Higher Education in Science and Engineering

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Executive Summary

Key takeaways:

- The number of science and engineering (S&E) degrees awarded continues to increase at all levels and across many fields. S&E degrees increased at the associate's, bachelor's, master's, and doctoral levels from 2000 to 2019, both in numbers and as shares of total degrees.

- Underscoring their importance in preparing students for employment in the skilled technical workforce (STW), community colleges in 2019 produced more degrees and certificates in S&E technology fields, which have a more applied focus, than in S&E fields.

- Women earned almost two-thirds of the degrees awarded in psychology, biological sciences, and social sciences in 2019 but received only about a quarter of those in engineering and computer sciences. In other S&E fields, they earned almost half of the degrees awarded.

- Blacks, Hispanics, and American Indians or Alaska Natives remain underrepresented among S&E degree recipients in almost all fields and degree levels relative to their representation in the general population.

- The total number of international students on visas enrolled at U.S. institutions of higher education declined by almost 23% from 2019 to 2020, largely reflecting the impact of COVID-19 on international student mobility. The decline was proportionately larger for undergraduates than for graduate students and was larger for students studying non-S&E fields than for those studying S&E fields. China continues to send the most students to U.S. institutions, with India second.

- Due to their significantly larger populations, China and India award more S&E first-university (bachelor's equivalent) degrees than the United States. At the doctoral level, however, the United States awards the most S&E degrees, though China leads in production of doctoral degrees in the natural sciences and engineering.

- The COVID-19 pandemic affected the entire U.S. higher education system. Available evidence suggests that it has threatened the financial viability of some institutions and disrupted the higher education plans of many students, especially women and primary caregivers, underrepresented minorities, and students from low-income families. Community colleges have been the most severely affected by enrollment declines, with males experiencing the most significant declines.

The U.S. higher education system consists of diverse academic institutions that train students in S&E across degree levels and fields. The system includes research and doctorate-granting universities, primarily undergraduate institutions, minority-serving institutions, community colleges, and many other types of institutions, including some that span multiple categories.

A small number of institutions awarded three-quarters of doctorates, over half of master's degrees, and nearly 45% of bachelor's degrees in S&E fields in 2019. These institutions are also where most university research is performed; 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 from 2000 to 2019. In addition, community colleges and other institutions train and certify students in S&E technology fields, contributing to the development of the STW as well as to the pool of talent that earns higher degrees. Skilled technical workers are individuals without a bachelor's degree who work in jobs that typically require S&E knowledge.
Many groups of Americans remain underrepresented among S&E degree recipients. While women are at or approaching parity with men at most degree levels overall and earn more than half of degrees in some fields, long-standing differences persist, especially in engineering, computer sciences, and mathematics and statistics. Blacks are underrepresented at all degree levels, while Hispanics and American Indians or Alaska Natives are underrepresented at all but the associate’s level. A larger proportion of Blacks than Asians and Whites earn S&E degrees, especially doctorates, from for-profit institutions, which may have consequences for debt levels and career outcomes.

From 2019 to 2020, the number of international students on visas enrolled at U.S. institutions of higher education declined significantly. Despite this decline, there was little change in the distribution of students coming from different countries or studying different S&E fields. China continues to send the most undergraduate students, and China and India send the majority of graduate students.

From 2012 to 2019, the rapid increase and then decline of international S&E graduate student enrollment at U.S. institutions was driven by enrollment patterns of students from India in master’s programs in computer sciences and engineering. At the doctoral level, trends were more stable.

India and China, much larger countries than the United States in terms of overall population, produced more S&E first-university (bachelor’s equivalent) degrees than the United States. At the doctoral level, the United States awarded the largest number of S&E degrees of any nation. Comparisons of doctoral degree production between the United States and other nations should take into consideration that a substantial number of U.S. S&E doctorate recipients are students on temporary visas but also that many of these students stay in the United States after graduation. When comparing only natural sciences (see Glossary section for definition) and engineering doctoral degrees, China surpassed the United States as the world’s largest producer of doctoral degrees in 2007 and has remained so ever since.
Introduction

This report provides an overview of science and engineering (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 but excludes professional practice degrees such as Doctor of Medicine.

The first section of this report provides overall information on the U.S. higher education system, with special emphasis on several types of institutions: research universities, minority-serving institutions (MSIs), and community colleges. It includes a sidebar focused on preliminary data on the effects of the COVID-19 pandemic on higher education. This section also provides information on sources of aid for undergraduate S&E education, with a focus on the federal government’s role. The second section looks at national 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, 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, with special emphasis on the sharp decline in international students that resulted from the first year of the COVID-19 pandemic. It also benchmarks the United States with other nations in terms of S&E degrees awarded.

Additional context for the topics covered in this report is available in other Indicators 2022 reports. More data on graduate students studying S&E, including enrollment by field and sources of financial support, are provided in the Indicators 2022 report “[2022] Academic Research and Development.” Additional educational data are available in “[2022] Elementary and Secondary STEM Education,” and further information on the labor force, including demographic characteristics and linkages between education and occupation, is provided in “[2022] The STEM Labor Force of Today: Scientists, Engineers, and Skilled Technical Workers.” Data on S&E degree awards at the state level are available in Science and Engineering Indicators State Indicators.
U.S. Institutions Providing S&E Higher Education

Institutions in S&E Higher Education

The U.S. higher education system consists of academic institutions that vary in mission; public, private nonprofit, or private for-profit status; degrees offered; learning environment; selectivity level; religious affiliation; cost; and other characteristics (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.

During the 2019–20 academic year, there were approximately 4,150 postsecondary degree-granting institutions in the United States, of which about 41% were public, 41% were private nonprofit, and 17% were private for-profit (Table HED-1). Public institutions awarded over two-thirds of all degrees and 70% of S&E degrees overall (Figure HED-1).

Table HED-1

Degree-granting institutions, by control and highest degree awarded: 2019–20

<table>
<thead>
<tr>
<th>Highest degree awarded</th>
<th>All degree-granting institutions</th>
<th>Public</th>
<th>Private nonprofit</th>
<th>Private for-profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>All degree levels</td>
<td>4,149</td>
<td>1,714</td>
<td>1,713</td>
<td>722</td>
</tr>
<tr>
<td>Associate's</td>
<td>1,340</td>
<td>880</td>
<td>93</td>
<td>367</td>
</tr>
<tr>
<td>Bachelor's</td>
<td>734</td>
<td>229</td>
<td>355</td>
<td>150</td>
</tr>
<tr>
<td>Master's</td>
<td>868</td>
<td>184</td>
<td>540</td>
<td>144</td>
</tr>
<tr>
<td>Doctoral</td>
<td>1,207</td>
<td>421</td>
<td>725</td>
<td>61</td>
</tr>
</tbody>
</table>

Note(s):
Control refers to 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).

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

Science and Engineering Indicators
Figure HED-1

Institutions and degrees, by level of degree and control: 2019

### Associate's degrees

<table>
<thead>
<tr>
<th>Institutions</th>
<th>All degrees</th>
<th>S&amp;E degrees</th>
</tr>
</thead>
</table>

- **Public**
- **Private nonprofit**
- **Private for-profit**

### Bachelor's degrees

<table>
<thead>
<tr>
<th>Institutions</th>
<th>All degrees</th>
<th>S&amp;E degrees</th>
</tr>
</thead>
</table>

- **Public**
- **Private nonprofit**
- **Private for-profit**
Note(s):
The percentages in this figure may show different numbers than those in Table HED-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).
Rather than provide a comprehensive overview of the entire system, this section of the report discusses several types of institutions that contribute to education and training in S&E fields. These types of institutions are not mutually exclusive, and some institutions fit multiple categories. Institutions of higher education, particularly some of the types of institutions discussed in this report, are not distributed evenly across states and regions of the country (e.g., see the Integrated Postsecondary Education Data System [IPEDS] CollegeMap for overall distribution; a map of historically Black colleges and universities [HBCUs] is provided here). This section also provides information on distance and online education and the finances of higher education.

Research Universities

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. The 131 Carnegie-classified very high research activity doctoral universities play a key role in producing S&E degrees in the United States (Table SHED-1) and also perform a significant portion (about three-quarters) of total academic research and development (R&D). For more detail on the contribution of research universities, especially in the realm of S&E graduate education, see the Indicators 2022 report “[2022] Academic Research and Development.”

Minority-Serving Institutions

There are more than 700 MSIs of seven types (NASEM 2019). MSIs may be defined by legislation (or historically defined) or by the percentage of minority student enrollment and other characteristics of the student body (or enrollment defined) (Li 2007; NASEM 2019). HBCUs and tribal colleges or universities are historically defined. High-Hispanic-enrollment institutions (HHEs), in contrast, are one example of enrollment-defined MSIs. 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, the number of S&E bachelor’s degrees earned by Blacks is increasing (NCSES WMPD 2021: Table 5-4). In 2018, S&E fields accounted for 32% of the bachelor’s degrees that Blacks earned at HBCUs and 30% of the bachelor’s degrees that Blacks earned across all institutions.

The number of Hispanics earning S&E bachelor’s degrees from HHEs has increased (NCSES WMPD 2021: Table 5-5). This reflects increasing numbers of Hispanics earning S&E bachelor’s degrees at HHEs and at other types of institutions. In 2018, S&E fields accounted for 34% of the bachelor’s degrees that Hispanics earned at HHEs and 36% of the bachelor’s degrees that Hispanics earned across all institutions.

MSIs also play an important role in training underrepresented minority students for doctoral-level study in S&E fields, and some award doctorate degrees themselves. 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 from 2015 to 2019 earned a bachelor’s degree from an HBCU (NCSES 2021c). Likewise, around 38% of Hispanic S&E doctoral recipients from 2015 to 2019 earned a bachelor’s degree from an HHE (NCSES 2021c). 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 (see
NSB Indicators 2020. More data on the importance of these institutions as baccalaureate origin institutions are 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). Many students do not take a linear path but rather move between institutions and employers as they pursue educational and career objectives, with some returning to community colleges to augment their skills (e.g., Bahr 2017). The Community College Research Center, using Department of Education data, reports that nearly 40% of undergraduates in 2018–19 attended public 2-year colleges. Of students who earned bachelor’s degrees in any field from 2008 to 2017, more than half (52%) had done some coursework at a community college, and one-fourth (25%) earned associate’s degrees. The figures were 47% and 17%, respectively, among S&E degree recipients. 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 2020 reported having attended a community or 2-year college (NCES SED 2020: Table 30), and about 6% had previously earned an associate’s degree (Table SHED-2).

Community college attendance, however, varies across degree fields and among demographic groups. The percentage of 2020 doctorate recipients with associate’s degrees ranged from around 3% among engineering doctorates to over 11% among medical and other health sciences doctorates; percentages having attended community college at all were higher (NCES SED 2020: Table 30). Among racial categories, Black S&E doctoral degree recipients had the largest percentage to have earned an associate’s degree (10%); Asians (3%) had the lowest percentage. In addition, among the civilian college graduate population in the United States, a greater proportion of military veterans than nonveterans attended community college and earned associate’s degrees (Milan 2018).

For-Profit Institutions

In 2019–20, there were 722 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 around 8% that award doctoral degrees (Table HED-1). Degrees awarded by for-profit institutions rose dramatically throughout the 2000s but declined each year from 2011 to 2019. For-profit academic institutions produce less than 3% of S&E degrees (Figure HED-1). The S&E degrees they award cluster in a few fields: 76% of S&E bachelor’s degrees awarded by for-profits in 2019 were in computer sciences, psychology, or political science and public administration; at the doctoral level, 86% of S&E degrees were in psychology, medical sciences, or political science and public administration. A larger proportion of Blacks than other groups earned S&E doctorates at for-profit institutions (25% in 2019, compared with 7% of Hispanics, 5% of Whites, and 3% of Asians).

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, Topper, and Richardson 2017; Perna et al. 2014). 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).
Since the start of the COVID-19 pandemic, distance education in higher education has become much more common, with implications for learning, student experience, instructional quality, and cost. Data on distance education are available through the IPEDS through the 2018–19 academic year. These data include instances in which instructional content is delivered exclusively through distance education (i.e., hybrid or blended courses are not included). While this information does not yet incorporate the effects of COVID-19, it can serve as a comparison point when new data become available. For more information on distance education and other impacts on higher education during COVID-19, see sidebar COVID-19 and Higher Education.

In 2018–19, most colleges and universities (56%) offered both distance education courses and distance education programs (NCES 2021b). Such programs and courses were most common at public colleges and universities and least common at private 2-year institutions, though these account for a small percentage of colleges, and many are special focus or technical institutions. In fall 2018, around 35% of total enrolled students were enrolled in distance education courses.

Enrollment of undergraduate and graduate students in distance education increased each year from 2012 to 2018, except for enrollment at for-profit institutions, which declined (de Brey et al. Digest of Education Statistics 2019: Table 311.15). This occurred during a period of overall decline in total enrollment (NCES 2021b). Public universities account for most students taking these courses.

In 2018, most students enrolled at public institutions who took only distance education courses lived in the same state as their institution (82%). At private institutions, both nonprofit and for-profit, most students lived in another state (63% for nonprofit, and 81% for for-profit) (NCES 2021b).

A more detailed analysis and review of distance and online education is available in the prior release of this report (see NSB Indicators 2020).

**SIDEBAR**

**COVID-19 and Higher Education**

Beginning in March 2020, the COVID-19 pandemic disrupted colleges and universities throughout the nation. The need for social distancing required an abrupt halt to in-person learning and a transition to online education. Schools closed residence halls and canceled public events. Although some reopened for in-person instruction in fall 2020, they did so with modifications and restrictions that affected campus life. Some schools had to revert to online instruction when COVID-19 case counts rose. The availability of vaccines and federal coronavirus relief funds enabled schools to resume more normal operations in fall 2021. However, new variants and continued economic insecurity still impacted the higher education plans of many people, especially underrepresented minorities and students from low-income families.

**Estimated effects on enrollment**

Graduating high school students’ college enrollment rates were disrupted by the pandemic. Enrollment in fall 2020 of newly graduated high school seniors dropped 6.8% from 2019, 4.5 times the decline of 1.5% from 2018 to 2019. Graduates from high-poverty secondary schools experienced the steepest drops in enrollment rates at postsecondary institutions (down 11.4% compared to 1.6% in 2019) (National Student Clearinghouse Research Center 2021).
Overall postsecondary enrollment, including both undergraduate and graduate students, dropped by 2.6% in fall 2020—nearly 500,000 students—compared with a decline of 1.3% or about 230,000 students from 2018 to 2019. Undergraduate enrollment declined by 3.6%, with public community colleges experiencing the steepest enrollment decline (down 10.1%). Enrollment at public and private non-profit 4-year institutions declined by lesser amounts (down 0.7% and 1.4%, respectively). With infrastructure previously in place for online learning, enrollment at private for-profit 4-year institutions increased by 6.4% in fall 2020, reversing a 10-year trend of declining enrollment (National Student Clearinghouse Research Center 2021).

In contrast to undergraduate enrollment, graduate enrollment increased (3.6%), likely reflecting the prevalence of already-existing online programs and financial support commitments that were made prior to the pandemic. However, over 130 doctoral programs, especially in social sciences and non-S&E fields, suspended fall 2020 enrollment of new students to focus on continuing students (Zahneis 2021). Additional impacts on academic R&D and academic researchers are described in the Indicators 2022 report “[2022] Academic Research and Development” sidebar COVID-19 and Academic R&D.

Enrollment impacts were geographically widespread but varied by state and within states. Fall 2020 undergraduate enrollment declined over 9% in three states, with nine more states experiencing a 5%–8% decrease in enrollment (National Student Clearinghouse Research Center 2021). Universities and colleges undertook or expanded various initiatives to address declining enrollment, such as making standardized entry tests optional and offering additional lower-cost online alternatives to in-person classes (Busteed 2021).

In California, overall enrollment in the nation’s largest community college system dropped around 12% in fall 2020, but some institutions experienced declines of 30%–50%. Declines were greatest among older students, male students, and first-time students (California Community College Chancellor’s Office 2021) as well as Black and Hispanic students (Bulman and Fairlie 2021). In Virginia, enrollment declined in 8 of 15 of the state’s public 4-year institutions, including 2 historically Black colleges and universities (HBCUs). Lack of home Internet access contributed to an 8% decline in enrollment at one HBCU (Masters 2021; State Council of Higher Education for Virginia 2021).

Spring 2021 enrollment data indicate that overall fall 2020 enrollment trends continued (National Student Clearinghouse Research Center 2021). Overall postsecondary enrollment declined by 3.5% from spring 2020 (about 600,000 students). Undergraduate enrollment was down 4.9%, community college enrollment fell 9.5%, and graduate enrollment continued to grow (up 4.6%).

In an effort to achieve a more normal academic year in 2021–22, universities set expectations for vaccination and wearing a face mask. In August 2021, the Food and Drug Administration provided full (nonemergency use) approval of the Pfizer vaccine. By September 2021, over 800 colleges had adopted vaccination mandates (Nadworny and Dey 2021).

**Estimated effects on degree completion, research opportunities, and job prospects**

Reversing an upward trend since 2012, recipients of a first undergraduate degree declined in 2020 due to a decline in associate’s degrees. The number of individuals receiving their first bachelor’s degree increased, but those receiving their first associate’s degree or certificate decreased (National Student Clearinghouse Research Center 2021). A September 2020 survey of about 6,000 students revealed that 50% of respondents enrolled in bachelor’s degree programs and 56% of those enrolled in associate’s degree programs reported that the pandemic would negatively affect their ability to complete their degree (Gallup 2020).
Research and employment opportunities for both undergraduate and graduate students were curtailed. Summer 2020 undergraduate internships were suspended, and ongoing research involving undergraduates was halted (Parry 2020; Stone 2020). In a survey of 10 public research universities, about a quarter of graduate and professional student respondents expected the pandemic to delay their graduation (Soria, Horgos, and McAndrew 2020). On a survey of 1,500 undergraduate students at a large public university, students reported reduced expectations for finding a job by graduation and for their expected earnings at age 35 (Aucejo et al. 2020). A study of 208 institutions awarding graduate science, technology, engineering, and mathematics degrees reported fewer job placements for graduates (Stewart et al. 2021).

The halting of research and the closing of universities also impacted the productivity of the faculty. A study of 284 faculty members reported that female authorship declined, and parents of children under age 6 experienced reductions in academic productivity (Krukowski, Jagsi, and Cardel 2021).

**Estimated effects on teaching, student learning, and student well-being**

The rapid transition to online learning in March 2020 presented challenges for both faculty and students. Respondents to a survey of almost 900 S&E faculty reported numerous barriers to teaching online, including lack of student motivation and issues related to academic integrity and equity (Seaman, Allen, and Ralph 2021). The vast majority (around 90%) of surveyed students at research universities reported learning obstacles associated with online instruction. Most reported that they lacked motivation to learn online and learned less when they could not interact with other students. Students with family responsibilities struggled to juggle online classes with child or elder care. Low-income and working-class students reported that they lacked a quiet place to study or the appropriate technology to take online classes; they also were not available at designated online meeting times (Soria et al. 2020).

More broadly, college students reported that their educational plans and mental health have been disrupted by the pandemic. Higher proportions of Blacks and Hispanics than of Whites reported that their postsecondary education plans were canceled, whereas higher proportions of Whites than of Blacks or Hispanics reported that they had to take classes in different formats (Liu 2021). A study of 195 students at one large university reported that students had concerns about their health and the health of people they love. These students also experienced difficulty in concentrating, trouble sleeping, social isolation, financial difficulties, and depressive or even suicidal thoughts (Son et al. 2020). Higher proportions of underrepresented minority students seeking counseling reported grief over the loss of a loved one, with the highest rate (17%) among American Indians or Alaska Natives (CCMH 2021). In a study of five large, public universities, low-income graduate and professional students reported financial hardships caused by many factors, including unexpected increases in living expenses and loss or reduction in income (Soria 2020). In a separate study of undergraduate students at 9 universities and graduate and professional students at 10 universities, one in five students reported food insecurity during the early months of the pandemic (Soria et al. 2020). A large majority (73%) of respondents to an April 2021 survey of presidents of 244 higher education institutions reported “student mental health” as the most pressing issue facing their intuitions (Taylor et al. 2021).

**Estimated effects on higher education finances**

Impacts on revenue and spending varied according to institution type and student demographics. Community colleges that primarily serve low-income families were hit the hardest. For some, their ongoing financial viability is threatened (California Community College Chancellor’s Office 2021). HBCUs are particularly vulnerable financially because many of their students come from families of modest income, and the schools’ endowments are less than those of non-HBCU schools (Manning 2020).
Throughout the higher education system, the pandemic introduced new costs, such as regular coronavirus testing and personal protective equipment. A survey of 68 member institutions of the National Association of Independent Colleges and Universities (NAICU) reported that revenue was lost from tuition, housing, and auxiliary services, such as sporting and theater events (Whitford 2021a; APLU 2020; NAICU 2020). Staffing cuts occurred at a wide range of institution types (Chronicle of Higher Education 2020). Declines in international student enrollment, discussed in the section International S&E Higher Education, reduced revenue for many institutions reliant on tuition from these students.

Several laws address the impact of COVID-19 on higher education. The Coronavirus Aid, Relief, and Economic Security Act of 2020 (March 2020) and the Coronavirus Response and Relief Supplemental Appropriations Act of 2021 (December 2020) together allocated $35 billion in emergency relief funds to universities and colleges, including $1 billion set aside for underrepresented minority college students and low-income, first-generation college students, with $500 million going directly to HBCUs. The American Rescue Plan (March 2021) includes $40 billion for higher education, half of which schools must spend on grants to students. Because of the infusion of federal coronavirus relief funds, overall state funding for higher education institutions remained roughly the same during the 2020–21 academic year as in 2019–20 (CSEP 2021; Laderman and Tandberg 2021; Whitford 2021b). Amounts awarded to states through these laws ranged from $83 million in Wyoming to just over $10 billion in California. As of 31 August 2021, the majority of states had spent about half of the appropriated funds, with a range from 27% (Hawaii) to 62% (Kentucky) (U.S. Department of Education 2021). In April 2021, 32% of respondents to a survey of 244 higher education institution presidents reported the long-term financial viability of their institution as a concern, down from 41% in February 2021 (Taylor et al. 2021).

S&E Higher Education: Cost, Debt, and Financial Aid

Earning a college degree commands a substantial wage premium (Carnevale, Cheah, and Hanson 2015) and provides additional benefits to individuals and society (Ma, Pender, and Welch 2016). For these 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, contributing to concerns about affordability of higher education (Archibald and Feldman 2012; U.S. Congress Joint Economic Committee 2017). Additionally, state support for higher education per student is proportionately lower than it was through most of the 2000s. However, at the undergraduate level, published tuition and fees have also increased far more than the actual price students or their families pay to cover a year of educational expenses.

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 (see the Indicators 2022 report “[2022] Academic Research and Development”). The percentage of bachelor’s and doctorate recipients holding debt related to their education has declined slightly over the last 10 years.

Cost of Undergraduate Education

College pricing is complex, and institutions operate at different prices. For example, during the 2020–21 academic year, average published tuition and fees were $3,770 at in-district public 2-year institutions, $10,560 at in-state public 4-year institutions, $27,020 at out-of-state public 4-year institutions, and $37,650 at private nonprofit 4-year institutions. Published tuition and fees have greatly increased over the last 30 years (College Board Trends in College Pricing and Student Aid 2020: Figure CP-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 institution types, net prices rose much more slowly than published prices over the past 15 years (College Board *Trends in College Pricing and Student Aid 2020*: Figure CP-8, Figure CP-9, Figure CP-10). Net price and published price vary based on family income and other factors, such as whether students attend an institution in their own state or in another state.

College affordability remains a concern for many. The average undergraduate charge at public 4-year institutions as a percentage of per capita disposable personal income increased from around 33% in the early 2000s to 41% in 2019, though it peaked at around 44% in 2013 and has declined since then (*Figure HED-2; NSB State Indicator S-25*: see hyperlink for definitions and calculation). Since 1994, this measure has increased in every state and, in 2019, ranged from a low of 26% in Wyoming to a high of 58% in Vermont, with eight states over 50% (NSB 2021b).

![Average undergraduate charge at public 4-year institutions as a percentage of disposable personal income and state support for higher education per full-time equivalent student: 2000–19](image)

**State support for higher education per full-time equivalent student (2012 constant $)**

**Average undergraduate charge at public 4-year institutions as a percentage of disposable personal income (%)**

Note(s):
Data come from the *Science and Engineering Indicators State Indicators*, Indicators S-25 and S-28. State support for higher education per full-time equivalent student is shown in constant 2012 dollars. See the *State Indicators* for more detail.

Source(s):
National Center for Education Statistics, *Digest of Education Statistics* (various years), data available as of June 2020; U.S. Bureau of Economic Analysis, State and Local Personal Income data (various years), data available as of December 2020; State Higher Education Executive Officers Association, State Higher Education Finance (various years), data available as of May 2020.

*Science and Engineering Indicators*
While it has increased most years since 2012, state support for higher education per full-time equivalent student remains lower in constant dollars than it was during most of the 2000s, at $6,407 in 2019 (Figure HED-2; NSB State Indicator S-28) (NSB 2021d). Since 2001, state support has also declined as a percentage of state gross domestic product in all but three states: Connecticut, Hawaii, and Wyoming (NSB State Indicator S-26) (NSB 2021a).

**Undergraduate Debt**

Level of undergraduate debt varies by time to degree and type of institution, but the amount of borrowing among those who graduate has remained stable over the past 5 years. At the same time, the percentage of students who borrow has declined. At public and private nonprofit 4-year institutions, 56% of 2018–19 graduates graduated with debt, holding an average debt level of $28,800 compared to 61% of 2013–14 graduates with an average debt level of $28,900 in 2019 dollars (College Board *Trends in College Pricing and Student Aid 2020: Figure SA-14* and accompanying text). A higher percentage of students who graduate from private for-profit institutions than from public or private nonprofit institutions borrow money and borrow in larger amounts (College Board *Trends in Student Aid 2018: Figure 16*). Debt level also varies by state (Institute for College Access & Success 2020; see Interactive Map).

**Doctorate Recipient Debt**

Debt levels are an indicator of external financial support for doctoral training, with some fields receiving more support than others. The percentage of doctorate recipients holding any debt related to their graduate education (around 30%) has declined slightly in the last 10 years (NCSES *SED 2020: Table 39*). A greater percentage of doctorate recipients in non-S&E fields (46%) reported graduate debt than those in S&E fields (26%) (NCSES *SED 2020: Table 38 and Table 39*). Levels of debt also vary among S&E fields. For instance, a larger proportion of doctorate recipients in psychology and social sciences hold graduate debt (44% hold debt, with an average of over $31,000) than do those in physical and earth sciences (15% hold debt, with an average of about $5,000) (NCSES *SED 2020: Table 38*).

A larger proportion of women than men accumulate higher amounts of graduate debt, which may be attributed to variability in debt levels across fields of study (NCSES *SED 2020: Table 40*). Across fields, a larger proportion of Black doctorate recipients than Asians, Whites, or Hispanics hold more than $30,000 in graduate school debt (NCSES *SED 2020: Table 41*).

Other factors potentially influencing debt include time to degree, marital and dependent status, and highest level of parental education. Many potential factors leading to greater indebtedness are related. For instance, a greater proportion of Black doctorate recipients possess other characteristics related to higher indebtedness: 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 section Demographic Attributes of S&E Degree Recipients and Scott-Clayton and Li 2016).

**Financial Aid for Undergraduate and Graduate Students**

In 2019–20, undergraduate students received $184 billion in federal, state, institutional, and other aid (excluding nonfederal loans), down from $218 billion in 2010–11 (College Board *Trends in College Pricing and Student Aid 2020: Figure SA-3*). Institutional grant aid increased by 72% ($23 billion in 2019 dollars) during this time. Average total aid per undergraduate student declined by only 1% because enrollment decreased by 7%.

Graduate students received $58 billion in federal, state, institutional, and other aid (excluding nonfederal loans) in 2019–20 (College Board *Trends in College Pricing and Student Aid 2020: Figure SA-4*). As with undergraduates, federal financial aid constituted the majority of graduate student aid over the past 10 years. Federal aid was around 68% ($40 billion) of total aid in 2019–20. Loans were the main component of federal aid: 92% ($37 billion in 2019–20); the remainder consisted of veterans’ benefits, education tax benefits, and work-study programs.
Trends in Undergraduate and Graduate S&E Degree Awards

The number of S&E degrees awarded has increased at all levels and across many fields. In numbers and as a percentage of total degrees, S&E degrees increased at the associate’s, bachelor’s, master’s, and doctoral levels from 2000 to 2019 (Figure HED-3). State-level data on S&E degrees as a percentage of higher education degrees conferred are available in NSB State Indicator S-20 (NSB 2021c).

Figure HED-3

S&E degrees awarded, by degree level: 2000 and 2019
Undergraduate Degree Awards

S&E coursework at the undergraduate level prepares knowledgeable citizens in a society increasingly reliant on science and technology. Over the past 20 years, the number of undergraduate degrees awarded by U.S. academic institutions has increased in both S&E and non-S&E fields. According to the U.S. Department of Education, the number of associate’s degrees awarded is projected to increase by 1%, and the number of bachelor’s degrees awarded should increase by 3% over the period spanning 2017–29 (Hussar and Bailey 2020).

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 2019, 104,000 out of more than 1 million associate’s degrees (10%) were in S&E fields (see NSB Indicators 2020: Table S2-4; Table SHED-3). The total number of S&E associate’s degrees awarded declined from 2003 to 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 and 31% in 2019) of S&E associate’s degrees (Figure HED-4). 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.
In 2019, community colleges awarded 123,000 associate’s degrees in S&E technologies—more degrees than in S&E fields, which is a long-standing trend. S&E technologies have a more applied focus and include technician programs in engineering, health sciences, and other S&E fields (Table SHED-3). Health technologies constitute the large majority of degrees in S&E technologies (71% in 2019), followed by engineering technologies (25% in 2019), with only 4% in other fields. Degrees in S&E technologies prepare students to enter skilled technical professions directly, without the greater investment of time and money associated with obtaining a bachelor’s or advanced degree. For more data on the STW, see the Indicators 2022 report “[2022] The STEM Labor Force of Today: Scientists, Engineers, and Skilled Technical Workers.” For data on state-level variation in associate’s degrees in technology, see NSB State Indicator S-17.

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 31,000) and health technologies (from 122,000 to 88,000) (Figure HED-5).
Certificates in S&E Technologies

This report includes data on certificate awards of less than 1 academic year and awards of at least 1 but less than 2 academic years. In 2019, universities and colleges awarded roughly twice as many certificates in S&E technologies (258,000) as associate’s degrees in S&E technologies (123,000) (Table HED-2 and Table SHED-3). However, this does not mean that 258,000 students earned certificates because students often earn one or more certificates alongside or instead of a degree. As with associate’s degrees in S&E technologies, most certificates in S&E technologies were in health, followed by engineering, with few in other S&E technology fields (Figure HED-6; Table HED-2). Certificate programs are offered at a wide range of institution types, but the large majority are provided by community colleges (Figure HED-7; Table SHED-4). They enable people with or without a higher education degree to gain competency in technical skills needed in today’s marketplace. Among respondents to the Adult Training and Education Survey who were employed in the STW in 2016, around two-thirds reported that their certificate was very useful in improving their skills, around 60% found it very useful in getting a job, and just under 40% said their certificate helped increase their pay (NCES 2021a). In terms of career pathways, women frequently use their certificate to become a health care practitioner, and men often use it for jobs in installation, maintenance, and repair (Lancaster 2020).
### Table HED-2
Certificates awarded in S&E technologies for selected levels, by field: 2019
(Number)

<table>
<thead>
<tr>
<th>Field</th>
<th>Certificates</th>
</tr>
</thead>
<tbody>
<tr>
<td>All fields</td>
<td>756,950</td>
</tr>
<tr>
<td>S&amp;E</td>
<td>50,363</td>
</tr>
<tr>
<td>Non-S&amp;E</td>
<td>706,587</td>
</tr>
<tr>
<td>S&amp;E technologies</td>
<td>257,782</td>
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<tr>
<td>Engineering technologies</td>
<td>65,521</td>
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<tr>
<td>Engineering technology, general</td>
<td>912</td>
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<tr>
<td>Architectural engineering technologies/ technicians</td>
<td>268</td>
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<tr>
<td>Audiovisual communications technologies/ technicians</td>
<td>2,641</td>
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<tr>
<td>Civil engineering technologies/ technicians</td>
<td>154</td>
</tr>
<tr>
<td>Communications technologies/ technicians and support services, other</td>
<td>21</td>
</tr>
<tr>
<td>Communications technology/ technician</td>
<td>160</td>
</tr>
<tr>
<td>Computer engineering technologies/ technicians</td>
<td>1,262</td>
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<tr>
<td>Construction engineering technologies</td>
<td>576</td>
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<tr>
<td>Drafting/ design engineering technologies/ technicians</td>
<td>2,811</td>
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<tr>
<td>Electrical engineering technologies/ technicians</td>
<td>3,944</td>
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<tr>
<td>Electromechanical instrumentation and maintenance technologies/ technicians</td>
<td>4,841</td>
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<tr>
<td>Engineering-related fields</td>
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<tr>
<td>Engineering-related technologies</td>
<td>311</td>
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<tr>
<td>Environmental control technologies/ technicians</td>
<td>5,077</td>
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<tr>
<td>Industrial production technologies/ technicians</td>
<td>6,753</td>
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<tr>
<td>Mechanical engineering related technologies/ technicians</td>
<td>2,154</td>
</tr>
<tr>
<td>Mining and petroleum technologies/ technicians</td>
<td>339</td>
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<tr>
<td>Nanotechnology</td>
<td>16</td>
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<tr>
<td>Nuclear engineering technologies/ technicians</td>
<td>17</td>
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<tr>
<td>Precision metal working</td>
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<tr>
<td>Quality control and safety technologies/ technicians</td>
<td>696</td>
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<tr>
<td>Engineering technologies/ technicians, other</td>
<td>195</td>
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<tr>
<td>Health technologies</td>
<td>189,000</td>
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<tr>
<td>Allied health and medical assisting services</td>
<td>44,851</td>
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<tr>
<td>Allied health diagnostic, intervention, and treatment professions</td>
<td>30,363</td>
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<tr>
<td>American Sign Language</td>
<td>1,084</td>
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<tr>
<td>Clinical/ medical laboratory science/ research and allied professions</td>
<td>7,426</td>
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<tr>
<td>Dental support services and allied professions</td>
<td>10,929</td>
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<tr>
<td>Dietetics and clinical nutrition services</td>
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<tr>
<td>Health aides/ attendants/ orderlies</td>
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<tr>
<td>Health and medical administrative services</td>
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<td>Health/ medical preparatory programs</td>
<td>918</td>
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<tr>
<td>Medical illustration and informatics</td>
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<tr>
<td>Mental and social health services and allied professions</td>
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</tr>
<tr>
<td>Ophthalmic and optometric support services and allied professions</td>
<td>398</td>
</tr>
<tr>
<td>Practical nursing, vocational nursing and nursing assistants</td>
<td>65,089</td>
</tr>
<tr>
<td>Rehabilitation and therapeutic professions</td>
<td>121</td>
</tr>
<tr>
<td>Science technologies</td>
<td>3,204</td>
</tr>
<tr>
<td>Science technologies/ technicians, general</td>
<td>6</td>
</tr>
<tr>
<td>Biology technician/ biotechnology laboratory technician</td>
<td>333</td>
</tr>
<tr>
<td>Nuclear and industrial radiologic technologies/ technicians</td>
<td>161</td>
</tr>
<tr>
<td>Physical science technologies/ technicians</td>
<td>2,038</td>
</tr>
<tr>
<td>Science technologies/ technicians, other</td>
<td>666</td>
</tr>
<tr>
<td>Other S&amp;E technologies</td>
<td>57</td>
</tr>
<tr>
<td>Intelligence, command control and information operations</td>
<td>20</td>
</tr>
</tbody>
</table>
Table HED-2
Certificates awarded in S&E technologies for selected levels, by field: 2019
(Number)

<table>
<thead>
<tr>
<th>Field</th>
<th>Certificates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Military applied sciences</td>
<td>21</td>
</tr>
<tr>
<td>Military systems and maintenance technology</td>
<td>9</td>
</tr>
<tr>
<td>Military technologies and applied sciences, other</td>
<td>7</td>
</tr>
</tbody>
</table>

**Note(s):**
Awards at the detailed field level in this table will not match other tables and figures in this report due to the allocation of all Industrial production technologies/technicians awards under Engineering technologies. Data only include awards of less than 1 academic year and awards of at least 1 but less than 2 academic years.

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

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Figure HED-6
Certificates awarded for selected levels, by field: 2019

**Source(s):**
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey.
Figure HED-7

Certificates awarded for selected levels and fields, by institution type: 2019

**Note(s):**
Institution type corresponds to the 2018 Carnegie Classification of Institutions of Higher Education. Associate’s colleges are also commonly known as community colleges and public 2-year colleges. Data only include awards of less than 1 academic year and awards of at least 1 academic year but less than 2 academic years.

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

**Science and Engineering Indicators**

### 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 received rose steadily from about 400,000 in 2000 to just under 725,000 in 2019 (see NSB *Indicators 2020*: Table S2-6; Table SHED-5). As a share of total bachelor’s degrees awarded, S&E degrees have increased slightly over this period, rising from 32% to 36%. State-level data on bachelor’s degrees and bachelor’s degrees in S&E fields are available in NSB *State Indicator S-18* and NSB *State Indicator S-19*, respectively.

Growth in S&E bachelor’s degrees conferred varied by field (Figure HED-8; Table SHED-5), with most degrees awarded in social sciences, followed by biological and agricultural sciences. Large public universities have long dominated degree conferral in all fields, including S&E. Additionally, in 2019, the very high research activity doctoral universities, as per the Carnegie Classification, awarded 44% of total U.S. S&E bachelor’s degrees, though they awarded only 32% of total bachelor’s degrees (Table SHED-1). The large contribution of these institutions to producing S&E bachelor’s degrees is also a long-standing pattern.
Figure HED-8

S&E bachelor's degrees awarded, by field: 2000–19

![Graph showing S&E bachelor's degrees awarded by field from 2000 to 2019.](Image)

**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, Table Builder.

Science and Engineering Indicators

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**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. From 2000 to 2019, master’s degrees awarded in S&E fields more than doubled from about 96,000 to about 210,000 (see NSB Indicators 2020: Table S2-8; Table SHED-6). According to the U.S. Department of Education, this increase is projected to continue at least through 2028 (Hussar and Bailey 2020). S&E master’s degrees as a percentage of master’s degrees in all fields increased from 21% in 2000 to 25% in 2019.

Increases occurred in most major fields but were most pronounced in computer sciences and engineering (Figure HED-9). Growth in these two fields was driven largely by more students on temporary visas earning degrees, especially since 2014, as shown in Figure HED-10 and discussed in more detail in the report section International S&E Higher Education.
Figure HED-9

S&E master’s degrees awarded, by field: 2000–19

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, Table Builder.

Science and Engineering Indicators
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. Data on financial support for doctoral education and its linkage to R&D performance at colleges and universities are available in the Indicators 2022 report “[2022] Academic Research and Development.”

S&E fields accounted for the majority (65%) of doctorates conferred by U.S. universities in 2019. During 2000–19, the number of U.S. S&E doctorates conferred annually increased from around 28,000 to 48,000, faster than the rise in total doctorate awards (from nearly 45,000 in 2000 to 74,000 in 2019) (see NSB Indicators 2020: Table S2-10; Table SHED-7). The number of doctoral degrees awarded is projected to continue increasing at least through 2028 (Hussar and Bailey 2020). Across fields, the biggest percentage increases since 2000 occurred in engineering, computer sciences, and medical sciences (Figure HED-11). The dramatic increases in master’s degrees awarded to students on temporary visas is not seen at the doctoral level; as discussed later in the report, however, students on temporary visas earn the majority of U.S. doctorates in several fields.
Since 2000, public universities experienced large increases in doctoral degree awards and in 2019 awarded most of the U.S. doctoral degrees in S&E fields (66%) and in all fields (61%). The 131 highest research activity doctoral universities award most of the U.S. doctoral degrees across virtually all fields of study (Table SHED-1). In 2019, these institutions awarded over 48,000 total doctorates (65% of all doctorates) and nearly 36,000 S&E doctorates (74% 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 from 2000 to 2019, from about 400 to over 2,000 (or 5% 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 2020, in S&E broad fields, the median ranged from 6.3 years for physical sciences and earth sciences to 7.9 years in psychology and social sciences (NCSES SED 2020: Table 31). Times in non-S&E fields are longer. Median time to degree varies by demographic group (NCSES SED 2020: 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 HED-12). Under- or overrepresentation by sex and racial or ethnic group varies by field of study and degree level (NCSES WMPD 2021). 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.

Figure HED-12

Representation of racial and ethnic groups in the U.S. population and among U.S. citizen and permanent resident S&E degree recipients: 2019

Note(s):
Hispanic may be any race; race categories exclude Hispanic origin. U.S. population data reflect the percentage of people in each racial or ethnic group in the U.S. population between ages 20 and 34 years on 1 July 2019. Degree totals may differ from those elsewhere in the report; degrees awarded to people of unknown or other race were excluded, as were degree earners on temporary visas.

Source(s):

S&E Degrees by Sex

On average, women earn half or more of overall higher education degrees at each level. However, for S&E fields overall, their shares are lower (Figure HED-13). Long-standing differences between men and women have diminished or disappeared in some fields but persist in others.
Historically high-participation S&E fields for women include psychology, biological sciences, and social sciences. In 2019, women earned 65% of degrees awarded across all degree levels in these fields. Historically lower-participation S&E fields include engineering; earth, atmospheric, and ocean sciences; mathematics and computer sciences; and physical sciences. In 2019, across all degree levels, women earned higher shares of degrees in earth, atmospheric, and ocean sciences (42%) and physical sciences (39%) than they did in engineering (24%) and mathematics and computer sciences (28%). They also earned 57% of the degrees awarded in agricultural sciences (Table SHED-3, Table SHED-5, Table SHED-6, Table SHED-7).
At the associate’s level, women’s share of S&E degrees increased from 43% to 48% from 2011 to 2019 (Table SHED-3). Women earned about three-fourths of the degrees in psychology, biological sciences, and social sciences but only about a fifth of the degrees in engineering and in mathematics and computer sciences. Women earned almost two-thirds of associate’s degrees in S&E technologies (63%), and sex differences by field followed the same pattern as in S&E degrees. In 2019, many more women (72,000) than men (16,000) earned associate’s degrees in health technologies, leading to careers such as nursing. By contrast, more men (26,000) than women (4,600) earned associate’s degrees in engineering technologies, leading to careers such as electronics maintenance and repair (Figure HED-14; Table SHED-8).

**Figure HED-14**

Associate’s degrees in S&E technologies awarded to U.S. citizen and permanent residents, by sex and field: 2019

![Bar graph showing the number of associate's degrees in S&E technologies awarded to men and women in 2019.](image)

**Note(s):**
Awards at the detailed field level in this table may not match other tables and figures in this report due to the allocation of all Industrial production technologies/technicians awards under Engineering technologies.

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

At the bachelor’s level, women’s share of S&E degrees remained stable at about half since 2011, although the trend over time varied across fields (Table SHED-5). For example, in agricultural sciences, degrees earned by both men and women increased; however, degrees earned by women grew faster, resulting in an overall increase in women’s share from 52% to 58%. In the rapidly growing but still male-dominated field of engineering, women’s share of total bachelor’s degrees increased from 19% to 23% from 2011 to 2019. In physical sciences, by contrast, the increase in bachelor’s degrees earned by women and men was almost identical, and women’s share of degrees earned remained stable at 41%.
Women earned about 45% of master’s degrees in S&E each year from 2011 to 2019 (Table SHED-6). In mathematics and computer sciences, degrees earned by both men and women increased rapidly. With faster growth, women’s share of degrees in these fields increased from 31% to 35%. Similarly, biological sciences experienced substantial growth in degrees earned, with women’s gain outpacing that of men and raising women’s share from 57% to 60%.

Trends in doctoral degrees broadly mirrored those at other degree levels; women increased their share of S&E degrees from 44% to 46% from 2011 to 2019 (Table SHED-7). Women earned more than half of doctorates in most social sciences fields and in biological and medical sciences. Women earned a quarter of doctoral degrees in engineering in 2019, up from 22% in 2011. Women also earned relatively low shares of doctoral degrees in computer sciences (23%) and in mathematics and statistics (30%), although they increased their share of degrees in these fields by a couple of percentage points.

S&E Degrees by Race and Ethnicity

The racial and ethnic composition of degree recipients has changed over time, reflecting population shifts and increasing rates of higher education attainment by members of underrepresented minority groups. Racial and ethnic groups vary in S&E degree attainment levels, and while the gap in educational attainment has narrowed, it remains (Figure HED-12).

These differences in educational attainment reflect lower rates of high school completion, college enrollment, and degree completion. (For information on immediate post–high school college enrollment rates, see the Indicators 2022 report “[2022] Elementary and Secondary STEM Education.”)

In 2019, Hispanics constituted 21% of the U.S. population ages 20–34 (a typical age range for higher education degree earners) but earned 16% of the S&E postsecondary degrees awarded that year across all degree levels. Blacks constituted 14% of the U.S. population ages 20–34 years but earned 9% of S&E degrees awarded. American Indians or Alaska Natives were 0.8% of the U.S. population and earned 0.4% of all S&E degrees awarded. These three groups are underrepresented in educational attainment. Asians constituted 7% of persons ages 20–34 and earned 11% of total S&E degrees conferred across all degree levels in 2019, while Whites constituted 54% of this age group and earned 58% of S&E degrees (Figure HED-12).

In most fields, Hispanics earn substantially larger proportions of S&E associate’s degrees than bachelor’s and higher degrees (Figure HED-15). S&E associate’s degrees earned by Hispanics tripled from 2011 to 2019 as they increased their share from 13% to 30%. Asians more than doubled their earned S&E associate’s degrees and increased their share from 5% to 9%. There was much slower growth for Blacks (3%) and Whites (3%), and both dropped in their shares of S&E associate’s degrees earned. American Indians or Alaska Natives earned fewer S&E associate’s degrees in 2019 than they did in 2011 (Table SHED-3).
Figure HED-15

S&E degrees awarded to Hispanics or Latinos and Blacks or African Americans, by degree level and field: 2019
Whites, Blacks, American Indians or Alaska Natives, and Native Hawaiian or Other Pacific Islanders all earned fewer associate’s degrees in S&E technologies in 2019 than they did in 2011, while Hispanics and Asians increased their numbers (Table SHED-3). Of degrees awarded in practical nursing in 2019, 45% went to Hispanics; almost 30% of degrees in mental and social health services went to Blacks (Table SHED-8).

Since 2011, the share of S&E bachelor’s degrees awarded annually to Hispanic students rose from 10% to 16%, while the share awarded to Black students declined slightly. The share awarded to Asians increased, and the share awarded to American Indians or Alaska Natives dropped (Figure HED-16). While the number of S&E bachelor’s degrees earned by White students increased from 2011 to 2019, their overall share declined.
Figure HED-16

Share of S&E bachelor’s degrees awarded to U.S. citizens and permanent residents, by selected race or ethnicity: 2000–19

Note(s):
Asian or Pacific Islander includes both Asian and Native Hawaiian or Other Pacific Islander for all years. Hispanic may be any race; race categories exclude Hispanic origin. White is excluded from this figure to show trends for other groups more clearly. Percentages may not add to total because data do not include people who did not report their race or 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, Table Builder.

Science and Engineering Indicators

At the master’s level, most racial or ethnic groups earned more S&E degrees in 2019 than in 2011 (Table SHED-6). The number of S&E master’s degrees earned by Hispanics increased the most, and the Hispanic share of total S&E master’s degrees increased from 8% to 11%. Asians increased their share of S&E master’s degrees from 9% to 10%. Blacks earned 30% more S&E master’s degrees in 2019 than in 2011 and increased their share from 10% to 11%. By contrast, American Indians or Alaska Natives earned numerically fewer master’s degrees in S&E in 2019 than in 2011. Social sciences and psychology were the top two master’s fields for all race or ethnicity groups except Asians, who more frequently earned master’s degrees in computer sciences and biology. Engineering master’s degrees as a percentage of all S&E degrees earned by each racial or ethnic group were highest for Asians (28%), followed by Whites (21%), Hispanics (18%), American Indians or Alaska Natives (12%), and Blacks (9%).

Many of these trends are similar for doctoral degree awards. Underrepresented minorities as a group—Blacks, Hispanics, and American Indians or Alaska Natives—earned more S&E doctorates in 2019 compared with 2011 (Figure HED-17 and Figure HED-18; Table SHED-7). In 2019, underrepresented minorities collectively earned 16% of S&E doctorates (up from 12% in 2011). In comparison, Asians earned about 10% of S&E doctorates in 2019, up slightly from 9% in 2011, while Whites earned 64%, down from 69% in 2011. S&E doctorates as a percentage of total doctorates earned by each racial or ethnic group varied from a low of 38% for Blacks to a high of 76% for Asians.
Figure HED-17

S&E doctoral degrees awarded, by race, ethnicity, and citizenship: 2000–19

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. Asian or Pacific Islander includes both Asian and Native Hawaiian or Other Pacific Islander in years since 2011. Doctoral degree data differ from doctoral degree data in other tables and figures in this report that are based on the National Center for Science and Engineering Statistics 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, Table Builder.

Science and Engineering Indicators
Racial and ethnic groups also vary in their fields of doctoral degree (Figure HED-19; Table SHED-7). In 2019, the top field for Black recipients was medical and other health sciences (40% of S&E doctorates awarded to Blacks), followed by psychology (16%), biological sciences (10%), and engineering and political science and public administration (each at 8%). Biological sciences and psychology were the top fields for Hispanics (each at 22%), followed by medical and other health sciences (15%), and engineering (13%). For Asians, the top fields were engineering (24%) and biological sciences (23%), followed by medical and other health sciences (17%) and physical sciences (10%).
S&E doctoral degrees earned, by field, citizenship, and selected race or ethnicity: 2019

Note(s):
Hispanic may be of any race; race categories exclude Hispanic origin. Not all race or ethnicity data are reported in this figure; race or ethnicity categories apply only to U.S. citizens and permanent residents.

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

Science and Engineering Indicators

S&E Degrees by Race, Ethnicity, and Sex

While women overall earn just under half of S&E degrees, there is variation in female shares among racial and ethnic groups. In 2019, underrepresented minority females earned higher shares of S&E degrees at all degree levels than their male counterparts. By contrast, White and Asian women earned more than half of associate’s degrees in S&E technologies, around half of S&E doctoral degrees, and fewer than half of S&E degrees at other levels (Figure HED-20; percentages are derived from Table SHED-3, Table SHED-5, Table SHED-6, and Table SHED-7).
Women’s share of S&E degrees, by degree level and selected race or ethnicity: 2019

Women in each of the five racial and ethnic groups shown in Figure HED-20 increased their shares of S&E associate’s degrees from 2011 to 2019 (Table SHED-3). This increase was most pronounced for Hispanics or Latinos, with women increasing their share from 49% in 2011 to 58% in 2019.

Overall, both men and women earned numerically fewer associate’s degrees in S&E technologies in 2019 than they did in 2011. Hispanics or Latinos and Asians, however, increased their numbers during this time, and women in these groups also increased their share. Across all five racial and ethnic groups shown in Figure HED-20, women earned 60% or more of these degrees in 2019, mainly in health technologies.

At the bachelor’s level, women’s shares across racial and ethnic groups changed little from 2011 to 2019. Over this period, Hispanic women and men each more than doubled the number of S&E degrees they earned. Among Blacks, growth rates in S&E degrees earned by Black men (33%) outpaced those of women (18%). Among American Indians and Alaska Natives, a decrease in degrees earned from 2011 to 2019 was greater for men (down 25%) than for women (down 18%).

The most notable change at the master’s level was the increase in the share of S&E degrees earned by female American Indians or Alaska Natives: 59% (326) of degrees in 2019, up from 52% in 2011 (306). However, this increase occurred against the backdrop of small totals and declining numbers of American Indians or Alaska Natives earning S&E master’s degrees (553 total for men and women in 2019, compared with 584 in 2011) (Table SHED-6).
At the doctoral level, the women of each race or ethnicity increased their share of S&E degrees earned; they also increased the number of S&E degrees earned in all cases except that of American Indian or Alaska Native women. Hispanic women earned about 80% more degrees in 2019 than in 2011 and increased their share of doctorates earned by Hispanics from 53% to 55%. Black women earned 76% more doctorates in 2019 than in 2011 and increased their share of degrees earned by Blacks from 65% to 69%. Both American Indian or Alaska Native women and men earned fewer S&E doctorates in 2019 than in 2011 (Table SHED-7).

Within S&E fields, differences between men and women are persistent across racial or ethnic groups and degree levels. For example, women in all racial and ethnic groups earned over 60% of bachelor’s degrees awarded in biological sciences in 2019 and over 50% of degrees in social sciences but under 30% of bachelor’s degrees in engineering and mathematics and computer sciences (Table HED-3). There were some variations: Black women earned a higher proportion of bachelor’s degrees in biological sciences (72%) and physical sciences (57%), and Asian women earned a higher proportion of degrees in earth, atmospheric, and ocean sciences (55%) than other women. Generally, however, the high- and low-participation fields for women hold across degree levels and across race and ethnicity.

Table HED-3
Women's share of S&E bachelor's degrees in selected fields for U.S. citizens and permanent residents, by race and ethnicity: 2019

<table>
<thead>
<tr>
<th>Citizenship status, race, and ethnicity</th>
<th>Biological sciences</th>
<th>Earth, atmospheric, and ocean sciences</th>
<th>Engineering</th>
<th>Mathematics and computer sciences</th>
<th>Physical sciences</th>
<th>Psychology</th>
<th>Social sciences</th>
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<tbody>
<tr>
<td>U.S. citizen or permanent resident</td>
<td>64</td>
<td>42</td>
<td>23</td>
<td>25</td>
<td>41</td>
<td>79</td>
<td>56</td>
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<td>23</td>
<td>25</td>
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<td>63</td>
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<td>45</td>
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<td>60</td>
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<tr>
<td>Other or unknown race or ethnicity</td>
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<td>43</td>
<td>23</td>
<td>24</td>
<td>40</td>
<td>77</td>
<td>57</td>
</tr>
</tbody>
</table>

Note(s):
Hispanic may be any race; race categories exclude Hispanic origin. For each demographic group, the cells shaded in green indicate that women’s share of S&E bachelor’s degrees earned is 50% or higher. The shading becomes darker as shares rise. Cells shaded in yellow or orange indicate that women’s share of S&E bachelor’s degrees earned is less than 50% and the shading becomes darker as shares fall.

Source(s):
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey.
International S&E Higher Education

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 decline in overall international student enrollment in U.S. institutions in fall 2020, exacerbated by the COVID-19 pandemic. Data on degree awards, however, show that increasing numbers of foreign students continue to earn U.S. S&E degrees at most degree levels (pre-COVID-19). 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 and India have seen rapid increases in S&E degree production over time, compared with a more moderate rise in the United States and most European nations.

International Students in U.S. Higher Education: Enrollment

International Student Enrollment During the COVID-19 Pandemic

In fall 2020, about 605,000 international students enrolled in degree programs in U.S. higher education institutions (Figure HED-21; Table HED-4). This represents a decline of almost 23% (177,000 students) from 2019, much larger than the declines in the previous 3 years, and reflects impacts of COVID-19 on international student mobility. The decline was proportionately larger for undergraduates (who declined from 419,000 in 2019 to 315,000 in 2020, around 25%) than for graduate students (who declined from 363,000 to 290,000, around 20%). It was also larger for students studying non-S&E fields (from 376,000 to 279,000, around 26%) than for those studying S&E fields (from 406,000 to 326,000 in 2020, around 20%). Though not captured in the data reported here, other sources indicate that declines may have been especially large for first-time enrollments (Baer and Martel 2020; Zhou and Gao 2021).

Figure HED-21

International students enrolled in U.S. higher education institutions, by level of enrollment: 2012–20
Despite this significant reduction in numbers, there was little change in relative international student enrollment either in terms of country of origin or field of study. At the undergraduate level, China remained the largest sender (around 35%) of S&E students. India sent around 8%, and other countries each sent 4% or less (Table SHED-9). Likewise, at the graduate level, China remains the top sender of S&E students (36%), followed by India (28%), with other countries each sending 3% or less (Table SHED-10).

Undergraduate S&E students on temporary visas still predominantly studied engineering (27% of enrolled international students), followed by computer sciences (24%) and social sciences (17%), with other fields at 10% or less. S&E graduate students on temporary visas studied engineering (35% of enrolled international students) and computer sciences (27%), with other fields at 9% or less.
Trends in S&E Graduate Degrees by Level

For the first time in this report, we present data on international students enrolled in S&E graduate programs at U.S. institutions of higher education disaggregated by master’s and doctoral students. International students in S&E master’s and doctoral programs show different patterns, and that includes declines due to the first year of the COVID-19 pandemic. While international S&E master’s students declined from 127,000 to 91,000 (28%) from 2019 to 2020, international doctoral students declined only from 103,000 to 97,000 (around 6.5%) (Figure HED-22).

Figure HED-22

International S&E graduate students enrolled in U.S. higher education institutions, by level of enrollment: 2012–20

Note(s):
Data include active foreign national students on F-1 visas and exclude those on optional practical training. Numbers are rounded to the nearest 10. The data reflect fall enrollment in a given year and include students with active status as of 15 November of that year.

Source(s):

The decline in S&E master’s students from 2019 to 2020, while more dramatic, represents the continuation of a trend since 2016, when the number of these students peaked at around 152,000. Prior to 2016, numbers had climbed even more precipitously than they have fallen since. Numbers of S&E doctoral students, by contrast, have remained far more stable. According to the Council of Graduate Schools, first-time enrollment of international graduate students in the United States declined by 43% for master’s students and 26% for doctoral students (Zhou and Gao 2021).

Disaggregating these trends by field reveals that most of the growth, and subsequent decline, in master’s enrollment was in engineering and computer sciences, with other fields remaining relatively stable prior to 2020 (Figure HED-23).
These trends may also be disaggregated by country of origin, which shows that they were driven primarily by students from India (Figure HED-24); their numbers peaked in 2016 and have declined each year since. Numbers of Chinese S&E master’s students rose more slowly but continued to rise through 2019 before dropping in 2020 during the pandemic.
S&E Bachelor’s Degrees

Students in the United States on temporary visas have consistently earned a small share (around 4%–7%) of S&E bachelor’s degrees, although their total number more than doubled from 21,000 in 2011 to nearly 50,000 in 2019 (Table SHED-5). In 2019, temporary visa holders earned the largest shares of bachelor’s degrees awarded in economics (19%), mathematics and statistics (19%), engineering (11%), and physics (10%). S&E fields accounted for nearly half (49%) of the bachelor’s degrees earned by students on temporary visas.31

S&E Graduate Degrees

Students on temporary visas are earning increasing shares of U.S. S&E master’s degrees—36% in 2019 compared with 26% in 2011—as their total numbers increased from about 39,000 to nearly 75,000 during this period (Table SHED-6).32 During this interval, the biggest increases were in engineering and computer sciences, though these trends have stabilized over the past 3 years. Similar to bachelor’s degrees, a considerable proportion of the master’s degrees earned by students on temporary visas are in S&E fields (54% in 2019, up from 46% in 2011).
Trends at the doctoral level have remained stable for a longer time (Table SHED-7). In 2019, students on temporary visas earned about 35% of S&E doctorates, around the same as in 2011. This relatively stable trend is observed across all broad S&E fields: the shares of doctorates awarded to temporary visa holders did not change much since 2011. During this time, the numbers of S&E doctoral recipients on temporary visas increased from around 13,200 to around 16,600.

Temporary visa holders earn half or more of U.S. doctoral degrees in certain S&E fields. In 2019, temporary visa holders earned 62% of doctorates in economics. They also earned more than half of doctorates in computer sciences (59%), engineering (58%), and mathematics and statistics (51%). For postgraduation information on U.S.-trained S&E doctorate recipients on temporary visas at the time of graduation, see the report “[2022] The STEM Labor Force of Today: Scientists, Engineers, and Skilled Technical Workers” section Stay Rates of Noncitizen U.S.-Trained S&E Doctorates.

Countries of Origin for Doctorate Recipients

Top Countries and Fields

Since 2000, U.S. universities have awarded over 290,000 doctorates to temporary visa holders, with the vast majority (nearly 250,000, or 86%) in S&E fields. Over that time, the top three countries—China, India, and South Korea—accounted for 55% (136,000) of all international recipients of S&E doctoral degrees, and the top 25 countries accounted for nearly 85% (210,000) (see Figure HED-25, Table HED-5). For 22 of the top 25 countries, 75% or more 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; for example, engineering doctorates constitute 35% of total doctoral degrees earned by Chinese students at U.S. universities. For India, the figure is nearly 40%, and for Iran, it is 66%.
Figure HED-25

Top 25 regions, countries, or economies of origin of U.S. doctorate recipients on temporary visas, by broad field: 2001–20

**Note(s):**
Data include temporary residents and non-U.S. citizens with unknown visa status. China includes Hong Kong. Science includes natural sciences and social and behavioral sciences fields.

**Source(s):**

*Science and Engineering Indicators*
**Table HED-5**  
Top 25 countries of origin of U.S. doctorate recipients on temporary visas, by broad doctoral field: 2001–20  
(Number)

<table>
<thead>
<tr>
<th>Country</th>
<th>All fields</th>
<th>All S&amp;E fields</th>
<th>Engineering</th>
<th>Agricultural sciences</th>
<th>Biological sciences</th>
<th>Computer sciences</th>
<th>Earth, atmospheric, and ocean sciences</th>
<th>Mathematics</th>
<th>Medical and other health sciences</th>
<th>Physical sciences</th>
<th>Psychology</th>
<th>Social sciences</th>
<th>Non-S&amp;E</th>
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<tr>
<td>All countries of origin (214 countries)(^a)</td>
<td>290,832</td>
<td>249,178</td>
<td>87,151</td>
<td>9,070</td>
<td>39,049</td>
<td>17,368</td>
<td>5,733</td>
<td>14,400</td>
<td>9,501</td>
<td>33,483</td>
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<td>28,529</td>
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<td>Top 25 countries of origin</td>
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<td>6,629</td>
<td>32,961</td>
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<td>12,001</td>
<td>7,761</td>
<td>28,509</td>
<td>3,722</td>
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<td>China(^b)</td>
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<td>2,956</td>
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s = suppressed for reasons of confidentiality and/or reliability.

\(^a\) Excludes cases with unknown country of origin.
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):

Science and Engineering Indicators
Although students from South Korea earned less than a third of the number of doctorates earned by students from China from 2000 to 2019, they earned almost the same number of non-S&E doctorates (about 6,200 vs. 6,700).

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

Although 8 of the top 25 countries are European, the top 10 is dominated by countries in Asia. More than 30% of students from the United Kingdom earned doctorates in non-S&E fields. This is the highest percentage of any of the top 25 countries.

**Trends**

From 2000 to 2008, the number of students earning S&E doctorates at U.S. universities doubled to about 4,100 for China and nearly tripled to 2,200 for India. Since 2008, patterns for these two countries have diverged. Numbers of Chinese doctorate recipients have increased to more than 5,700 in 2019. Numbers of Indian doctorate recipients have stayed relatively flat, with a slight decline over the last several years to about 1,900. South Korea saw an increase from about 700 students earning S&E doctorates in the United States in 2000 to about 1,150 in 2008. Since then, numbers have slowly declined to about 800 in 2019. One other notable trend is an increase in the number of doctorate recipients from Iran, rising steadily from about 150 in 2010 to 960 in 2020 (see NCSES *SED 2020: Table 26* and, for older trend data, NCSES *SED 2010: Table 25 and 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 (OECD 2020). Although the United States continues to have a relatively high percentage (38%) 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, 40%) with these levels of education (Figure HED-26). Of 25- to 34-year-olds in the United States, 28% hold a bachelor's degree as their highest degree, which is higher than the Organisation of Economic Co-operation and Development (OECD) average of 24%. However, only 12% attain education higher than a bachelor’s degree, which is lower than the OECD average of 15% (OECD 2020). Moreover, the increase in attainment among younger people relative to older people visible in other OECD economies is not visible in the United States.
Science and Engineering Indicators

In the United States, large variation exists in the proportion of 25- to 34-year-olds with a postsecondary degree (in international comparisons, this is often referred to as tertiary attainment).\textsuperscript{35} There are differences between demographic groups (de Brey et al. Digest of Education Statistics 2019: 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 76% in the District of Columbia to a low of 32% in New Mexico (OECD 2020).

**First-University Degrees in S&E Fields**

First-university degrees are defined as terminal undergraduate degree programs (see the Glossary section for a more detailed definition) and are often used in international comparisons to accommodate differences among countries in higher education systems. In general, it can be useful to think of a first-university degree as equivalent to a bachelor’s degree. According to the most recent estimates, the United States awarded about 810,000 S&E first-university degrees (Figure HED-27; Table SHED-11).\textsuperscript{35} India and China, much larger countries than the United States in terms of overall population, produced 2.3 million and 1.8 million S&E first-university degrees, respectively. Previous editions of Indicators...
have reported single years of first-university degree data for India. This edition utilizes new data from the All India Survey on Higher Education to provide trend data back to 2011. Other nations reporting large numbers of S&E first-university degrees include Brazil (315,000), Mexico (241,000), the United Kingdom (180,000), Japan (173,000), Turkey (150,000), Germany (147,000), South Korea (139,000), and France (128,000).

Figure HED-27

S&E first-university degrees, by selected region, country, or economy: 2000–18

Note(s):
To facilitate international comparison, data for the United States are those reported to the Organisation for Economic Co-operation and Development, which vary slightly from the National Center for Science and Engineering Statistics classification of fields presented in other sections of the report. Data are not available for Brazil for 2000–03 or for India for 2000–10.

Source(s):

Science and Engineering Indicators

S&E first-university degrees as a proportion of all first-university degrees vary across countries (Figure HED-28). For the United States, the figure is about 41%. Of the countries and economies displayed in Figure HED-28, the United States awards the highest percentage of degrees in social sciences (18%) and the lowest percentage in engineering (7%).
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 41,000), followed by China (about 40,000), India (27,000), the United Kingdom (17,000), Germany (15,000), Brazil (11,000), France and Spain (about 9,000 each), and Japan (7,000) (Figure HED-29; Table SHED-12).
Figure HED-29

S&E doctoral degrees, by selected region, country, or economy: 2000–18

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. However, as mentioned earlier and discussed in “[2022] The STEM Labor Force of Today: Scientists, Engineers, and Skilled Technical Workers,” many of these doctorate recipients stay in the United States for subsequent employment after obtaining their degree.

In most of the nations shown in Figure HED-30, S&E doctoral degrees constituted more than half of total doctorate degrees. In addition, for most of these nations, the largest proportion of S&E doctoral degrees was awarded in the physical and biological sciences and in mathematics and statistics. However, in China, South Korea, and Japan, engineering students receive the most S&E doctoral degrees. When comparing only natural sciences (including physical and biological sciences; mathematics and statistics; computer sciences; earth, atmospheric, and ocean sciences; and agricultural 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 2018, China awarded nearly 38,000 doctorates in these fields; the United States awarded 31,000. While this trend is projected to continue, at the same time there is evidence to suggest that the quality of China’s doctoral education has risen and that most Chinese doctorate recipients receive their degrees from that nation’s elite universities (Zwetsloot et al. 2021).

Figure HED-30

Doctoral degrees by broad area of study, by selected region, country, or economy: 2018

Note(s):
Computer sciences is included under engineering for China and Japan. To facilitate international comparison, data for the United States are those reported to the Organisation for Economic Co-operation and Development, which vary slightly from the National Center for Science and Engineering Statistics classification of fields presented in other sections of the report.

Source(s):

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. Across OECD countries, international students account for an average of less than 5% of bachelor’s or equivalent enrollment, 13% of master’s or equivalent enrollment, and 22% of doctoral or equivalent enrollment (OECD 2020).

Across nations, international students also favor S&E fields and tend to enroll in these fields at higher levels than domestic students (OECD 2020). As shown in earlier sections, these trends are also observed among international students in U.S. institutions.
More internationally mobile students (undergraduate and graduate) come to the United States than to any other country (18% of internationally mobile students worldwide) (Figure HED-31). Other top destinations for international students include the United Kingdom, Australia, Germany, Russia, and France. The top 20 destination countries in 2018 together received around 80% of internationally mobile students worldwide. China is also an increasingly popular destination for globally mobile students, now in the top 10.

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). China excludes Hong Kong.


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 (in all fields) has risen dramatically, from around 2 million in 2000 to 5.6 million in 2018 (OECD 2020). According to data from the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics, China and India send the most students abroad; their combined share of outbound internationally mobile students rose from 19% in 2008 to 25% in 2018. Around one-third of Chinese
students studying abroad came to the United States in 2018, a proportion that changed very little in the previous 5 years. Around 39% of Indian students studying abroad came to the United States in 2018, down from 46% in 2014. An increasing number of Indian students are studying in Australia (21% in 2018, up from 12% in 2014) and Canada (10% in 2018, up from 7% in 2014).

A related 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.\textsuperscript{43} However, across nations, border closures due to the pandemic may affect global mobility patterns.
Conclusion

The U.S. higher education system consists of a range of institution types that address diverse student populations and regional and national 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. Recent data, however, indicate a decline in international student enrollment at U.S. academic institutions in fall 2020 accelerated by the COVID-19 pandemic. Beyond international student enrollment, the pandemic affected students and institutions across U.S. higher education in numerous ways, often exposing or exacerbating inequalities. Maintaining the preeminence of U.S. S&E higher education while serving Americans of all backgrounds represents a continuing aspiration that was placed in sharp focus by the challenges posed by the pandemic.
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 PhD 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 EdD, DMA, DBA, DSc, DA, or DM, and others, as designated by the awarding institution.”

European Union (EU): The EU comprises 27 member nations: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. Data in this report reflect the period before the departure of 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 United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics, the Organisation of Economic Co-operation and Development (OECD), and Eurostat and excludes students who travel for credit mobility.

Natural sciences: The combined group of physical and biological sciences; mathematics and statistics; computer sciences; agricultural sciences; and earth, atmospheric, and ocean sciences.

Science and engineering (S&E) fields: Degree award data cover degrees in the following S&E fields: astronomy; chemistry; physics; atmospheric sciences; earth, atmospheric, and 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

HBCU: historically Black college or university

HHE: high-Hispanic-enrollment institution

HSI: Hispanic-serving institution
IIE: Institute of International Education
IPEDS: Integrated Postsecondary Education Data System
ISCED: International Standard Classification of Education
MSI: minority-serving institution
NAICU: National Association of Independent Colleges and Universities
NCES: National Center for Education Statistics
NCSES: National Center for Science and Engineering Statistics
NSB: National Science Board
NSF: National Science Foundation
OECD: Organisation for Economic Co-operation and Development
OPT: optional practical training
R&D: research and development
S&E: science and engineering
SED: Survey of Earned Doctorates
SEVIS: Student and Exchange Visitor Information System
UIS: UNESCO Institute for Statistics
UNESCO: United Nations Educational, Scientific and Cultural Organization
References


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 completion data for degrees (associate’s, bachelor’s, master’s, and doctoral) as well as certificates below (less 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 (2018–19).

3 The Carnegie Classification of Institutions of Higher Education is available at http://carnegieclassifications.iu.edu/. The Basic Classification categorizes academic institutions primarily based on highest degree conferred, level of degree production, and research activity. This report uses the 2018 Carnegie Classification.

4 However, graduates from many different types of institutions go on to earn S&E doctoral degrees, as discussed by Burrelli and Rapoport (2008), Fiegener and Proudfoot (2013), and other sources.

5 For a list of all types and how they are designated, see NASEM 2019: Table 3-1 and Table 3-2. One comprehensive list of MSIs is maintained at https://cmsi.gse.rutgers.edu/content/msi-directory.

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 2017–18, there were 101 HBCUs 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 HHE institutions are defined by the U.S. Department of Education as nonprofit public and private institutions of higher education whose full-time equivalent enrollment of undergraduate students is at least 25% Hispanic, according to data that institutions reported in IPEDS, conducted by the National Center for Education Statistics (NCES). Institutions that enroll between 15% and 24% Hispanic students 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 non-profit 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 HHE status. 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 2021: Table 5-6.

9 A recent trend among states is to allow more community colleges to offer bachelor’s degrees. See Love et al. (2021) for more information.


11 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 2020: Table 30), likely reflecting that many foreign students come to the United States specifically for graduate training.

12 Data are from IPEDS.

13 Most of the remainder, 14%, were in “other social sciences.”
Information on the history of distance and correspondence and online education may be found in Harasim (2000).

No standard guideline exists that specifies how much education must be delivered via technology to qualify as online or distance education (Miller, Topper, and Richardson 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.

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 2020a).

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. In addition to tuition and fees, room and board constitutes another expense for students.

At the time of doctoral degree conferral, 41% of 2020 doctorate recipients held debt related to their undergraduate or graduate education, or both (NCSES SED 2020: Table 38).

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.

The College Board defines graduate students as master’s, doctoral, and professional students. For most of this report, when data on graduate students are presented, professional students are not included.

Occupational outcomes of graduates are covered in the Indicators 2022 report “[2022] The STEM Labor Force of Today: Science, Engineering, and Skilled Technical Workers.” 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/.

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.

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 over 2 million in 2019.

In 2019, 707 U.S. institutions enrolled graduate students, including 695 enrolling master’s students and 410 enrolling doctoral students (NCSES GSS 2019: Table 4-5).

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

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.” Limited data about S&E degree attainment of another group, military veterans, are available in Milan (2018).
The analysis here focuses on U.S. citizens and permanent residents. Race and ethnicity data are not available for temporary visa holders in the data sources used here. Some changes by race and ethnicity over time may reflect the way NCES and other federal statistical agencies collect information on this topic and how students self-identify over time. 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 2019, 7% of bachelor’s degree recipients were students of more than one race or other or unknown race or ethnicity. Of these, essentially the same number (71,000) were more than one race as other or unknown race or ethnicity (70,000); however, the 2019 totals reflect a large increase since 2011 in numbers classified as more than one race and a large decrease in those classified as other or unknown race or ethnicity.

More information on educational attainment by demographic group is available from the Department of Education’s Institute of Education Sciences’ annual Digest of Education Statistics. According to this report, in 2019 the percentage of people ages 25–29 with a bachelor’s or higher-level degree in any field differed among Blacks (29%, up from 20% in 2011), Hispanics (21%, up from 13% in 2011), American Indian or Alaska Natives (14%, down from 17% in 2011), Asians and Pacific Islanders (68%, up from 56% in 2011), Whites (45%, up from 39% in 2011), and persons of more than one race (34%, up from 32%) (de Brey et al. Digest of Education Statistics 2019: Table 104.20).

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.

Data in this section come from the Department of Homeland Security’s (DHS’s) Student and Exchange Visitor Information System (SEVIS), which collects administrative data, including numbers of international students enrolled in colleges and universities who are on visas (DHS/ICE 2020). It may not include students enrolled in online-only programs who are not physically present in the United States. Data include students enrolled in associate’s, bachelor’s, master’s, and doctoral degree 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 (2020), which constitutes another valuable source of information on international students in the United States and related topics.

From 2011 to 2019, the number of U.S. citizens and permanent residents earning bachelor’s degrees increased from about 1.7 million to 1.9 million. In 2019, around 35% of bachelor’s degrees awarded to U.S. citizens and permanent residents were in S&E fields.

During this interval, the number of U.S. citizens and permanent residents earning S&E master’s degrees increased from 151,000 to 210,000.

Data are from IPEDS. According to SED data, temporary visa holders represented 37% of U.S. S&E doctoral recipients in 2019.

Data are based on national labor force surveys and are subject to sampling error; therefore, small differences among countries may not be meaningful (OECD 2020).


The international degree data presented in this report were obtained largely from OECD’s statistical database, OECD.Stat (2021b). For a few countries not available from OECD, as noted in the Supplemental Tables, data were obtained from Eurostat (2021) 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 from IPEDS and other sources, as 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.

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

38 In 2019, 35% of U.S. S&E doctorates were earned by students on temporary visas, according to IPEDS. Equivalent data are not available from OECD.

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


41 For data on U.S. students studying abroad, see IIE’s Open Doors report (2020).


43 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 HED-31, which are from 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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