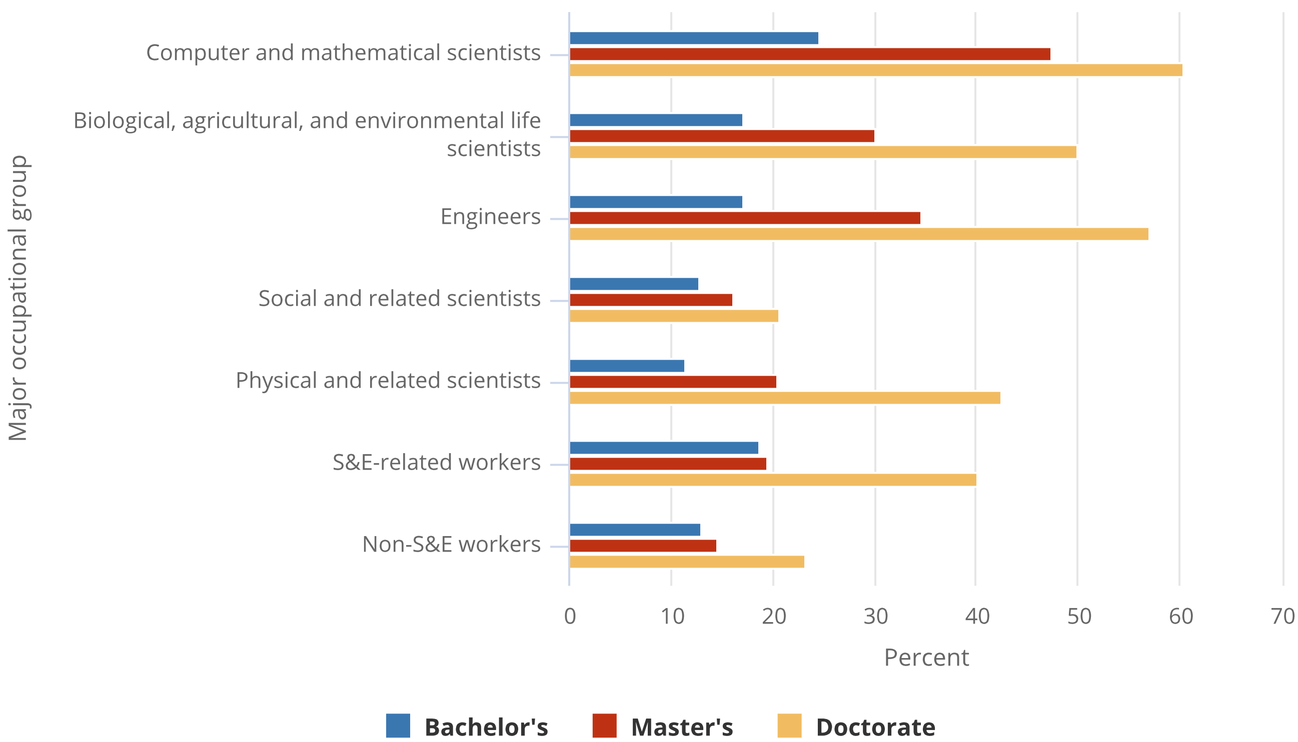
Source(s):
U.S. Census Bureau, American Community Survey (ACS), 2010, 2019, Public Use Microdata Sample (PUMS), data as of 25 October 2020.

Science and Engineering Indicators

In 2019, the proportion of foreign-born workers with a bachelor's degree or higher was greater among workers in S&E and S&E-related occupations compared to those in non-S&E occupations. However, their distribution varied by occupation and degree level (**Figure LBR-32**). The 2019 NSCG shows that foreign-born workers accounted for 21% of workers in S&E occupations at the bachelor's degree level, 38% at the master's degree level, and 45% at the doctoral degree level. Foreign-born workers accounted for 25% of computer and mathematical scientists at the bachelor's degree level and 60% of computer and mathematical scientists with doctorates. Similarly, approximately one-half of engineers and life scientists at the doctoral degree level, and about one-third of these workers at the master's degree level were foreign born. In comparison, foreign-born workers were less common among social and related scientists and physical and related scientists among most degree levels. In addition, data from the 2019 SDR show that among U.S.-trained S&E doctorate holders employed in the higher education sector, 33% were foreign born in 2019, with more than half of them being U.S. citizens (Table SLBR-36).

Figure LBR-32

Foreign-born workers with a bachelor's degree or higher, by highest degree level and major occupation: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
Non-S&E occupations includes middle-skill and non-STEM occupations.

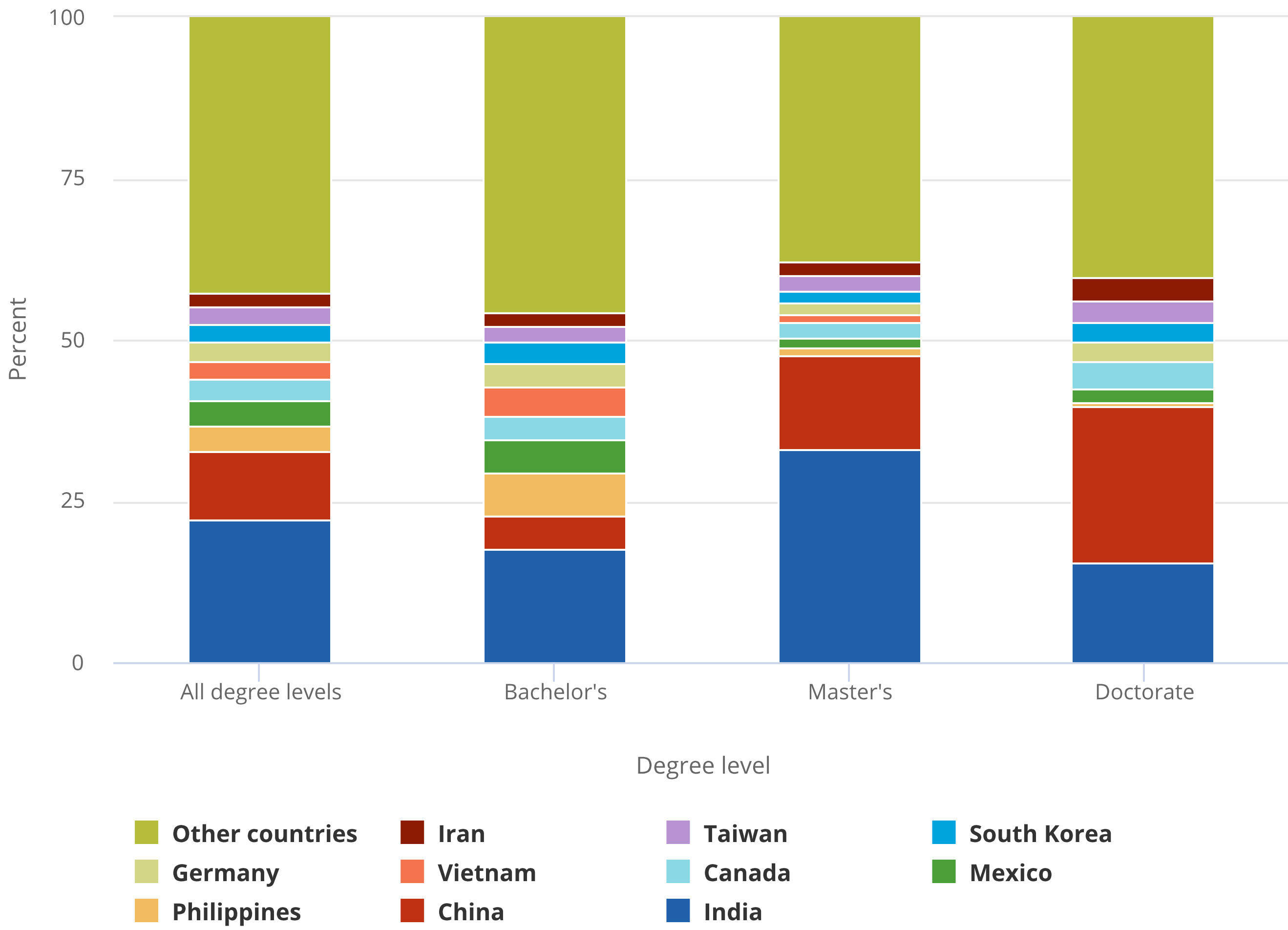
Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Among S&E highest degree holders in the United States in 2019 who are foreign born, one-half were from Asia, with India (22%) and China (11%) as the leading birthplaces (**Figure LBR-33**). For those with S&E doctorates, however, China provided a higher proportion (24%) than India (15%). These patterns, by source region and country, have been stable since at least 2003 (NSB 2016; NSB 2018; NSB 2019b).

Figure LBR-33

Country of birth of foreign-born S&E highest degree holders living in the United States, by degree level: 2019



Note(s):
Countries shown are for the top 10 places of birth for S&E highest degree holders at all degree levels.

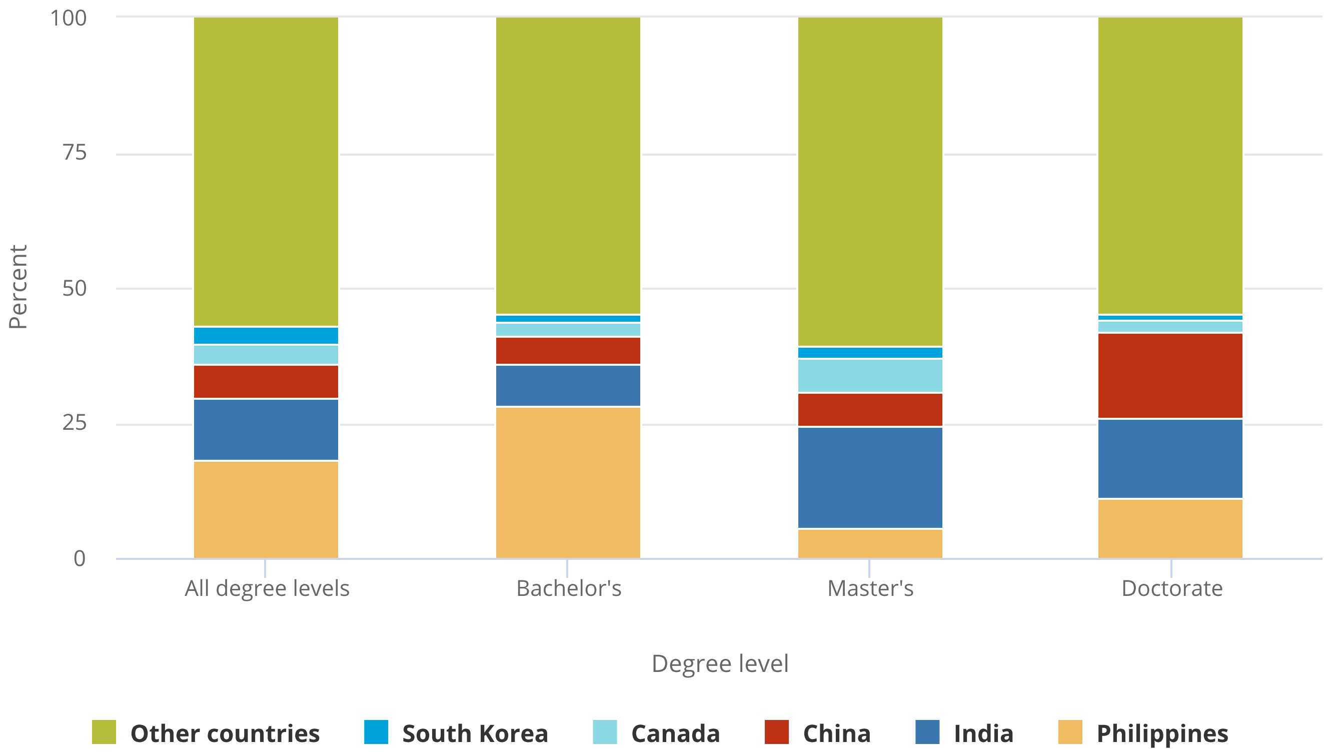
Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

About 56% of foreign-born individuals with their highest degree in S&E-related fields also came from Asian countries. Among the top five places of birth, the Philippines is the leading place of birth (18%), followed by India (11%) and China (6%) (**Figure LBR-34**). At the doctoral degree level, China (16%), India (15%), and the Philippines (11%) are the leading birthplaces, but at the master's degree level, India (19%) is the leading birthplace, and at the bachelor's degree level, the Philippines is the leading birthplace.

Figure LBR-34

Country of birth of foreign-born S&E-related highest degree holders living in the United States, by degree level: 2019



Note(s):
Countries shown are for the top five places of birth for S&E-related highest degree holders at all degree levels.

Source(s):
National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2019.

Science and Engineering Indicators

Universities and firms help shape the pool of noncitizens in the U.S. STEM workforce. Universities select international students to receive F-1 (student) and J-1 (exchange visitor) visas (see forthcoming *Indicators 2022* report “Higher Education in Science and Engineering” for more details on trends in student visas), and many of these visa holders stay in the United States after graduation to work, which is discussed more in the next section.[25] Firms select skilled noncitizens for work-based purposes primarily through the H-1B temporary visas.[26] In 2019, the United States issued about 188,000 H-1B visas, the majority of which are in S&E or S&E-related occupations (U.S. Department of State, Bureau of Consular Affairs 2020a, 2020b; DHS/USCIS 2020a).[27] Almost three-quarters of these new H-1B visa recipients were from India, and 13% were from China (DHS/USCIS 2020a). The composition of the H-1B visa trends has been stable for over a decade (NSB 2019b).

Stay Rates of Noncitizen U.S.-Trained S&E Doctorates

Most U.S. S&E doctorates who are noncitizens at graduation expect to remain in the United States after graduation. According to the NCSES (2020b) 2019 SED, more than three-fourths (77%) of noncitizen recipients (both temporary visa holders and permanent residents) of S&E doctorates who graduated during the 2016–19 period planned to remain in the United States in the year after graduation (Table SLBR-37). The proportion of noncitizen S&E doctorate recipients that plan to stay in the United States after graduation is more generally referred to as the *expected stay rate* or the *1-year stay rate*. These rates have been stable over the last decade. One-half of noncitizens at graduation had definite plans to stay in the United States, either continuing employment or accepting an offer of a postdoc or other employment in the United States.

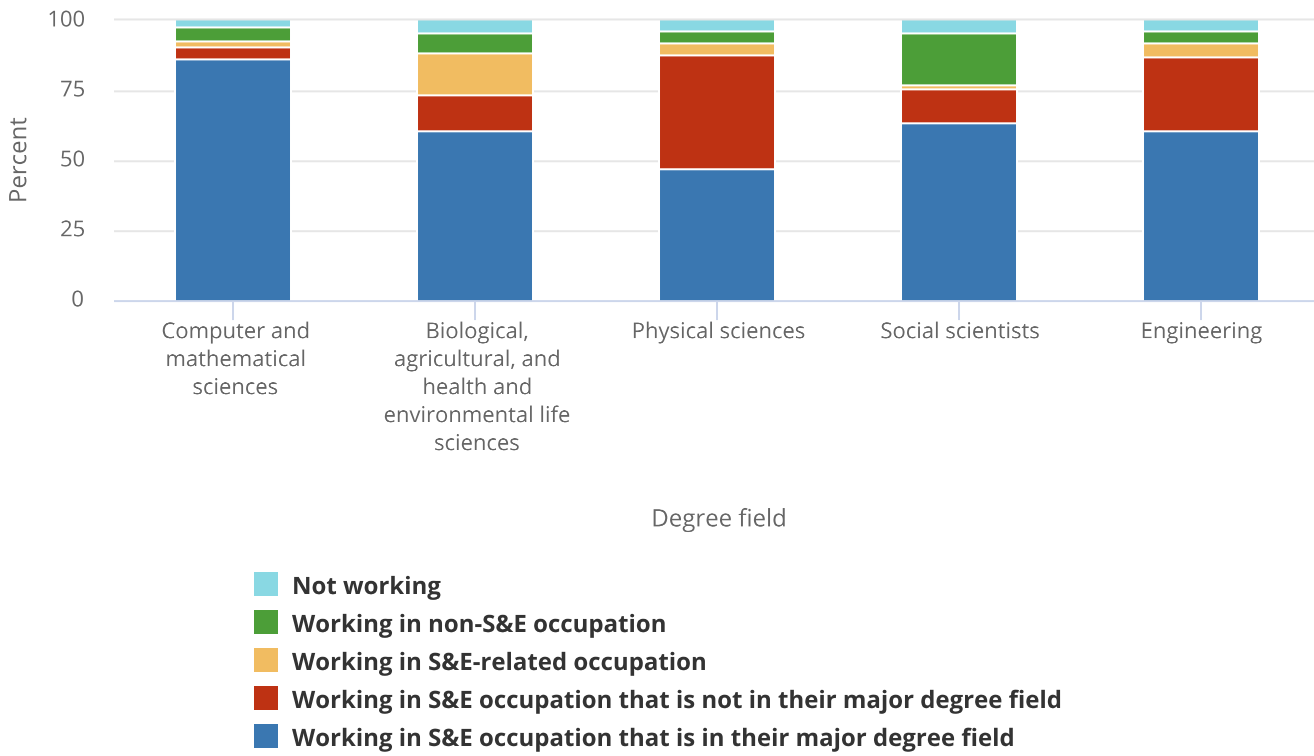
Expected stay rates vary by place of citizenship. Students from China and India, two of the largest source countries for recipients of U.S. S&E doctoral degrees on temporary visas (see forthcoming *Indicators 2022* report "Higher Education in Science and Engineering" for more details on foreign-born enrollment and degree attainment at U.S. institutions), have relatively high expected stay rates (82%–88%) (Table SLBR-37). Stay rates also vary somewhat by field of degree; doctoral recipients in the social sciences (59%) have lower stay rates than those receiving doctorate degrees in other broad S&E fields of study. The expected stay rates by country and by field are consistent with the 5- and 10-year stay rates reported in the *Indicators 2020* **"Science and Engineering Labor Force"** report.[28]

Many S&E doctorate recipients on temporary visas at graduation who remain in the United States for subsequent employment become U.S. citizens or permanent residents (Okrent and Burke 2021). Based on the 2017 SDR and the 2006–15 SED, approximately 31% of the 2006–15 graduating cohort of S&E doctorate recipients that were in the United States in 2017 were temporary visa holders at the time of graduation. In 2017, more than two-thirds of these temporary visa holders had become U.S. citizens or permanent residents.

The 2019 SDR and the 2008–17 SED show that among U.S. S&E doctorate recipients on temporary visas at graduation (2008–17) and in the United States in 2019, the vast majority were working (between 95% and 98% across degree fields) in 2019. Across all fields, 64% worked in the same field as their doctoral degree. At the one extreme, 87% of temporary visa holders at graduation with a doctorate in mathematics and computer sciences were working as computer and mathematical scientists (**Figure LBR-35**). At the other extreme, 47% of temporary visa holders at graduation with a doctorate in the physical sciences worked as physical scientists, but 40% worked in other S&E occupations.

Figure LBR-35

Employment of U.S. S&E doctorate recipients on temporary visas at graduation, by degree field at graduation (2008–17) and occupation (2019)



Note(s):
Percentages are based on the number of doctorate recipients who reported citizenship status at the time of graduation in the Survey of Earned Doctorates (SED).

Source(s):
National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR), 2019, and SED, 2008–17.

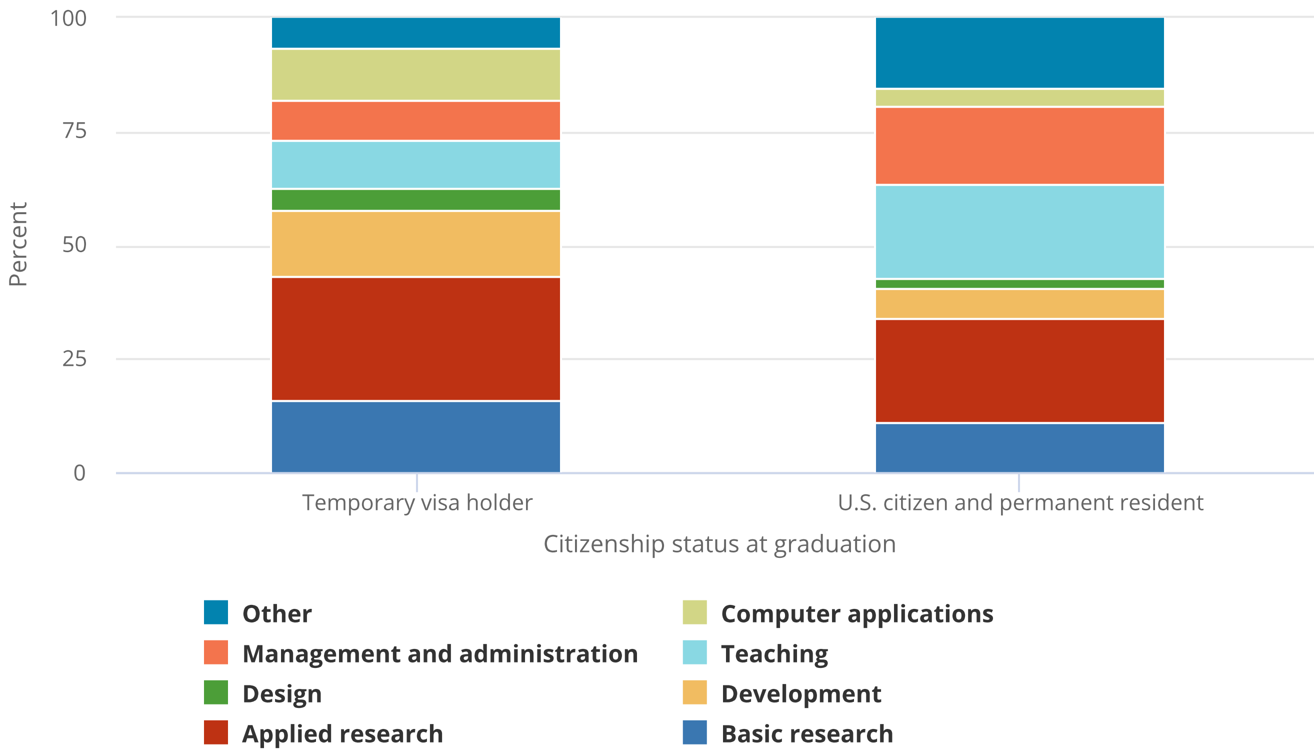
Science and Engineering Indicators

Of the remaining fields, most U.S. S&E doctorate recipients on temporary visas at graduation (2008–17) worked in an S&E or S&E-related occupation in 2019 (**Figure LBR-35**). Some 87% of engineering doctorates on temporary visas at graduation worked as engineers or in other S&E occupations. A relatively large proportion of doctorates in biological, agricultural, and health and environmental life sciences on temporary visas at graduation worked in S&E-related occupations (15%), which includes health-related occupations. Compared to other fields, social sciences doctorate holders worked proportionately the most in non-S&E occupations (19%).

Although there are differences in the work activities of S&E doctorate recipients who were on temporary visas compared to U.S. citizens and permanent residents at the time of graduation, both tend to engage primarily in R&D and design or teaching (**Figure LBR-36**). In 2019, about 63% of U.S. S&E doctorate recipients on temporary visas at graduation engaged primarily in R&D and design of equipment, processes, structures, and models, whereas 43% of U.S. citizens or permanent residents worked mostly in these activities. U.S. citizens and permanent residents comprised a larger proportion of doctorate recipients engaged in teaching at 21% compared to 10% of temporary visa holders. This is related to temporary visa holders being employed at higher proportions in nonacademic occupations compared to U.S. citizens and permanent residents (Okrent and Burke 2021). Temporary visa holders at graduation also worked more than U.S. citizens and permanent residents in computer application activities (12% vs. 4%), whereas U.S. citizens and permanent residents engaged more in management and administrative activities (17% vs. 9%).

Figure LBR-36

Employed U.S. S&E doctorate recipients living in the United States, by primary work activity (2019) and citizenship status at graduation (2008–17)



Note(s):
Percentages are based on the number of doctorate recipients who reported citizenship status at time of graduation in the Survey of Earned Doctorates (SED). Design includes the design of equipment, processes, structures, and models.

Source(s):
National Center for Science and Engineering Statistics, Survey of Doctorate Recipients (SDR), 2019, and SED, 2008–17.

Science and Engineering Indicators

Conclusion

Scientists and engineers are the backbone of the creation, development, and application of STEM knowledge and expertise in the U.S. economy. Reflecting this historical context, previous *Indicators* reports focused on workers with a bachelor's degree or higher in S&E occupations: mathematical and computer scientists, life scientists, physical scientists, social scientists, and engineers. However, many other occupations increasingly require STEM skills and expertise to adapt and maintain new processes and technologies (e.g., health care; construction trades; installation, maintenance, and repair; and production occupations). Unlike previous *Indicators* reports, which narrowly focused on workers with a bachelor's degree or higher in S&E occupations, this report broadly defines workers in STEM at all educational levels across a wide range of occupations that are integral to the creation of new products and processes using STEM knowledge and technical skills. As a result, the STEM workforce makes up nearly a quarter of the total workforce in the United States, with less than one-fourth of these workers having a bachelor's degree or higher and working in S&E occupations.

Within the STEM workforce, differences in employment by sector, industry, and location arise between workers based on educational backgrounds. For example, the for-profit business sector is the primary employer of STEM workers with at least a bachelor's degree, but 4-year academic institutions continue to be the primary employer of STEM doctorate holders. However, since the early 1990s, for-profit businesses employ an increasing share of doctorate-holding STEM workers, which may reflect the increasing dominance of businesses in R&D performance and funding. STEM workers without a bachelor's degree, also known as STW, are highly concentrated in the medical industry, construction, and manufacturing industries. In terms of location, STEM workers with at least a bachelor's degree are found mostly in coastal states where innovation hubs are located, whereas the STW is concentrated in the Southern and Midwestern regions.

Workers in STEM occupations tend to have favorable labor market outcomes compared to non-STEM workers, including higher salaries and lower unemployment rates (even during the COVID-19 pandemic). However, these benefits are not equally distributed across sex and race or ethnicity. While women, Blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives have increased in number and proportion of the general population over the past decades, they still remain underrepresented in STEM. In addition, these underrepresented groups tend to be paid less on average than their male and Asian and White counterparts. Lastly, most of the analysis in this report is based on pre-pandemic data, and major structural shifts in the STEM labor market may have occurred because of the COVID-19 pandemic. For example, preliminary evidence shows that compared to men, women in STEM were disproportionately more affected by COVID-19 in terms of unemployment, research activities, and publishing (Krukowski, Jagsi, and Cardel 2020; Kowal et al. 2020). Such a change can have lasting effects on the disparities between men and women in STEM for several years in the future.

Foreign-born workers account for a considerable share of STEM employment in the United States, but the flow of foreign-born workers to the United States may also be disrupted by COVID-19. Temporary visa holders, a subset of foreign-born workers, comprise a large proportion of U.S.-trained STEM doctorate holders; the bulk of these students remain in the United States and work in occupations aligned with their doctoral field of study after graduation. However, international enrollment at U.S. institutions dropped during the pandemic, as discussed in the forthcoming *Indicators 2022* report, "Higher Education in Science and Engineering," and other sources (Baer and Martel 2020). Changes in where students go to school during the pandemic could have long-term effects on the noncitizen STEM workforce in the future. In addition, changes to current H-1B visa programs may also restrict noncitizen immigration to the United States (DHS/USCIS 2020b; 2020c; DOL 2020b), and these changes are not shown in the data presented in this analysis.

The STEM labor force is comprehensive and diverse, made up of workers at all education levels in a wide variety of occupations that use STEM knowledge and expertise. Many factors, including STEM training pathways and career opportunities, global competition, and demographic trends, among others, may affect the availability of workers equipped with STEM expertise as well as the type of jobs that the U.S. economy generates in the future. Timely analysis of STEM labor force trends provides 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 27 member nations: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. Unless otherwise noted, Organisation for Economic Co-operation and Development data on the EU draw from 28 nations, which include the United Kingdom (UK) prior to the 2016 Brexit referendum, which marked the withdrawal of the UK from the EU.

Foreign-born workers: Those whose nativity is outside of the United States, regardless of citizenship. Foreign-born workers can be U.S. citizens or permanent residents.

Involuntarily out-of-field (IOF) employment: Employment of workers who reported on the National Survey of College Graduates (NSCG) that they were working "in an area outside the field of [one's] highest degree" because a "job in highest degree field [was] not available." The IOF rate is the proportion of all employed individuals who report IOF employment.

Involuntarily part-time (IPT) employment: Employment of workers who reported on the NSCG that they "usually work fewer than 35 hours per week on the principal job [they] held during the week of February 1, 2019" because "a full-time job [was] not available." The IPT rate is the proportion of all employed individuals who report IPT employment.

Labor force: A subset of the population that includes only those who are employed and those who are not working but actively seeking work (unemployed).

Middle-skill occupations: For purposes of this report, middle-skill occupations refer to science, technology, engineering, and mathematics (STEM) workers only, even though middle-skill occupations usually include both STEM and non-STEM workers (see *STEM middle-skill occupations*).

Noncitizens: A subset of foreign-born workers who are temporarily in the United States on visas or are permanent residents. This includes temporary visa holders on H-1B, J-1, and L-1 visas and Green Card holders.

Non-S&E (non–science and engineering) occupations: Include the following occupation categories for workers with a bachelor's degree or higher: non-S&E managers; management-related occupations; non-S&E precollege teachers; non-S&E postsecondary teachers; social service and related occupations; sales and marketing occupations; arts, humanities, and related occupations; and other non-S&E occupations. For detailed occupations within these categories, see the National Center for Science and Engineering Statistics (NCSES) Taxonomy of Occupations (NCSES *NSCG 2017*: **Technical Table A-1**). It includes middle-skill occupations (see *Middle-skill occupations*) and non-STEM occupations (see *Non-STEM occupations*).

Non-STEM occupations: Primarily includes occupations in management (excluding S&E and S&E-related managers, industrial production managers, and farmers, ranchers, and agricultural managers), sales (excluding sales engineers), transportation and material moving (excluding transportation inspectors and pumping station operators), office and administrative support, and education and training. See Table SLBR-1 for a full list of non-STEM occupations.

Non-STEM workforce or non-STEM workers: A subset of the U.S. workforce in non-STEM occupations (see *non-STEM occupations*).

Postdoctoral researcher (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.

R&D and design: Includes the work activities of basic research, applied research, development and design of equipment, processes, structures, and models.

Scientists and engineers: Individuals who have an S&E or S&E-related degree or who work in an S&E occupation (see *S&E occupations*) or S&E-related occupation (see *S&E-related occupations*).

S&E degree fields: Degree fields at the bachelor's level or higher in the following categories: (1) computer and mathematical sciences; (2) biological, agricultural, and environmental life sciences; (3) physical and related sciences; (4) social sciences; and (5) engineering. At the doctoral degree level, the medical and health sciences are included under S&E (i.e., science, engineering, and health [SEH]) because these data correspond to the doctorate holder's research or scholarship degree level, which are research-focused degrees. For detailed degree fields within these major categories, see the NCSES Taxonomy of Disciplines (NCSES *SDR 2019*: **Technical Table A-1**).

S&E occupations: Occupations in the following five major categories: (1) computer and mathematical scientists; (2) biological, agricultural, and environmental life scientists; (3) physical scientists; (4) social scientists; and (5) engineers. For more details and examples of the minor and fine S&E occupations, see the NCSES Taxonomy of Occupations (NCSES *NSCG 2017*: **Technical Table A-1**).

S&E-related degree fields: Degree fields at the bachelor's level or higher in the following categories: (1) health, science, and mathematics teacher education; (2) technology and technical fields; and (3) other S&E-related fields. For detailed degree fields within these categories, see the NCSES Taxonomy of Disciplines (NCSES *SDR 2019*: **Table A-1**).

S&E-related occupations: These occupations require science and technology expertise but are not part of the five major categories of the S&E occupations. S&E-related occupations include these four minor occupations: (1) health, (2) S&E managers, (3) S&E precollege teachers, and (4) technologists and technicians. For more detail and examples of fine S&E-related occupations, see the NCSES Taxonomy of Occupations (NCSES *NSCG 2017*: **Technical Table A-1**).

Skilled technical workforce (STW): Workers in S&E (see *S&E occupations*), S&E-related (see *S&E-related occupations*), and STEM middle-skill occupations (see *STEM middle-skill occupations*) who do not have a bachelor's degree or higher.

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

STEM middle-skill occupations: A range of occupations that require a high level of scientific and technical knowledge, although these occupations do not require a bachelor's degree for entry (see *Middle-skill occupations*). STEM middle-skill occupations are primarily in construction trades, installation, maintenance, and production. See Table SLBR-1 for a full list of middle-skill occupations.

STEM workforce or STEM workers: A subset of the U.S. workforce comprised of S&E (see *S&E occupations*), S&E-related (see *S&E-related occupations*), and STEM middle-skill occupations (see *STEM middle-skill occupations*).

Underrepresented minorities: Races or ethnicities whose representation in S&E education and S&E employment is smaller than their representation in the U.S. population. This includes Blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives.

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

GSS: Survey of Graduate Students and Postdoctorates in Science and Engineering

IOF: involuntarily out of field

IPT: involuntarily part time

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 The standard definition of the term *labor force* is a subset of the population that includes both those who are employed and those who are not working but seeking work (unemployed); other individuals are not considered to be in the labor force. Unless otherwise noted, when data refer only to employed persons, the term *workforce* is used. For data on unemployment rates by occupation, calculations assume that unemployed individuals are seeking further employment in their most recent occupation.

2 NCSES has developed an STW initiative to measure and understand the STW. One of the activities of the initiative is to develop a new federal survey called the National Training, Education, and Workforce Survey, which is currently being planned with a target data collection start in 2022. For more details on the initiative, visit **https://www.nsf.gov/statistics/stw/skilled-technical-workforce.cfm**.

3 These five S&E broad occupational categories are divided into finer occupational categories (Table SLBR-1). Examples of workers in S&E occupations are software engineers, agricultural and food scientists, physicists, economists, psychologists, and mechanical engineers. These occupations are identified in the NCSES taxonomy of occupations (see *NSCG 2017*: **Technical Table A-1** for taxonomy) and can also be identified by the BLS standard occupation codes (Table SLBR-1).

4 A primary difference in the NCSES taxonomy and the identification of S&E and S&E-related occupations used in this report is that the ACS and CPS data used in this report do not allow for the separation of teachers by level: primary, secondary, or postsecondary. The NCSES taxonomy places postsecondary teachers of S&E fields of study in S&E occupations. When using the ACS or CPS data, all teachers are included in non-STEM occupations regardless of subject matter and level of teaching.

5 Estimates of the size of the S&E workforce may vary across the different surveys because of differences in the scope of the data collection (the NSCG collects data from individuals with at least a bachelor's degree); because of the type of survey respondent (the NSCG collects data from individuals, the OES survey collects data from employers, and the ACS collects data from households); or because of the level of detail collected on an occupation, which aids in classifying a reported occupation into a standard occupational category. For example, the NSCG estimate of the number of workers in S&E occupations includes postsecondary teachers of S&E fields; however, postsecondary teachers in ACS are grouped under a single occupation code regardless of field and are, therefore, not included in the ACS estimate of the number of workers in S&E occupations.

6 The methodology used to identify STEM middle-skill occupations has not changed since the *Indicators* report *Science and Engineering Labor Force 2019*, and details can be found in the section "Skilled Technical Workforce Data" of the **Technical Appendix**.

7 Other federal agencies have an established STEM taxonomy.
-U.S. Census Bureau: **Women Making Gains in STEM Occupations but Still Underrepresented (census.gov)**.
-Bureau of Labor Statistics options for defining STEM under the Standard Occupational Classification (SOC) system: **https://www.bls.gov/soc/attachment_a_stem.pdf**.
-Department of Homeland Security list of eligible STEM fields to study and work in the United States: **https://studyinthestates.dhs.gov/stem-opt-hub/additional-resources/eligible-cip-codes-for-the-stem-opt-extension**.

8 The SOC Policy Committee recommendation to the Office of Management and Budget, which includes options for defining STEM occupations under the 2018 SOC system can be found here: **https://www.bls.gov/soc/attachment_a_stem_2018.pdf**. Accessed 18 October 2020. ONET STEM occupations can be found here: **https://www.onetonline.org/find/stem?t=0**. Accessed 18 October 2020. These recommendations do not include middle-skill occupations but are referred to here for purposes of comparing their recommendations to our expanded definition that does include middle-skill occupations.

9 A new federal survey called the National Training, Education, and Workforce Survey (see endnote 2) will include questions about educational attainment, credential attainment, and training of workers without a bachelor's degree.

10 CPS data for a longer period (1990–2019) confirm this long-term trend for workers with a bachelor's degree or higher in S&E occupations and for workers at all educational levels in S&E technician and computer programming occupations (Table SLBR-6). The information in Table SLBR-6 is organized to be consistent with data from previous cycles for comparability over time.

11 The CPS is the source of the official U.S. unemployment rate.

12 At the doctorate level, data for 2015, 2017, and 2019 differed from earlier years shown here. SESTAT incorporated data from the SDR, which correspond to the doctor's research and scholarship degree level and are research-focused degrees. The NSCG data used for 2015, 2017, and 2019 cover all doctorates regardless of type.

13 Beside the unemployment rate, the IPT rate is the most widely available measure of labor underutilization (Bell and Blanchflower 2021). Along with the IPT rate (U-6 measure) and the unemployment rate (U-3 measure), BLS publishes four other measures of labor underutilization: U-1, the percentage of civilian labor force unemployed 15 weeks or longer; U-2, the percentage of civilian labor force that are job losers and persons who completed temporary jobs; U-4, the percentage of civilian labor force and discouraged workers that are unemployed and discouraged; and U-5, the percentage of civilian labor force and marginally attached workers that are unemployed, discouraged, and marginally attached. See **https://www.bls.gov/lau/stalt.htm** for more details.

14 All earnings reported are in current dollars unless otherwise noted as constant dollars.

15 Health sciences is included in S&E fields of study because these data correspond to the doctor's research or scholarship degree level, which are research-focused degrees.

16 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.

17 Three NSF surveys—the 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 business 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.

18 According to NCSES's (2021e) 2019 GSS, the majority of academic postdocs (60%) in 2019 were supported by research grants; the rest were supported by fellowships, traineeships, or other mechanisms (NCSES *GSS 2019*: **Table 3-6**).

19 Those with faculty rank (e.g., research faculty, scientist, associate, fellow, postdoc) may conduct research and hold an administrative position (e.g., president, provost, chancellor) or teach (e.g., teaching and adjunct faculty).

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

21 Information on workers in S&E-related occupations reported in the NSCG began to be collected in 2003.

22 According to NCSES, women, persons with disabilities, and some racial or ethnic groups—Blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives—are underrepresented in S&E. That is, their representation in S&E education and S&E employment is smaller than their representation in the U.S. population. (see NCSES ***WMPD 2021*** for more details.) Although some of these groups may have reached parity with their representation in the U.S. population in some occupations within STEM, they are still defined as underrepresented following the NCSES definition.

23 The choice of price deflator is nontrivial, affecting the magnitude of the constant dollar median salaries. The U.S. Census Bureau uses the BLS Consumer Price Index for all Urban Consumers Research Series to deflate income estimates (Census Bureau 2020b). This price index is known to be an upper-bound estimate of the cost of living (Gordon 2006). The Federal Reserve Board uses the Bureau of Economic Analysis' personal consumption expenditure (PCE) price index to measure price changes (Board of Governors of the Federal Reserve System 2016). The PCE price index is a subset of prices in the GDP price index, and it captures prices paid by rural and urban households as well as payments made on behalf of households by third parties (like health insurance payments). While the different price indexes produce constant dollar median salaries that differ in magnitude, the trends in constant dollar measures are similar over time for the analysis in this report. Hence, in this report, the constant dollar median salaries based on the PCE price index are presented, and discussion of the constant dollar median salaries only pertain to changes over time.

24 Kimberlé Crenshaw (1989) introduced the term *intersectionality* in critiquing how traditional feminist ideas and antiracist policies exclude black women because they face overlapping discrimination unique to them.

25 Another pathway to employment for noncitizens is the Optional Practical Training, which allows graduates who were on student visas (i.e., F-1) to stay in the United States for up to an additional 3 years to work full time on their student visa (Zwetsloot et al. 2019). Optional Practical Training approvals (257,000) outpaced initial H-1B approvals (115,000) between 2014 and 2016, and more than half (53%) of the Optional Practical Training participants were STEM graduates (Ruiz and Budiman 2018).

26 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 (DOL 2020a). High-skill labor can also enter the United States for employment through the J-1 (exchange) and L-1 (intracompany transferee programs).

27 However, precise counts of H-1B visas issued to individuals in these occupations cannot be obtained because U.S. Citizenship and Immigration Services does not classify occupations with the same taxonomy used by NSF.

28 *Stay rates* refer to the proportion of U.S. S&E doctorate recipients on temporary visas at graduation that remain in the United States after graduation. Among temporary visa holders who received their S&E doctoral degrees approximately 5 years and 10 years before 2017, 71%–72% remained in the United States in 2017 (**NSB 2019b**). Updated 5- and 10-year stay rates were not available for this report.

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