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Higher Education

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

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Executive Summary

Key takeaways:

- Containing a diversity of institutions, the U.S. higher education system serves a range of students and strives to meet many societal goals.
- Science and engineering (S&E) fields continue to grow across degree levels. In numbers and as a percentage of total degrees, S&E degrees increased at the associate's, bachelor's, master's, and doctoral levels between 2000 and 2017.
- Many groups of Americans remain underrepresented among S&E degree recipients.
- The United States remains the destination for the largest number of internationally mobile students worldwide. However, over the past 2 years, the total number of international students enrolled in U.S. institutions has declined.
- Among the major S&E degree–producing countries worldwide, China has seen a rapid increase in its S&E degree production over time, compared with a more moderate rise in the United States and the European Union.

The U.S. higher education system consists of diverse academic institutions—including research and doctorate-granting universities, primarily undergraduate institutions, minority-serving institutions, community colleges, and others, including some that span multiple categories—that train students in S&E across degree levels and fields. A small number of institutions awarded three-quarters of doctorates, nearly half of master's degrees, and 40% of bachelor's degrees in S&E fields in 2017. These institutions are also where most university research is performed (see the forthcoming *Science and Engineering Indicators 2020* report "Academic Research and Development"): integration of academic S&E research and doctoral education is a key feature of the U.S. system.

More students are earning S&E degrees. In numbers and as a percentage of total degrees, S&E degrees increased at the associate's, bachelor's, master's, and doctoral levels between 2000 and 2017. In addition, community colleges train students in S&E and related fields including technologies, contributing to the pool of talent that earns higher degrees and to the development of the skilled technical workforce.

While the costs of higher education have increased over time, the percentages of bachelor's and doctoral degree recipients who graduate with debt have remained roughly the same over the last 10 years. Among graduate students, sources of financial aid differ dramatically between master's and doctoral students. In 2017, one-third of S&E master's students received funding, in contrast to around 90% of S&E doctoral students. Most S&E doctoral students rely on multiple funding sources (e.g., institutional, federal) and mechanisms (e.g., research and teaching assistantships and fellowships). The federal role in S&E graduate training remains important, although it has diminished over time. In 2017, the federal government supported 15% of full-time S&E graduate students (down from nearly 21% in 2004), including around one-quarter of doctoral students.

Many groups of Americans remain underrepresented among S&E degree recipients. Women are at or approaching parity with men at most degree levels overall, but within fields, long-standing differences persist, especially in engineering, computer sciences, and mathematics and statistics. Blacks are underrepresented at all degree levels; Hispanics and American Indians and Alaska Natives are underrepresented at all but the associate's level. Members of different racial and ethnic groups are more likely to earn S&E degrees, especially doctorates, from for-profit institutions, which may have consequences for debt levels and career outcomes.

The U.S. higher education system remains a top destination for foreign S&E students. Although 2018 marked a second year of decline in the total number of foreign students studying in the United States, the decline was small (less than 1%), and more undergraduate and graduate students were studying S&E fields. Four countries—China, India, South Korea, and Saudi Arabia—account for more than half of foreign students in the United States. The number of Chinese S&E graduate students studying in the United States has continued to increase (by 11% over the last 2 years), whereas the number of Indian S&E graduate students sharply declined (by 22% over the last 2 years).

Foreign students account for about one-third of U.S. S&E doctorate recipients, a relatively stable proportion over time. They account for half or more of the doctorate recipients in engineering, computer sciences, and economics. China, India, and South Korea are the top three source countries for foreign recipients of U.S. S&E doctoral degrees. In comparison, students on temporary visas earn a smaller share (around 5%) of S&E bachelor's degrees; however, the number of these students has more than doubled over the last 10 years.

Other nations' higher education systems have become increasingly competitive. S&E first university degrees awarded by Chinese institutions doubled to 1.7 million between 2005 and 2015, far outpacing most other countries, including the United States. Institutions in the United States award more S&E doctoral degrees than any other nation. However, in natural sciences and engineering, China surpassed the United States in 2007 as the world's largest producer of doctoral degrees and has remained so since.

Introduction

This report provides a portrait of S&E higher education in the United States, including trends over time and comparisons with other nations. S&E fields, as defined in this report, include astronomy, chemistry, physics, atmospheric sciences, earth sciences, ocean sciences, mathematics and statistics, computer sciences, agricultural sciences, biological sciences, psychology, social sciences, and engineering. At the doctoral level, the medical and health sciences are included under S&E because the doctoral-level data correspond to the doctor's-research/scholarship degree level, which includes research-focused degrees.

The report is divided into four main sections. The first section provides an overview of the U.S. higher education system, with special emphasis on several types of institutions, and on distance and online education. This section also provides information on sources of aid for undergraduate and graduate S&E education, with a focus on the federal government's role. The second section looks at trends over time in S&E degree awards at the undergraduate and graduate levels, highlighting patterns by field. The third section focuses on the demographic attributes of S&E degree recipients, including sex and race and ethnicity. It examines trends by degree level and field. The final section focuses on international S&E higher education. This section provides data on students on temporary visas who study or earn degrees in the United States. It also benchmarks the United States with other nations in terms of S&E degrees awarded.

U.S. Institutions Providing S&E Higher Education

The U.S. higher education system consists of diverse academic institutions that vary in mission; public, private nonprofit, or private for-profit status; degrees offered; learning environment; selectivity level; religious affiliation; and cost (McFarland et al. 2019). This institutional diversity is often regarded as a strength of the U.S. higher education system (Harris 2013), allowing it to serve a range of students and meet many societal goals.

Institutions in S&E Higher Education

During the 2017–18 academic year, there were approximately 4,400 postsecondary degree-granting institutions in the United States, of which about 37% were public, 40% were private nonprofit, and 23% were private for-profit (**Table 2-1**).[1,2] Public institutions awarded two-thirds of all degrees and nearly 70% of S&E degrees overall (**Figure 2-1**).

TABLE 2-1

Degree-granting institutions, by control and highest degree awarded: 2017–18

(Number)

Highest degree awarded	All degree-granting institutions	Public	Private nonprofit	Private for-profit
All degree levels	4,401	1,643	1,739	1,019
Associate's	1,508	885	103	520
Bachelor's	789	193	353	243
Master's	936	189	589	158
Doctoral	1,168	376	694	98

Source(s)

National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Institutional Characteristics.

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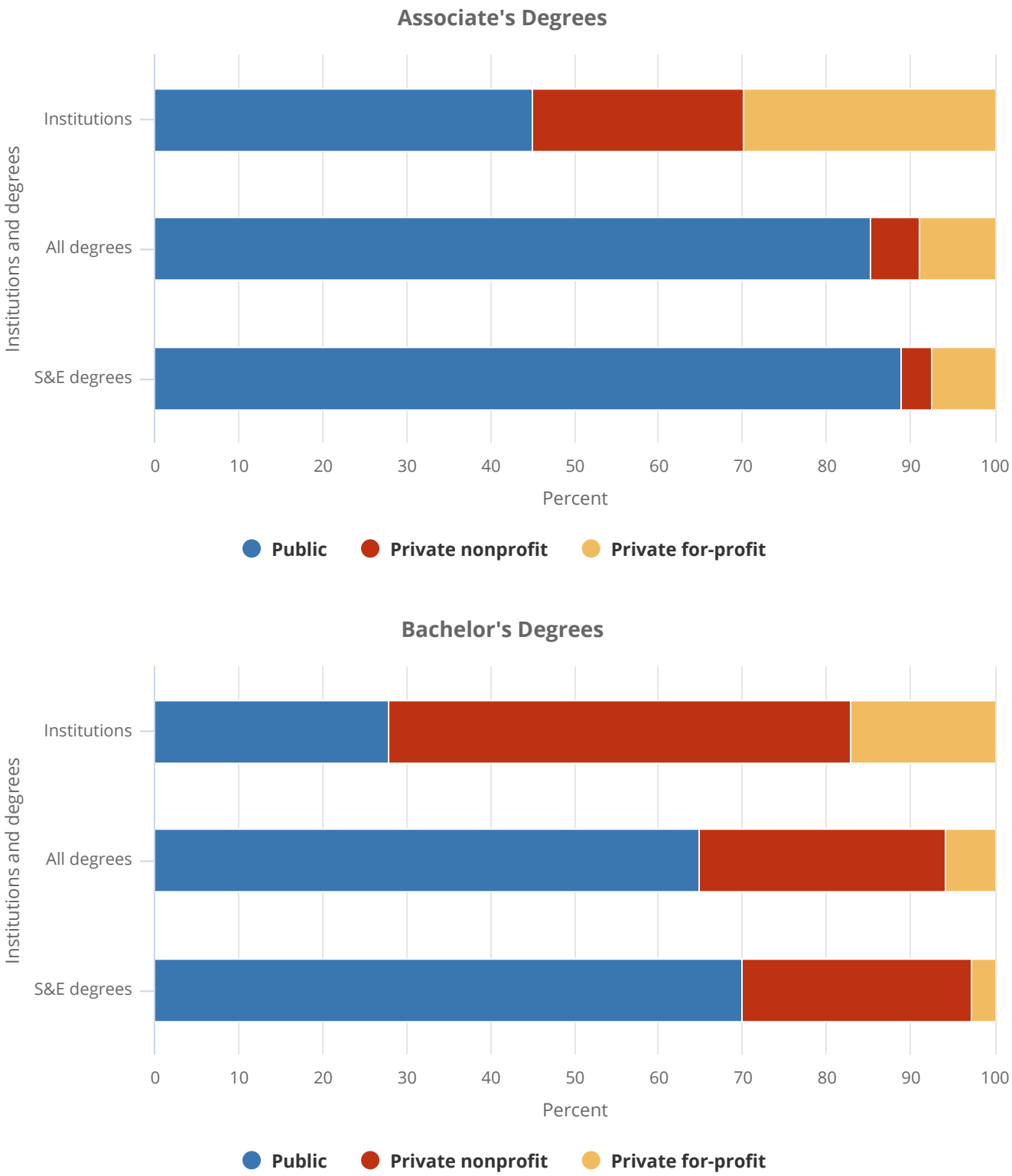
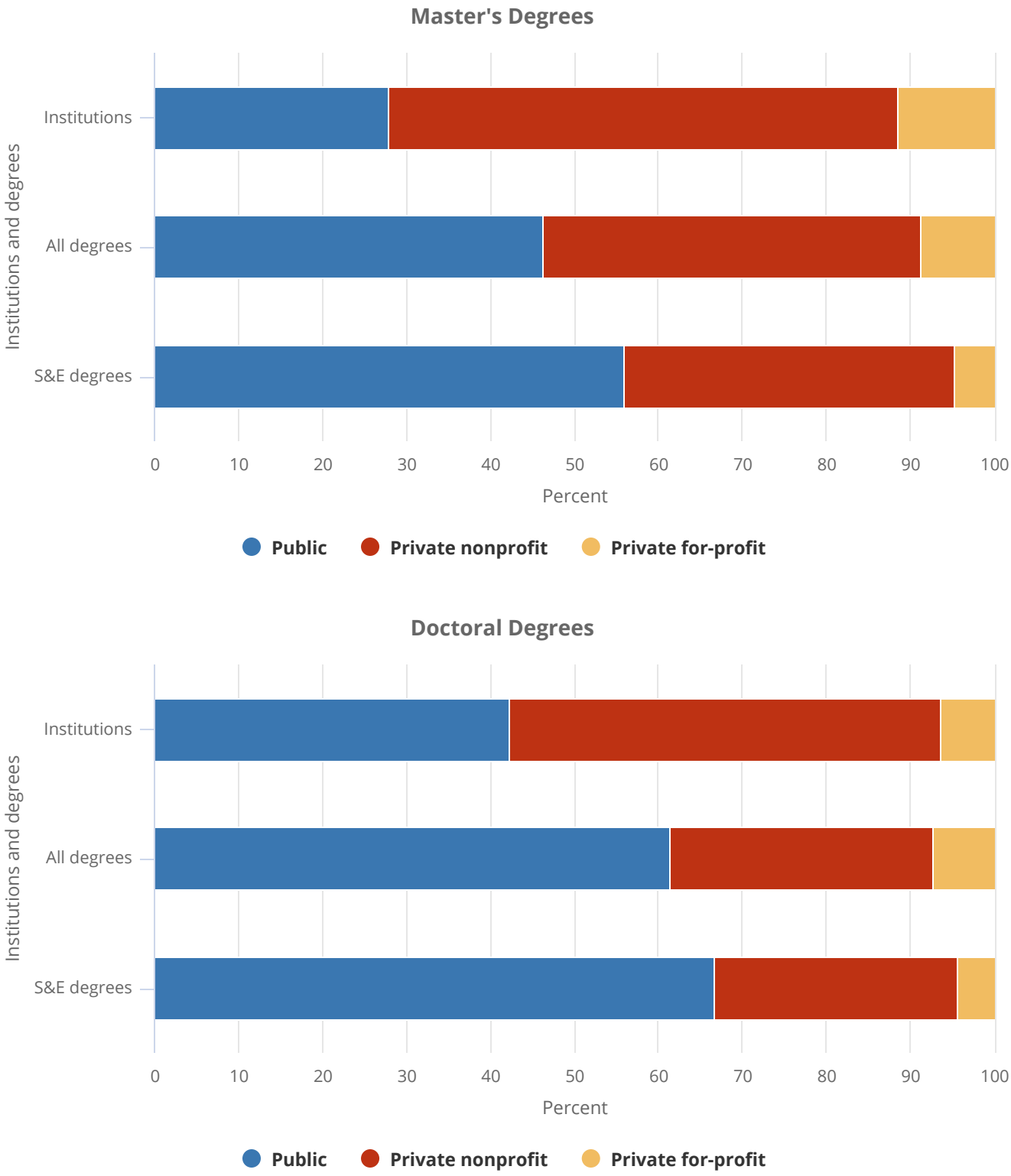
FIGURE 2-1

Institutions and degrees, by level of degree and control: 2017





Note(s)
The percentages in this figure may show different numbers than those in **Table 2-1** because the table lists each institution once, under its highest degree granted. In this figure, institutions may be in multiple categories (e.g., an institution with doctorates as the highest degree awarded that also awards bachelor's and master's degrees).

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Institutional Characteristics and Completions.

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Institutions of higher education can be classified in ways beyond the split among public, private nonprofit, and private for-profit. The Carnegie Classification of Institutions of Higher Education is widely used to characterize differences in academic institutions.[3] The 115 Carnegie-classified "highest research activity" doctoral universities, for example, play a key role in producing S&E doctoral degrees in the United States (Table S2-1).[4]

Minority-Serving Institutions

There are more than 700 federally designated minority-serving institutions (MSIs) of seven types (National Academies of Sciences, Engineering, and Medicine [NASEM] 2019).[5] MSIs may be defined by legislation ("historically defined") or by the percentage of minority student enrollment and other characteristics of the student body ("enrollment defined") (Li 2007; NASEM 2019). Historically black colleges or universities (HBCUs) and tribal colleges or universities are historically defined.[6] High-Hispanic-enrollment institutions (HHEs), in contrast, are one example of enrollment-defined MSIs.[7] Some institutions may qualify as more than one type of MSI, and there is substantial diversity in institutional characteristics between different MSIs (NASEM 2019). The number of institutions in historically defined MSI categories are more or less fixed, whereas the numbers of institutions included in enrollment-defined MSI categories may change. This has implications for interpreting trends over time.

MSIs enroll a substantial fraction of underrepresented minority undergraduates. The number of blacks earning S&E bachelor's degrees from HBCUs has remained roughly constant, likely reflecting the capacity of these institutions. Overall, across all institutions, numbers of S&E bachelor's degrees earned by blacks are increasing (NCSES ***WMPD 2019***: **Table 5-8**). In 2016, S&E fields accounted for roughly 30% of the bachelor's degrees blacks earned at HBCUs; the percentage of S&E bachelor's degrees blacks earned across all institutions was about the same.

Numbers of Hispanics earning S&E bachelor's degrees from HHEs have increased, whereas the percentage has remained roughly the same (NCSES ***WMPD 2019***: **Table 5-9**).[8] This reflects increasing numbers of Hispanics earning S&E bachelor's degrees at HHEs and at other types of institutions. In 2016, S&E fields accounted for roughly one-third of the bachelor's degrees that Hispanics earned at HHEs; the percentage of S&E bachelor's degrees Hispanics earned across all institutions was about the same.

MSIs also play an important role in training underrepresented minority students for doctoral-level study in S&E fields. A considerable share of black and Hispanic S&E doctoral recipients received their bachelor's degree from an MSI. Around 25% of black S&E doctoral recipients between 2013 and 2017 earned a bachelor's degree from an HBCU (NCSES 2019b). Likewise, around 37% of Hispanic S&E doctoral recipients between 2013 and 2017 earned a bachelor's degree from an HHE (NCSES 2019b). The percentages of black and Hispanic S&E doctoral recipients whose baccalaureate origins were HBCUs and HHEs, respectively, have been relatively stable for several decades.[9] More data on the importance of these institutions as baccalaureate origin institutions is available in Burrelli and Rapoport (2008) and Fiegener and Proudfoot (2013), as well as in Hrabowski and Henderson (2017, 2019), who emphasize the role that predominantly white institutions must also play in preparing underrepresented minority students for S&E doctoral training.

Community Colleges

Community colleges (also known as public 2-year colleges or associate's colleges) play a key role in providing broad access to higher education. Community colleges prepare students to enter the workforce with certificates or associate's degrees, or to transition to 4-year institutions (frequently without earning associate's degrees).[10] Of students who earned bachelor's degrees in any field between 2010 and 2017, more than half (53%) had done some coursework at a community college and about one-fourth (26%) earned associate's degrees. The figures were 47% and 18%, respectively, among S&E degree recipients.[11] Community colleges also provide a pathway that ultimately leads some students to earn doctoral degrees. About 20% of students receiving S&E doctoral degrees in 2017 reported having attended a community or 2-year college (NCSES ***SED 2017***: **Table 30**), and about 6% had previously earned an associate's degree (Table S2-2).[12]

Community college attendance, however, varies across degree fields and between demographic groups. The percentage of 2017 doctorate recipients with associate's degrees ranged from less than 4% among engineering doctorates to nearly 11% among medical and other health sciences doctorates; percentages having attended community college were higher (NCSES ***SED 2017***: **Table 30**). Black S&E doctoral degree recipients were most likely to have earned an associate's degree (11%) and Asians least likely (less than 3%). In addition, among the civilian college graduate population in the United States, military veterans were more likely to have attended community college, and to have earned associate's degrees, than nonveterans (Milan 2018).

For-Profit Institutions

In 2017–18, there were about 1,000 degree-granting private for-profit higher education institutions in the United States. About half of these institutions award only associate's degrees; the remainder award higher degrees, including 10% that award doctoral degrees (**Table 2-1**). Degrees awarded by for-profit institutions rose dramatically throughout the 2000s but declined in recent years.[13]

For-profit academic institutions are not large producers of S&E degrees (**Figure 2-1**). The S&E degrees they award cluster in a few fields: 75% of S&E bachelor's degrees awarded by for-profits in 2017 were in computer sciences, psychology, or political science and public administration;[14] at the doctoral level, 88% of S&E degrees were in psychology, medical sciences, or political science and public administration.

Distance and Online Education

Distance education is learning where the teacher and student are separated by time or space (Miller, Topper, and Richardson 2017). Distance education has been around for more than 100 years, whereas online education is a relatively new phenomenon, mirroring the growth of technologies such as the personal computer and the Internet (Miller et al. 2017; Perna et al. 2014).[15] Distance education offerings can be delivered through a range of technologies and in a variety of modes: completely distance education, traditional or in-person instruction, and a combination often referred to as hybrid or blended instruction (RTI International 2017). Distance education may occur synchronously (live) or asynchronously (prerecorded) in time, and online courses may be offered to students living on campus, without any physical distance from the instructor (RTI International 2017).

Distance and online education enable higher education institutions to reach more students by providing greater flexibility and expanding access in remote locations. About 18% of the U.S. adult population live in "higher education deserts," whereas only about 2% live in "online deserts," according to a study by Rosenboom and Blagg (2018). The study defines a higher education desert as "either having no colleges and universities within 25 miles or having access to a single community college as the only broad-access public institution within 25 miles." Online deserts are "areas where Internet speeds are below 25 megabits per second for downloads and 2 megabits per second for uploads."

Nationally representative data on distance education are available through the Integrated Postsecondary Education Data System (IPEDS). These data include instances where instructional content is delivered exclusively through distance education (i.e., hybrid or blended courses are not included; see RTI International 2017).[16] The number of distance education programs offered by degree-granting higher education institutions, as defined by IPEDS, stayed roughly the same between 2016 and 2017 (at about 21,000), after a period of rapid growth (from about 11,000 in 2012). This overall trend includes a decline in programs offered at the associate's and bachelor's levels and a continued increase in those at the master's and doctoral levels. In contrast, enrollment of undergraduate and graduate students in distance education increased each year from 2012 to 2016, except for enrollment at for-profit institutions, which declined. Public, private nonprofit, and for-profit institutions all offer distance education programs; however, public universities account for most students taking these courses (Seaman, Allen, and Seaman 2018).[17]

Most distance education students also take courses on campus; of those who take only distance education courses, 56% do so through institutions in their home state. In S&E fields, distance education programs are most likely to be offered in computer sciences, social sciences, and psychology at the associate's and bachelor's levels; in computer sciences and engineering at the master's level; and in medical and health sciences and engineering at the doctoral level.[18]

Although no nationally representative data exist specifically for online education, a recent analysis of data from massive open online courses (MOOCs) taught on edX by its founding partner institutions found that these courses primarily draw students from affluent countries and continue to face low completion and retention rates (Reich and Ruipérez-Valiente 2019). According to the study, MOOCs have been most successful in helping universities outsource online master's degrees for professionals. The study, however, noted that this finding might not be broadly generalizable and that information from other edX partners or MOOC providers might "reveal different dynamics." Related to this, although the literature around online education is robust, it remains unclear how generalizable results from any one program or class are to others, given the complexity of the landscape (Miller et al. 2017). Studies have explored issues such as whether online options substitute for existing university options or expand enrollment (e.g., Goodman, Melkers, and Pallais 2018), how learning outcomes compare with those from traditional courses (e.g., Joyner 2018), and whether course completions lead to beneficial outcomes like higher earnings or job mobility (e.g., Hadavand, Gooding, and Leek 2018).

Cost and Financing of S&E Higher Education for Undergraduate and Graduate Students

This section provides information on undergraduate and graduate students' cost and debt. In terms of cost, published tuition and fees have increased far more than net price. Although the level of undergraduate debt varies by type of institution, the frequency and amount of borrowing have increased little over the past 5 years. Among graduate students, master's students are largely self-supporting, whereas doctoral students rely on multiple funding sources and mechanisms to support their education. The percentage of doctorate recipients holding debt related to their graduate education has changed little over the last 10 years.

Cost of Undergraduate Education

Earning a college degree commands a substantial wage premium (Carnevale, Cheah, and Hanson 2015) and provides other benefits to individuals and society (College Board 2016). For these and other reasons, many students and their families invest in higher education. Increases in published prices over time have far exceeded inflation or increases in average family income,[19] contributing to concerns about affordability of higher education (Archibald and Feldman 2012; U.S. Congress Joint Economic Committee 2017).

College pricing is complex and often poorly understood. Institutions operate at different prices. For example, during the 2018–19 academic year, average tuition and fees were $3,660 at public 2-year institutions, $10,500 at public 4-year institutions, and $36,980 at private nonprofit 4-year institutions.[20] Published tuition and fees have greatly increased over the last 30 years (College Board ***Trends in College Pricing 2018***: **Figure 3**).

Net price, defined by the College Board as "what the student and/or family must cover after grant aid and savings from tax credits and deductions are subtracted," is more relevant for students than published price. Across institutional types, net prices rose much more slowly than published prices (College Board ***Trends in College Pricing 2018***: **Table 7**). For 2018–19, average net tuition and fees were $3,740 at public 4-year institutions and $14,610 at private nonprofit 4-year institutions. At public 2-year institutions, students on average received enough funding through grant aid and federal education tax credits and deductions to more than cover tuition and fees. Net price, however, varies based on family income (College Board ***Trends in College Pricing 2018***: **Figure 2017_11**). In addition, the cost of attending public 4-year universities varies by state of residence and whether students attend an institution in their own state or in another state.[21] The affordability of college also depends on time to degree and the amount of money spent on other living expenses, like room and board.

Undergraduate Debt

Level of undergraduate debt varies by type of institution, but the frequency and amount of borrowing among those who graduate have increased little over the past 5 years. At public 4-year institutions, 58% of 2016–17 graduates borrowed, holding an average of $26,900 in debt. At private nonprofit 4-year institutions, 61% of 2016–17 graduates borrowed, holding an average of $32,600 in debt (College Board ***Trends in Student Aid 2018***: **Figure 15**). Since the 2011–12 academic year, the percentage of bachelor's degree recipients holding debt has remained essentially the same (about 60%), while the average level of debt has risen by 3% in inflation-adjusted dollars (College Board ***Trends in Student Aid 2018***: **Figure 15**).[22]

Students who attend private for-profit institutions are more likely to borrow (87% of bachelor's degree recipients) and to borrow larger amounts (32% borrowed more than $50,000, vs. 7% of those earning bachelor's degrees from public universities) (College Board ***Trends in Student Aid 2018***: **Figure 16**).

Debt level also varies by state. Average debt for 2016–17 graduates of public 4-year colleges and universities ranged from $19,800 in Utah to $36,700 in Pennsylvania. Average debt for graduates of private nonprofit colleges and universities ranged from $16,800 in Utah to $38,800 in Connecticut (The Institute for College Access & Success 2018). Cost of living may account for some of the differences among states.[23]

Sources of Support for Graduate Education

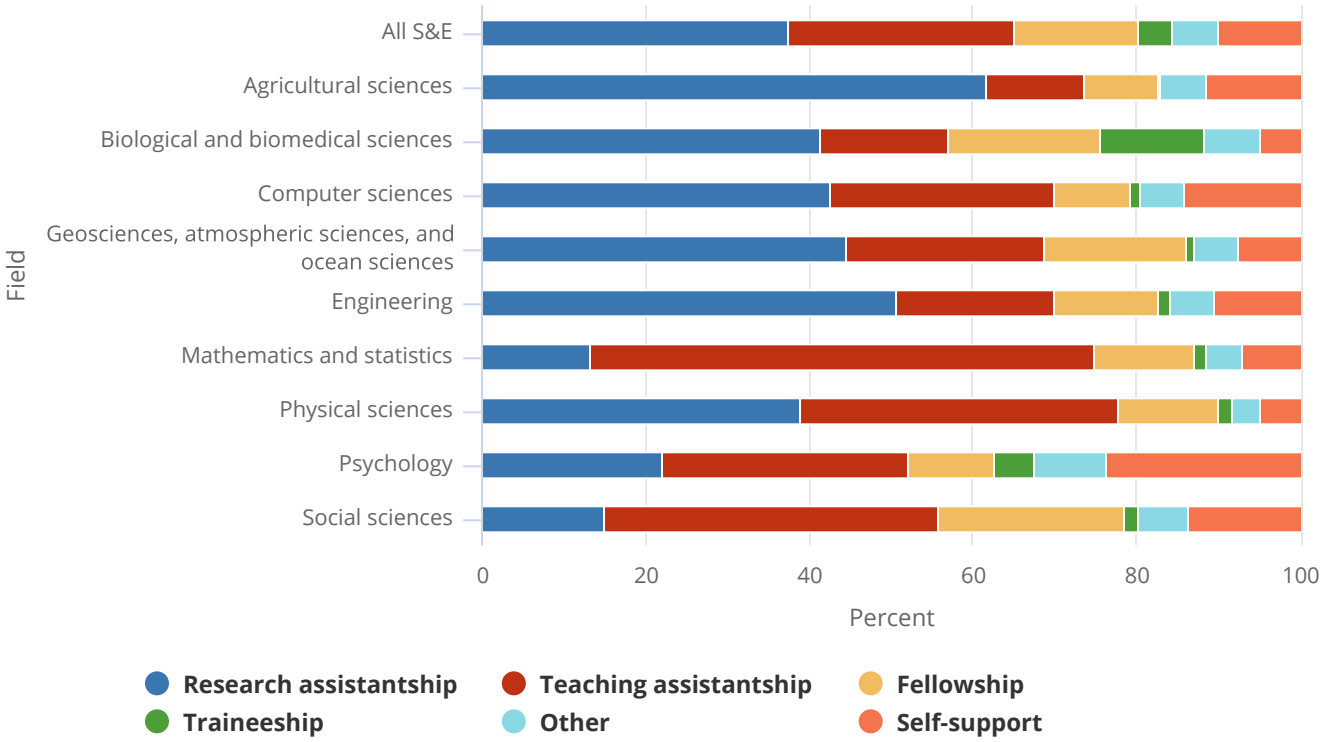
Graduate students' sources of financial support depend on their level of study.[24] Master's students are largely self-supporting, whereas only a small minority of doctoral students self-finance.[25] In 2017, two-thirds of S&E master's students paid for their graduate program using personal sources (Arbeit, Davies, and Yamaner 2019; NCSES ***GSS 2017***: **Table 3-1**); by contrast, only around 10% of doctoral students did so.[26] These differences generally hold across all S&E fields.

Other main sources of support for graduate students include academic institutions (where a student is enrolled) and the federal government. Academic institutions were the primary source of support for 24% of master's students and 57% of doctoral students. Federal support is discussed in the section "Federal Support for S&E Graduate Students." Financial support may be delivered through various mechanisms, including research assistantships (RAs), teaching assistantships (TAs), and fellowships.[27] TAs and fellowships are mainly institutionally funded, whereas nearly half of RAs are funded through federal academic research grants.[28]

Most doctoral students are supported by multiple sources or mechanisms during graduate school, even in a single academic year. Patterns of support vary by field (**Figure 2-2**; ***GSS 2017***: **Table 3-1**) and the type of institution attended (**Table 2-2**). For example, in 2017, doctorate recipients from the "highest research activity" doctoral universities (based on Carnegie classification) were less likely to self-support (7%) than those who attended other types of institutions. Even among this group of institutions, however, public and private universities used funding mechanisms at different rates (**Table 2-2**).

FIGURE 2-2

Full-time S&E doctoral students, by field and mechanism of primary support: 2017



Note(s)
Self-support includes any loans (including federal) and support from personal or family financial contributions.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS).

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TABLE 2-2

Primary support mechanisms for S&E doctorate recipients, by 2015 Carnegie classification and control of doctorate-granting institution: 2017

(Percent)

Carnegie classification and institutional control	All doctorate recipients	Fellowship or traineeship	Grant	Teaching assistantship	Research assistantship	Personal	Other	Unknown
All institutions (number)[a]	41,909	9,332	594	7,226	14,176	4,088	1,626	4,867
Doctoral: Highest research activity	100.0	23.8	1.4	17.9	36.4	6.5	3.4	10.6
Public institutions	100.0	18.3	1.0	20.8	39.5	7.3	3.6	9.4
Private nonprofit institutions	100.0	38.5	2.4	9.9	28.2	4.3	2.8	14.0
Doctoral: Higher research activity	100.0	14.5	1.2	21.2	30.2	14.6	5.2	13.0
Public institutions	100.0	12.4	1.3	23.5	32.2	13.2	5.3	12.1
Private nonprofit institutions	100.0	20.2	1.0	15.4	24.9	18.3	4.8	15.3

TABLE 2-2

Primary support mechanisms for S&E doctorate recipients, by 2015 Carnegie classification and control of doctorate-granting institution: 2017

(Percent)

Carnegie classification and institutional control	All doctorate recipients	Fellowship or traineeship	Grant	Teaching assistantship	Research assistantship	Personal	Other	Unknown
Doctoral: Moderate research activity	100.0	9.2	s	7.8	8.7	47.5	s	19.6
Public institutions	100.0	s	0.0	s	s	s	9.6	15.1
Private nonprofit institutions	100.0	11.0	s	7.8	8.0	35.2	s	34.6
Private for-profit institutions	100.0	s	0.0	s	s	s	8.0	9.9
Medical schools and medical centers	100.0	39.1	3.9	1.9	27.4	14.3	4.6	8.6
Public institutions	100.0	36.9	3.1	2.7	34.0	12.0	5.0	6.2
Private nonprofit institutions	100.0	44.3	5.8	0.0	12.0	19.8	3.8	14.3
Other or not classified	100.0	20.9	s	2.6	15.3	24.1	s	28.8
Public institutions	100.0	s	2.5	s	s	s	10.2	20.0
Private nonprofit institutions	100.0	13.0	s	2.0	5.0	33.5	s	40.8
Private for-profit institutions	100.0	s	0.0	0.0	0.0	s	0.0	58.3

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

[a] Includes respondents from institutions without a Carnegie classification or of unknown control.

Note(s)

Personal support mechanisms include personal savings, other personal earnings, other family earnings or savings, and loans. Research assistantships include research assistantships and other assistantships. Traineeships include internships and residencies. Other support mechanisms include employer reimbursement or assistance, foreign support, and other sources. Percentages may not add to total because of rounding.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2017 Survey of Earned Doctorates (SED).

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Funding mechanisms also vary by demographic groups (Table S2-3) for U.S. citizens and permanent residents who earned S&E doctorates between 2015 and 2017. Overall, men (31%) earning S&E doctorates were more likely to be supported by RAs than women (22%), whereas women (18%) were more likely to self-support than men (10%). Women (16%) and men (17%) were around equally likely to be supported by TAs. Asians (32%) and whites (29%) were most likely to have primary RA support. To some extent, demographic differences in support mechanisms relate to field-of-study differences. However, certain patterns hold across fields. For example, black doctorate recipients were more likely to use personal sources of funding in every S&E field for which data were available. Data on primary source of support for S&E doctorate recipients by race, ethnicity, sex, and field are available (NCSES ***WMPD 2019***: **Table 7-26**). These differences may also reflect variation among groups in the types of institutions attended.

Doctorate Recipient Debt

Debt levels are an indicator of external financial support for doctoral training. The percentage of doctorate recipients (around 35%) holding any debt related to their graduate education has not changed much in the last 10 years (NCSES ***SED 2017***: **Table 39**).[29]

Debt levels vary by field of study. A greater percentage of doctorate recipients in non-S&E fields (50%) than in S&E fields (29%) reported graduate debt (NCSES ***SED 2017***: **Table 38**). Levels of debt also vary among S&E fields. For instance, doctorate recipients in psychology and social sciences are more likely to hold graduate debt (49% hold debt, with an average of nearly $25,000) than those in physical and earth sciences (19% hold debt, with an average of about $5,000) (NCSES ***SED 2017***: **Table 38**).

Debt levels also vary across demographic groups. Women are more likely than men to accumulate higher graduate debt (NCSES ***SED 2017***: **Table 40**). Across fields, black doctorate recipients are most likely to hold more than $30,000 in graduate school debt, and Asians are least likely (NCSES ***SED 2017***: **Table 41**). Other factors influencing debt include the type of institution attended, time to degree, marital and dependent status, and highest level of parental education (Schacht, Hoffler, and Fiegener 2018 in preparation).

Many factors leading to greater indebtedness are related. For instance, black doctorate recipients are more likely to possess other characteristics related to higher indebtedness: for example, many are female, attend for-profit institutions, and earn degrees in non-S&E fields or S&E fields like psychology and social sciences, which have lower levels of external financial support (see the later section "Demographic Attributes of S&E Degree Recipients" and Scott-Clayton and Li 2016).[30]

National Investment in S&E Higher Education

This section discusses sources of financial aid for undergraduate and graduate students, as well as federal support for S&E graduate students. The federal government is the largest provider of financial aid to undergraduate and graduate students. It also supports a large number of S&E doctoral students through RAs (through research grants to universities) and other funding mechanisms.

Financial Aid for Undergraduate and Graduate Students

In 2017–18, undergraduate students received $184 billion in federal, state, institutional, and other aid (excluding nonfederal loans) (College Board ***Trends in Student Aid 2018***: **Figure 3**).[31] Over the last 10 years, federal financial aid has constituted most undergraduate student aid, although the federal percentage of total aid declined from 74% ($153 billion) in 2010–11 to 61% ($112 billion) in 2017–18. In 2017–18, loans constituted half of the federal investment in higher education ($56 billion) and Pell Grants constituted 25% ($28 billion).[32]

Among nonfederal sources, grants from institutions themselves grew steadily throughout the last decade, increasing from 21% ($26 billion) to 26% ($49 billion) of total aid. State grants declined slightly, and private and employer grants remained steady (each constituting 6% to 7%).

Graduate students received $57 billion in federal, state, institutional, and other aid (excluding nonfederal loans) in 2017–18 (College Board ***Trends in Student Aid 2018***: **Figure 4**). As with undergraduates, federal financial aid constituted the majority of graduate student aid over the past 10 years. Federal aid was around 72% ($41 billion) of total aid in 2017–18. Loans were the main component of federal aid: 91% ($38 billion in 2017–18); the remainder consisted of veterans' benefits, education tax benefits, and work-study programs.

Federal Support for S&E Graduate Students

Federal support for S&E graduate students reflects a continuation of the historic partnership between the federal government and the nation's research universities to integrate the performance of basic scientific research and the education and training of the next generation of scientists and engineers (National Research Council 2012). It is an indicator of the strength of the university-government partnership.

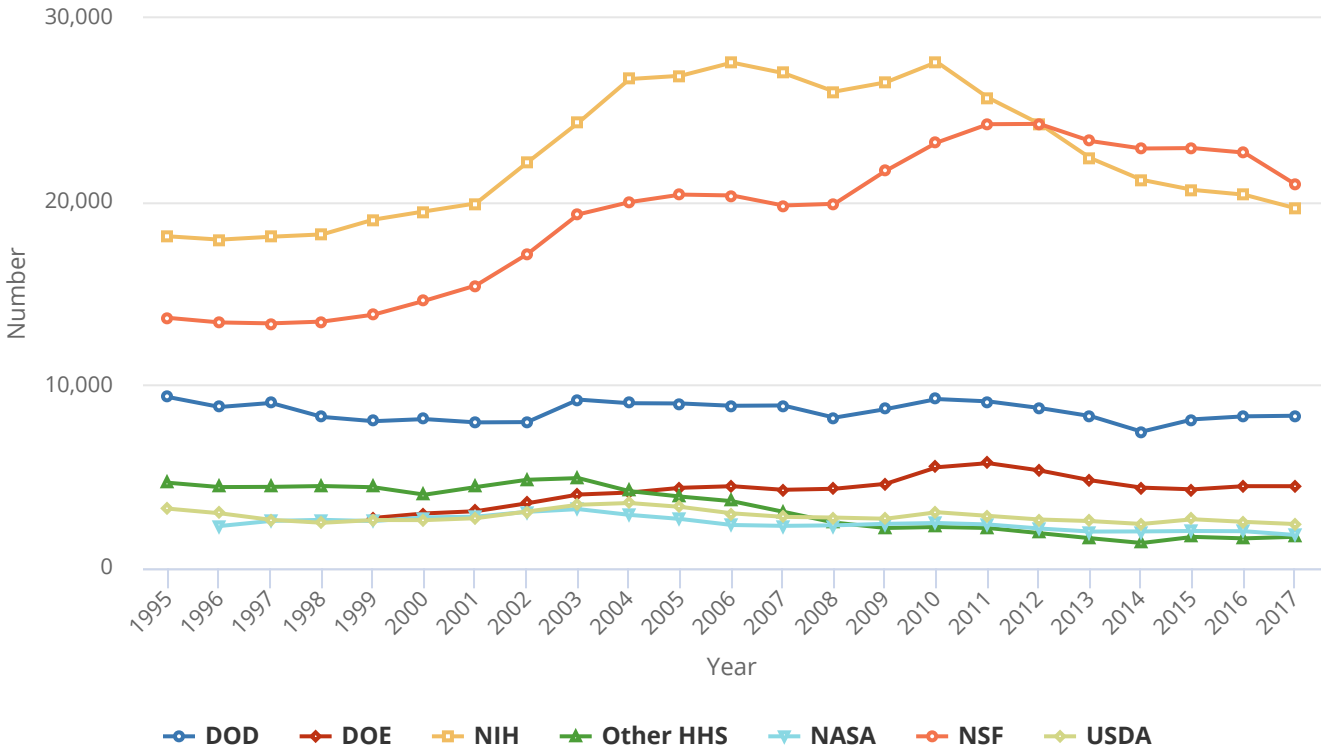
The federal government supported 15% of full-time S&E graduate students (just under 70,000) in 2017 (NCSES ***GSS 2017***: **Table 1-6**), down from nearly 21% (84,000) in 2004. This overall figure masks differences in federal support for master's (about 12,000 students, or 5%) and doctoral (about 57,000 students, or 24%) students. The federal government supports a higher percentage of doctoral students than master's students in all S&E fields.

The largest numbers of federally supported graduate students are in engineering (22,000), biological and biomedical sciences (18,000), and physical sciences (10,000). Together, these three fields contain around half of total graduate students but more than 70% of federally supported students (NCSES ***GSS 2017***: **Table 3-1**).

The National Science Foundation (NSF) and the National Institutes of Health (NIH) supported the most graduate students in 2017: 21,000 and 20,000, respectively. Together, these two agencies supported nearly 60% of federally supported graduate students (NCSES ***GSS 2017***: **Table 1-7**). However, in recent years, the numbers of students supported have declined (**Figure 2-3**). Other agencies supporting substantial numbers of S&E graduate students in 2017 were the U.S. Department of Defense (DOD: 8,300) and the U.S. Department of Energy (DOE: 4,500), followed by the Department of Agriculture (USDA), the National Aeronautics and Space Administration, and other agencies in the U.S. Department of Health and Human Services.

FIGURE 2-3

Full-time graduate students in science, engineering, and health primarily supported by federal sources, by agency: 1995–2017



DOD = Department of Defense; DOE = Department of Energy; HHS = Department of Health and Human Services; NASA = National Aeronautics and Space Administration; NIH = National Institutes of Health; NSF = National Science Foundation; USDA = Department of Agriculture.

Note(s)
USDA was added in 1985, NASA was added in 1996, and DOE was added in 2000. In 2007, eligible fields were reclassified, newly eligible fields were added, and the survey was redesigned to improve coverage and coding of eligible units. In this figure, 2007 data represent data as collected in 2007. In 2014, the survey frame was updated after a comprehensive frame evaluation study. The study identified potentially eligible but not previously surveyed academic institutions in the United States with master's- or doctorate-granting programs in science, engineering, or health. A total of 151 newly eligible institutions were added, and two private for-profit institutions offering mostly practitioner-based graduate degrees were determined to be ineligible. In 2017, enrollment and financial support were collected separately for master's and doctoral students. The list of disciplinary fields eligible for the Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS) was updated to align with the National Center for Science and Engineering Statistics Taxonomy of Disciplines. Two institutions became newly eligible, and 13 became ineligible. This figure excludes other federal agencies.

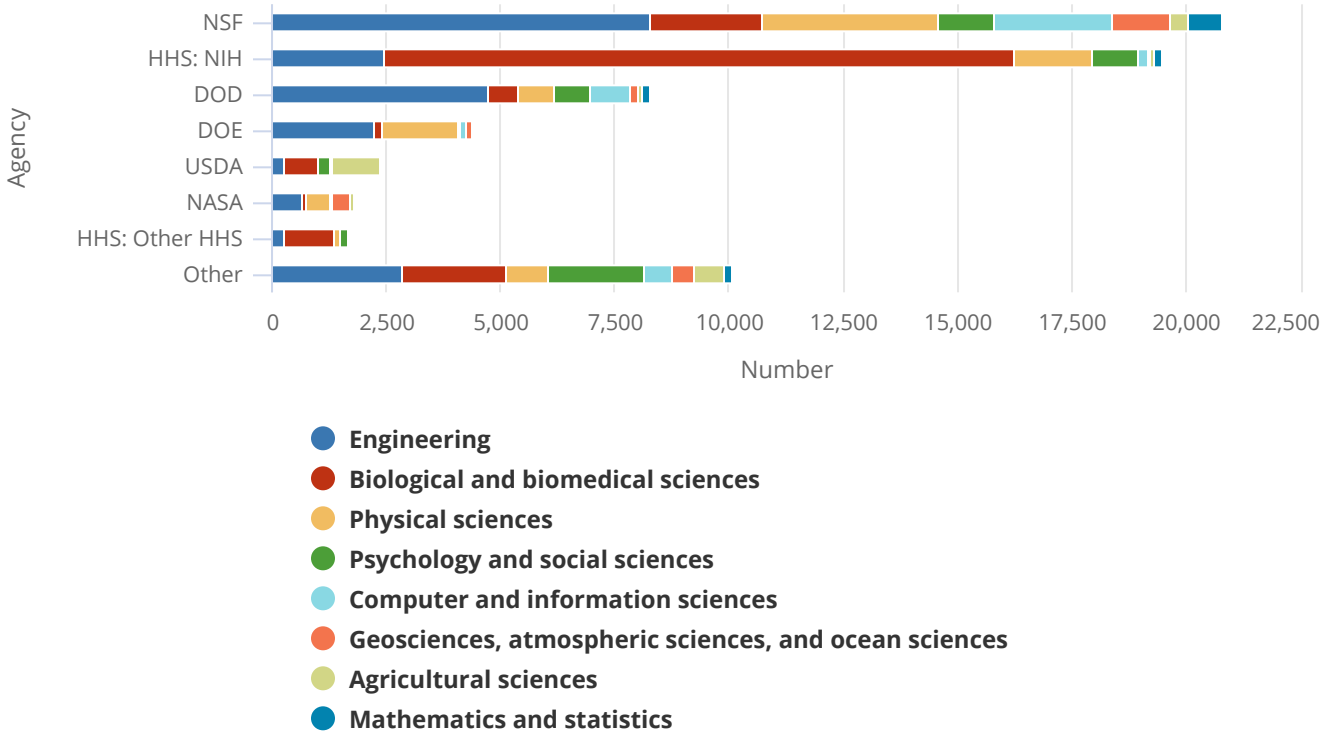
Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS).

Science and Engineering Indicators

In their support patterns across fields, agencies take on portfolios consistent with their missions (**Figure 2-4**, NCSES ***GSS 2017***: **Table 3-3**). NSF supports substantial numbers of students across a range of fields, whereas about 70% of those supported by NIH are in biological and biomedical sciences and health fields. More than half of the students funded by DOD study engineering, and nearly 90% funded by DOE are in physical sciences and engineering.

FIGURE 2-4

Full-time graduate students in science, engineering, and health primarily supported by the federal government, by field and agency: 2017



DOD = Department of Defense; DOE = Department of Energy; HHS = Department of Health and Human Services; NASA = National Aeronautics and Space Administration; NIH = National Institutes of Health; NSF = National Science Foundation; USDA = Department of Agriculture.

Note(s)
Agricultural sciences also include natural resources and conservation. Biological and biomedical sciences also include health. Multi- and interdisciplinary studies were excluded.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS).

Science and Engineering Indicators

RAs are the primary mechanism the federal government uses to fund graduate students. Among full-time S&E graduate students primarily funded by the federal government in 2016, 71% received RAs, followed by fellowships (13%) and traineeships (9%).

Reflective of overall enrollment patterns, about 70% of graduate students supported by the federal government in 2016 were enrolled in public institutions.[33] Seventy-eight percent were enrolled in Carnegie-classified “highest research activity” doctoral universities, and another 13% were enrolled in “higher research activity” doctoral universities. Only 2% of federally supported graduate students were enrolled in “moderate research activity” doctoral universities, along with about 4% at medical schools and 2% at master’s colleges and universities.[34]

Trends in Undergraduate and Graduate S&E Degree Awards

Undergraduate Degree Awards

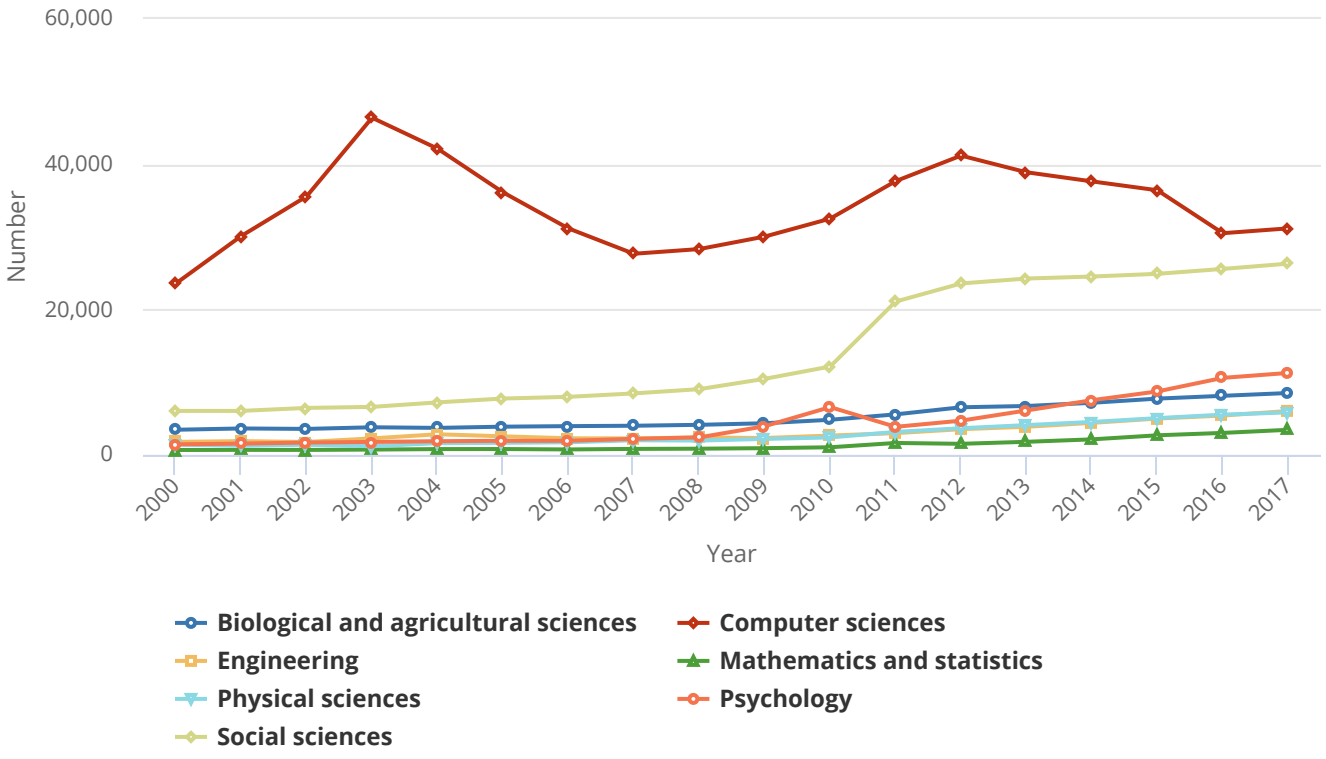
S&E coursework at the undergraduate level prepares students, S&E degree earners and those who major in non-S&E fields, to become knowledgeable citizens in a society ever more reliant on science and technology.[35] Over the past 20 years, the number of undergraduate degrees awarded by U.S. academic institutions has increased in S&E and non-S&E fields. According to the U.S. Department of Education, numbers of associate's degrees awarded are projected to continue increasing at least through 2028, while numbers of bachelor's degrees awarded are projected to stay roughly the same (Hussar and Bailey 2019).

S&E Associate's Degrees

Associate's degrees are the final degree earned by some students, whereas others continue their education at 4-year colleges or universities and earn higher degrees. Many who transfer from community colleges to baccalaureate-granting institutions do not earn associate's degrees before transferring; they may be able to transfer credit for specific courses. Relatively few associate's degrees are awarded in S&E fields. In 2017, 93,000 out of more than 1 million associate's degrees (9%) were in S&E fields (Table S2-4 and Table S2-5). The total number of S&E associate's degrees awarded declined between 2003 and 2007 but has risen in almost all years since then. Until 2012, the overall trend mirrored the pattern in computer sciences, which account for a large portion (nearly 50% in 2012) of S&E associate's degrees (**Figure 2-5**). Since 2012, the total number of S&E associate's degrees has continued to increase despite a decline in the number of computer sciences degrees.

FIGURE 2-5

S&E associate's degrees awarded, by field: 2000–17



Note(s)
Physical sciences include earth, atmospheric, and ocean sciences.

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey; National Center for Science and Engineering Statistics, National Science Foundation, Integrated Data System (IDS).

Science and Engineering Indicators

In 2017, community colleges awarded 133,000 associate's degrees in S&E technologies—more degrees than in S&E fields themselves, which is a long-standing trend. S&E technologies have a more applied focus and include engineering, health sciences, and other S&E technologies.[36] These degrees prepare students for skilled technical jobs (jobs requiring S&E technical expertise but not necessarily a 4-year degree; for more, see the forthcoming *Science and Engineering Indicators 2020* report "Science and Engineering Labor Force"). The number of associate's degrees awarded in S&E technologies peaked at 166,000 in 2012; since then, it has declined for engineering technologies (from 41,000 to 32,000) and health technologies (from 122,000 to 96,000). The decline in associate's degrees in S&E technologies is greater than the increase seen in S&E associate's degrees, meaning that the trends reflect more than students switching from one set of fields to the other.

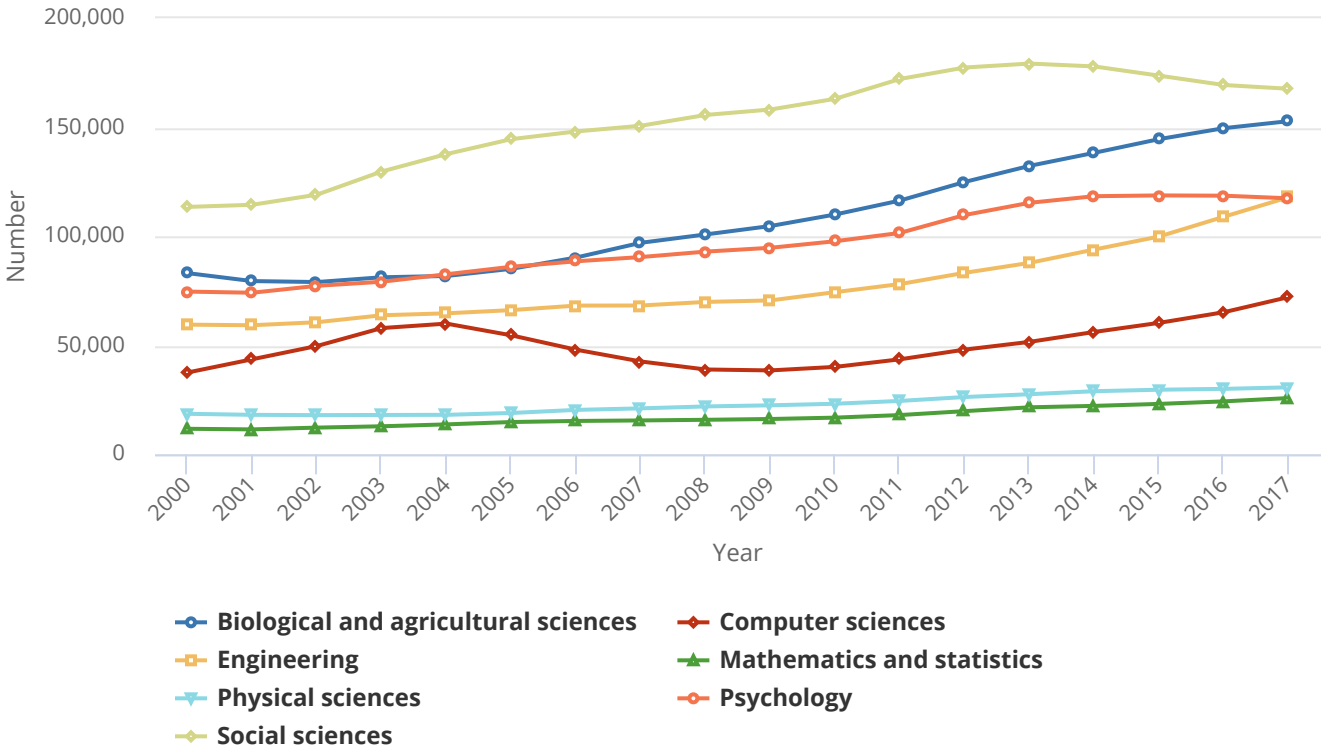
S&E Bachelor's Degrees

The baccalaureate accounts for nearly 70% of all S&E degrees awarded. The number of S&E bachelor's degrees awarded rose steadily from about 400,000 in 2000 to more than 680,000 in 2017 (Table S2-6 and Table S2-7).[37] As a share of total bachelor's degrees awarded, S&E degrees have increased slightly over this period, rising from 32% to 35%.

Growth in bachelor's degrees conferred varied by field (**Figure 2-6**, Table S2-6 and Table S2-7). In computer sciences, the number of bachelor's degrees increased sharply from 2000 to 2004 and dropped as sharply through 2009, but it has increased again since then, surpassing its previous high. In biological sciences, the largest field in natural sciences, numbers of bachelor's degrees awarded were relatively flat until 2004, then grew substantially. The number of engineering degrees reached the same level as those in psychology.

FIGURE 2-6

S&E bachelor's degrees awarded, by field: 2000–17



Note(s)
Physical sciences include earth, atmospheric, and ocean sciences.

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey; National Center for Science and Engineering Statistics, National Science Foundation, Integrated Data System (IDS).

Science and Engineering Indicators

Large public universities have long dominated degree conferral in S&E and in all fields. Additionally, in 2017, the "highest research activity" doctoral universities, as classified by Carnegie, awarded a disproportionately high percentage of S&E bachelor's degrees (40%) relative to total bachelor's degrees (28%); this is also a long-standing pattern.

Attainment and Retention in Undergraduate Education

One concern about the ability to produce and retain S&E talent in the United States is that many students who start undergraduate programs in these fields do not complete them (President's Council of Advisors on Science and Technology 2012). Degree attainment and retention are measured by the U.S. Department of Education's Beginning Postsecondary Students (BPS) survey, which examined a nationally representative cohort of first-time, beginning students at the end of their first year in 2011–12, followed up with them 3 years later, and will contact them 6 years later.[38] Data from BPS have been used to look at retention and attainment in S&E fields and at students switching into and out of S&E majors.

The data show that attrition—the rate at which students leave their institution or switch in and out of majors—varies across S&E and non-S&E majors. Students who declared an S&E major were more likely than those who declared a non-S&E major to remain enrolled in postsecondary education 3 years later *in any field* (i.e., the initially declared major or any other field). For example, 78% of natural sciences and engineering majors and 80% of social sciences majors were enrolled 3 years later, compared with 74% of non-S&E majors.

In contrast, a smaller proportion of students who declared majors in natural sciences and engineering (69%) or social and behavioral sciences (67%) remained enrolled *in their field* 3 years after beginning their postsecondary education, relative to students who declared non-S&E majors (82%). However, because more than half of students start in non-S&E or undeclared majors, the absolute number of students switching into S&E fields is larger than those switching out (National Science Board 2018).[39]

Graduate Degree Awards

S&E Master's Degrees

Master's degrees may fully prepare students for established career tracks in some S&E fields. In others, they primarily mark a step toward doctoral degrees. Between 2000 and 2017, master's degrees awarded in S&E fields more than doubled from about 96,000 to about 206,000. According to the U.S. Department of Education, this increase is projected to continue at least through 2028 (Hussar and Bailey 2019). Increases occurred in most major fields and were strongest in engineering, computer sciences, mathematics and statistics, and biological sciences. The numbers of master's degrees awarded in computer sciences and engineering declined between 2004 and 2007 but have since increased to their highest points in the last 17 years, with especially rapid growth since 2014. More information on S&E master's degrees is available in Table S2-8 and Table S2-9.[40]

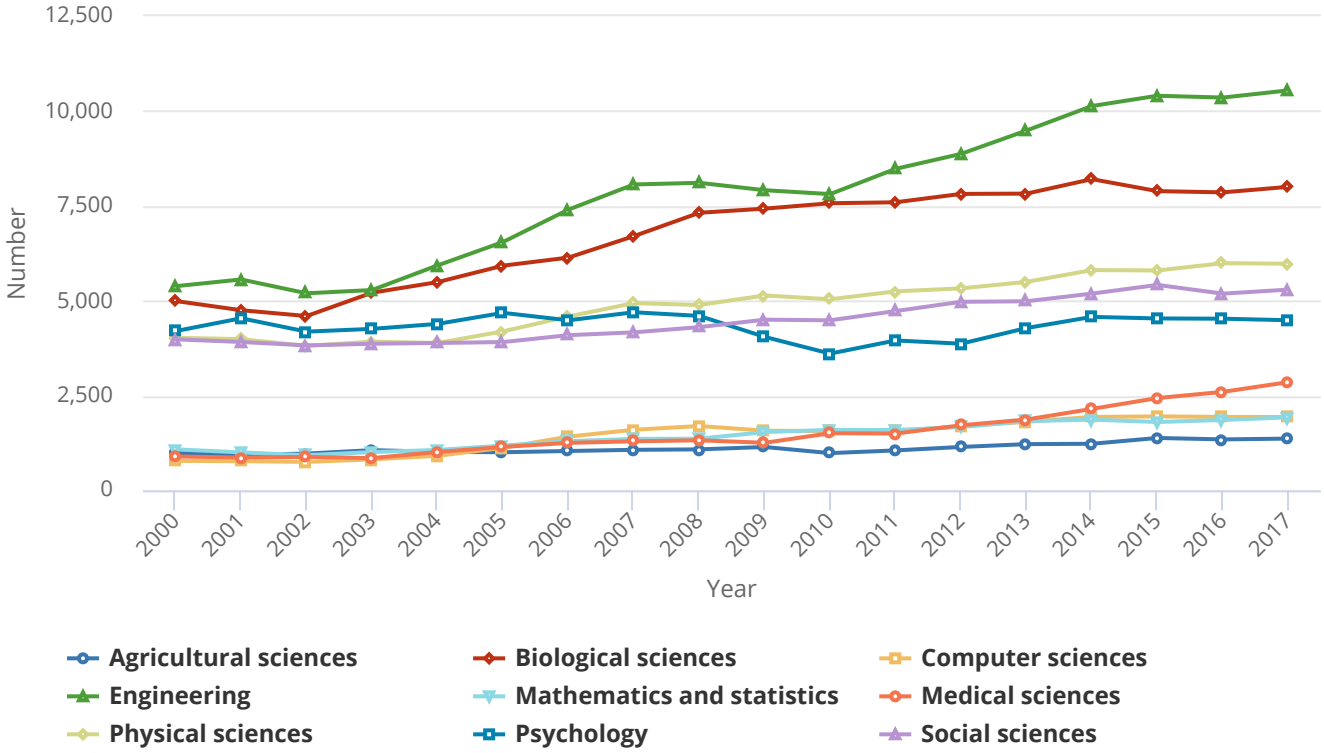
S&E Doctoral Degrees

Doctoral education in the United States generates new knowledge by closely linking specialized education and research experience. The results are important for U.S. competitiveness in a global knowledge-based economy and for society as a whole. Doctoral education prepares a new generation of researchers and a highly skilled workforce for academia, industry, government, and nonprofit organizations. The number of doctoral degrees awarded is projected to continue increasing at least through 2028 (Hussar and Bailey 2019).

S&E fields account for the majority (64%) of doctorates conferred by U.S. universities. During 2000–17, the number of U.S. S&E doctorates conferred annually increased from around 28,000 to 46,000, faster than the rise in total doctorate awards (from nearly 45,000 in 2000 to more than 71,000 in 2017) (Table S2-10 and Table S2-11). Across fields, the biggest percentage increases occurred in engineering, computer sciences, and medical sciences (**Figure 2-7**).[41]

FIGURE 2-7

S&E doctoral degrees awarded, by field: 2000–17



Note(s)
Physical sciences include earth, atmospheric, and ocean sciences. Data differ from doctoral degree data in other tables and figures in this report that are based on the National Science Foundation Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical sciences.

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey; National Center for Science and Engineering Statistics, National Science Foundation, Integrated Data System (IDS).

Science and Engineering Indicators

Since 2000, public universities experienced large increases in doctoral degree awards and in 2017 awarded most doctoral degrees in S&E fields (67%) and in all fields (61%).[42] The 115 "highest research activity" doctoral universities award most doctoral degrees across virtually all fields of study (Table S2-1). In 2017, these institutions awarded nearly 45,000 total doctorates (63% of all doctorates) and nearly 33,000 S&E doctorates (72% of all S&E doctorates). Although still small, the number of S&E doctorates awarded by for-profit institutions (across all classification types) increased fivefold between 2000 and 2017, from about 400 to nearly 2,000 (4% of S&E doctorates).

Time to Doctoral Degree Completion

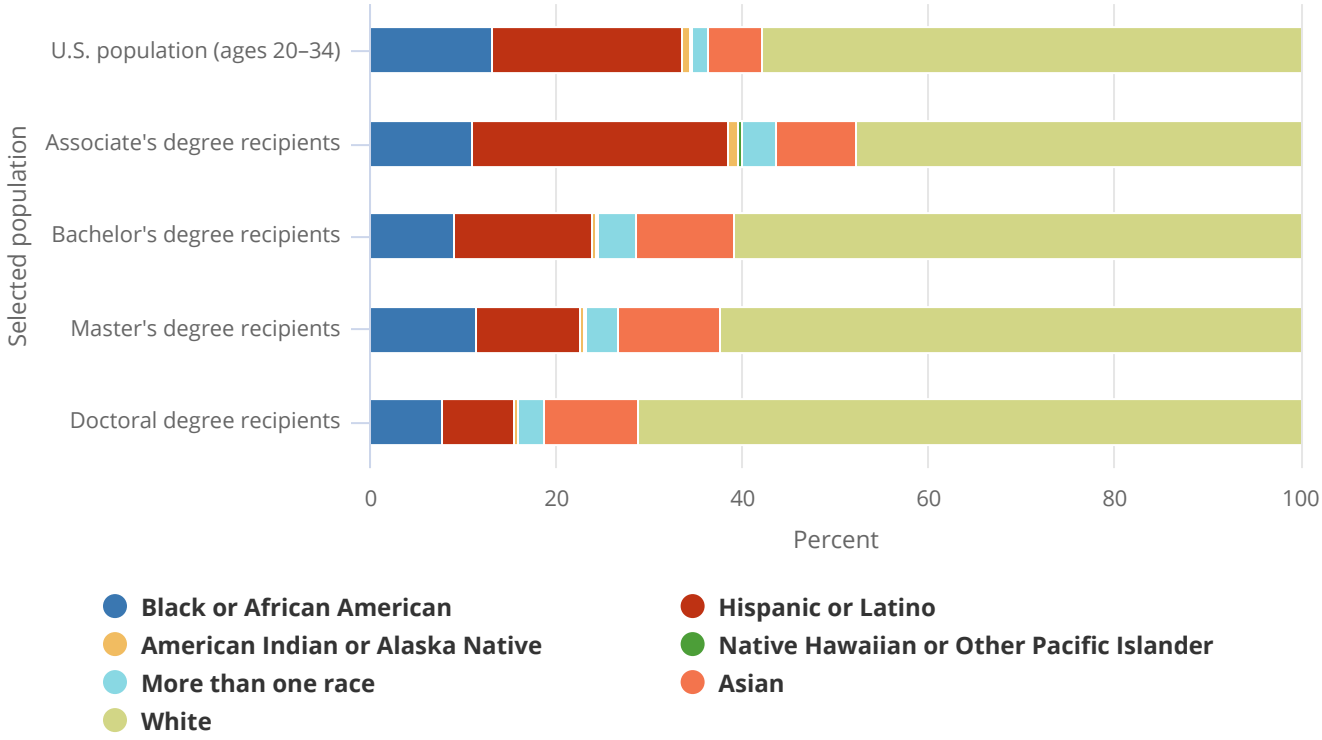
The time required to earn a doctoral degree has important implications for those pursuing a degree, the universities awarding the degree, and the agencies and organizations funding doctoral study. Median time to degree (as measured by time from graduate school entry to doctorate receipt) varies across fields. For 2017, in S&E, the median ranged from 6.2 years for physical sciences and earth sciences to 7.8 years in psychology and social sciences (NCSES ***SED 2017***: **Table 31**). Times in non-S&E fields are longer. However, across all fields, median time to degree has decreased over the last 10 years. Median time to degree varies by demographic group (NCSES ***SED 2017***: **Table 32**), but these variations largely reflect differences among broad fields of study.

Demographic Attributes of S&E Degree Recipients

The presence of certain groups among S&E degree recipients differs from their overall representation in the U.S. population (**Figure 2-8**).[43] Under- or overrepresentation by sex and racial or ethnic group varies by field of study and degree level (NCSES 2019b).[44,45]

FIGURE 2-8

Representation of racial and ethnic groups in the U.S. population and among S&E degree recipients: 2017



Note(s)
Hispanic may be any race; race categories exclude Hispanic origin. U.S. population data reflect the percentage of people in each racial and ethnic group in the U.S. population between ages 20 and 34 on 1 July 2017. Degree totals may differ from those elsewhere in the report; degrees awarded to people of unknown or other race were excluded.

Source(s)
U.S. population data from the U.S. Census Bureau. Degree data from National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey.

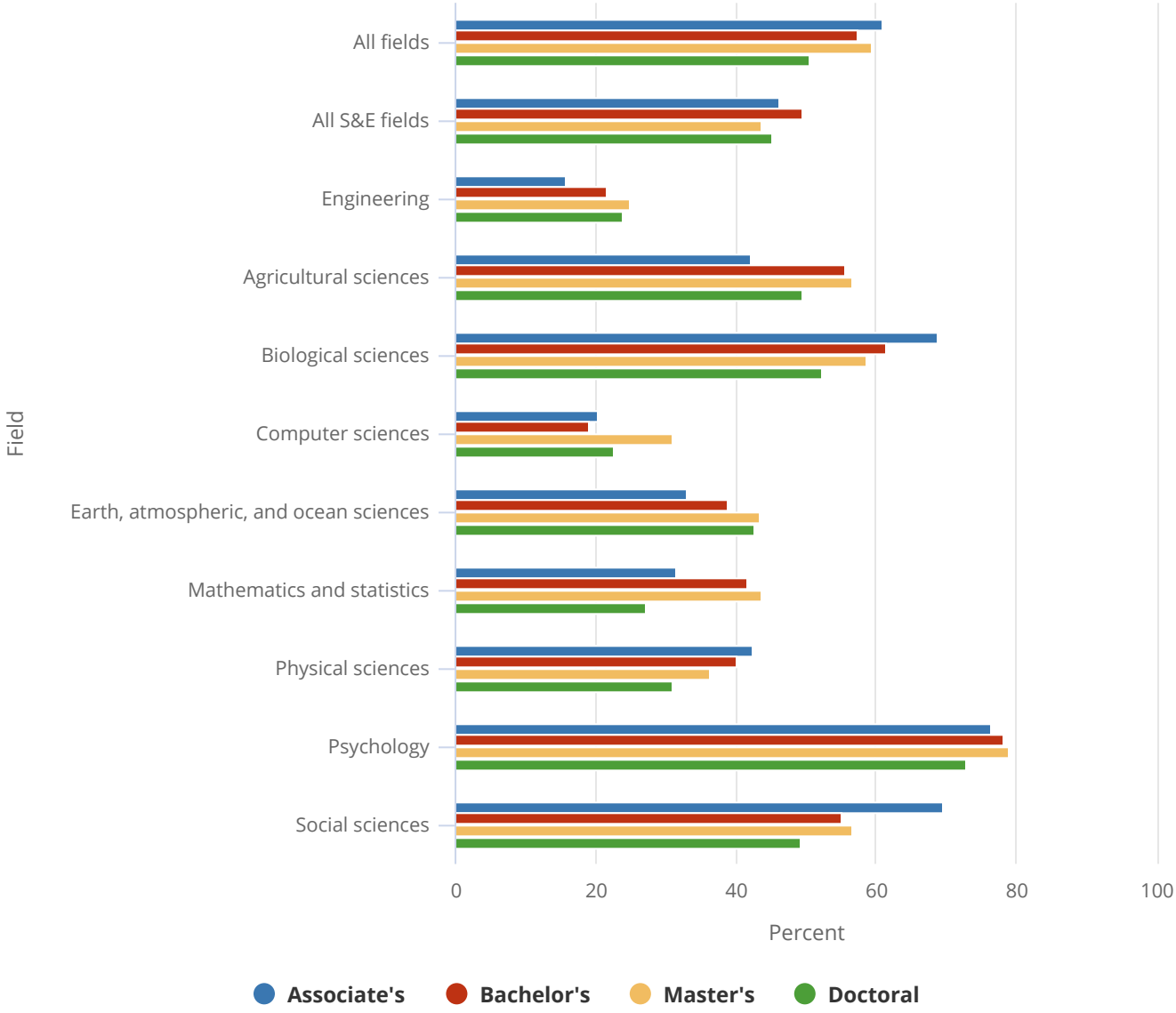
Science & Engineering Indicators

S&E Degrees by Sex

On average, women earn half or more of associate's, bachelor's, master's, and doctoral degrees overall; in S&E fields, their shares are lower (**Figure 2-9**; see also Table S2-4, Table S2-6, Table S2-8, and Table S2-10). Long-standing differences between men and women persist in some fields but are gradually diminishing in others.

FIGURE 2-9

S&E degrees awarded to women, by degree level and field: 2017



Note(s)
Doctoral degree data in this figure differ from doctoral degree data in other tables and figures in this report that are based on the National Science Foundation Survey of Earned Doctorates and that refer to research doctorates only.

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey.

Science and Engineering Indicators

Historically high-participation S&E fields for women include psychology, biological sciences, and social sciences. In 2017, women earned about half or more degrees awarded at all degree levels in these fields. Historically low S&E participation fields include engineering; earth, atmospheric, and ocean sciences; computer sciences; mathematics and statistics; and physical sciences. Women's participation in these fields varies. The physical (low participation) and social (high participation) sciences include fields where women's participation rates differ from the overall trends. In chemistry, for example, women approached near parity with men at the bachelor's and master's levels, but not at the doctoral level. In economics, women earned around one-third of bachelor's and doctoral degrees.

Since 2000, women's overall share of S&E bachelor's degrees has remained at about half, although the trend over time varies across fields. In computer sciences and mathematics and statistics, the number of women earning bachelor's degrees increased during this interval; the number of men, however, grew at a faster rate than the number of women, resulting in an overall decline in women's share from 28% to 19% in computer sciences and from 48% to 42% in mathematics and statistics (Table S2-6).

Unlike S&E bachelor's-level degrees, the share of doctoral degrees received by women increased across virtually all S&E fields since 2000 (Table S2-10). Overall, S&E doctorates earned by women increased from 11,000 (39%) in 2000 to 21,000 (45%) in 2017. Women earned more than half of doctorates in most social sciences fields and in biological and medical sciences in 2017. Women earned about one-quarter of doctoral degrees in engineering in 2017, up from 16% in 2000; however, there was variability across engineering fields. Women earned relatively low shares of doctoral degrees in computer sciences (23%) and mathematics and statistics (27%).[46]

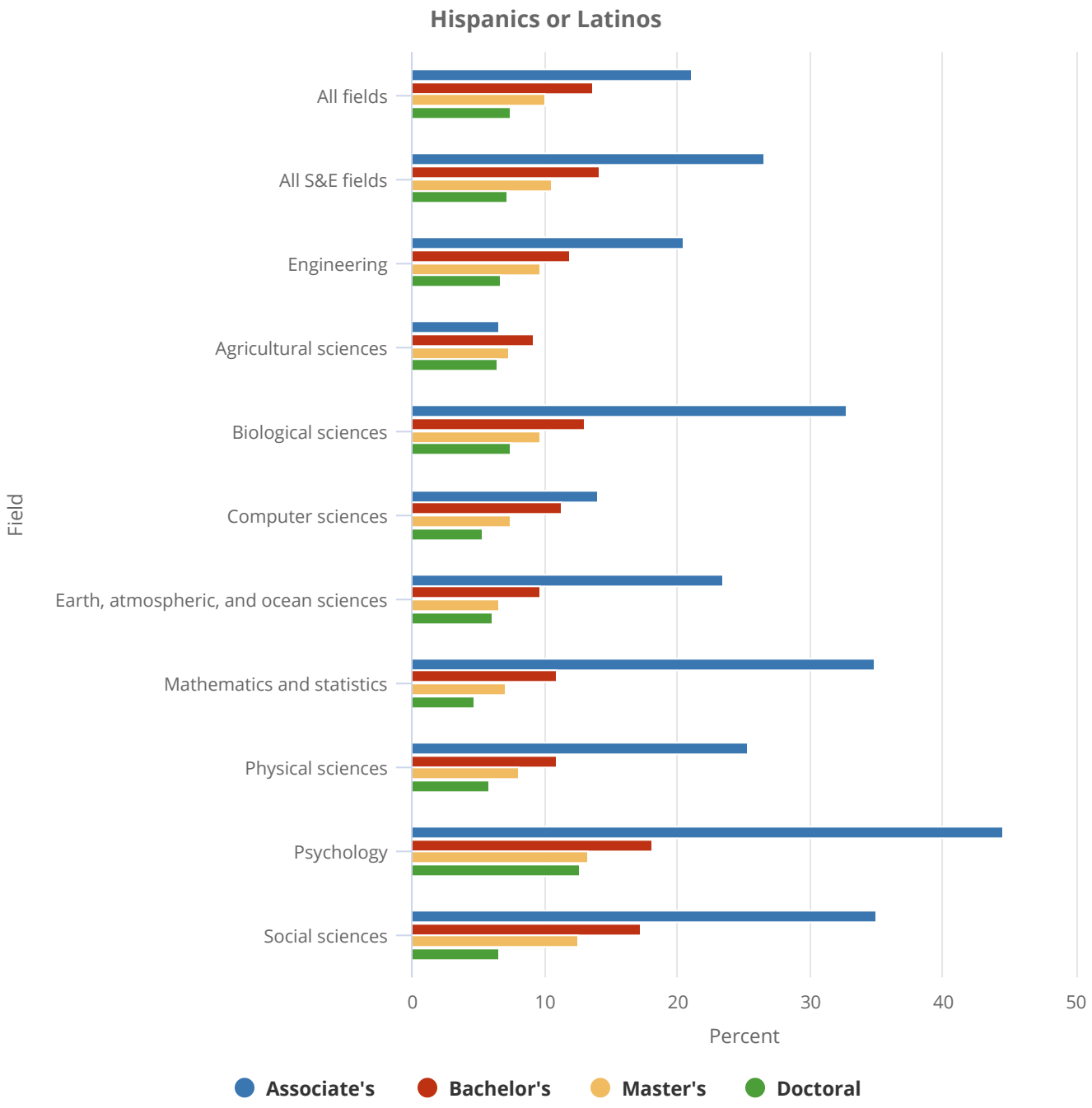
S&E Degrees by Race and Ethnicity

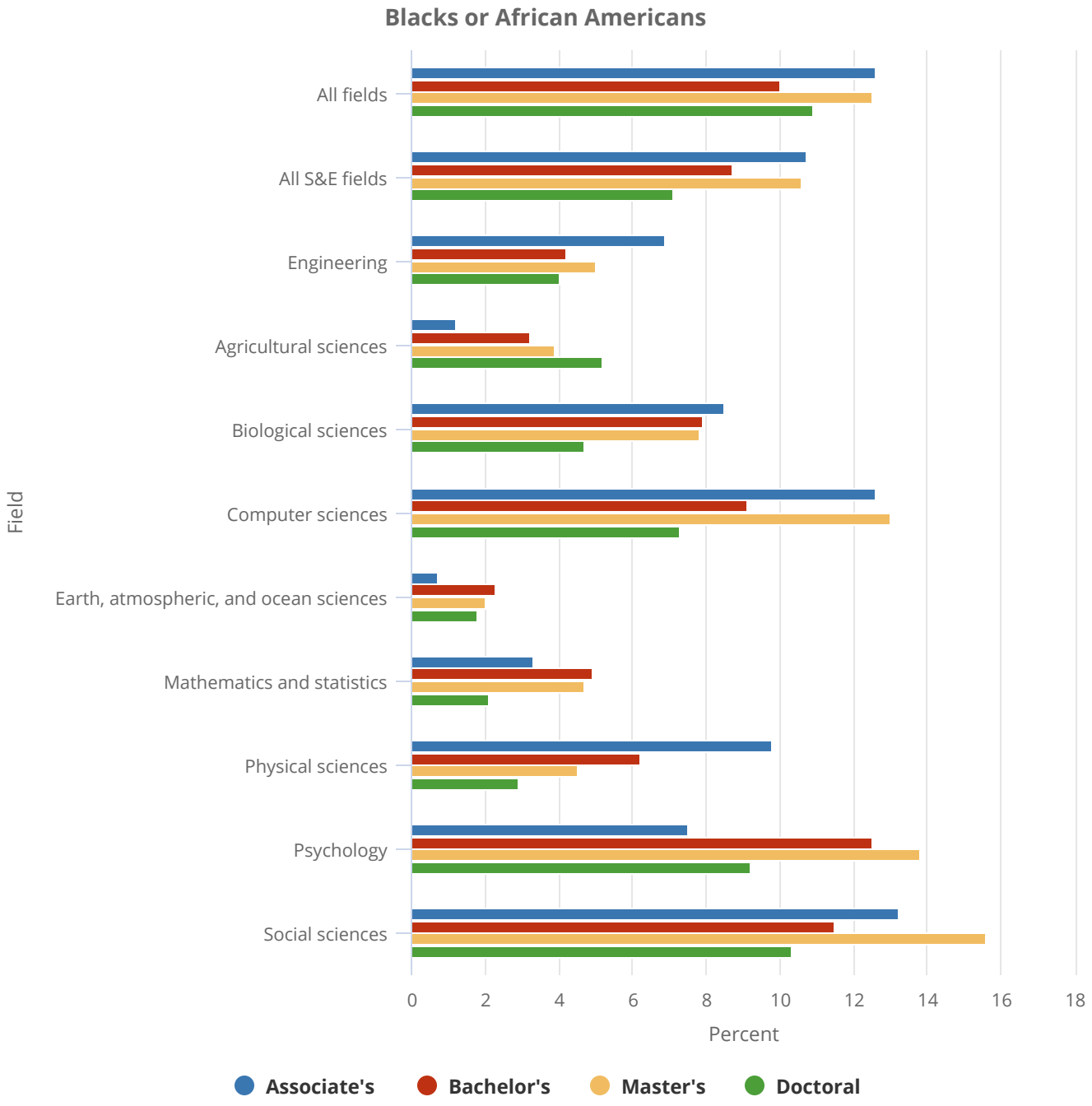
The racial and ethnic composition of S&E degree recipients has changed over time, reflecting population changes and increasing rates of higher education attainment by members of underrepresented minority groups. The gap in educational attainment has narrowed across racial and ethnic groups, but it remains. In 2017, the percentage of people ages 25–29 with a bachelor's or higher-level degree in any field differed among blacks (23%), Hispanics (19%), and whites (42%) (Snyder et al. ***Digest of Education Statistics 2017***: **Table 104.20**). These gaps in many cases reflect lower rates of high school completion, college enrollment, and degree attainment. (For information on immediate post–high school college enrollment rates, see the *Science and Engineering Indicators 2020* report "**Elementary and Secondary Mathematics and Science Education**.")

Racial and ethnic groups vary in S&E degree attainment levels. In most fields, Hispanics earn substantially larger proportions of S&E associate's degrees than bachelor's and higher degrees. Blacks, by contrast, do so in only some S&E fields (**Figure 2-10**). Since 2000, the share of S&E bachelor's degrees awarded annually to Hispanic students nearly doubled while the share awarded to black students remained flat. The share awarded to Asians increased slightly, and the share awarded to American Indians or Alaska Natives dropped (absolute numbers also declined). While the number of S&E bachelor's degrees earned by white students increased between 2000 and 2017 (Table S2-7), their overall share declined (**Figure 2-11**). The number of degrees earned by students of more than one race and other or unknown race or ethnicity, increased from 14,000 to 48,000 during this period.[47]

FIGURE 2-10

S&E degrees awarded to Hispanics or Latinos and blacks or African Americans, by degree level and field: 2017





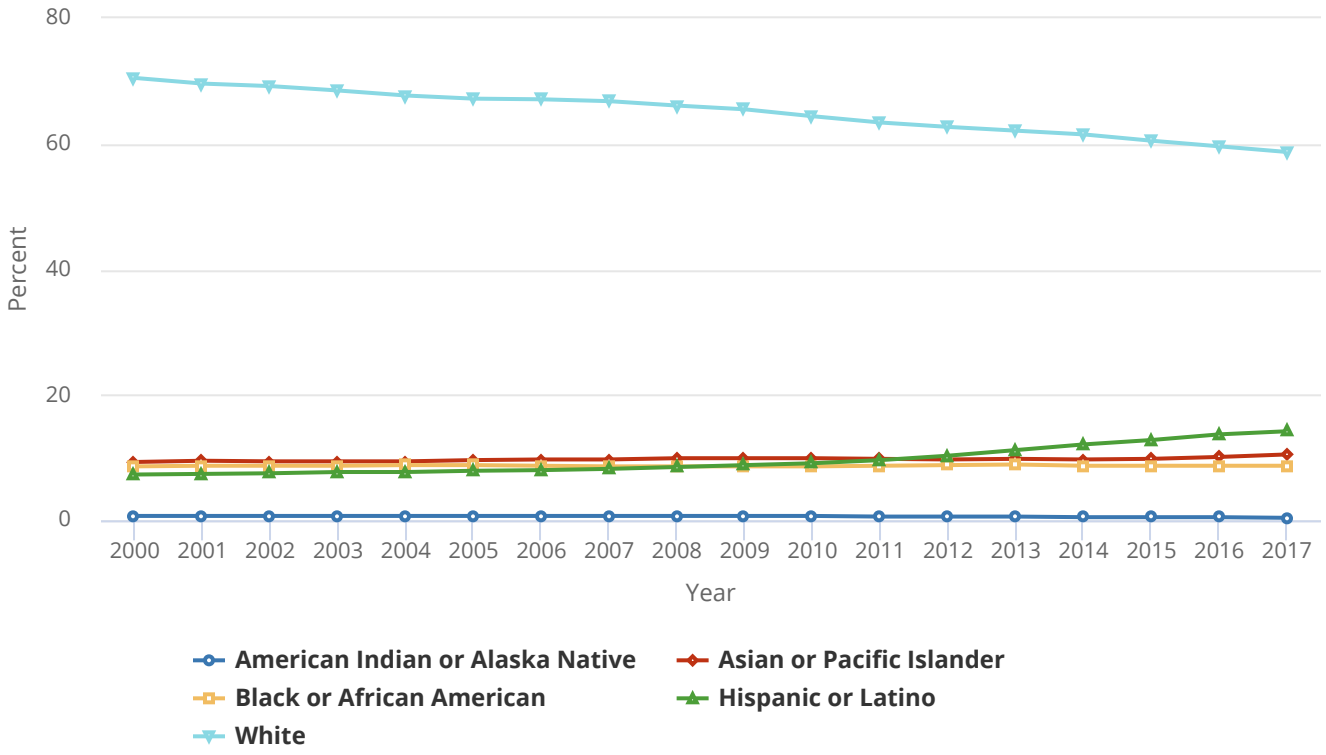
Note(s)
Hispanic may be any race; race categories exclude Hispanic origin. Doctoral degree data in this figure differ from doctoral degree data in other tables and figures in this report that are based on the National Science Foundation Survey of Earned Doctorates and that refer to research doctorates only. The greatest differences are in psychology, education, and medical and other life sciences. These data reflect totals for U.S. citizens and permanent residents at all degree levels.

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey.

Science and Engineering Indicators

FIGURE 2-11

Share of S&E bachelor's degrees awarded to U.S. citizens and permanent residents, by race and ethnicity: 2000–17



Note(s)
Hispanic may be any race; race categories exclude Hispanic origin. Percentages may not add to total because data do not include people who did not report their race and ethnicity and those who reported more than one race.

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey; National Center for Science and Engineering Statistics, National Science Foundation, Integrated Data System (IDS).

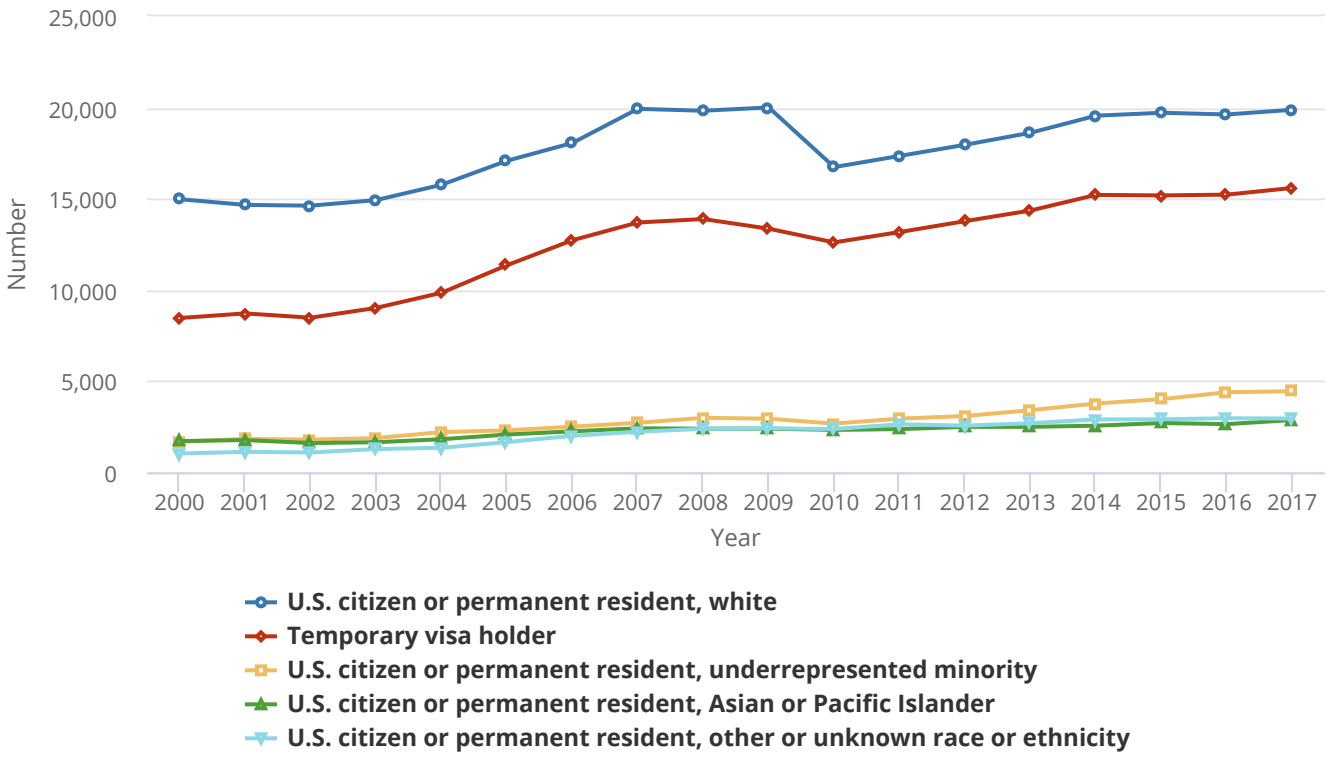
Science and Engineering Indicators

Social sciences and psychology were the most common S&E bachelor's degree fields among many racial and ethnic groups. Engineering degrees were more common among Asians and whites than among other groups. Asians were also more likely to earn biological sciences bachelor's degrees compared with other groups (Table S2-7).

Many of these trends over time are similar for doctoral degree awards. Overall, underrepresented minorities—blacks, Hispanics, and American Indians or Alaska Natives—earned more S&E doctorates in 2017 compared with 2000 (**Figure 2-12** and **Figure 2-13**, Table S2-11). In 2017, blacks and Hispanics collectively earned 14% of S&E doctorates (up from 8% in 2000). In comparison, Asians earned about 9% of S&E doctorates in 2017 (unchanged from 2000), while whites earned 66% (down from 77% in 2000). S&E doctorates as a percentage of total doctorates varied across racial and ethnic groups: from a low of 38% for blacks to a high of 75% for Asians.

FIGURE 2-12

S&E doctoral degrees awarded, by race, ethnicity, and citizenship: 2000–17



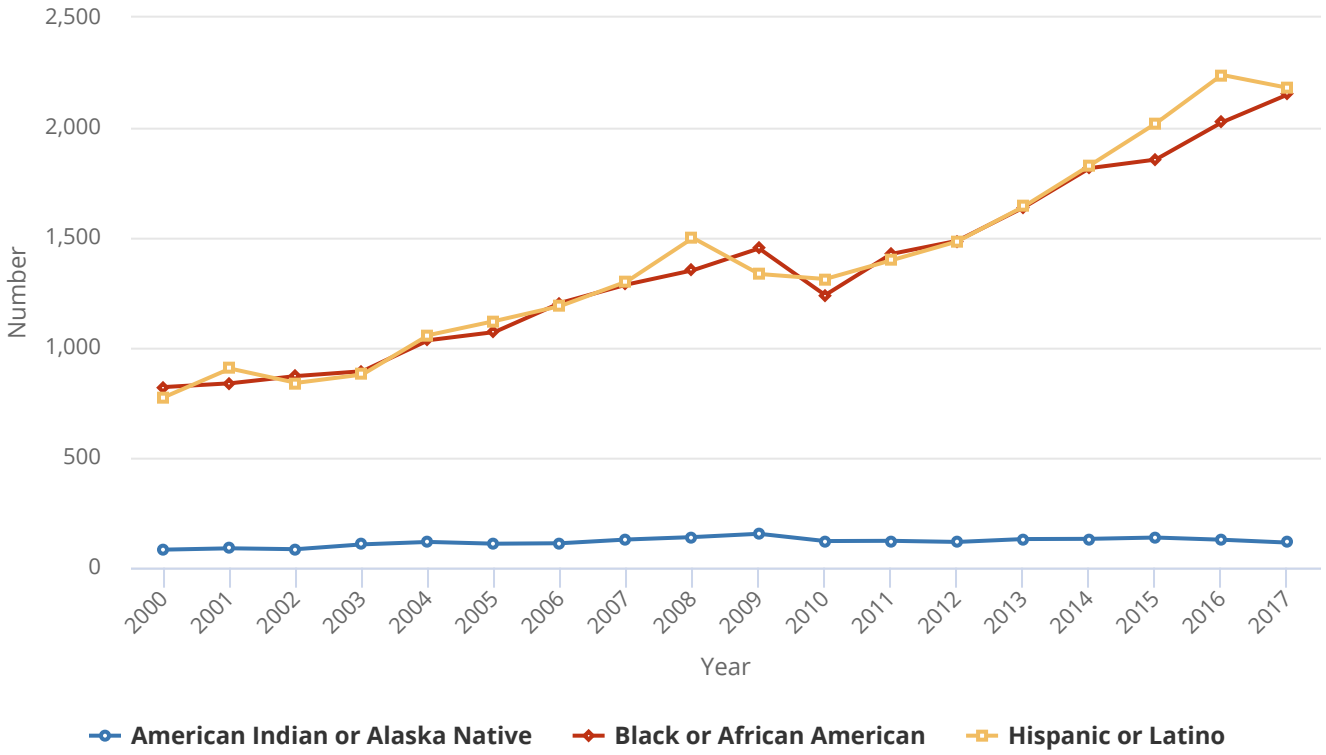
Note(s)
Underrepresented minority includes American Indian or Alaska Native, black or African American, and Hispanic or Latino. Hispanic may be any race; race categories exclude Hispanic origin. Doctoral degree data differ from doctoral degree data in other tables and figures in this report that are based on the National Science Foundation Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical or other health sciences. The large drop in U.S. data in 2009 is due to the change in doctoral categories in the survey.

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey; National Center for Science and Engineering Statistics, National Science Foundation, Integrated Data System (IDS).

Science and Engineering Indicators

FIGURE 2-13

S&E doctoral degrees awarded to U.S. citizen and permanent resident underrepresented minorities, by race and ethnicity: 2000–17



Note(s)
Doctoral degree data in this table data differ from data found in other tables and figures in this report that are based on the National Science Foundation Survey of Earned Doctorates and that refer to research doctorates only. Greatest differences are in psychology and medical or other health sciences. Hispanic may be any race; race categories exclude Hispanic origin. The large drop in 2009 is due to the change in doctoral categories in the survey.

Source(s)
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey; National Center for Science and Engineering Statistics, National Science Foundation, Integrated Data System (IDS).

Science and Engineering Indicators

Racial and ethnic groups also vary in their fields of doctoral degree (Table S2-11). In 2017, the top field for black recipients was medical and other health sciences (32% of S&E doctorates awarded to blacks), followed by psychology (18%), biological sciences (13%), and political science and public administration (9%). Psychology is the top field for Hispanics (24%), followed by biological sciences (20%), engineering (14%), and medical and other health sciences (14%). For Asians, the top fields are engineering and biological sciences (24% each), followed by medical and other health sciences (15%) and psychology (8%).[48]

Blacks were more likely to earn S&E doctorates at for-profit institutions (in 2017, 25% did so, compared with 7% of Hispanics, 4% of whites, and 3% of Asians). While the number of S&E doctorates earned by blacks from "highest research activity" doctoral universities rose from about 500 in 2000 to more than 850 in 2017, the percentage of blacks who earned doctorates from these institutions declined from 61% to 40% during this time.

S&E Degrees by Race, Ethnicity, and Sex

In 2017, underrepresented minority women earned more than half of their racial or ethnic group's S&E bachelor's degrees, whereas white and Asian women earned slightly less than half (Table S2-12).[49] Similarly, women earned more than half of the S&E doctorates across all groups except whites, where they earned 49%.

Within fields, differences between men and women appear to hold across racial and ethnic groups. Women in all racial and ethnic groups earned most bachelor's degrees awarded in social and behavioral sciences and about half of bachelor's degrees awarded in natural sciences (ranging from 45% for whites to 53% for blacks). However, the difference in the number of bachelor's degree awards between women and men is especially high in engineering across all racial and ethnic groups. Among blacks, the proportion of bachelor's degree awards in engineering that went to women declined from 36% to 25% between 2000 and 2017; in natural sciences, it declined from nearly 60% in 2000 to 53% in 2017 (in both cases, however, absolute numbers of women earning doctorates increased).

International S&E Higher Education

In the 1990s, many countries, coming to view an educated population and workforce as a valuable national resource, began to expand their higher education systems. Flows of students worldwide increased, often reflecting government incentives and programs. More recently, several countries have adopted policies to encourage the return of students who studied abroad, attract international students, or both. Students who enroll in tertiary (postsecondary) institutions outside their own countries have opportunities to expand their knowledge of other societies and languages and improve their employability in globalized labor markets.

This section provides data on international students in U.S. institutions (enrollment and degrees earned) and the U.S. position in higher education within a global context. The data show a recent decline in overall international student enrollment in U.S. institutions. Data on degree awards, however, show that more foreign students continue to earn U.S. S&E degrees.[50] Foreign students on temporary visas earn a substantial proportion of U.S. doctoral degrees in S&E fields such as engineering, computer sciences, and economics. The global emphasis on building S&E capabilities is evident in international data: China has seen a rapid increase in its S&E degree production over time, compared with a more moderate rise in the United States and the EU.

International Students in U.S. Higher Education: Enrollment

In fall 2018, about 804,400 international students enrolled in degree programs in U.S. higher education institutions (**Table 2-3**).[51] Although these students possess citizenship from 225 countries or economies of origin, 4 countries—China, India, South Korea, and Saudi Arabia—were the top senders of undergraduate and graduate students, accounting for more than half of the total (**Figure 2-14**).

TABLE 2-3

International students enrolled in U.S. higher education institutions, by broad field and academic level: 2012–18

(Number)

Broad field and academic level	2012	2013	2014	2015	2016	2017	2018
All fields							
All levels	633,070	673,480	747,400	776,720	840,160	808,640	804,420
Undergraduate	349,400	371,990	405,930	416,350	450,850	440,720	435,260
Graduate	283,680	301,490	341,470	360,380	389,310	367,920	369,150
S&E fields							
All levels	278,180	305,610	355,910	384,540	420,610	406,240	413,040
Undergraduate	115,800	130,050	147,790	157,820	176,570	176,930	179,440
Graduate	162,390	175,570	208,110	226,720	244,040	229,310	233,600
Non-S&E fields							
All levels	354,890	367,870	391,500	392,190	419,550	402,400	391,380
Undergraduate	233,600	241,950	258,140	258,520	274,280	263,790	255,830
Graduate	121,290	125,920	133,360	133,660	145,270	138,610	135,550

Note(s)

Data include active foreign national students on F-1 visas and exclude those on optional practical training. Undergraduate level includes associate's and bachelor's degrees; graduate level includes master's and doctoral degrees. Numbers are rounded to the nearest 10. Detail may not add to total because of rounding. The data reflect fall enrollment in a given year and include students with "active" status as of 15 November of that year.

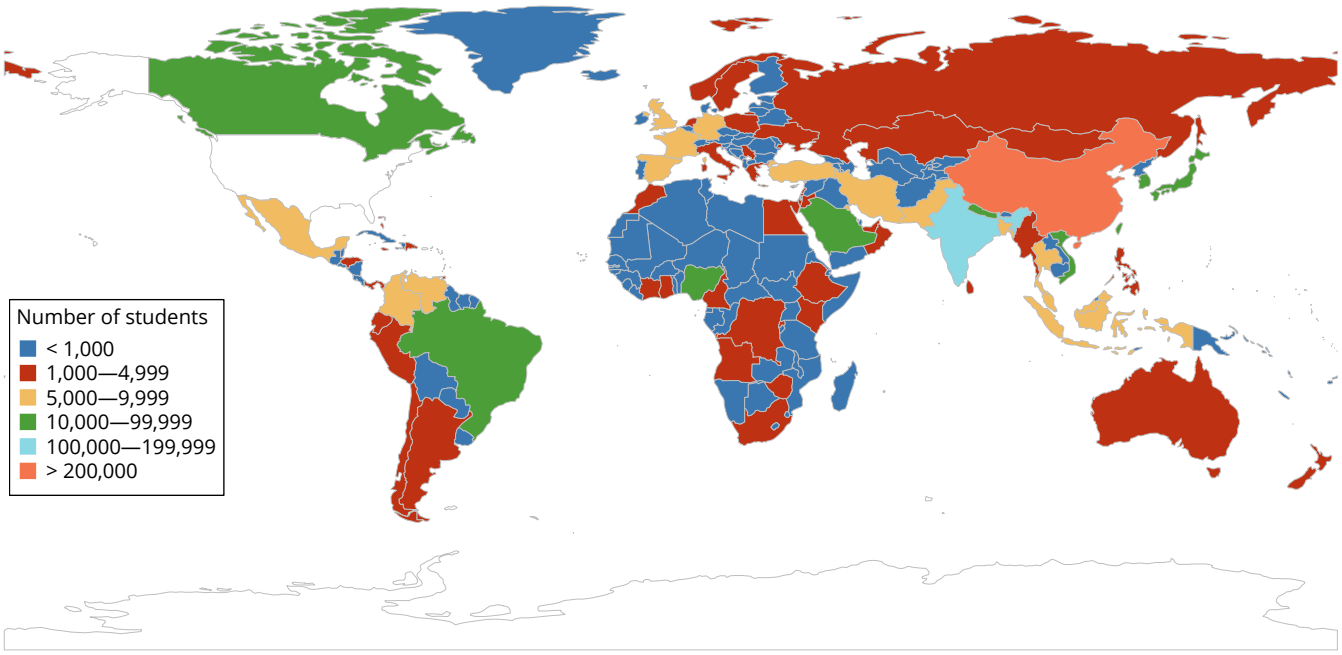
Source(s)

U.S. Department of Homeland Security, U.S. Immigration and Customs Enforcement, special tabulations (2018) of the Student and Exchange Visitor Information System (SEVIS) database.

Science and Engineering Indicators

FIGURE 2-14

International students enrolled in U.S. higher education institutions, by region, country, or economy of origin: 2018



Note(s)
Data include active foreign national students on F-1 visas and exclude those on optional practical training. Undergraduate level includes associate's and bachelor's degrees; graduate level includes master's and doctoral degrees. The data reflect fall enrollment in a given year and include students with "active" status as of 15 November of that year. Figure shading represents the natural log of the number of students.

Source(s)
U.S. Department of Homeland Security, U.S. Immigration and Customs Enforcement, special tabulations (2018) of the Student and Exchange Visitor Information System (SEVIS) database.

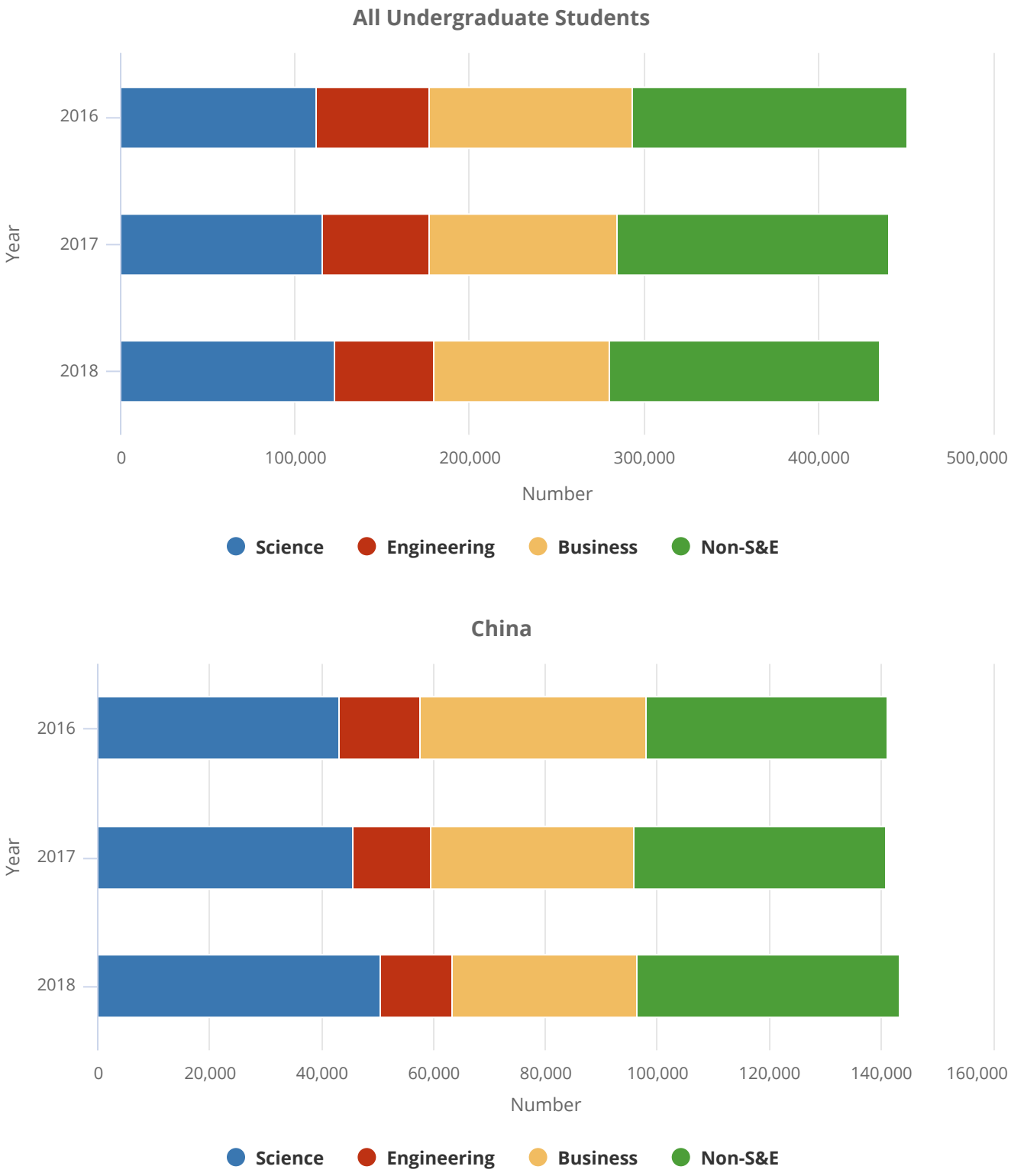
Science and Engineering Indicators

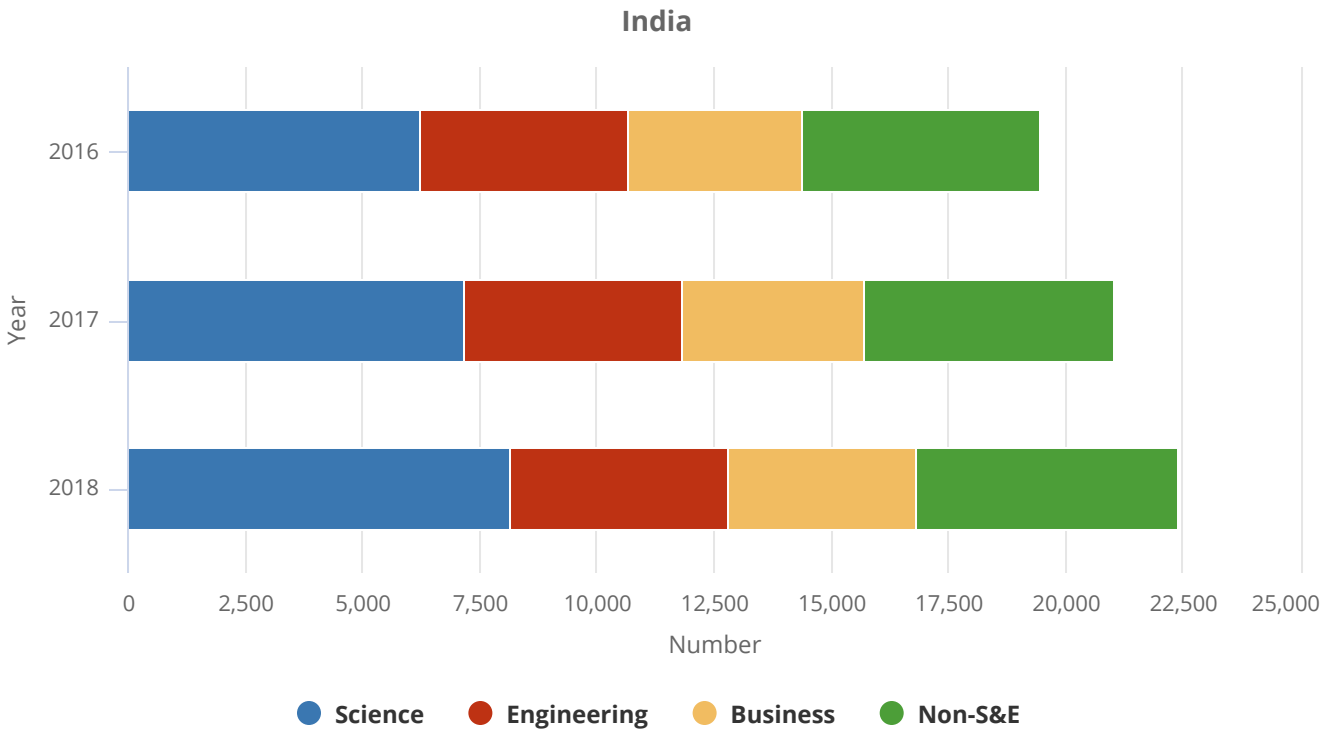
Between 2017 and 2018, the number of international students declined by about 4,000 (less than 1%).[52] This represents a second year of decline but is smaller than the decline of about 31,500 students (nearly 4%) between 2016 and 2017. Underlying this overall decline is a mixed picture that varies by student level, field of study, and country of origin.

In 2018, just over half of all international students were enrolled at the undergraduate level (mostly in bachelor's degree programs). Between 2017 and 2018, the number of international undergraduate students declined (by about 5,500 or just over 1%); however, the number studying S&E fields increased (by about 2,500 or just over 1%), after holding essentially flat between 2016 and 2017 (**Table 2-3**, **Figure 2-15**). The rise in S&E enrollment was driven by rising enrollment in science; by contrast, enrollment declined in engineering for the second year in a row (Table S2-13). Among the top five countries sending undergraduates to study engineering, only Vietnam saw consistent increases in the numbers over the last 2 years (Table S2-13).[53]

FIGURE 2-15

International undergraduate students enrolled in U.S. higher education institutions, by broad area of study: 2016–18





Note(s)
Data include active foreign national students on F-1 visas and exclude those on optional practical training. Undergraduate level includes associate's and bachelor's degrees. Numbers are rounded to the nearest 10. Detail may not add to total because of rounding. The data reflect fall enrollment in a given year and include students with "active" status as of 15 November of that year.

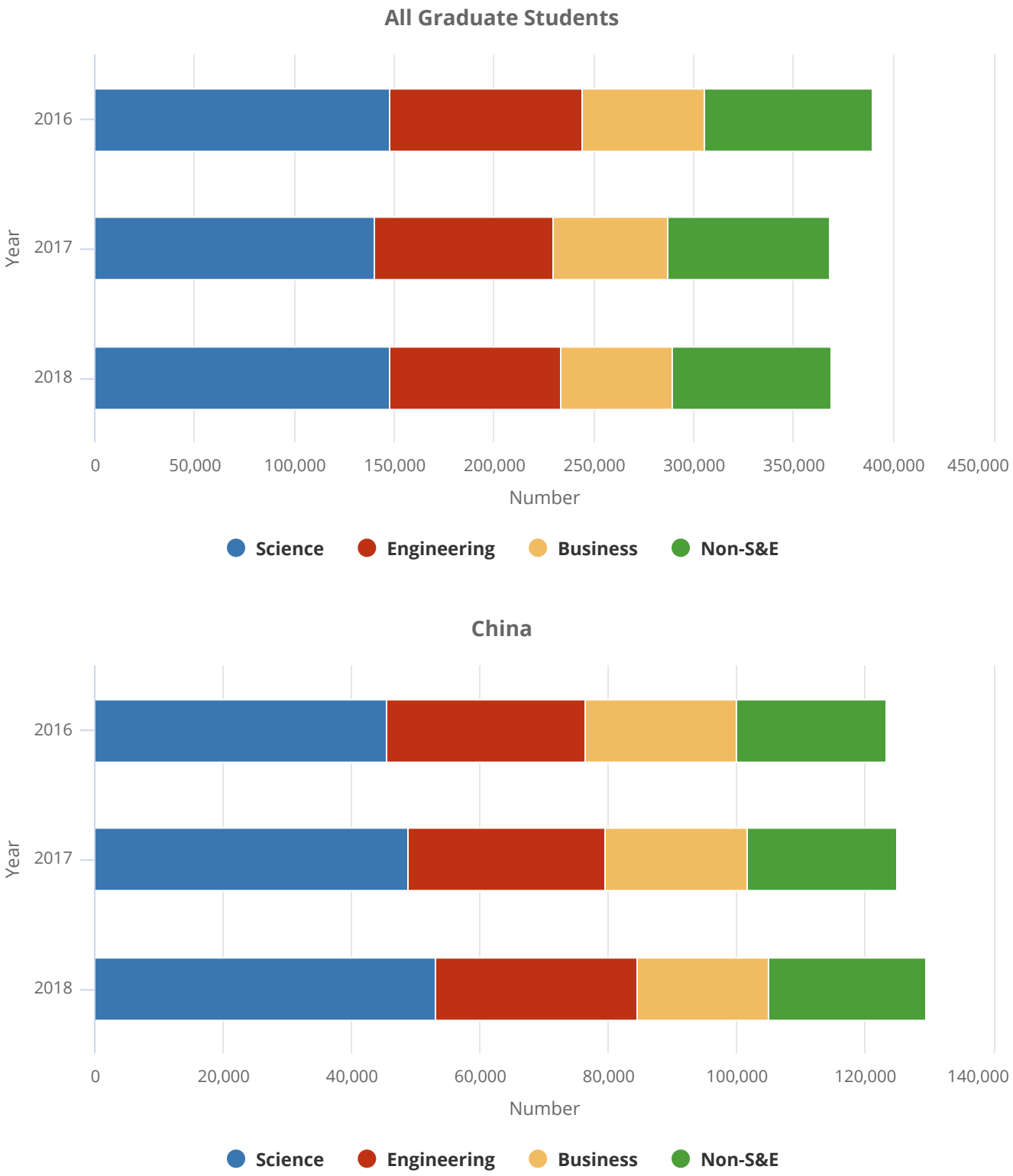
Source(s)
U.S. Department of Homeland Security, U.S. Immigration and Customs Enforcement, special tabulations (2018) of the Student and Exchange Visitor Information System (SEVIS) database.

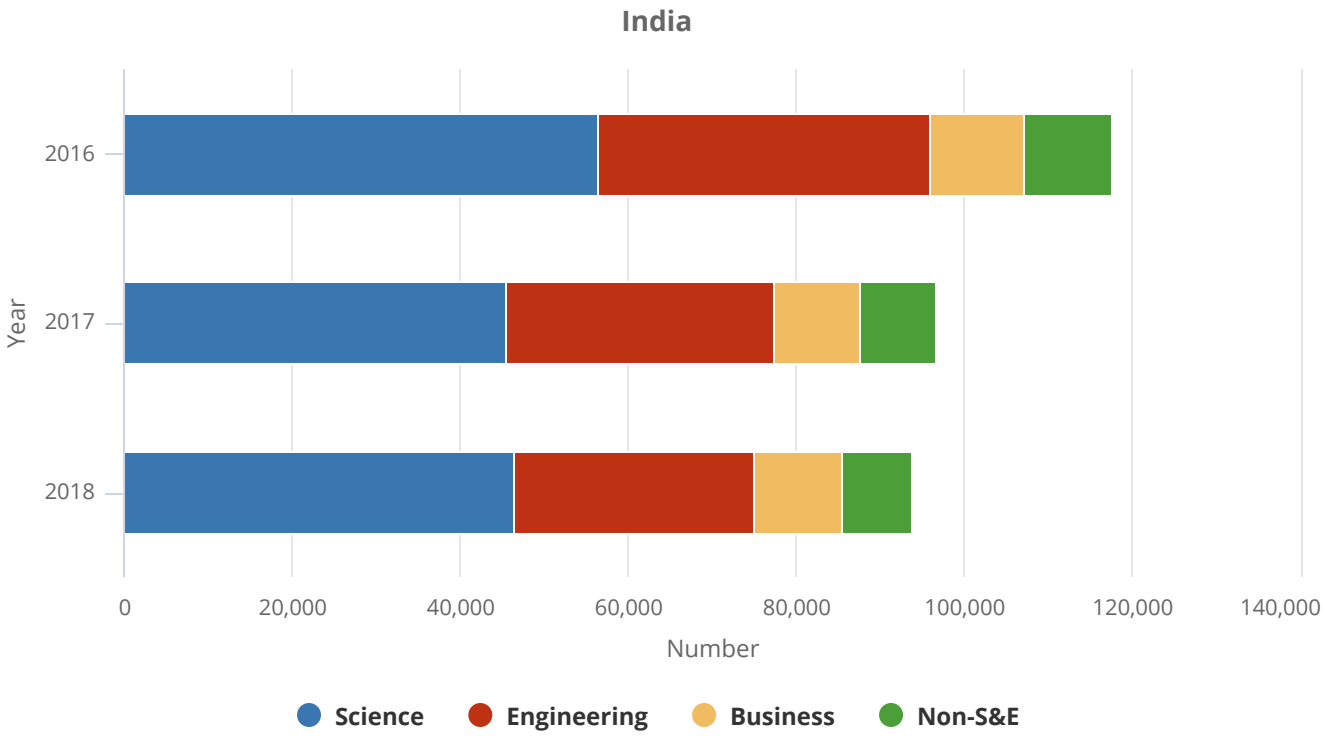
Science and Engineering Indicators

Unlike undergraduate enrollment, international graduate student enrollment rose slightly from 2017 to 2018 (from 368,000 to 369,000) after a considerable decline (6%) between 2016 and 2017.[54] The number studying S&E fields also increased (by 2%) (**Table 2-3**). Although these increases do not erase the declines of the previous year, they call into question whether those declines represent a trend. As is the case for undergraduates, the rise in S&E graduate enrollment was driven by those studying science fields, whose numbers increased back to 2016 levels. The number of those studying engineering, however, declined for the second year in a row. Since 2016, countries like Iran and Saudi Arabia have seen declines in the numbers of graduate students, especially in engineering. But China and India, and the contrast between them, dominate the story because of the large numbers of students from those countries who study in the United States (**Figure 2-16**, Table S2-14).

FIGURE 2-16

International graduate students enrolled in U.S. higher education institutions, by broad area of study: 2016–18





Note(s)
Data include active foreign national students on F-1 visas and exclude those on optional practical training. Graduate level includes master's and doctoral degrees. Numbers are rounded to the nearest 10. Detail may not add to total because of rounding. The data reflect fall enrollment in a given year and include students with "active" status as of 15 November of that year.

Source(s)
U.S. Department of Homeland Security, U.S. Immigration and Customs Enforcement, special tabulations (2018) of the Student and Exchange Visitor Information System (SEVIS) database.

Science and Engineering Indicators

The number of Chinese S&E graduate students at U.S. institutions has increased by more than 8,000 (11%) since 2016, with the largest gains in computer sciences and mathematics and statistics. India's numbers, during the same interval, declined sharply, by nearly 21,000 (22%). In 2016, India sent the most students to study engineering, surpassing China by nearly 9,000. China has now surpassed India as the largest sender of graduate students in engineering, largely due to a major reduction in the number of Indian engineering graduate students (a 28% decline) during this interval.

International Students in U.S. Higher Education: Degrees Earned

S&E Bachelor's Degrees

Students in the United States on temporary visas have consistently earned a small share (around 4%–6%) of S&E bachelor's degrees, although their total number more than doubled from 17,000 in 2009 to nearly 42,000 in 2017 (Table S2-7). In 2017, temporary visa holders earned a disproportionately large share of bachelor's degrees awarded in economics (18%), mathematics and statistics (17%), and engineering (10%). S&E fields account for nearly half (46%) of the bachelor's degrees earned by students on temporary visas.[55]

S&E Graduate Degrees

Students on temporary visas are earning increasing shares of U.S. master's degrees: 18% in 2017 compared with 12% in 2012 (Table S2-9; their total number increased from about 90,000 to more than 145,000 during this period).[56] Similar to bachelor's degrees, a considerable share of the master's degrees earned by students on temporary visas are in S&E fields (56% in 2017, up from 46% in 2012).

Trends at the doctoral level have remained stable for a longer time (Table S2-11). In 2017, students on temporary visas earned about one-quarter of U.S. doctorates awarded across all fields and one-third of those awarded in S&E, around the same as in 2008 (the total numbers for both groups have risen only modestly over the last 10 years). This relatively stable trend is also observed across all broad S&E fields, where the shares of doctorates awarded to temporary visa holders did not change much over the last 10 years.[57]

Temporary visa holders earn half or more of U.S. doctoral degrees in certain S&E fields. In 2017, temporary visa holders earned 57% of doctorates in engineering, reflecting a long-standing pattern. They also earned most doctorates in computer sciences (56%) and economics (59%), as well as nearly half of the doctorates in mathematics and statistics (49%) and physics (45%).

In terms of financing their doctoral education, S&E doctorate recipients on temporary visas were more likely to have an RA (49%) and less likely to use personal funds (2%) than their U.S. citizen and permanent resident peers (27% and 14%, respectively; see Table S2-3); this is a long-standing pattern.[58]

Countries of Origin for Doctorate Recipients

Top Countries and Fields

Since 2000, U.S. universities have awarded nearly a quarter of a million doctorates to temporary visa holders, the vast majority (around 85%) in S&E fields. Over that time, the top three countries—China, India, and South Korea—accounted for just over half (54%) of all international recipients of S&E doctoral degrees, and the top 25 countries accounted for nearly 85% (**Table 2-4**, **Figure 2-17**). For 16 of the top 25 countries, more than 80% of the students who earn doctorates in the United States did so in S&E fields. For 15 of the top 25 countries, engineering is the most popular S&E field: engineering doctorates constitute nearly 35% of total doctoral degrees earned by Chinese students at U.S. universities, for example. For India, the figure is nearly 40%, and for Iran, it is nearly 70%.

TABLE 2-4

Top 25 regions, countries, or economies of origin of U.S. doctorate recipients on temporary visas, by field: 2000–17

(Number)

Region, country, or economy	All fields	All S&E fields	Engineering	Agricultural sciences	Biological sciences	Computer sciences	Earth, atmospheric, and ocean sciences	Mathematics	Medical and other health sciences	Physical sciences	Psychology	Social sciences	Non-S&E
All regions, countries, or economies of origin (212 regions, countries, or economies)[a]	246,126	210,053	72,416	7,886	34,142	13,785	4,732	11,889	7,750	28,671	4,186	24,596	36,073
Top 25 regions, countries, or economies of origin	204,400	176,632	64,660	5,725	28,894	12,033	3,853	9,761	6,433	23,514	3,182	18,577	27,768
China[b]	71,864	66,690	24,714	1,748	11,879	4,962	1,623	4,874	1,492	10,923	598	3,877	5,174
India	31,069	29,050	12,222	775	5,933	2,399	343	756	1,396	3,432	274	1,520	2,019
South Korea	23,697	18,160	7,476	584	2,132	941	272	851	663	1,804	454	2,983	5,537
Taiwan	12,036	9,127	3,253	250	1,823	419	143	368	713	937	258	963	2,909
Canada	8,178	5,765	955	168	1,219	220	200	282	322	671	664	1,064	2,413
Turkey	7,959	6,629	2,814	226	590	451	78	338	50	662	144	1,276	1,330
Thailand	4,928	4,261	1,665	359	496	212	36	137	469	366	32	489	667
Iran	4,522	4,345	3,113	43	179	307	49	132	37	324	20	141	177
Japan	4,011	2,991	443	76	433	82	83	94	164	335	179	1,102	1,020
Mexico	3,700	3,131	831	402	440	114	110	190	73	287	36	648	569
Germany	3,523	2,746	474	70	447	169	123	213	63	469	134	584	777
Brazil	2,828	2,352	420	307	444	137	81	126	149	113	46	529	476
Russia	2,827	2,496	382	16	342	136	77	279	17	863	44	340	331
Italy	2,582	1,998	502	44	208	98	83	151	22	314	38	538	584
Colombia	2,410	2,028	651	133	397	54	94	105	58	178	34	324	382
Egypt	2,065	1,870	929	70	258	169	45	20	123	129	7	120	195
France	2,045	1,646	558	40	223	61	99	83	23	288	17	254	399
Romania	2,041	1,782	256	19	215	253	35	302	16	451	39	196	259
Saudi Arabia	1,938	1,384	498	51	146	149	37	49	201	72	15	166	554
United Kingdom	1,845	1,300	137	29	254	42	120	114	66	198	78	262	545
Jordan	1,743	1,519	636	66	155	136	s	84	178	144	s	101	224
Greece	1,711	1,511	557	43	167	217	25	98	37	182	31	154	200
Spain	1,634	1,032	258	28	141	50	39	50	37	104	16	309	602
Bangladesh	1,628	1,515	747	31	119	218	s	26	38	150	s	162	113
Argentina	1,616	1,304	169	147	254	37	27	39	26	118	12	475	312

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

[a] Excludes cases with unknown region, country, or economy of origin.

[b] China includes Hong Kong.

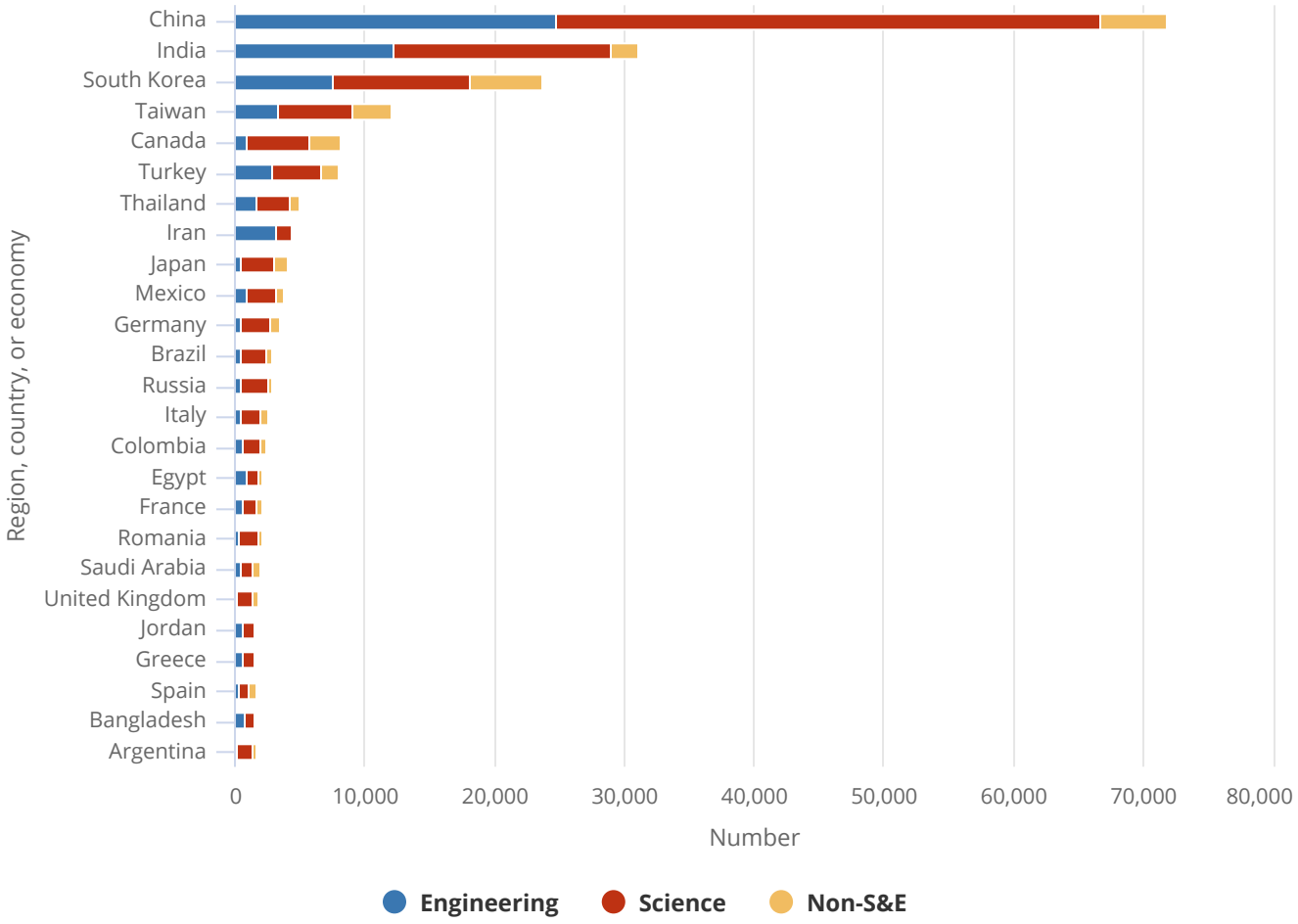
Note(s)
Data include temporary residents and non-U.S. citizens with unknown visa status. Rank is based on total number of doctorates.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2017 Survey of Earned Doctorates (SED).

Science and Engineering Indicators

FIGURE 2-17

Top 25 regions, countries, or economies of origin of U.S. doctorate recipients on temporary visas, by broad field: 2000–17



Note(s)
Data include temporary residents and non-U.S. citizens with unknown visa status. China includes Hong Kong.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2017 Survey of Earned Doctorates (SED).

Science and Engineering Indicators

Although students from South Korea earned only one-third of the number of doctorates earned by students from China between 2000 and 2017, they earned more non-S&E doctorates (about 5,500 for South Korea and 5,200 for China).

Canada and Mexico are in the top 10 countries where students earn doctorates in the United States. For Canadian students earning doctorates in the United States, the most popular S&E fields are biological and social sciences; for Mexican students, the most popular fields are engineering and social sciences.

Although 9 of the top 25 countries are European, only Turkey falls into the top 10. Students from Spain earn the highest percentage of doctorates in non-S&E fields of any of the top 25 countries, at more than 35%. Students from Russia and Romania focus heavily on physical sciences.

Trends

Between 2000 and 2008, the number of students earning doctorates at U.S. universities doubled to about 4,500 for China and nearly tripled to 2,300 for India. Since 2008, patterns for these two countries have diverged. Numbers of Chinese doctorate recipients have increased to nearly 5,600 in 2017. Numbers of Indian students have stayed relatively flat, with a slight decline over the last several years to about 2,000. South Korea saw an increase from about 1,000 students earning doctorates in the United States in 2000 to about 1,500 in 2009. Since then, numbers have slowly declined to about 1,100 in 2017. One other notable trend is an increase in the number of doctorate recipients from Iran, rising steadily from about 140 in 2008 to 770 in 2017 (see NCSES ***SED 2017***: **Table 26** and, for older trend data, NCSES ***SED 2010***: **Table 26**).

U.S. Position in Global S&E Higher Education

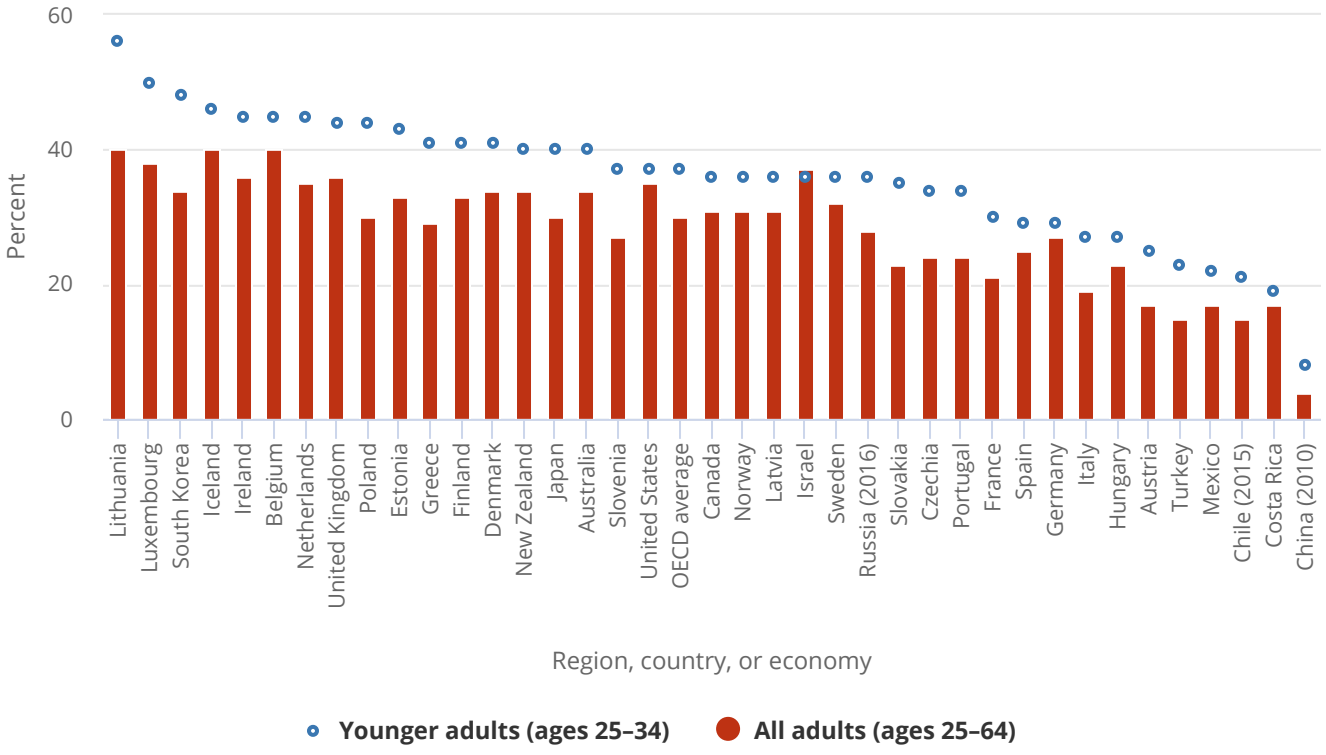
Educational Attainment

Overall Attainment Levels

Educational attainment, measured as the proportion of a population that has reached a specific level of education, is often used as a proxy for human capital and the skill levels associated with that level (Organisation for Economic Co-operation and Development [OECD] 2018a). Although the United States continues to have one of the highest percentages of the population ages 25–64 with a bachelor's or higher degree, many countries have now surpassed the United States in the percentage of the younger population (ages 25–34) with these levels of education (**Figure 2-18**).[59] Of 25- to 34-year-olds in the United States, 26% hold a bachelor's degree, which is higher than the OECD average of 22%. However, only 12% attain education higher than a bachelor's degree, which is lower than the OECD average of 15% (OECD 2018b). Moreover, the increase in attainment among younger people relative to older people so visible in many systems is not visible in the United States.

FIGURE 2-18

Attainment of a bachelor's degree or higher, by region, country, or economy and age group: 2017 or most recent year



OECD = Organisation for Economic Co-operation and Development.

Note(s)
Data include degrees at International Standard Classification of Education (ISCED) 2011 levels 6 (bachelor's or equivalent), 7 (master's or equivalent), and 8 (doctorate or equivalent). Regions, countries, or economies for which data at the short-cycle tertiary level (ISCED level 5) were not available independently are not included.

Source(s)
Organisation for Economic Co-operation and Development, *Education at a Glance 2018: OECD Indicators* (2018).

Science and Engineering Indicators

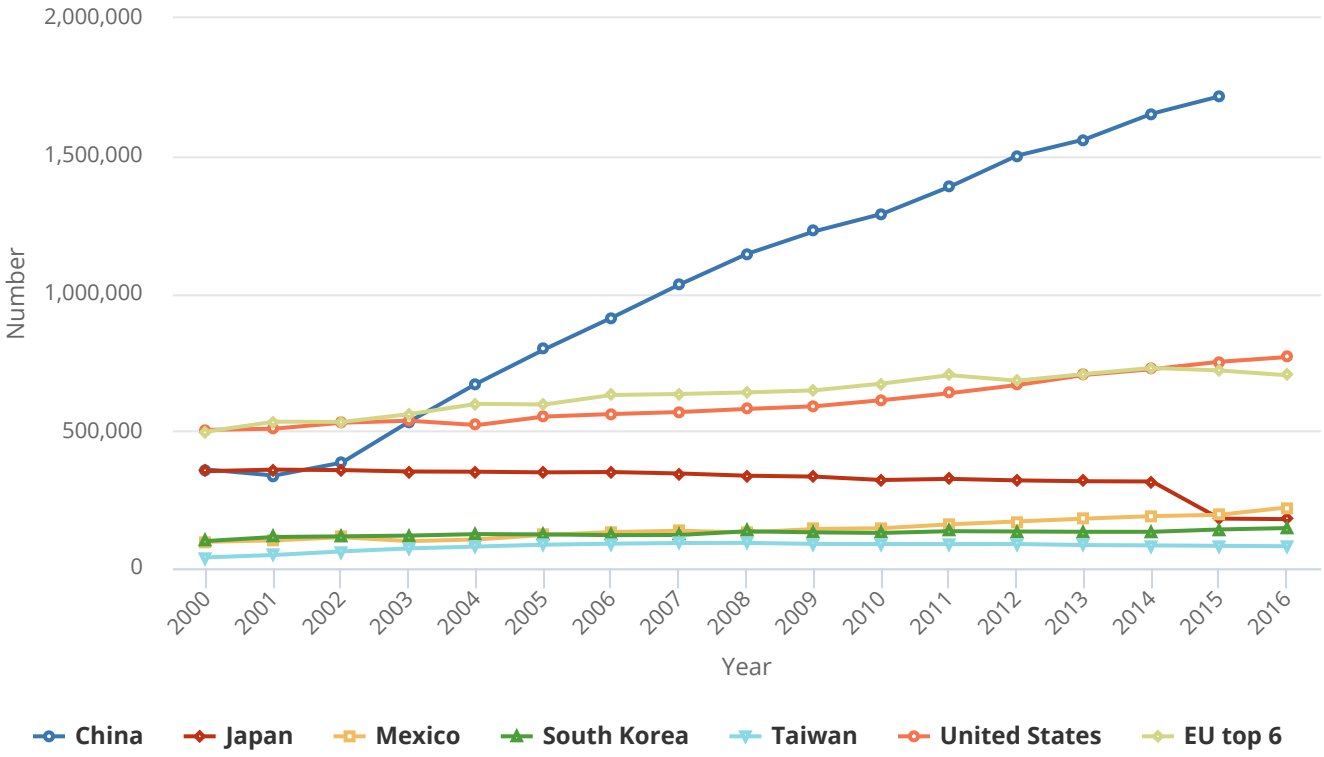
In the United States, there is large variation in the proportion of 25- to 34-year-olds with a postsecondary degree (in international comparisons, this is often referred to as tertiary attainment).[60] There are differences between demographic groups (Snyder et al. ***Digest of Education Statistics 2017***: **Table 104.20** and **Table 104.60**). There is also geographic variation in the United States, with tertiary attainment levels ranging from a high of 73% in the District of Columbia to a low of 30% in Nevada (OECD 2018b). Parents' levels of educational attainment also matter: 70% of 25- to 64-year-olds with at least one tertiary-educated parent have themselves attained tertiary education. Percentages are substantially lower for those with less-educated parents.

First University Degrees in S&E Fields

First university degrees are defined as terminal undergraduate degree programs (see the **Glossary** section for more detailed definition) and are often used in international comparisons to accommodate differences among countries in higher education systems. According to the most recent estimates, the United States awarded nearly 800,000 S&E first university degrees.[61,62] The 28 EU members together produced nearly 1 million, with the top 6 EU members accounting for about 70% of the EU total.[63] China produced 1.7 million S&E first university degrees in 2015, the most recent year for which data were available. The number of S&E first university degrees produced by China doubled over the last 10 years, while other degree-producing large countries have seen only modest increases (**Figure 2-19**, Table S2-15). Much of China's increase has been in engineering, which accounted for nearly 70% of China's S&E first university degrees in the most recent year available. India reports a figure even higher than China's (4.6 million in 2016), with more than half (52%) of its S&E first university degrees in the social and behavioral sciences.[64]

FIGURE 2-19

S&E first university degrees, by selected region, country, or economy: 2000–16



EU = European Union.

Note(s)
Data are not comparable with data presented in earlier *Indicators* reports because of a change to the International Standard Classification of Education 2011 and to a more aggregated taxonomy of fields. To facilitate international comparison, data for the United States are those reported to the Organisation for Economic Co-operation and Development, which varies slightly from the National Science Foundation classification of fields presented in other sections of the report. Data are not available for all regions, countries, or economies for all years. The EU top 6 total includes aggregated data for the six EU members producing the highest number of S&E first university degrees in 2016: France, Germany, Italy, Poland, Spain, and the United Kingdom. The dip in data after 2014 may be an artifact of using a different data source through 2014.

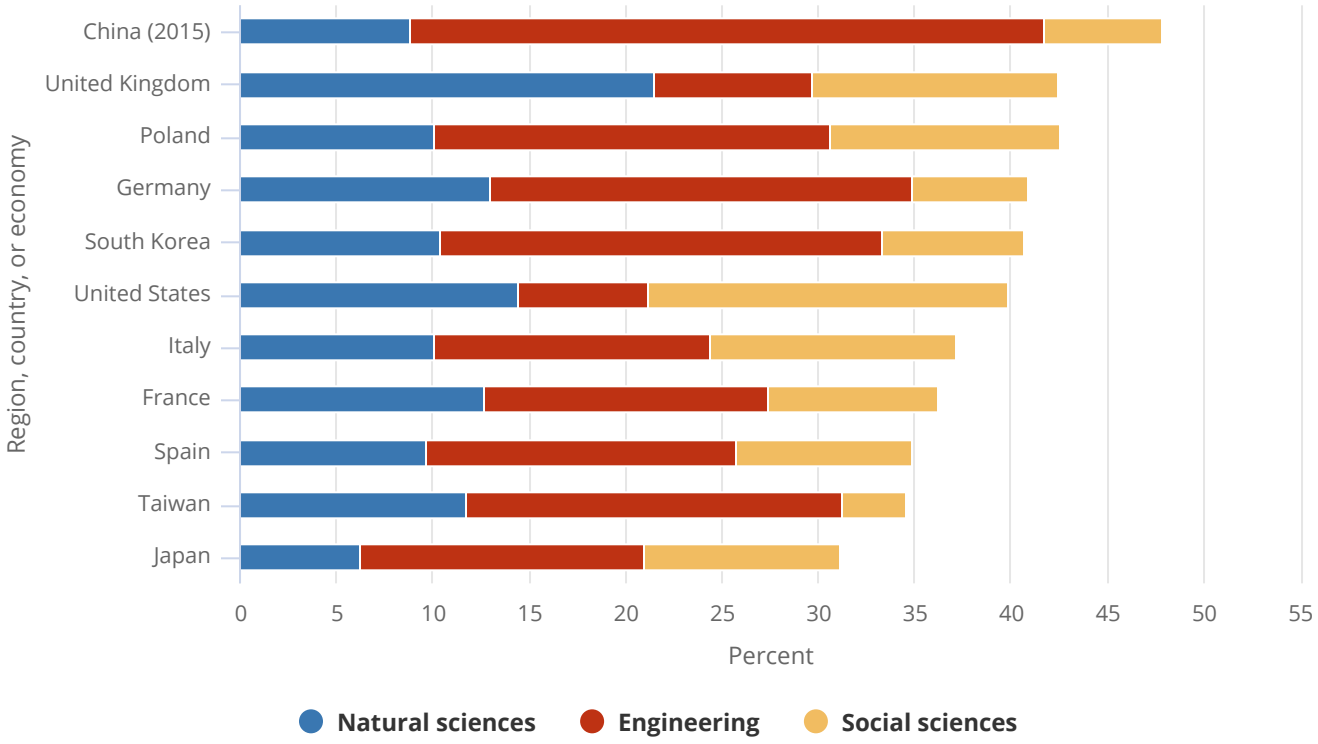
Source(s)
Organisation for Economic Co-operation and Development (OECD), OECD.Stat; Eurostat, Education and training database; Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Survey of Education (various years); National Bureau of Statistics of China, *China Statistical Yearbook* (various years); Ministry of Education, *Educational Statistics of the Republic of China (Taiwan)* (various years).

Science and Engineering Indicators

S&E first university degrees as a proportion of all first university degrees vary across countries (**Figure 2-20**). For the United States, the figure is about 40%, lower than that of China, South Korea, and several European nations. Of the countries and economies displayed in **Figure 2-20**, the United States awards the highest percentage of degrees in social sciences (19%) but the lowest percentage in engineering (7%).

FIGURE 2-20

Total first university degrees by S&E field, by selected region, country, or economy: 2016 or most recent year



Note(s)
Natural sciences include agricultural sciences; biological sciences; computer sciences; earth, atmospheric, and ocean sciences; and mathematics. Data are not comparable with data presented in earlier *Indicators* reports because of a change to the International Standard Classification of Education 2011 and to a more aggregated taxonomy of fields. To facilitate international comparison, data for the United States are those reported to the Organisation for Economic Co-operation and Development, which varies slightly from the National Science Foundation classification of fields presented in other sections of the report.

Source(s)
Organisation for Economic Co-operation and Development (OECD), OECD.Stat; Eurostat, Education and training database; Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Survey of Education (various years); National Bureau of Statistics of China, *China Statistical Yearbook* (various years); Ministry of Education, *Educational Statistics of the Republic of China (Taiwan)* (various years).

Science and Engineering Indicators

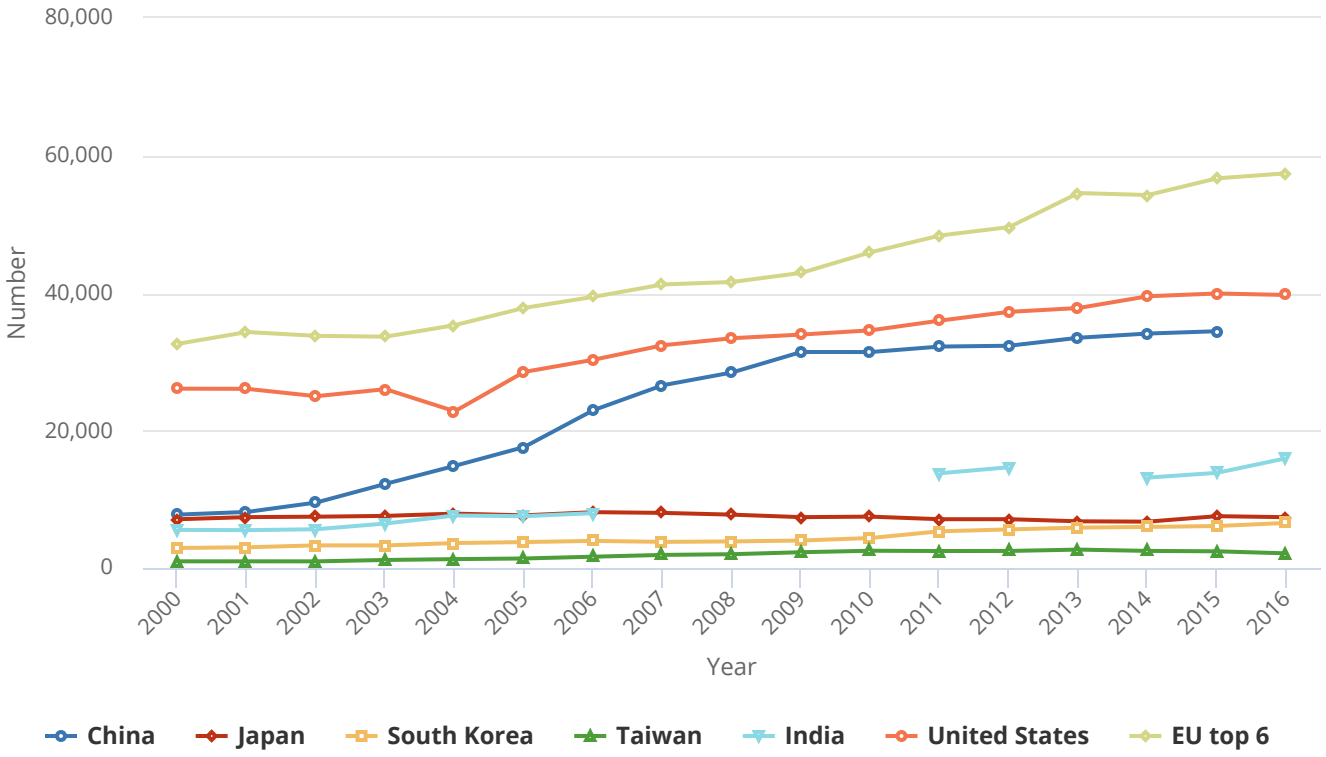
S&E Doctoral Degrees

According to the most recent estimates, the United States awards the largest number of S&E doctoral degrees of any country (about 40,000), followed by China (about 34,000); Germany, India, and the United Kingdom (about 16,000 each); and Russia (about 14,000) (Table S2-16).[65] Together, the European Union (EU) countries awarded more (about 77,000) S&E doctoral degrees than the United States; with the top six EU members accounting for 75% of the EU total.[66] Comparisons of doctoral degree production between the United States and other nations should include the consideration that a substantial number of U.S. S&E doctorate recipients are students on temporary visas.[67] However, many of these doctorate recipients stay in the United States for subsequent employment after obtaining their degree. (For a discussion on "stay rates" of foreign recipients of U.S. doctoral degrees, see the forthcoming *Science and Engineering Indicators 2020* report "Science and Engineering Labor Force.")

The number of S&E doctoral degrees awarded in China rose from 2000 to 2009, when the increase slowed (**Figure 2-21**). In 2007, the Chinese Ministry of Education announced that China would begin to limit admissions to doctoral programs and focus more on the quality of graduate education (Mooney 2007). When comparing only natural sciences and engineering doctoral degrees, China surpassed the United States as the world's largest producer in 2007 and has remained so ever since (in 2015, China awarded 32,000 doctorates in these fields; the United States awarded 30,000).

FIGURE 2-21

S&E doctoral degrees, by selected region, country, or economy: 2000–16



EU = European Union.

Note(s)
Data are not comparable with data presented in earlier *Indicators* reports because of a change to the International Standard Classification of Education 2011 and to a more aggregated taxonomy of fields. To facilitate international comparison, data for the United States are those reported to the Organisation for Economic Co-operation and Development, which varies slightly from the National Science Foundation classification of fields presented in other sections of the report. The EU top 6 total includes aggregated data for the six EU members producing the highest number of S&E doctoral degrees in 2016: France, Germany, Italy, Spain, Sweden, and the United Kingdom. The EU top total 6 includes estimated data for some countries and some years when country data are not available. Data for China and India are shown in only years when data were available.

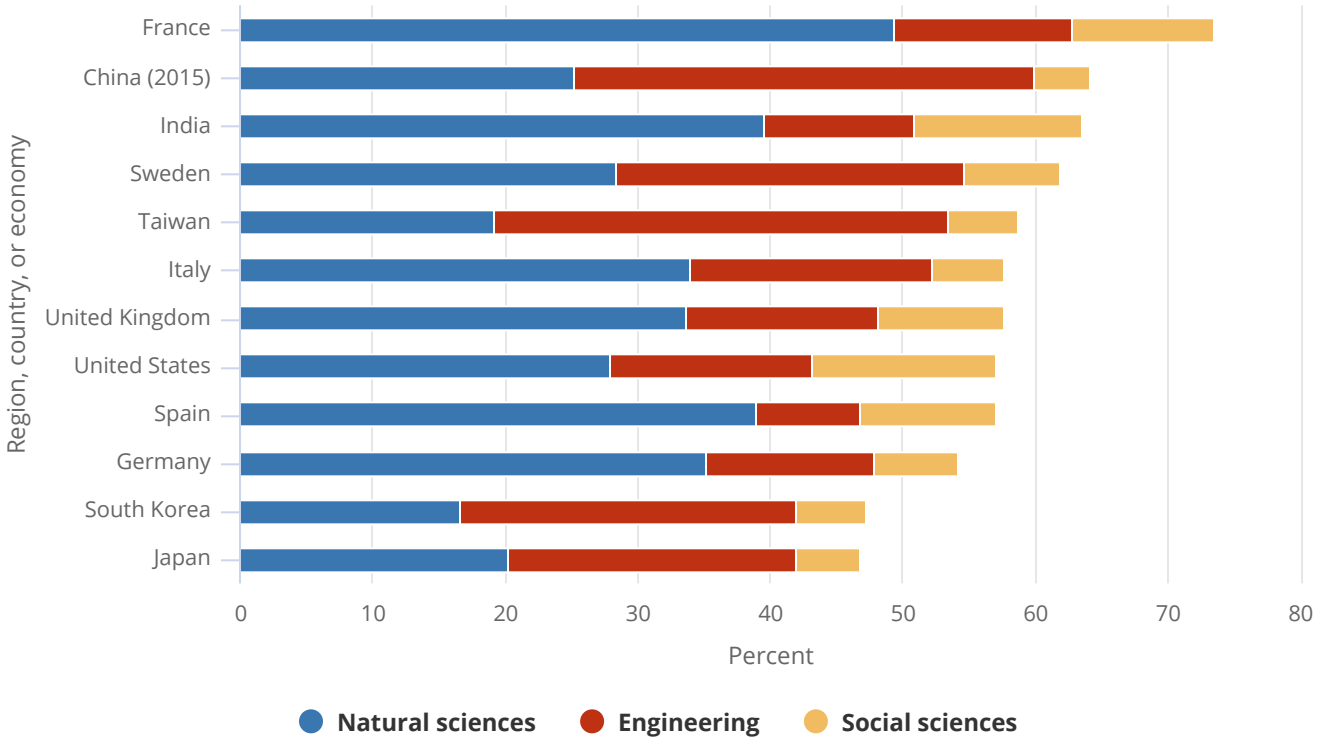
Source(s)
Organisation for Economic Co-operation and Development (OECD), OECD.Stat; Eurostat, Education and training database; Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Survey of Education (various years); National Bureau of Statistics of China, *China Statistical Yearbook* (various years); Ministry of Education, *Educational Statistics of the Republic of China (Taiwan)* (various years).

Science and Engineering Indicators

In the United States, and in France, Germany, India, Italy, Spain, Sweden, and the United Kingdom, the largest numbers of S&E doctoral degrees were awarded in natural sciences (**Figure 2-22**, Table S2-16). In other countries and economies, the proportion of S&E doctoral degrees in engineering is greater; for China, South Korea, and Taiwan, for example, more than 50% of S&E doctorates are awarded in engineering.

FIGURE 2-22

Total doctoral degrees by broad area of study, by selected region, country, or economy: 2016 or most recent year



Note(s)
Natural sciences include agricultural sciences; biological sciences; computer sciences; earth, atmospheric, and ocean sciences; and mathematics. Data are not comparable with data presented in earlier *Indicators* reports because of a change to the International Standard Classification of Education 2011 and to a more aggregated taxonomy of fields. To facilitate international comparison, data for the United States are those reported to the Organisation for Economic Co-operation and Development, which varies slightly from the National Science Foundation classification of fields presented in other sections of the report.

Source(s)
Organisation for Economic Co-operation and Development (OECD), OECD.Stat; Eurostat, Education and training database; Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Survey of Education (various years); National Bureau of Statistics of China, *China Statistical Yearbook* (various years); Ministry of Education, *Educational Statistics of the Republic of China (Taiwan)* (various years).

Science and Engineering Indicators

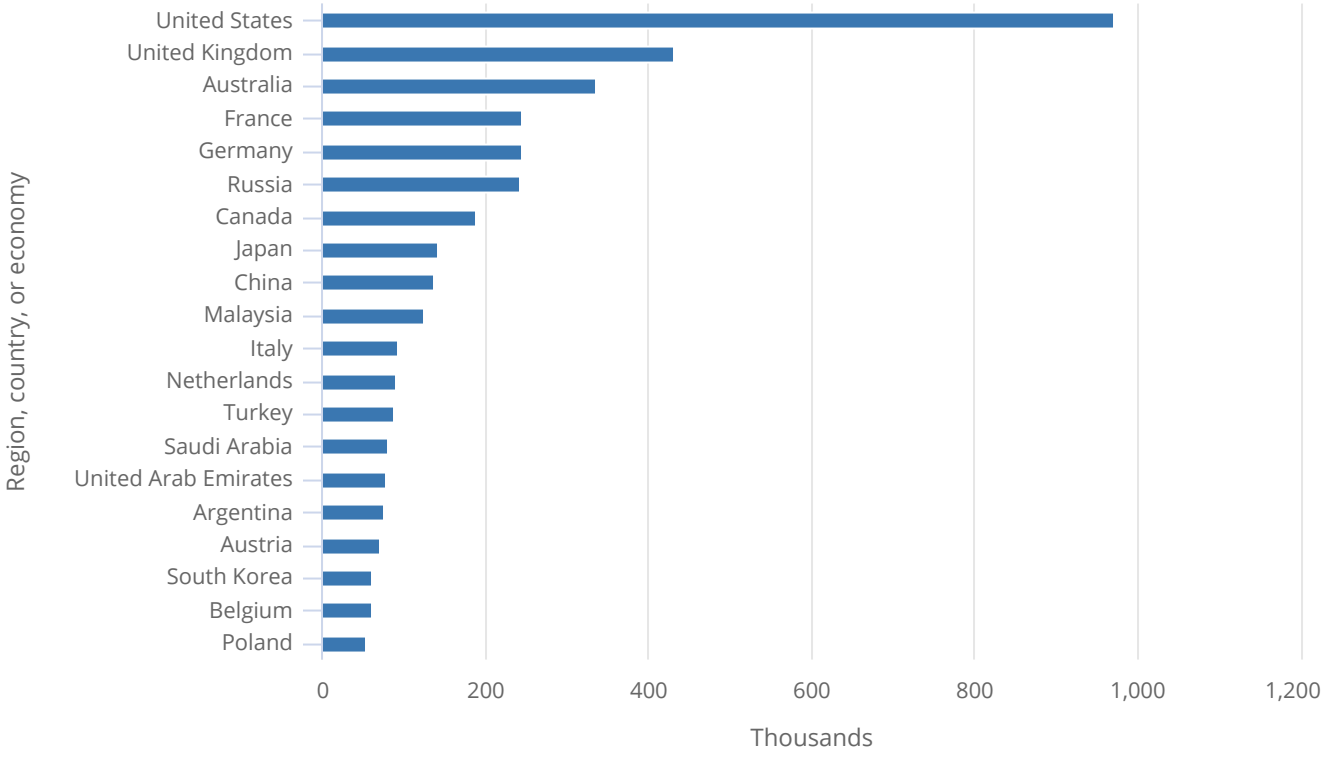
International Student Mobility

Internationally mobile students are those who have crossed a national or territorial border for purposes of education and are now enrolled outside their countries of origin. Students become increasingly mobile at more advanced levels of education. Globally, international students account for only 6% of total enrollment in higher education, but they represent 26% of enrollment in doctoral programs (OECD 2018a). International students also favor S&E fields: globally, one-third of them were enrolled in S&E fields in 2016. As shown in earlier sections, these trends are also observed among international students in U.S. institutions.[68]

More internationally mobile students (undergraduate and graduate) come to the United States than to any other country (19% of internationally mobile students worldwide) (**Figure 2-23**).[69] Other top destinations for international students include the United Kingdom, Australia, France, Germany, and Russia. The top 20 destination countries in 2016 together received about 75% of internationally mobile students worldwide.[70] China is also an increasingly attractive destination for globally mobile students.[71]

FIGURE 2-23

Internationally mobile students enrolled in tertiary education, by selected region, country, or economy: 2016



Note(s)
Data are based on the number of students who have crossed a national border and moved to another country with the objective of studying (i.e., mobile students).

Source(s)
United Nations Educational, Scientific and Cultural Organization (UNESCO), special tabulations (2018) of the Institute for Statistics database.

Science and Engineering Indicators

The U.S. share of worldwide internationally mobile students has declined slightly over time, reflecting several factors. The number of internationally mobile students in higher education worldwide has risen dramatically, from 2 million in 1999 to 5 million in 2016 (OECD 2018a). China and India send the most students abroad: their combined share of outbound internationally mobile students rose from 19% in 2008 to 23% in 2017. Another factor is increasing competition among countries for international students: some have set targets for attracting certain numbers. Countries like Australia and Canada have recently reported double-digit growth in international students.[72]

Conclusion

The U.S. higher education system consists of a diversity of institutional types that address different student populations and needs in S&E education. Across degree levels, S&E fields continue to grow. However, many groups of Americans are still underrepresented among S&E degree recipients. The United States remains a top destination for foreign students, especially in S&E fields; more foreign students continue to earn U.S. S&E degrees. The data, however, indicate a recent decline in international student enrollment at U.S. academic institutions. Maintaining the preeminence of U.S. S&E higher education, while serving Americans of all backgrounds, represents a continuing aspiration.

Glossary

Definitions

Control (of institution): A classification of whether an institution is operated by publicly elected or appointed officials (public control) or by privately elected or appointed officials and derives its major source of funds from private sources (private control).

Doctoral degree: In this report, "doctoral degree" or "doctorate" means a research doctorate. The Integrated Postsecondary Education Data System terms these degrees "doctor's degree-research/scholarship" and defines them as "a Ph.D. or other doctor's degree that requires advanced work beyond the master's level, including the preparation and defense of a dissertation based on original research, or the planning and execution of an original project demonstrating substantial artistic or scholarly achievement. Some examples of this type of degree may include Ed.D., D.M.A., D.B.A., D.Sc., D.A., or D.M., and others, as designated by the awarding institution."

European Union (EU): The EU comprises 28 member nations: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

First university degree: A terminal undergraduate degree program; these degrees are classified within level 6 (bachelor's degree or equivalent) or level 7 (master's degree or equivalent, including "long first degrees") in the 2011 International Standard Classification of Education (ISCED), which was developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Individual countries use different names for the first university degree (e.g., *corso di Laurea* in Italy, *diplom* in Germany, *licence* in France, and *bachelor's degree* in the United States and in Asian countries). For more on ISCED levels, see the Technical Appendix.

Internationally mobile students: Students who have crossed a national or territorial border for purposes of education and are now enrolled outside their countries of origin. This term refers to degree mobility in data collected by the UNESCO Institute for Statistics, OECD, and Eurostat and excludes students who travel for credit mobility.

Massive open online course (MOOC): An online course made available over the Internet without charge to an unlimited number of people.

Natural sciences: These include mathematics and agricultural; biological; computer; earth, atmospheric, and ocean; and physical sciences.

Science and engineering (S&E) fields: Degree award data cover degrees in the following S&E fields: astronomy, chemistry, physics, atmospheric sciences, earth sciences, ocean sciences, mathematics and statistics, computer sciences, agricultural sciences, biological sciences, psychology, social sciences, and engineering. At the doctoral level, the medical and health sciences are included under S&E because these data correspond to the doctor's-research/scholarship degree level, which includes research-focused degrees.

Underrepresented minorities: This category comprises three racial or ethnic minority groups (blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives) whose representation in S&E education is smaller than their representation in the U.S. population.

Key to Acronyms and Abbreviations

BPS: Beginning Postsecondary Students

DOD: U.S. Department of Defense

DOE: U.S. Department of Energy

EU: European Union

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

HBCU: historically black college or university

HHE: high-Hispanic-enrollment institution

HSI: Hispanic-serving institution

IPEDS: Integrated Postsecondary Education Data System

ISCED: International Standard Classification of Education

MOOC: massive open online course

MSI: minority-serving institution

NCES: National Center for Education Statistics

NCSES: National Center for Science and Engineering Statistics

NIH: National Institutes of Health

NSB: National Science Board

NSF: National Science Foundation

OECD: Organisation for Economic Co-operation and Development

RA: research assistantship

S&E: science and engineering

SED: Survey of Earned Doctorates

SEVIS: Student and Exchange Visitor Information System

TA: teaching assistantship

UIS: UNESCO Institute for Statistics

UNESCO: United Nations Educational, Scientific and Cultural Organization

USDA: Department of Agriculture

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Notes

1 Whether an institution is operated by publicly elected or appointed officials, or by privately elected or appointed officials and derives its major source of funds from private sources, is referred to as its control.

2 Most data on institutions and some data on degrees used in this report come from the Department of Education's Integrated Postsecondary Education Data System (IPEDS), which includes completions data for degrees (associate's, bachelor's, master's, and doctoral), as well as certificates below (fewer than 1 academic year, at least 1 but fewer than 2 academic years, and at least 3 but fewer than 4 academic years) and above (postbaccalaureate and post-master's) the bachelor's level.

3 The Carnegie Classification of Institutions of Higher Education is available at **http://carnegieclassifications.iu.edu/**. The Basic Carnegie classification categorizes academic institutions primarily based on highest degree conferred, level of degree production, and research activity. This report uses the 2015 Carnegie classification.

4 Graduates from many different types of institutions go on to earn S&E doctoral degrees (Burrelli and Rapoport 2008; Fiegener and Proudfoot 2013).

5 For a list of all types and how they are designated, see **NASEM 2019**: **Table 3-1** and **3-2**.

6 The Higher Education Act of 1965, as amended, defines an HBCU as "any historically black college or university that was established prior to 1964, whose principal mission was, and is, the education of black Americans." In 2015–16, 102 HBCUs were in operation in 19 states, the District of Columbia, and the U.S. Virgin Islands. Half were public institutions, and half were private nonprofit.

7 The number of HHEs more than doubled from 189 in 1994 to 432 in 2015. About 300 institutions enroll between 15% and 24% Hispanic students and are considered "emerging HHEs." Many researchers use *high-Hispanic enrollment* and *Hispanic-serving institution* (HSI) interchangeably. HSIs meet a federally designated criterion (i.e., public and private nonprofit institutions whose undergraduate, full-time equivalent student enrollment is at least 25% Hispanic) and are eligible to apply for Hispanic-serving institution status. Because there is no information on whether institutions apply for the HSI designation, the National Center for Science and Engineering Statistics (NCSES) uses the 25% enrollment criterion to determine which institutions have high Hispanic enrollment. For additional information, see **https://www2.ed.gov/about/offices/list/ope/idues/hsidivision.html**.

8 For information on S&E bachelor's degrees awarded by tribal colleges and universities to American Indian or Alaska Native students, see NCSES ***WMPD 2019***: **Table 5-10**.

9 This analysis is based on a custom data tabulation from the Survey of Earned Doctorates.

10 A recent trend among states is to allow more community colleges to offer bachelor's degrees. See Fulton (2015) for more information.

11 These figures come from the 2017 National Survey of College Graduates, accessed using the Scientists and Engineers Statistical Data System: **https://www.nsf.gov/statistics/sestat**.

12 These figures are for U.S. citizens and permanent residents earning S&E doctoral degrees. The percentages for students on temporary visas are lower (NCSES ***SED 2017***: **Table 30**), likely reflecting that many foreign students come to the United States specifically for graduate training.

13 Data are from IPEDS.

14 Most of the remainder, 18%, were in "other social sciences."

15 Information on the history of distance and correspondence and online education may be found in Harasim (2000).

16 No standard guideline exists that specifies how much education must be delivered via technology to qualify as online or distance education (Miller et al. 2017). IPEDS defines distance education as "education that uses one or more technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students and the instructor synchronously or asynchronously." Distance education courses are courses "in which the instructional content is delivered exclusively via distance education." Distance education programs are those "for which all the required coursework for program completion is able to be completed via distance education courses." For more detail, see **https://surveys.nces.ed.gov/ipeds/VisGlossaryAll.aspx**.

17 This analysis is based on 2016 IPEDS data.

18 This is for doctoral degrees-research/scholarship only. Medical and health sciences distance education programs are prevalent at all degree levels but are only included in S&E at the doctoral level. This analysis is based on 2017 IPEDS data.

19 Published price is "the price institutions charge for tuition and fees, as well as room and board, in the case of students residing on campus" (College Board 2018a).

20 Tuition and fee figures represent charges to full-time first-year undergraduate students over the course of a 9-month academic year of 30 semester hours or 45 quarter hours. Average tuition and fee prices reflect in-district charges for public 2-year institutions and in-state charges for public 4-year institutions. In addition to tuition and fees, room and board constitutes another expense for students.

21 Limited data on the residence and migration of first-time freshmen are available from IPEDS.

22 Note that these debt figures are for degree recipients only. Students who have taken on debt but left without earning a degree are not included.

23 For public institutions, data were not available for Connecticut, the District of Columbia, or North Dakota. For private nonprofit institutions, data were not available for Alaska, Arizona, Delaware, Idaho, Nevada, North Dakota, Rhode Island, or Wyoming.

24 This report discusses *sources* and *mechanisms* of graduate student funding. Funding sources include federal, institutional, and personal or self-support, among others. Funding mechanisms include assistantships, fellowships, and traineeships, among others.

25 Starting with 2017, the Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS) collects data separately for master's and doctoral students. Analyses using GSS data in this report include health fields.

26 Personal sources include loans (including federal loans) or personal or family financial contributions. Note that there may be some differences between numbers reported in Arbeit and colleagues (2019) and those reported here because different fields are included in some analyses.

27 In 2017, these were the most common funding mechanisms for S&E doctoral students (37% received RAs, 27% TAs, and 15% fellowships) (NCSES ***GSS 2017***: **Table 3-5**).

28 Tabulations from the 2016 GSS were created using the **NCSES interactive data tool**.

29 At the time of doctoral degree conferral, 44% of 2017 doctorate recipients held debt related to their undergraduate or graduate education, or both (NCSES ***SED 2017***: **Table 38**).

30 A recent analysis, however, concluded that underrepresented minority status mattered to debt levels even after accounting for educational and other factors (Schacht et al. in preparation).

31 Sources used by the College Board are available at **https://trends.collegeboard.org/student-aid/notes-sources**. Note that this section reflects information for all students, not just those studying S&E fields.

32 The remainder includes veterans' benefits, education tax benefits, and work-study programs and Federal Supplemental Educational Opportunity Grants.

33 This ranges from less than 60% for NIH to more than 97% for USDA.

34 Tabulations of the 2016 GSS were created using the NCSES interactive data tool.

35 Occupational outcomes of graduates are covered in the forthcoming *Science and Engineering Indicators 2020* report "Science and Engineering Labor Force." In addition, the U.S. Census Bureau has produced a visualization mapping college majors and occupation groups, which can be broken out by a student's field of study and demographic characteristics: **https://www.census.gov/dataviz/visualizations/stem/stem-html/**.

36 Van Noy and Zeidenberg (2014) distinguish between "S&E" and "technician" programs at community colleges. S&E programs tend to prepare students for occupations requiring a bachelor's degree or higher. Technician programs tend to prepare students for occupations requiring associate's degrees or certificates (although some go on to bachelor's degrees or higher). Relative to those in "technician" programs, a higher proportion of students in S&E programs seek to transfer to 4-year institutions, and fewer of them seek associate's degrees or certificates.

37 The total number of bachelor's degrees conferred annually by U.S. universities and colleges in all fields increased from fewer than 1.3 million in 2000 to nearly 2 million in 2017.

38 For more information, see **https://nces.ed.gov/surveys/bps/about.asp**.

39 Other sources of limited information on attainment and retention exist. For example, the Department of Education collects data on outcomes for students who enroll in 2-year and 4-year institutions: **https://nces.ed.gov/programs/coe/indicator_tta.asp**. In addition, the National Student Clearinghouse provides snapshots of student enrollment and completion: **https://nscresearchcenter.org/snapshot-report-yearly-success-and-progress-rates-2019/**.

40 In 2017, 695 U.S. institutions enrolled graduate students, including 678 enrolling master's students and 399 enrolling doctoral students (NCSES ***GSS 2017***: **Table 4-5**).

41 The Survey of Earned Doctorates also collects information on interdisciplinary doctoral degrees. Analysis of some of these data is available in Millar and Dillman (2012).

42 Public universities awarded particularly high percentages of doctorates in the agricultural sciences (94%, which may reflect land-grant status; see **https://www.aplu.org/about-us/history-of-aplu/what-is-a-land-grant-university/index.html**) and in atmospheric sciences (86%).

43 For the demographic trends presented in this section, unless otherwise noted, racial and ethnic group totals are compared with totals for U.S. citizens and permanent residents. For sex, the comparison is with totals across all citizenships.

44 This report refers to racial and ethnic groups following the standards for collection of data on race and ethnicity announced by the Office of Management and Budget in 1997, as described in **https://ncses.nsf.gov/pubs/nsf19304/technical-notes#racial-and-ethnic-information**. To facilitate ease of reading, the report sometimes adopts a shorthand when referring to specific groups (e.g., "black" for "black or African American," "Hispanic" for "Hispanic or Latino"). Additionally, the category "Asian or Pacific Islander" was replaced in 2011 with the separate categories "Asian" and "Native Hawaiian or Other Pacific Islander." When trends for "Asians" are discussed, they include "Asian or Pacific Islander" before 2011 and "Asian" from 2011 on.

45 Limited data about S&E degree attainment of another group, military veterans, is available in Milan (2018).

46 Trends in master's degrees earned by sex broadly mirror those of bachelor's and doctoral degrees in growth over time and differences between fields in the proportion of degrees earned by women.

47 Some changes by race and ethnicity over time may reflect the way the National Center for Education Statistics and other federal statistical agencies collect information on this topic. Beginning in 2011, some students may be classified as multiracial; in the past, they may have been reported as American Indian or Alaska Native, Asian or Pacific Islander, black, Hispanic, or white. In 2017, 7.5% of bachelor's degree recipients were students of more than one race or other or unknown race or ethnicity.

48 Trends in master's degrees awarded across racial and ethnic groups resemble those found in the data on bachelor's degree awards.

49 In addition to Table S2-12, NCSES ***WMPD 2019*** provides data on degree awards by field that allow race, ethnicity, and sex to be disaggregated. For associate's degrees, see NCSES ***WMPD 2019***: **Table 4-3**. For bachelor's degrees, see ***WMPD 2019***: **Table 5-7**. For master's degrees, see ***WMPD 2019***: **Table 6-4 and 6-5**. For doctoral degrees, see ***WMPD 2019***: **Table 7-8**.

50 There may be a time lag between patterns observed in enrollment data and those observed in degree data. Degrees take several years to earn, and not all enrolled students earn degrees.

51 Data in this section come from the Department of Homeland Security's Student and Exchange Visitor Information System (SEVIS), which collects administrative data, including numbers of international students enrolled in colleges and universities in the United States. Data include students enrolled in associate's, bachelor's, master's, and doctoral programs whose status is listed as "active" in the SEVIS database on 15 November of each year. Those participating in optional practical training (OPT) are excluded. Data on OPT students are provided by the Institute of International Education's annual *Open Doors* report, which constitutes another valuable source of information on international students in the United States and related topics.

52 This finding is generally consistent with the Institute of International Education's Fall 2018 International Student Enrollment Hot Topics Survey, which noted a 1.7% decline in 2018 enrollments below 2017 levels in the 540 institutions surveyed: **https://www.iie.org/en/Research-and-Insights/Open-Doors/Data/Fall-International-Enrollments-Snapshot-Reports**.

53 India's numbers rose by about 4% from 2016 to 2017 and remained essentially the same in 2018. China's numbers declined by 11%. South Korea saw a 16% decline (to 2,300), and Saudi Arabia saw a decline of 37% (to 7,000).

54 Other surveys also indicate declines during this period, particularly in first-time enrollment (Institute of International Education 2018; NCSES ***GSS 2017***; Okahana and Zhou 2018, 2019).

55 Between 2009 and 2017, the number of U.S. citizens and permanent residents earning bachelor's degrees increased from about 1.6 million to 1.9 million (by about 20%). In 2017, around one-third of bachelor's degrees awarded to U.S. citizens and permanent residents were in S&E fields.

56 During this interval, the number of U.S. citizens and permanent residents earning master's degrees remained essentially flat (between 650,000 and 670,000).

57 During the same time, the number of U.S. citizens and permanent residents earning S&E doctorates increased from about 27,500 to about 30,000.

58 More information on how international students, at the undergraduate and graduate levels, are funded is available from the Institute of International Education: **https://www.iie.org/Research-and-Insights/Open-Doors/Data/International-Students/Primary-Source-of-Funding**.

59 These data are based on the 2011 International Standard Classification of Education (ISCED) and are not comparable with data presented in earlier volumes of *S&E Indicators* based on ISCED 1997. Data are based on national labor force surveys and are subject to sampling error; therefore, small differences among countries may not be meaningful (OECD 2018a).

60 For more information, see **https://www.oecd-ilibrary.org/education/isced-2011-operational-manual/tertiary-education_9789264228368-9-en**.

61 The international degree data presented in this report were obtained largely from OECD's statistical database, OECD.Stat. For a few countries not available from OECD, as noted in the Supplemental Tables, data were obtained from Eurostat or from country-specific sources. Because of changes in the International Standard Classification of Education (more information about which is available in **https://www.nsf.gov/statistics/2018/nsb20181/assets/561/comparability-of-international-data-in-tertiary-education.pdf**), data from 2000 to 2012 may not be strictly comparable with data from 2013 and subsequent years. Caution is warranted in interpreting time trends across this interval. For consistency and comparability, U.S. data as reported by OECD were used and may differ from U.S. data presented in other sections of this report. More detailed methodology notes on international first university degrees and international doctoral degree data are available in the Technical Appendix.

62 For international degree comparisons between the United States and other countries, this report uses data as reported to OECD, which may differ from IPEDS.

63 These countries are The United Kingdom, Germany, France, Poland, Italy, and Spain.

64 Time trend data for India are lacking. Additionally, India may combine International Standard Classification of Education levels 5 (associate's-level degrees) and 6 (bachelor's-level degrees) in its reporting, making comparisons with other countries difficult.

65 For international degree comparisons between the United States and other countries, this report uses data as reported to OECD, which may differ from IPEDS. Additionally, for international degree comparisons, S&E does not include medical or other health fields because international sources cannot separate the MD degrees from degrees in the health fields, and the MDs are professional or practitioner degrees, not research degrees.

66 These countries are Germany, the United Kingdom, France, Spain, Italy, and Sweden.

67 In 2017, 34% of U.S. S&E doctorates were earned by students on temporary visas, according to IPEDS. Equivalent data are not available from OECD.

68 Higher education institutions have also opened increasing numbers of campuses in other countries. Data on international branch campuses is maintained by the Cross-Border Education Research Team (**http://cbert.org/**), and the most recent available data were reviewed in ***Indicators 2018***: **Chapter 2**.

69 Data on internationally mobile students come from UNESCO's Institute for Statistics. More information on the data is available at **http://uis.unesco.org/sites/default/files/documents/education-statistics-faqs-2018-en.pdf**. *Project Atlas* from the Institute of International Education is another valuable resource on international student mobility, including trends in U.S. students who earn degrees abroad (**https://www.iie.org/Research-and-Insights/Project-Atlas**).

70 For data on U.S. students studying abroad, see Institute of International Education's *Open Doors* report.

71 See Project Atlas from the Institute of International Education: **https://www.iie.org/Research-and-Insights/Project-Atlas**.

72 See **https://www.teqsa.gov.au/latest-news/publications/statistics-report-teqsa-registered-higher-education-providers-2018**. Numbers reported by other sources, for instance, for Canada (available at **https://cbie.ca/international-students-surpass-2022-goal/**), may differ from those in **Figure 2-23**, which are from UNESCO's Institute for Statistics (UIS). One possible reason for the discrepancy is that UIS data cover students who pursue higher education degrees outside their country of origin and do not include students who are under short-term for-credit study and exchange programs that last less than a full academic year. For more information, see **https://www.iie.org/en/Research-and-Insights/Project-Atlas/FAQs#Q6**.

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Suzanne Day, Harvard University

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Nicole Smith, Georgetown University

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Report Authors

Josh Trapani
Senior Analyst
Science & Engineering Indicators Program
National Center for Science and Engineering Statistics
jtrapani@nsf.gov

Katherine Hale (retired)
Senior Analyst
Science & Engineering Indicators Program
National Center for Science and Engineering Statistics

NCSES

National Center for Science and Engineering Statistics
Directorate for Social, Behavioral and Economic Sciences
National Science Foundation
2415 Eisenhower Avenue, Suite W14200
Alexandria, VA 22314
Tel: (703) 292-8780
FIRS: (800) 877-8339
TDD: (800) 281-8749
ncsesweb@nsf.gov