

2021 DOCTORATE RECIPIENTS FROM U.S. UNIVERSITIES

National Center for Science and Engineering Statistics
Directorate for Social, Behavioral and Economic Sciences
National Science Foundation



About this report

The Survey of Earned Doctorates (SED), the data source for this report, is an annual census of individuals who earn research doctoral degrees from accredited U.S. academic institutions. The survey is sponsored by the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation and by three other federal agencies: the National Institutes of Health, the Department of Education, and the National Endowment for the Humanities.

Monitoring the number of degrees awarded in science and engineering fields is an important part of the mission of NCSES, the nation's leading provider of statistical data on the U.S. science and engineering enterprise. The data from the SED are reported in several publications. The most comprehensive and widely cited publication is this summary report, *Doctorate Recipients from U.S. Universities*. This annual report calls attention to major trends in doctoral education and is organized into four recurring themes and a special focus area that highlight important questions about doctorate recipients. Online, the reader is invited to explore trends in greater depth through detailed data tables and interactive graphics (<https://nces.gov/sed/>). Technical notes and related resources are provided to aid in interpreting the data, and report content is available for downloading. The SED data are also available via an interactive data tool with data from the SED and other NCSES surveys (<https://ncesdata.nsf.gov/>) and the SED Restricted Data Analysis System (<https://ncesdata.nsf.gov/rdas>).

Table of Contents

Executive summary	5
U.S. doctorate awards	7
Field of doctorate	13
Path to the doctorate	20
Postgraduation trends	27
Special focus: COVID-19 pandemic impacts on doctorate recipients	35
Glossary	45
Data source	47
Notes	49
Appendix	51
Acknowledgments and citation	59
Contact author	60

Executive summary

Doctoral education trains scientists, engineers, researchers, and scholars, all of whom are critical to the nation's progress. These individuals create and share new knowledge and new ways of thinking that lead, directly and indirectly, to new products, services, and works of art. Annual counts of doctorate recipients from U.S. universities are measures of the incremental investment in human resources devoted to science, engineering, research, and scholarship, and these counts can serve as leading indicators of the capacity for knowledge creation and innovation in various domains.

Changes in the characteristics of this population over time reflect political, economic, social, technological, and demographic trends. These include the following:

- Increased representation of women, minorities, and temporary visa holders
- Emergence of new fields and changes in the relative popularity of other fields, particularly within science and engineering (S&E)
- Changes in completion time for doctoral study
- Expansion of the postdoctoral pool
- Shifting academic employment opportunities after graduation
- Different pathways to the doctoral degree

Understanding these connections is necessary to informing policy discussions regarding this country's doctoral education system.

In addition, this report highlights changes in doctorate recipients' graduate experiences and postgraduation plans during the COVID-19 pandemic. The data in this report cover the 2021 academic year (1 July 2020 to 30 June 2021) and are collected from doctorate students who complete the Survey of Earned Doctorates (SED) as they approach graduation. This is the first year in which the data collection fully coincided with the pandemic, and this report includes the results of questions that were specifically added to the survey to measure the pandemic's impact on doctorate recipients.

Key takeaways from the 2021 data include the following:

- The number of doctorate recipients from U.S. universities dropped for the second consecutive year. The decline from 55,224 doctorate recipients in 2020 to 52,250 in 2021 was the steepest 1-year decline (-2,974) in the history of the SED.
- Between 2020 and 2021, the number of U.S. citizen and permanent resident doctorate recipients decreased by 8% to 31,674, while temporary visa holders decreased by 5% to 17,638.
- The decline in the number of doctorate recipients between 2020 and 2021 was proportionately larger in non-S&E fields (-10%) than in S&E fields (-4%). The fields with the largest declines in the number of doctorate recipients were humanities and arts (-787), education (-463), health sciences (-338), and physical sciences (-307).
- In 2021, nearly half of doctorate recipients who responded to questions about the impacts of COVID-19 said their research had been disrupted. For 85% of them, disruptions stemmed from limited or no access to resources.
- While nearly 40% of doctorate recipients who responded to COVID-19 impact questions indicated the timeline for completing the doctoral degree was delayed by the pandemic, only 7% said funding for their doctoral studies had been reduced or suspended.

- The impact of the COVID-19 pandemic varied largely by field and nature of doctoral work, with research disruptions reported in larger proportions by doctorate recipients in fields where laboratories, equipment, and other facilities are indispensable, such as biological and biomedical sciences, physical sciences, and visual and performing arts.
- While the proportion of doctorate recipients with definite commitments increased in most S&E fields in the past two years, academic employment rates were down and the postdoctorate rate in the United States increased in all fields except biological and biomedical sciences.
- Compared to those with firm postgraduation commitments, larger proportions of S&E doctorate recipients who were still seeking employment or negotiating job offers reported that the COVID-19 pandemic had delayed their doctoral completion timeline, changed their immediate postgraduate employment or education plans, changed their long-term career plans or goals, or affected their plans about where to live in the year after graduation.

U.S. doctorate awards

Each new cohort of doctorate recipients augments the supply of prospective scientists, engineers, researchers, and scholars. Data on the composition of these cohorts reveal changes in the presence of different demographic groups.

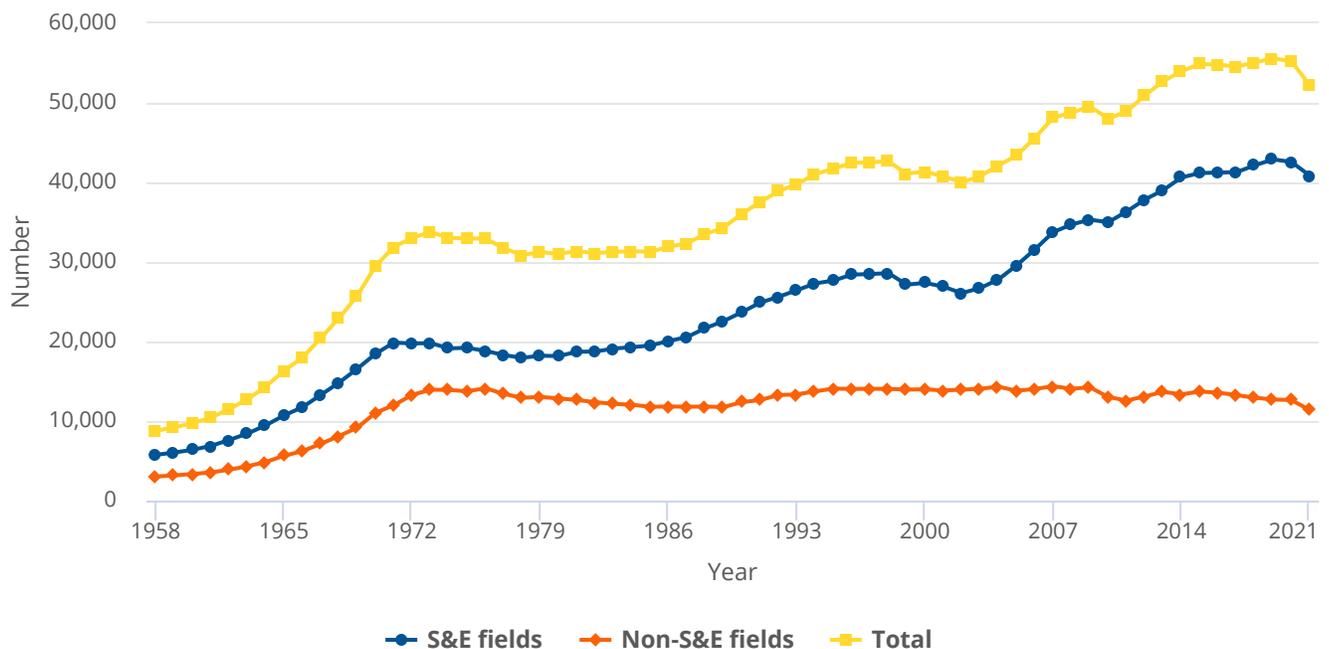
Overall trends

The number of research doctoral degrees awarded by U.S. institutions in 2021 decreased to 52,250, down from 55,224 in 2020, according to the Survey of Earned Doctorates (SED) (figure 1). Since the survey's inception in 1957, the number of doctorates awarded shows an upward trend—average annual growth of 3.0%—punctuated by periods of slow growth and even decline. However, the decline in 2021 is the second consecutive annual drop and the steepest in the history of the SED (-5.4%).

Since the SED began collecting data, the number of research doctorates awarded in science and engineering (S&E) fields has exceeded the number of non-S&E doctorates, and over time the gap has widened. From 1985 to 2021, the number of S&E doctorate recipients has more than doubled, while the number of non-S&E doctorate recipients in 2021 declined to just below the 1985 count. As a result, the proportion of S&E doctorates to all doctorates climbed from 62% in 1985 to 78% in 2021. The 2021 decline in the number of doctorate recipients was larger in S&E than in non-S&E fields, but the proportion was greater for non-S&E than for S&E fields.

Figure 1

Doctorates awarded by U.S. colleges and universities: 1958–2021



S&E = science and engineering.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-1.

Citizenship

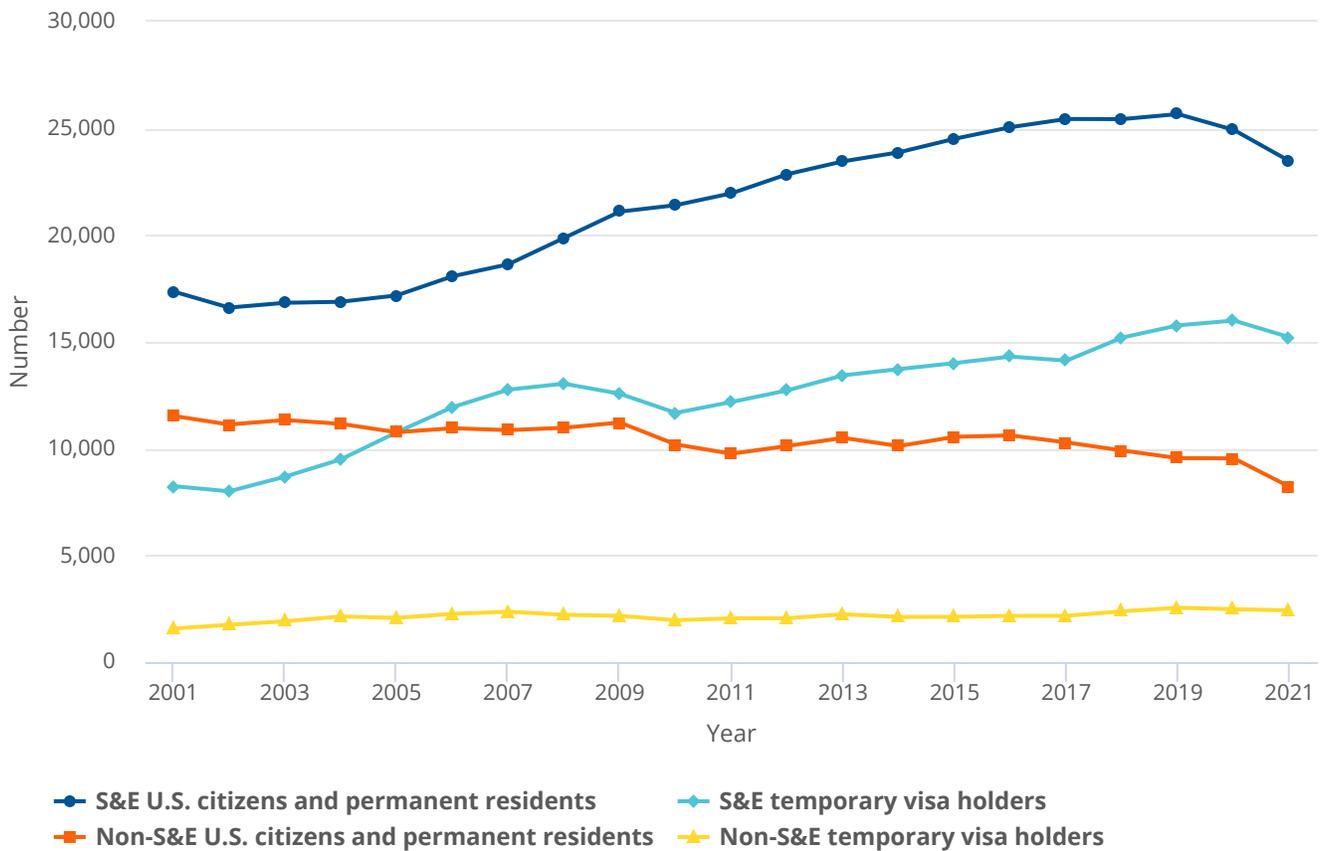
Trends in citizenship

In 2021, the number of doctorates in S&E fields awarded to temporary visa holders was 15,216, down 784 from 2020 (figure 2). Despite this decline, S&E doctorates awarded to temporary visa holders have increased 85% since 2001 and 25% since 2011. Over the past 20 years, the proportion of S&E doctorates awarded to temporary visa holders peaked at 41% in 2007, held steady at about 36% between 2010 and 2017, and increased to 39% in 2021.

In comparison, although starting from a larger base, the number of S&E doctorates awarded to U.S. citizens and permanent residents decreased by 1,464 in 2021; overall, it has experienced a slower relative increase over the past 20 years (35% since 2001 and 7% since 2011).

Figure 2

Doctorates awarded in S&E and non-S&E fields, by citizenship status: 2001–21



S&E = science and engineering.

Note(s):

Excludes respondents who did not report citizenship. Counts of unreported citizenship fluctuated between 1,989 and 4,137.

Source(s):

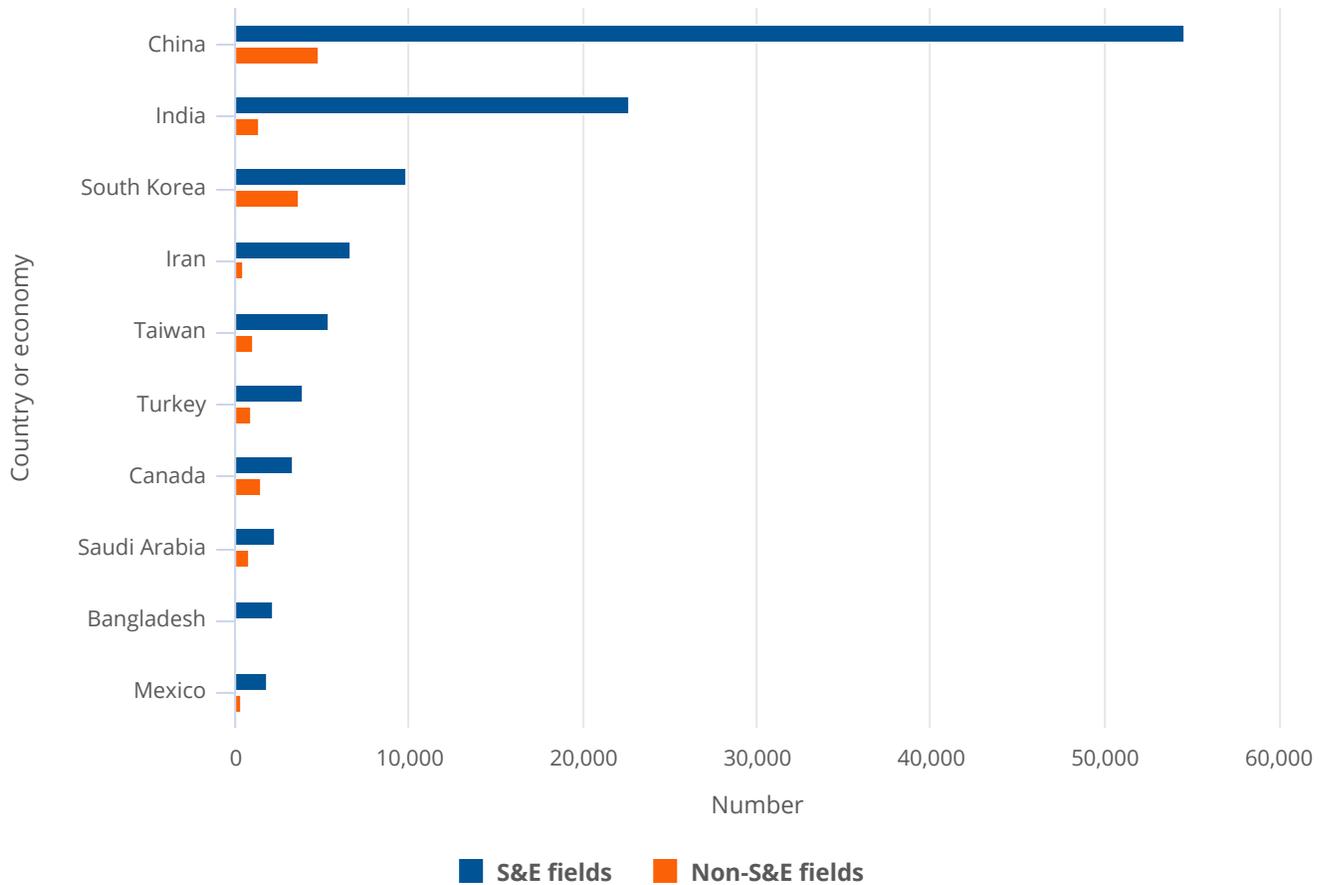
National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-6 and table 1-7.

Countries or economies of foreign citizenship

The number of doctorate recipients on temporary visas is highly concentrated in a few places of origin. Between 2011 and 2021, 10 places accounted for 70% of the 181,446 doctorates awarded to temporary visa holders, and the top 3 countries—China, India, and South Korea—accounted for over half (53%) (figure 3). Between 70% and 94% of doctorate recipients from each of these top 10 locations earned a doctorate in an S&E field.

Figure 3

Top 10 countries or economies of foreign citizenship for doctorate recipients with temporary visas: 2011–21



S&E = science and engineering.

Note(s):

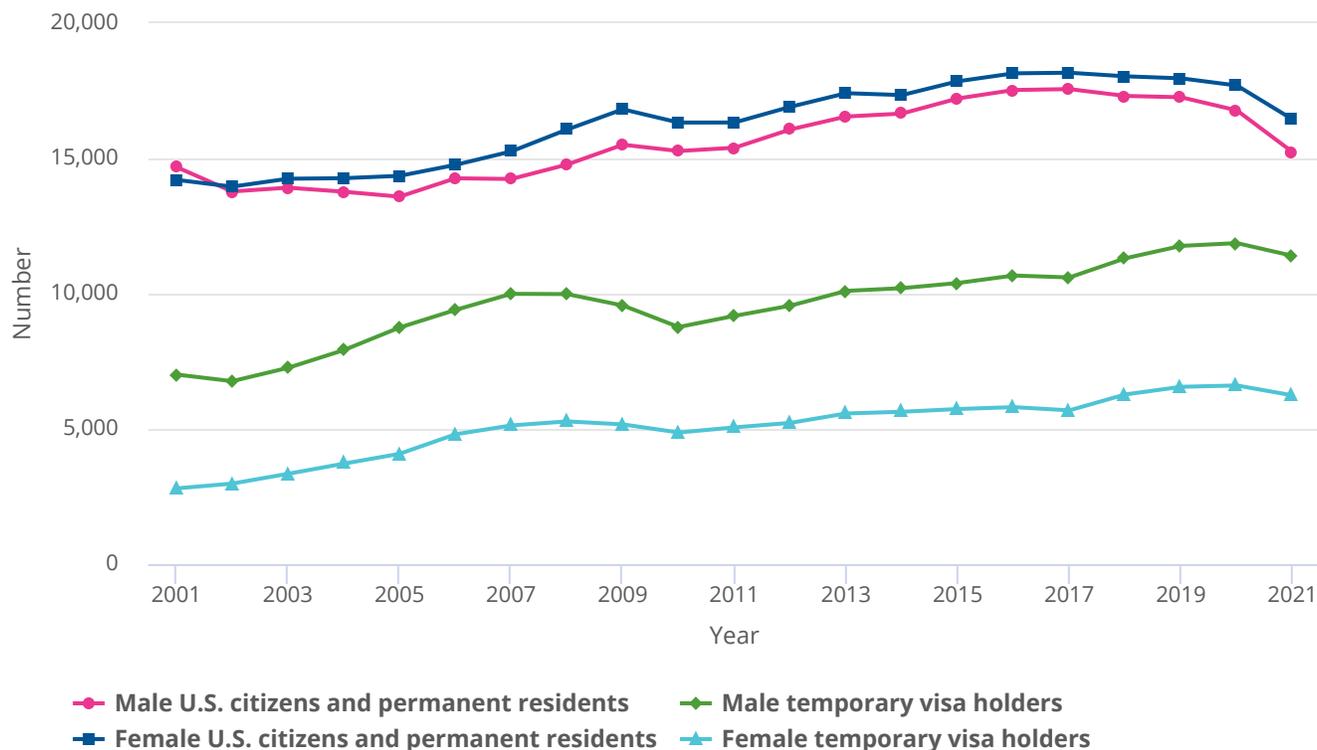
China includes Hong Kong. Ranking based on total number of doctorate recipients.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 7-7 and table 7-8.

Citizenship and sex

In 2021, women earned 46% of all doctorate awards. Since 2002, women have earned just over half of all doctorates awarded to U.S. citizens and permanent residents and more than 30% of doctorates awarded to temporary visa holders (figure 4). In the past 10 years, the proportion of women has been stable in both citizenship categories (51%–52% for U.S. citizens and permanent residents and 35%–36% for temporary visa holders).

Figure 4**Doctorates awarded, by sex and citizenship: 2001–21****Note(s):**

Excludes respondents who did not report sex or citizenship.

Source(s):

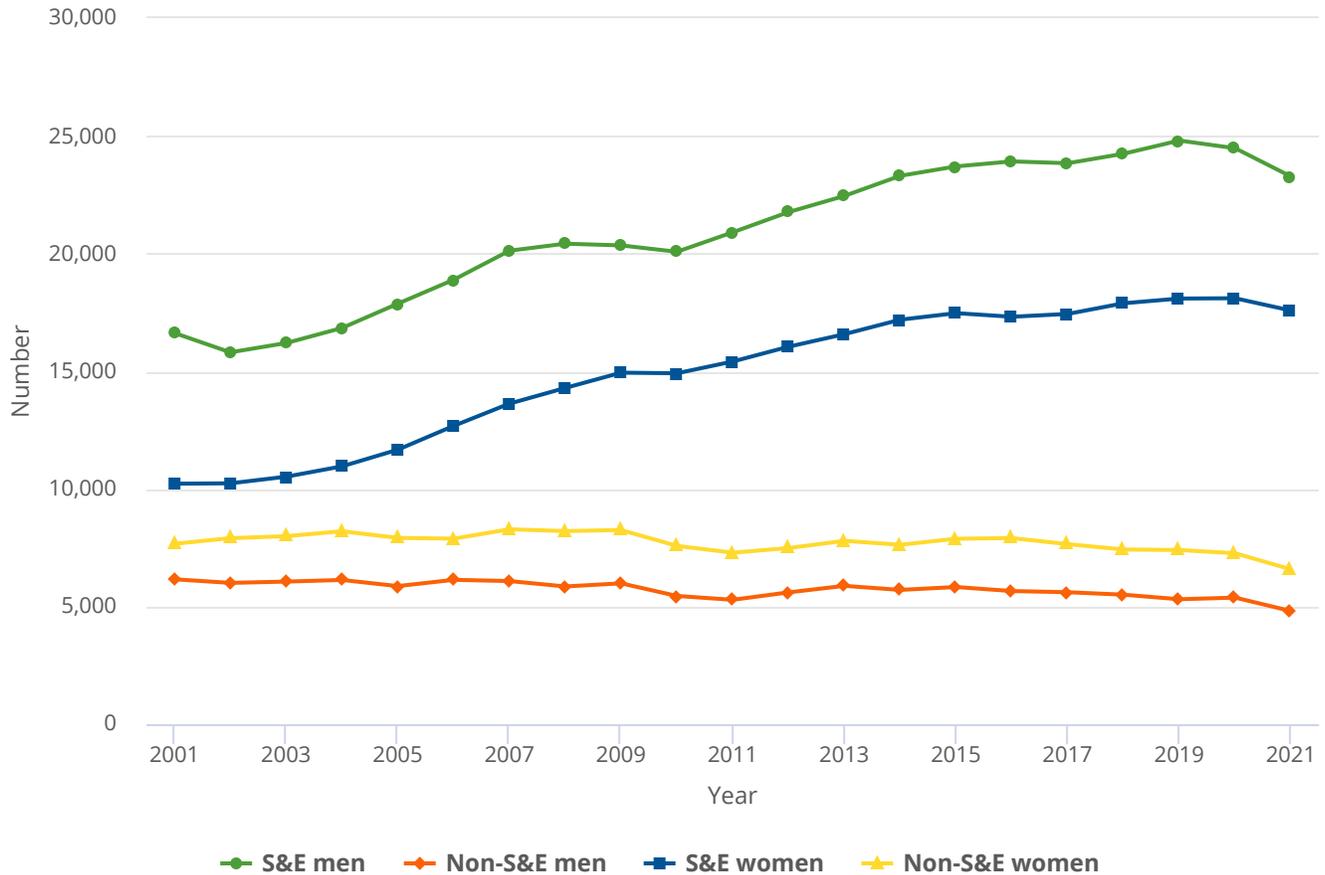
National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-9 and table 1-10.

Sex

In the past 20 years, most of the growth in the number of doctorates earned by both men and women has been in S&E fields ([figure 5](#)). During this period, the number of female doctorate recipients in S&E fields increased by 72%, although starting from a smaller base, compared with a 40% increase in the number of male S&E doctorate recipients. The proportion of female doctorate recipients in S&E increased from 38% in 2001 to 42% in 2010, and it has remained fairly stable since then.

In non-S&E fields, women earned 58% of doctorates in 2021, a proportion that has changed little since the early 2000s. Between 2001 and 2021, the number of female non-S&E doctorate recipients declined by 14%, while the number of male doctorate recipients in those fields declined by 22%.

Between 2019 and 2021, the decline in the number and proportion of male S&E doctorate recipients was larger than the decline in female S&E doctorate recipients. In contrast, in non-S&E fields, the decline was larger among women than among men.

Figure 5**Doctorates awarded, by sex and field: 2001–21**

S&E = science and engineering.

Note(s):

Excludes respondents who did not report sex.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-4, table 1-5, and table 3-2.

Race and ethnicity

From 2001 to 2021, the proportion of doctorates earned by White U.S. citizens and permanent residents declined from 77% to 67%, and the proportion earned by Asian U.S. citizens and permanent residents increased from 7% to 10%.¹ The participation in doctoral education by Black or African American and Hispanic or Latino U.S. citizens and permanent residents increased, although starting from a small number.

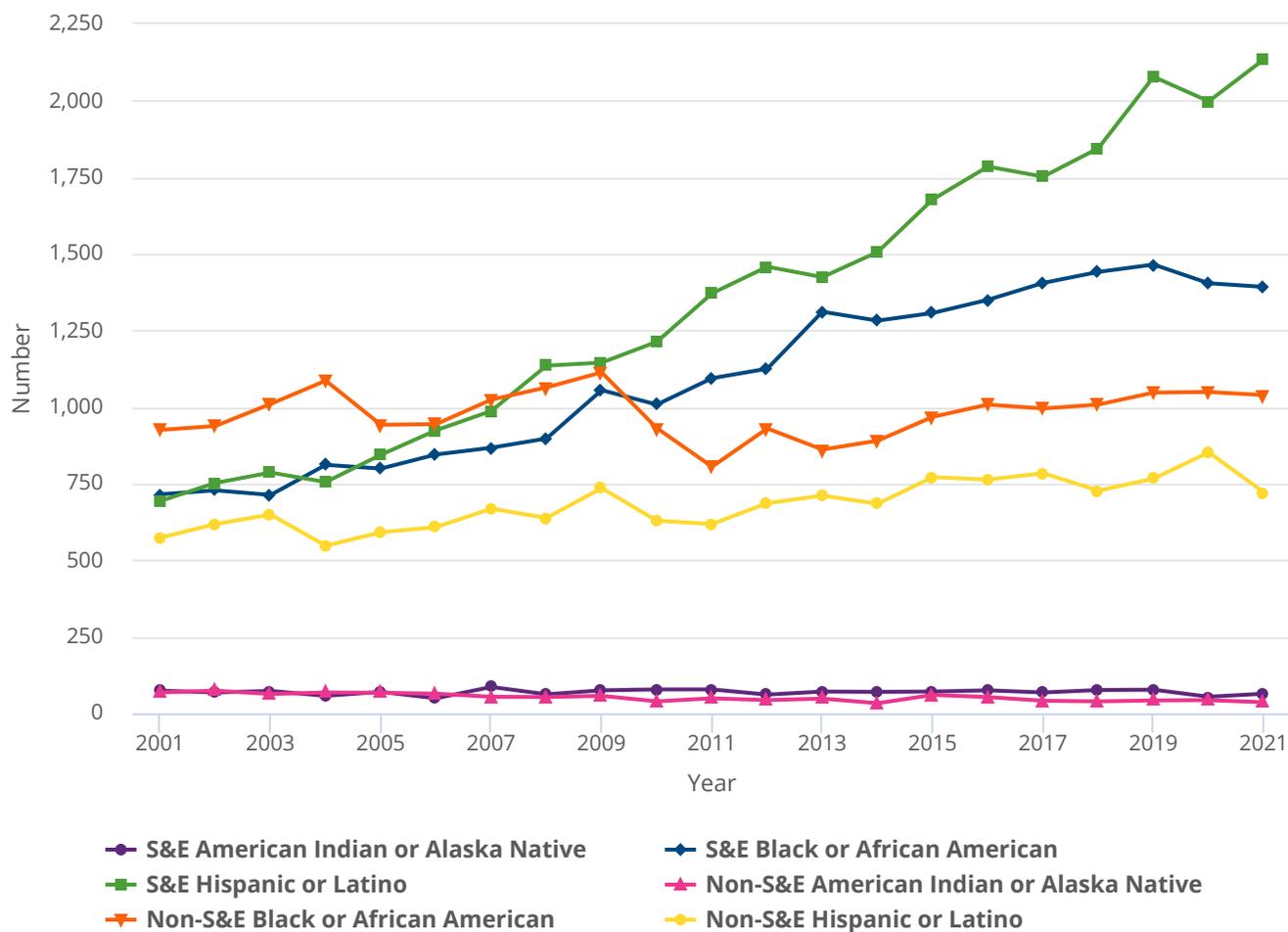
In the past 20 years, the number of Hispanic or Latino doctorate recipients in S&E increased from 693 to 2,135 (figure 6). As a result, the proportion of doctorates earned by this group among U.S. citizens and permanent residents grew from 4% in 2001 to 9% in 2021. The number of Black or African American doctorate recipients in S&E increased from 715 in 2001 to 1,392 in 2021, and the proportion of doctorates they earned among U.S. citizens and permanent

residents increased from 4% to 6% during this period. Between 2019 (before the COVID-19 pandemic) and 2021, however, the number of Black or African American doctorate recipients in S&E declined by 73 and the number of Hispanic or Latino doctorate recipients in S&E increased by 57.

Between 2001 and 2021, the number of American Indian or Alaska Native doctorate recipients in S&E fluctuated between 49 and 86. Since 2019, it declined from 77 to 64, remaining under 0.5% of S&E doctorates awarded to U.S. citizens and permanent residents.

Figure 6

Doctorates earned by underrepresented minority U.S. citizens and permanent residents, by field: 2001–21



S&E = science and engineering.

Note(s):

Excludes U.S. citizen and permanent resident respondents who did not report race or ethnicity. Counts of unreported race or ethnicity fluctuated between 434 and 982.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-8, table 1-11, table 3-3, and table 3-4.

Field of doctorate

As researchers expand their understanding of the world, new fields of study emerge and existing fields change. Observing which fields are attracting growing proportions of students can provide early insight into where future research breakthroughs may occur.

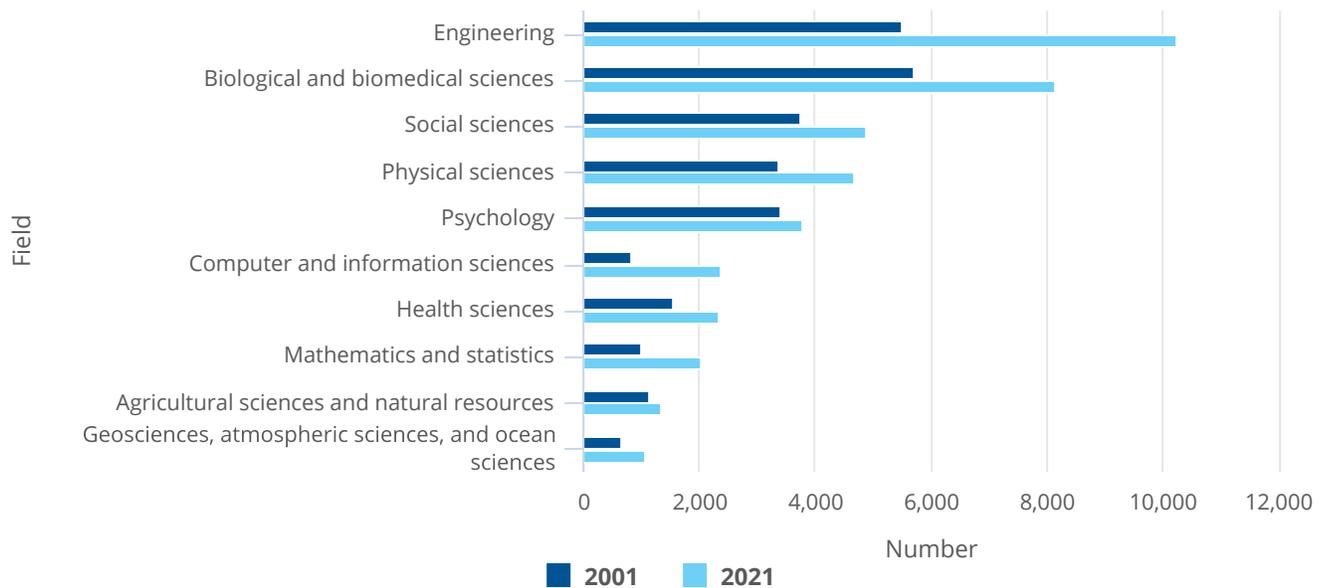
Field of doctorate trends

S&E

Doctorates in science and engineering (S&E) fields are a growing share of all doctorates awarded. Over the past 2 decades, every broad S&E field except psychology and agricultural sciences and natural resources increased both in number and share of all doctorates. These two fields increased in the number of doctorate recipients, but their share of all doctorates awarded declined. Among S&E fields, engineering grew the most, from 14% of all doctorates in 2001 to 20% in 2021 ([figure 7](#)).

Figure 7

Doctorates awarded in S&E broad fields: 2001 and 2021



S&E = science and engineering.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-3.

Between 2020 and 2021, all S&E broad fields declined in the number of doctorate recipients ([table A](#)). The S&E fields with the largest declines in doctorate recipients were physical sciences (-307) and biological and biomedical sciences (-529); the S&E fields with the lowest declines were computer and information sciences (-2) and mathematics and statistics (-12).

Table A

S&E doctorates awarded, by broad field: 2019–21

(Number)

Field	2019	2020	2021
S&E fields	42,898	42,580	40,859
Agricultural sciences and natural resources	1,488	1,470	1,334
Biological and biomedical sciences	8,678	8,410	8,149
Computer and information sciences	2,220	2,363	2,361
Engineering	10,298	10,471	10,240
Geosciences, atmospheric sciences, and ocean sciences	1,272	1,241	1,064
Health sciences	2,582	2,669	2,331
Mathematics and statistics	2,010	2,024	2,012
Physical sciences	5,307	5,000	4,693
Psychology	3,909	3,871	3,797
Social sciences	5,134	5,061	4,878

S&E = science and engineering.

Source(s):

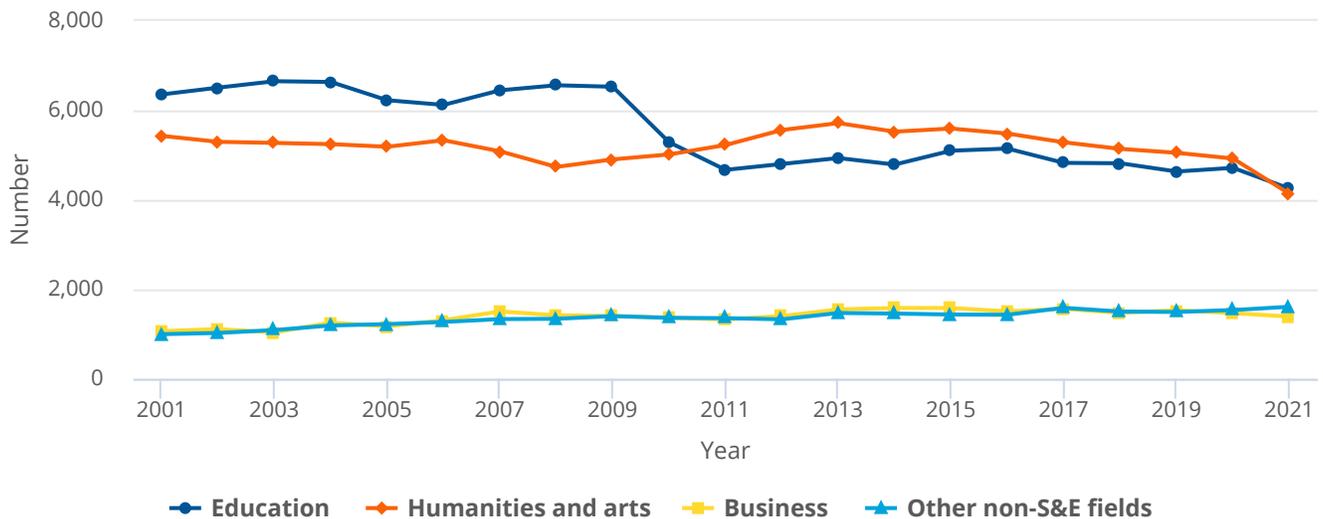
National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-4 and table 1-5.

Non-S&E

Among non-S&E broad fields, in the past 20 years the number of doctorates awarded in humanities and arts declined, while the number in business increased (figure 8). Since 2011, the number of doctorates in education declined by 418.²

Figure 8

Doctorates awarded in non-S&E broad fields: 2001–21



S&E = science and engineering.

Note(s):

For details on the drop in education doctorates between 2009 and 2011, see "Time series data changes" in the "Data Source" section.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-3.

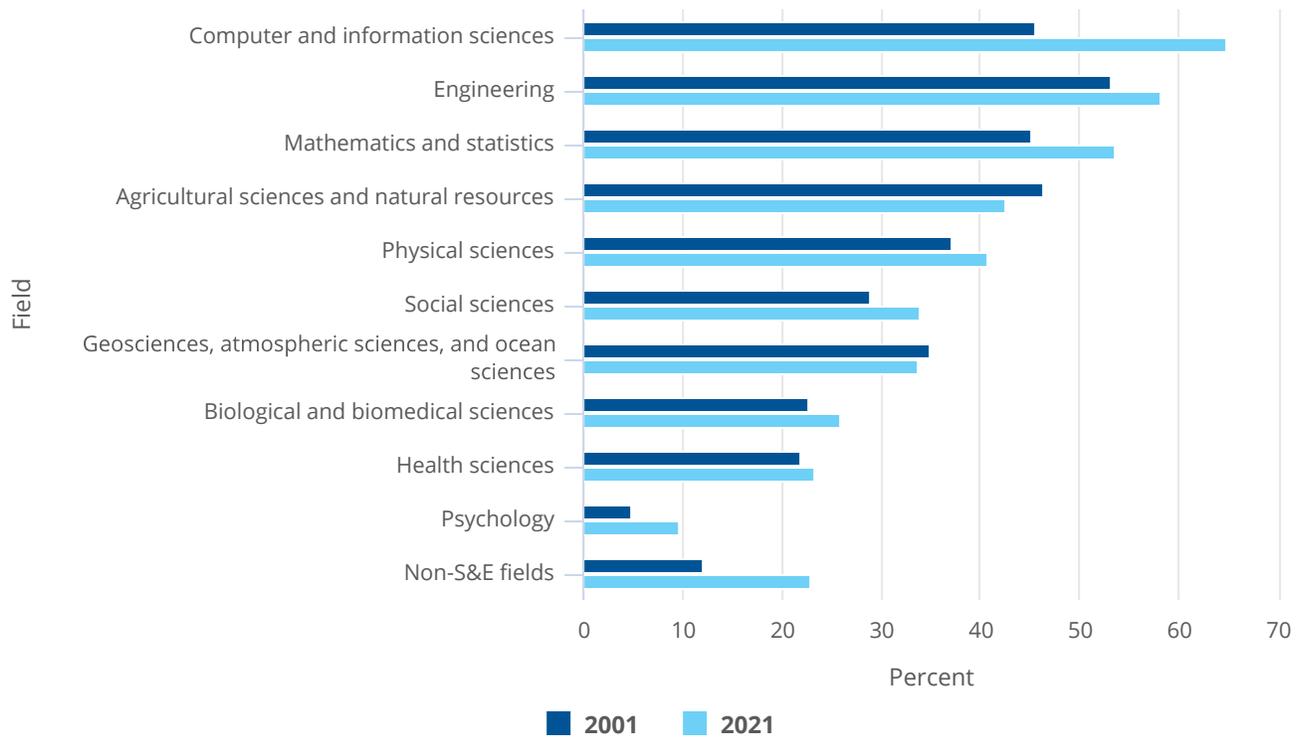
Between 2020 and 2021, the number of doctorates in non-S&E broad fields declined. The largest drop was in humanities and arts (-787), followed by education (-463).

Temporary visa holders

In the past 2 decades, the number of doctorate recipients who are U.S. citizens and permanent residents increased in every broad field of study except in education³ and in humanities and arts. During this period, the number of doctorates awarded to temporary visa holders also increased in every broad field.⁴

In 2021, temporary visa holders earned the majority of doctorates in computer and information sciences (65%), engineering (58%), and in mathematics and statistics (54%) (figure 9). The largest increases in the proportions of temporary visa holders since 2001 were in computer and information sciences, mathematics and statistics, and non-S&E fields.

Figure 9
Doctorate recipients on temporary visas, by broad fields: 2001 and 2021



S&E = science and engineering.

Note(s):
 Percentages are based on the number of doctorate recipients who reported citizenship.

Source(s):
 National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-6.

Minority U.S. citizens and permanent residents

In 2021, 67% of the 31,674 doctorate recipients who were U.S. citizens or permanent residents were White; 10% were Asian, 9% Hispanic or Latino, 8% Black or African American, and 3% identified as more than one race ([table B](#)).⁵ The remaining doctorate recipients were either American Indian or Alaska Native or Native Hawaiian or Other Pacific Islander, or they did not report their race or ethnicity.

Table B

Doctorates awarded to U.S. citizens and permanent residents, by race or ethnicity: 2021

(Number and percent)

Race and ethnicity	Number	Percent
U.S. citizens and permanent residents	31,674	100
Hispanic or Latino	2,856	9.0
Not Hispanic or Latino	28,350	89.5
American Indian or Alaska Native	100	0.3
Asian	3,022	9.5
Black or African American	2,431	7.7
White	21,333	67.4
More than one race	1,088	3.4
Other race or race not reported	376	1.2
Ethnicity not reported	468	1.4

S&E = science and engineering.

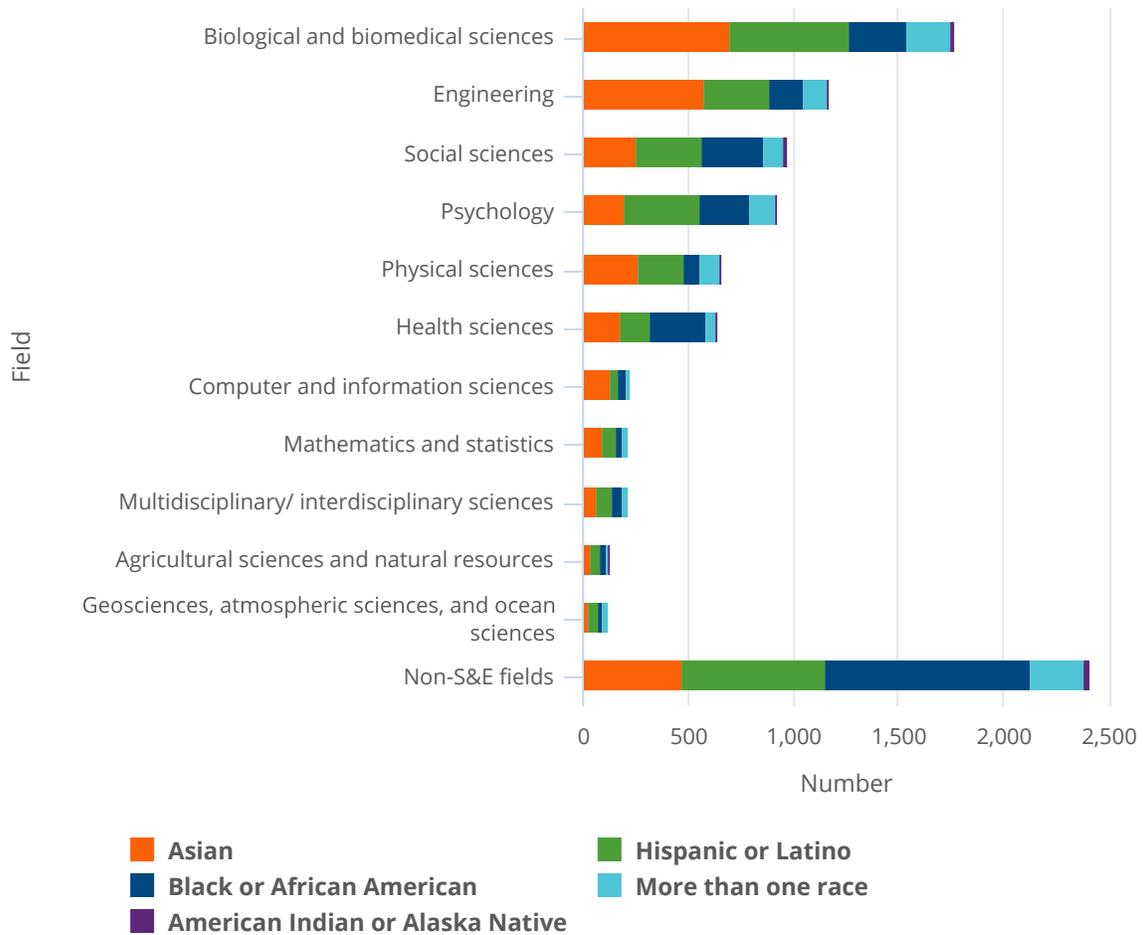
Note(s):

Percentages may not sum to 100 due to rounding.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-11.

Among minority U.S. citizens and permanent residents, doctorate recipients of different racial or ethnic backgrounds are more heavily represented in some broad fields than in others. In 2021, Asians earned a larger share of doctorates than other racial and ethnic minority groups in computer and information sciences, engineering, mathematics and statistics, physical sciences, and biological and biomedical sciences. Black or African American doctorate recipients were the largest minority group in health sciences and in non-S&E fields (particularly in education),⁶ and Hispanics or Latinos were the largest minority group among doctorate recipients in psychology; social sciences; agricultural sciences and natural resources; and geosciences, atmospheric sciences, and ocean sciences ([figure 10](#)).

Figure 10**Doctorates awarded to minority U.S. citizens and permanent residents, by selected race, ethnicity, and broad field: 2021**

S&E = science and engineering.

Note(s):

Excludes U.S. citizen and permanent resident respondents who did not report race or ethnicity or were Native Hawaiian or Other Pacific Islander.

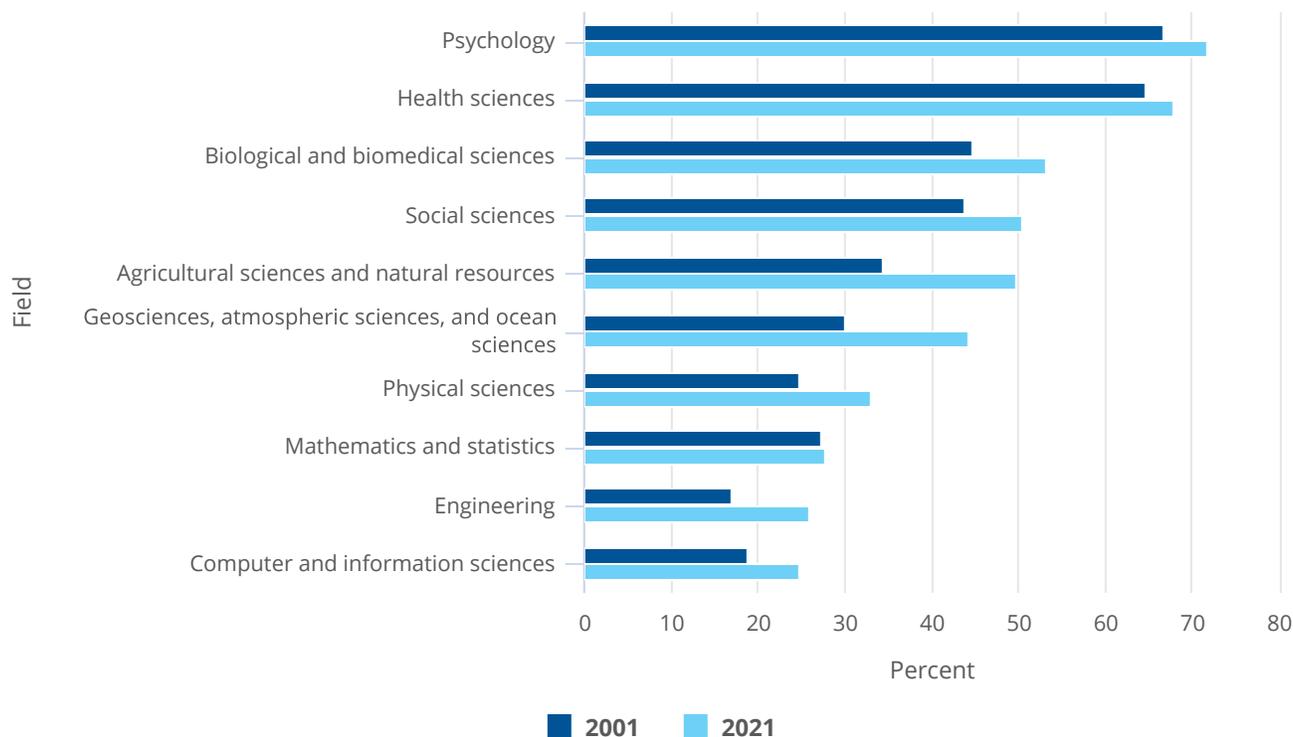
Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 3-4.

Women

Overview

Women's share of doctorates has grown over the past 2 decades in most S&E broad fields ([figure 11](#)). In 2021, women earned 49% or more of the doctorates in psychology, education, health sciences, biological and biomedical sciences, social sciences, agricultural sciences and natural resources, humanities and arts, and other non-S&E fields.⁷

Figure 11**Doctorates awarded to women, by S&E broad field: 2001 and 2021**

S&E = science and engineering.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-4 and table 1-5.

Women earned between about 25% and 44% of the doctorates awarded in engineering; mathematics and statistics; computer and information sciences; physical sciences; and geosciences, atmospheric sciences, and ocean sciences in 2021. However, women's shares of doctorates in most of these broad fields have grown over the past 20 years. From 2001 to 2021, the proportion of female doctorates grew between 8 and 15 percentage points in agricultural sciences and natural resources; geosciences, atmospheric sciences, and ocean sciences; engineering; biological and biomedical sciences; and physical sciences. In psychology, social sciences, and computer and information sciences, women's share grew by about 5–7 percentage points each during this period.

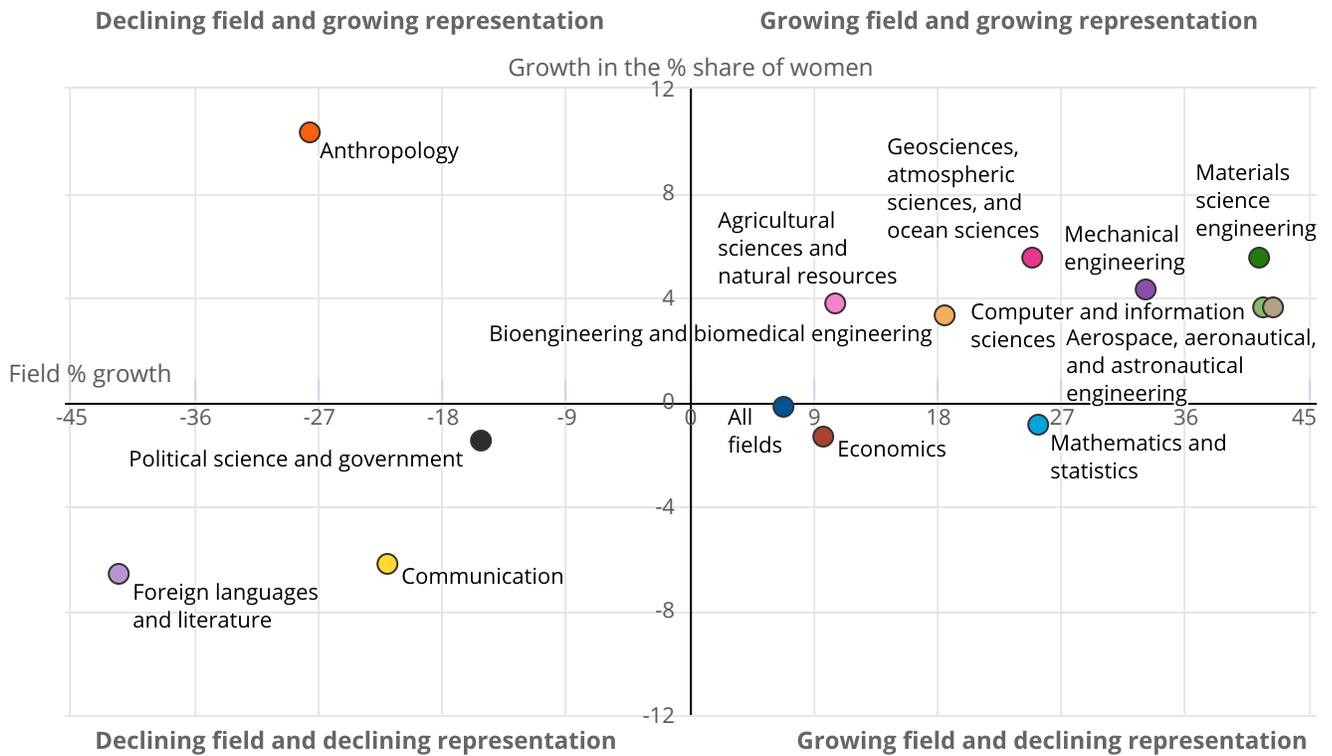
Growing and declining S&E fields

The growth or decline in the share of female doctorate recipients in different fields does not always track with the overall growth of those fields. Between 2011 and 2021, the number of doctorate recipients in all fields increased by 7% while the share of women declined by 0.2 percentage points ([figure 12](#)).

From 2011 to 2021, the proportion of female doctorate recipients increased between 3 and 6 percentage points in seven of the nine top growing fields: aerospace, aeronautical, and astronautical engineering; computer and information sciences; material science engineering; mechanical engineering; geosciences, atmospheric sciences, and ocean sciences; bioengineering and biomedical engineering; and agricultural sciences and natural resources. Women's share of doctorates also increased 10 percentage points in anthropology, a field where the overall number of doctorates awarded declined by 28%.

Despite the growth in the number of doctorate recipients in mathematics and statistics and in economics in the past 10 years, women’s shares of doctorates in these fields declined about 1 percentage point. The proportion of female doctorate recipients also declined in communication, political science and government, and foreign languages and literature—fields in which the overall number of doctorates declined as well.

Figure 12
Fastest-changing fields for female doctorate recipients and rates of change: 2011–21



Note(s):
 Fastest-changing fields for female doctorate recipients are the fields with the highest or lowest growth in the number of women between 2011 and 2021. Growth in the share of women refers to the difference in the percentage of women in a field during this period. Field of study growth is the overall change in the number of doctorate recipients in this period in a field (including both women and men).

Source(s):
 National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-5.

Path to the doctorate

Some paths to the doctoral degree are less traveled and some are more difficult to navigate, owing to a variety of influences that shape doctoral study. These paths may lead to different postgraduate outcomes.

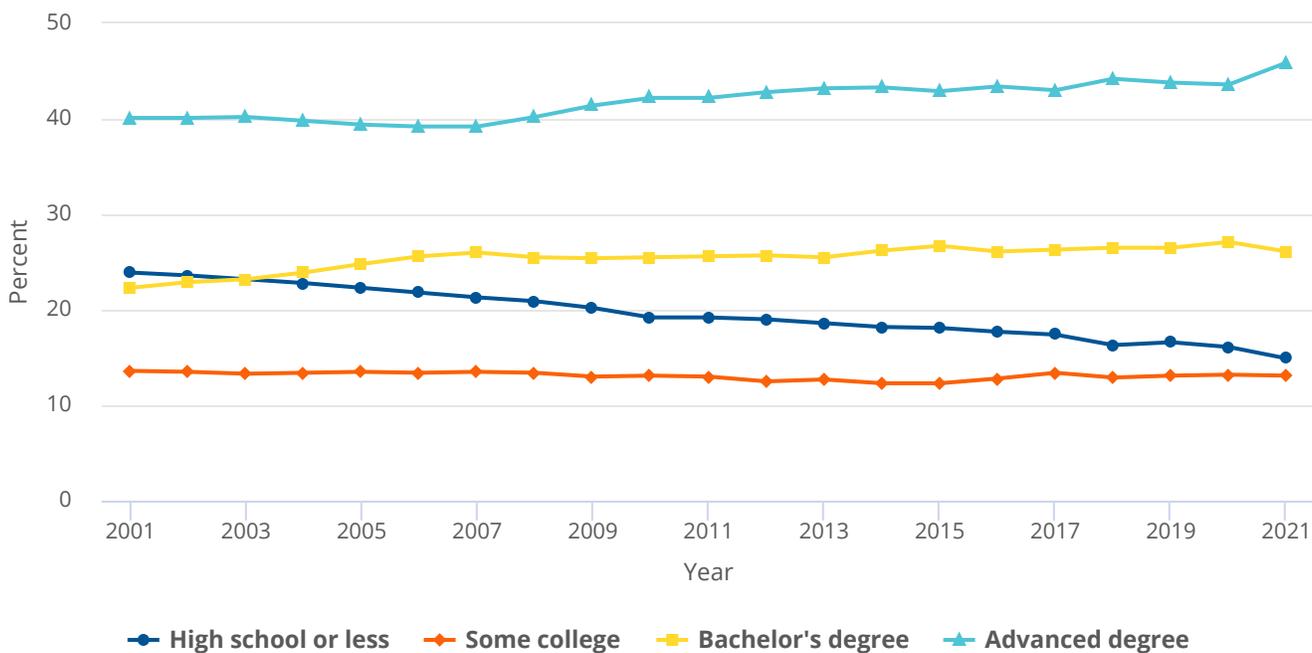
Parental education

Overview

The parents of recent doctorate recipients are better educated than the parents of earlier doctorate cohorts. The proportion of doctorate recipients from families in which neither parent has earned more than a high school diploma declined in the past 20 years, and the proportion of those with at least one parent with some college stayed flat. In contrast, during the same period, the proportions of doctorate recipients with at least one parent holding a bachelor's degree or at least one parent holding an advanced degree both increased (figure 13).

Figure 13

Doctorate recipients, by highest parental educational attainment of either parent: 2001–21



Note(s):

Percentages are based on the number of doctorate recipients who responded to the item on the highest educational attainment for either parent. Percentages may not sum to 100 due to rounding and because of doctorate recipients who reported "not applicable" for both father's and mother's education beginning in 2004. Advanced degree includes master's degree, professional degree, and research doctorate.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-14 and table 5-5.

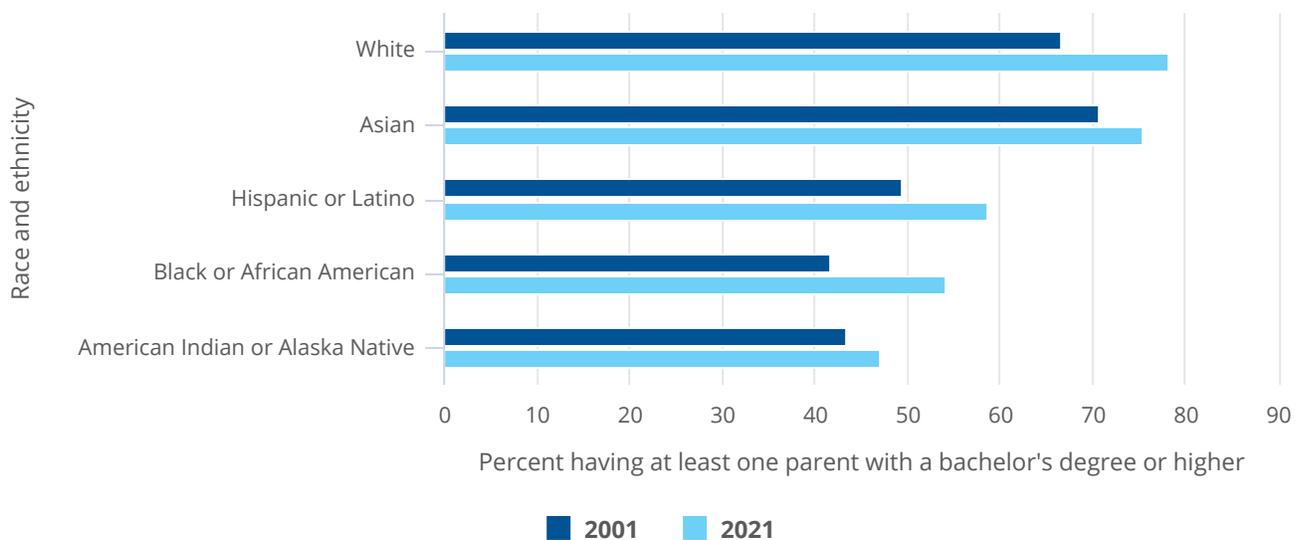
Race and ethnicity

Between 2001 and 2021, the pattern of rising parental educational attainment is visible among all races and ethnicities for doctorate recipients who were U.S. citizens or permanent residents ([figure 14](#)).

Nonetheless, a smaller proportion of doctorate recipients who are underrepresented minorities—Black or African American, Hispanic or Latino, and American Indian or Alaska Native—had at least one parent with a bachelor’s degree than did Asian or White doctorate recipients. In 2021, 78% of Asian and 75% of White doctorate recipients had at least one parent who held a bachelor’s degree or higher, compared with between 47% and 59% of doctorate recipients who were Black or African American, Hispanic or Latino, or American Indian or Alaska Native.

Figure 14

Highest parental educational attainment of U.S. citizen and permanent resident doctorate recipients, by race and ethnicity: 2001 and 2021



Note(s):

Percentages are based on the number of doctorate recipients who are U.S. citizens or permanent residents.

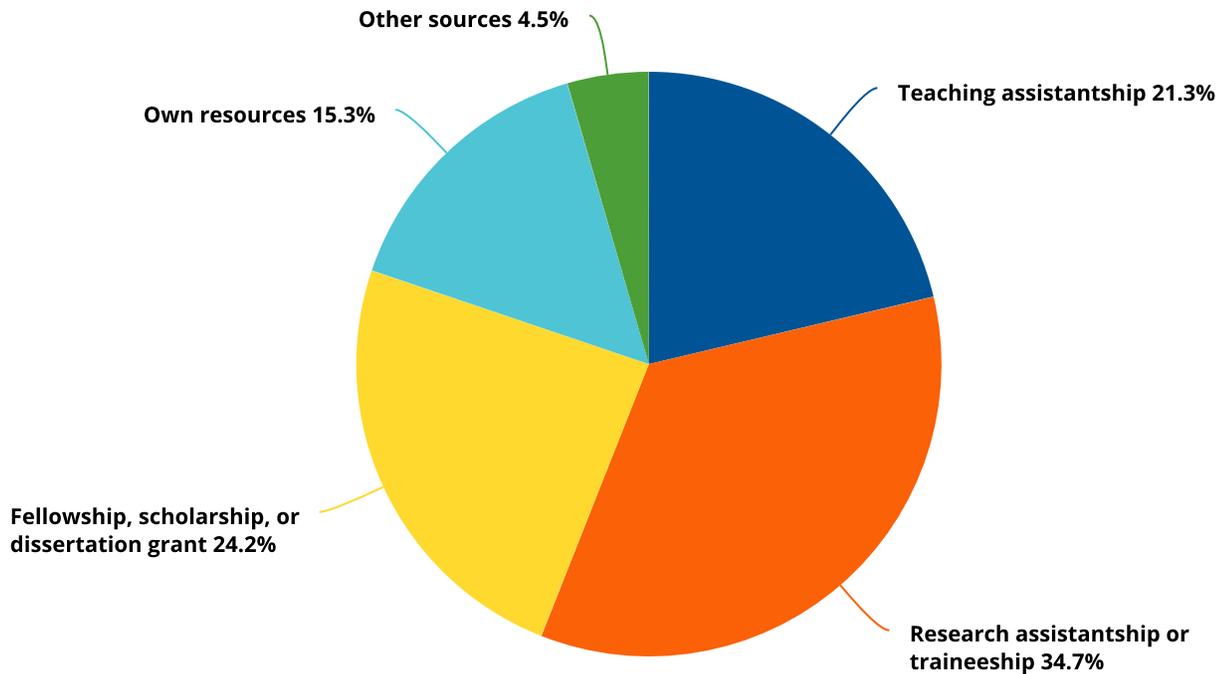
Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-14 and table 5-5.

Sources of financial support

Overview

In 2021, 35% of doctorate recipients were primarily supported by research assistantships or traineeships; 24% by fellowships, scholarships, or dissertation grants; and 21% by teaching assistantships. About 15% of doctorate recipients relied primarily on their own resources—loans, personal savings, personal earnings, and the earnings or savings of their spouse, partner, or family—to finance their graduate studies, and 5% relied on such other sources, such as employer reimbursement and foreign support ([figure 15](#)).

Figure 15**Primary source of financial support for doctorate recipients: 2021****Note(s):**

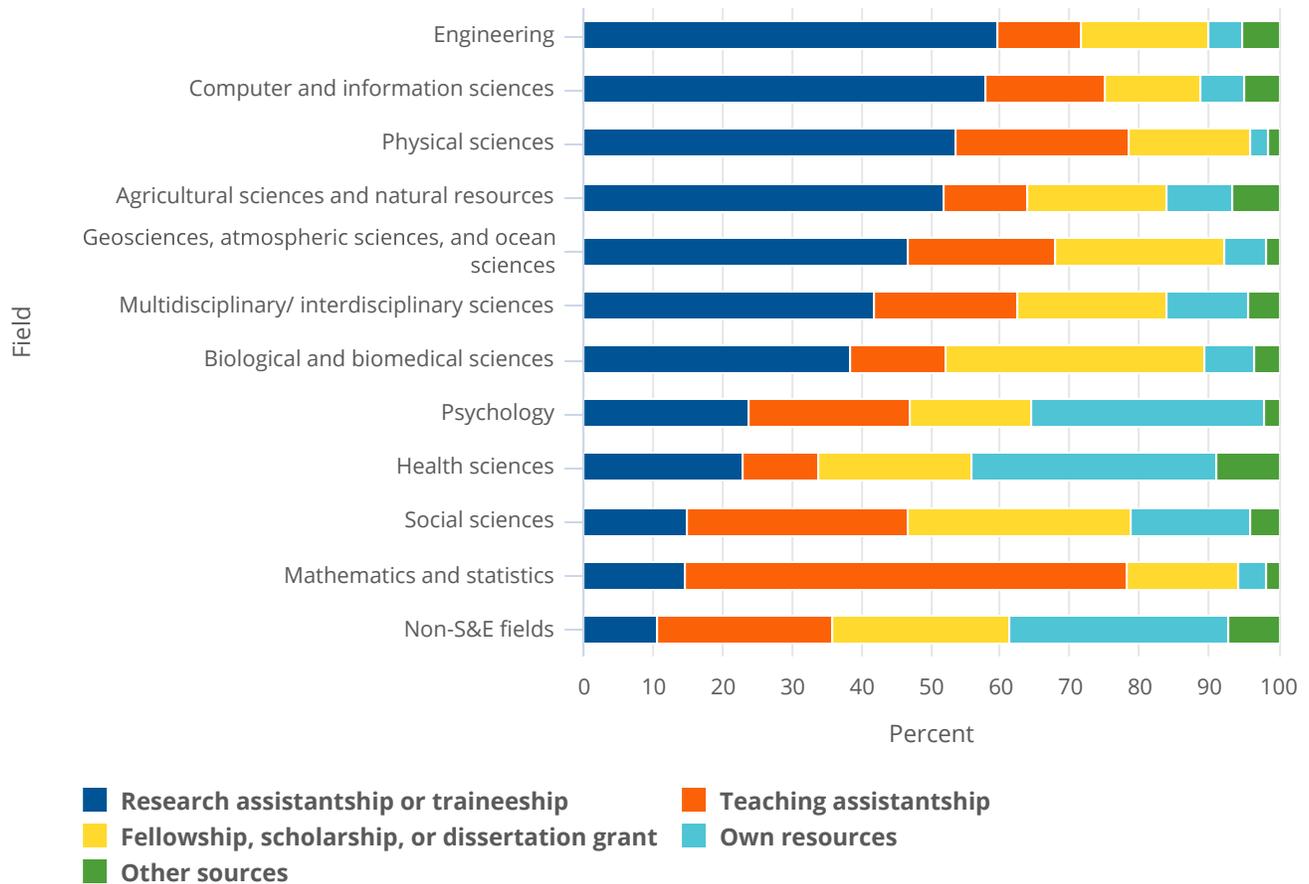
Percentages are based on the number of doctorate recipients who responded to the primary source of financial support item. Research assistantship or traineeship includes other assistantships and internships or clinical residencies. Own resources includes loans, personal savings, personal earnings outside the institution sources listed, and earnings or savings of spouse, partner, or family. Other sources includes employer reimbursement or assistance and foreign support.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 4-1.

Doctorate field

Doctorate recipients' primary sources of financial support vary by field. In 2021, research assistantships were the most common primary source of financial support for doctorate recipients in engineering, computer and information sciences, physical sciences, and agricultural sciences and natural resources. In mathematics and statistics, teaching assistantships were most frequent. Fellowships, scholarships, or dissertation grants and research assistantships or traineeships were the most common for doctoral students in biological and biomedical sciences. Over a third of doctorate recipients in health sciences and a third of those in psychology relied on their own resources as their primary source of financial support. In social sciences, doctorate recipients most commonly reported their primary source was either fellowships, scholarships, or dissertation grants (32%) or teaching assistantships (32%) (**figure 16**).

Figure 16**Primary source of financial support for S&E doctorate recipients, by broad field: 2021**

S&E = science and engineering.

Note(s):

Percentages are based on the number of doctorate recipients who responded to the primary source of financial support item. Research assistantship or traineeship includes other assistantships and internships or clinical residencies. Own resources includes loans, personal savings, personal earnings outside the institution sources listed, and earnings or savings of spouse, partner, or family. Other sources includes employer reimbursement or assistance and foreign support.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 4-1 through table 4-3.

Graduate debt

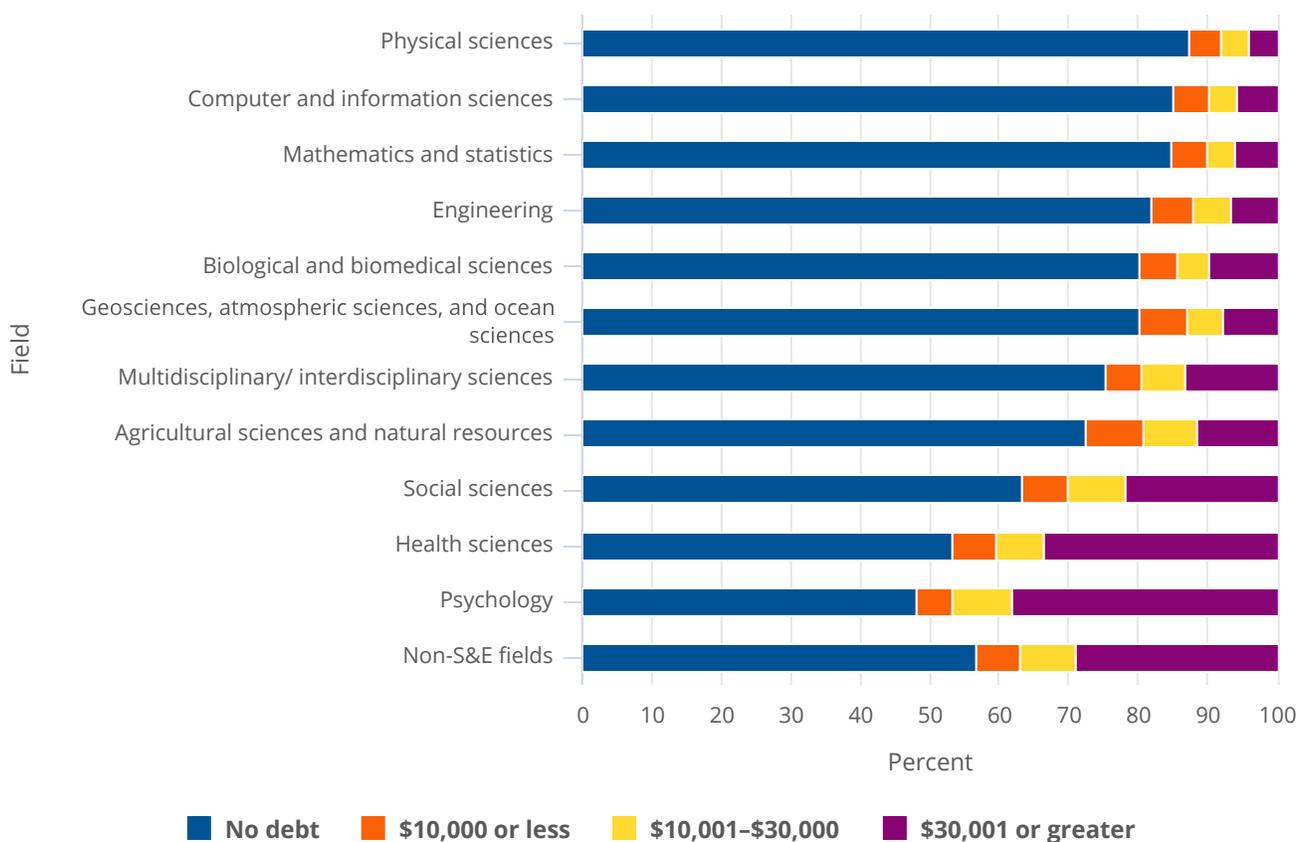
The amount of education-related debt incurred by doctorate recipients during graduate school is an indicator of the availability of financial support and the affordability of graduate education.⁸ In 2021, large majorities (73% and above) of doctorate recipients in physical sciences; computer and information sciences; mathematics and statistics; engineering; geosciences, atmospheric sciences, and ocean sciences; multidisciplinary/interdisciplinary sciences; and agricultural sciences and natural resources reported holding no debt related to their graduate education (figure 17). These are also fields that tend to receive the support of the federal government and academic institutions in the form of research assistantships or traineeships; fellowships, scholarships, or dissertation grants; or teaching assistantships.⁹ In social sciences, health sciences, and in non-S&E fields, the proportion of doctorate recipients with no debt ranged between 53% and 63%; in psychology, it was 48%.

Within each broad field of study, 5%–8% of doctorate recipients had incurred low levels (\$10,000 or less) of graduate debt. The shares of doctoral graduates with graduate debt burdens over \$30,000 were greatest in psychology (38%), health sciences (33%), and non-S&E fields (29%).

In 2021, doctorate recipients in three of the S&E fields with the lowest median education-related cumulative debt—computer and information sciences, engineering, and physical sciences—had the highest median expected annual salaries. In these fields, median expected salaries at graduation were more than triple the median cumulative debt (figure 18).

In contrast, doctorate recipients in psychology and non-S&E fields reported among the lowest median expected annual salaries. In psychology, the median cumulative debt was \$22,000 higher than the median expected salary at graduation. And in non-S&E fields, the median cumulative debt was \$2,500 higher than median expected salary.

Figure 17
Graduate debt of doctorate recipients, by broad field: 2021



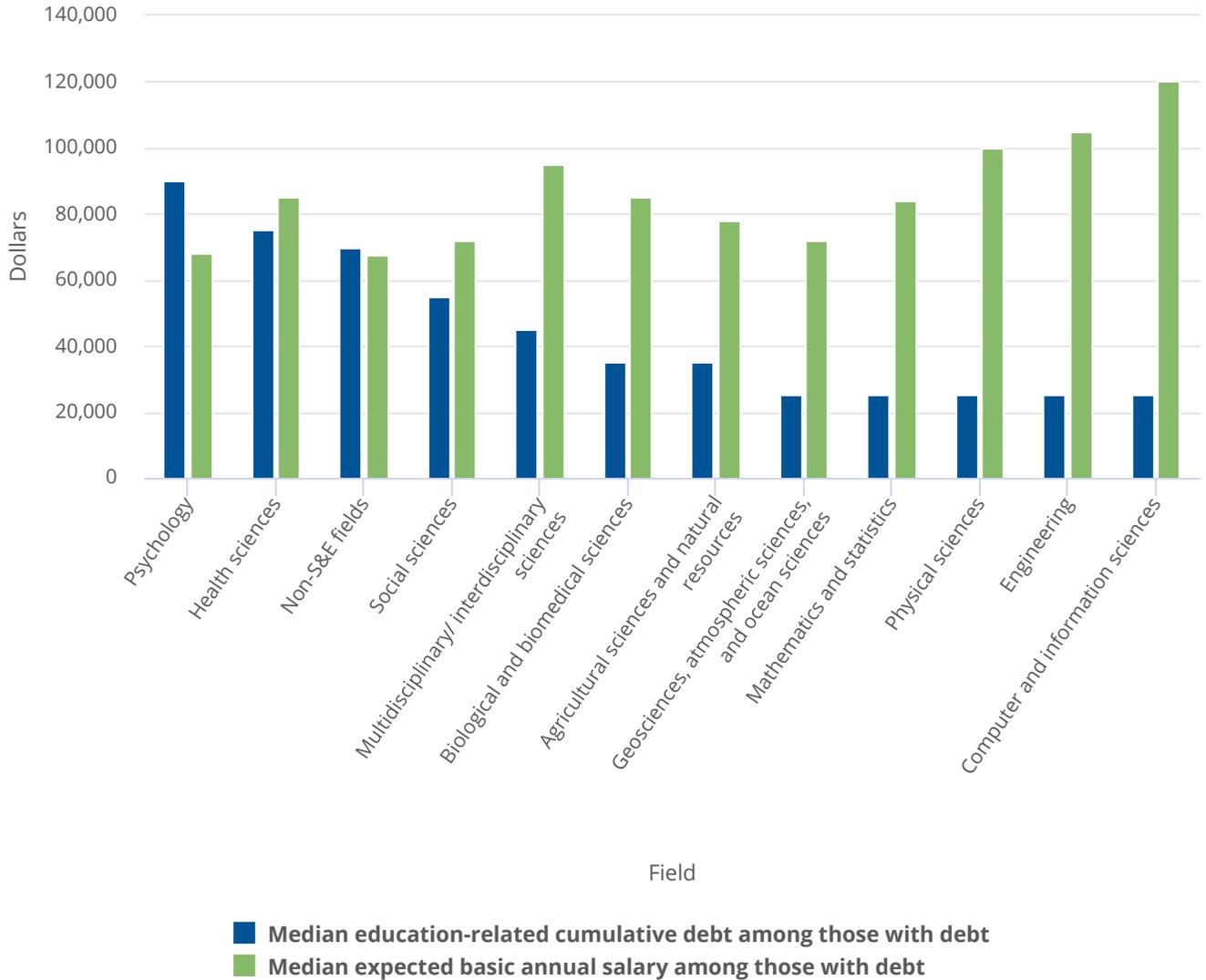
S&E = science and engineering.

Note(s):
 Percentages are based on the number of doctorate recipients who responded to the graduate debt item (47,286 respondents).

Source(s):
 National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-13 and table 4-4.

Figure 18

Median basic annual salary and median education-related cumulative debt for debt-holding doctorate recipients with definite non-postdoc employment commitments in the United States, by broad field: 2021



S&E = science and engineering.

Note(s):

Definite non-postdoc employment commitment excludes postdoctoral study. Calculation of median debt excludes doctorate recipients reporting no debt.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-13, table 4-4, table 6-6, and table 6-7.

Time to degree

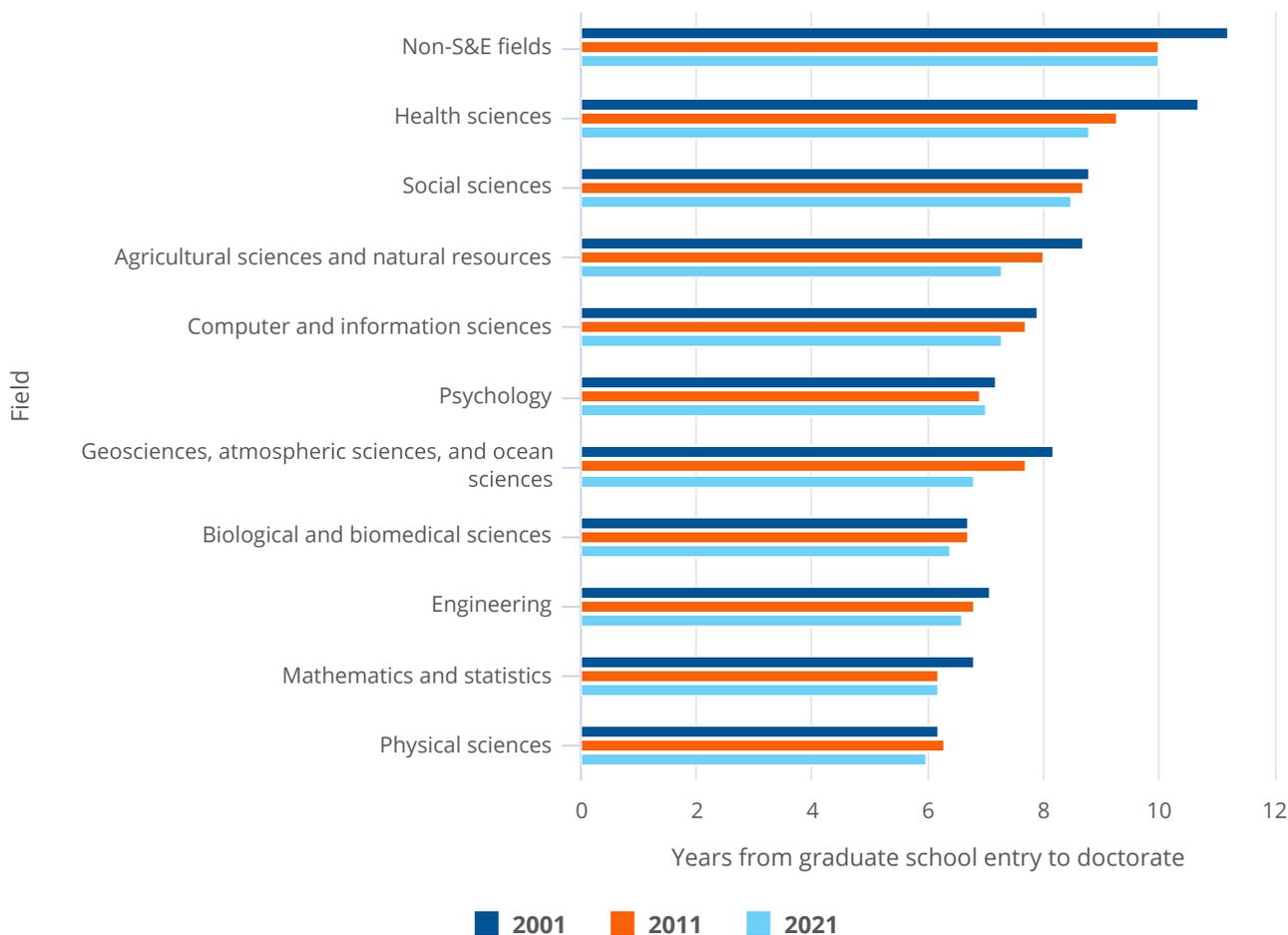
Earning a doctorate in non-S&E fields takes years longer than completing an S&E doctorate.¹⁰ In 2021, the longest median time from graduate school entry to doctoral degree in S&E fields was in health sciences and in social sciences at nearly 9 years, respectively, lower than the 10-year median time to degree in non-S&E fields.

Over the past 20 years, median time to degree declined the most in health sciences, falling about 2 years from 10.7 to 8.8 years, with most of this decline seen between 2001 and 2011. Agricultural sciences and natural resources, as well as geosciences, atmospheric sciences, and ocean sciences, declined about a year to a year and a half over the past 2 decades.

Non-S&E fields declined about a year from 11.2 to 10.0 years between 2001 and 2011 (figure 19).

Figure 19

Median time to degree of doctorate recipients, by broad field: 2001–21



S&E = science and engineering.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 1-12 and table 3-6.

Postgraduation trends

A graduate's first position after earning the doctoral degree may reflect broad economic conditions and can shape later career opportunities, earnings, and choices. Over the longer term, the early career patterns of doctorate recipients may influence the decisions of future students considering careers as scientists, engineers, scholars, and researchers.

Job market

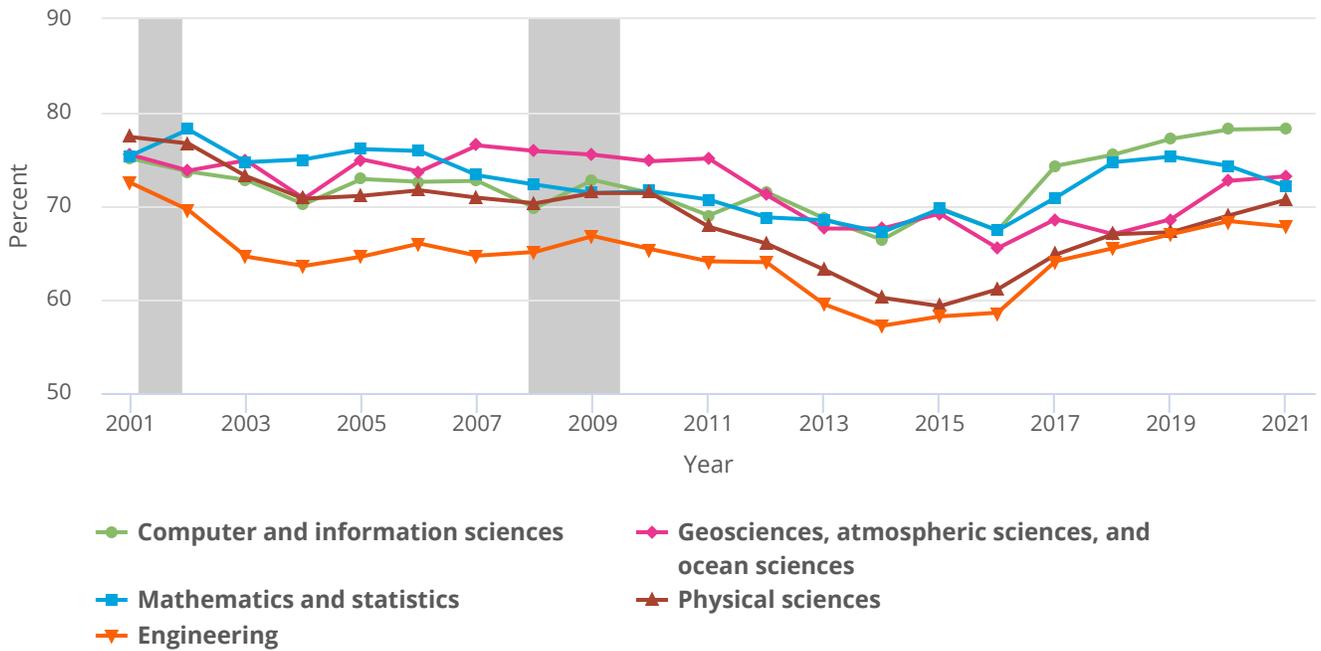
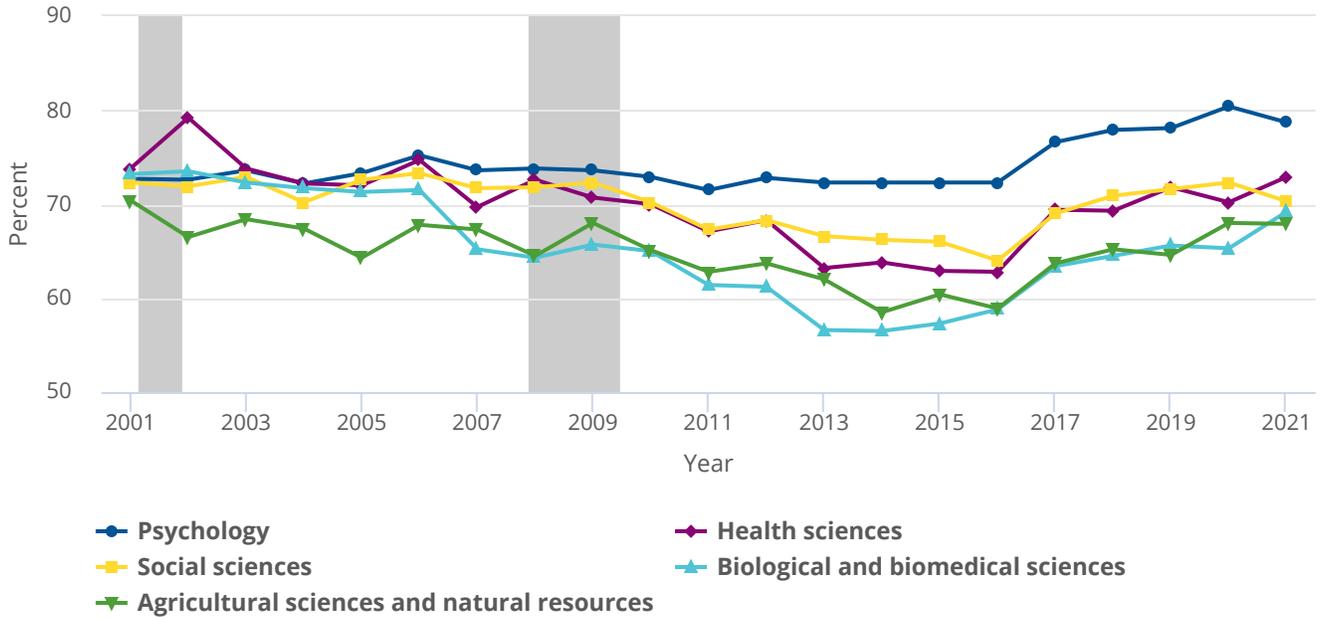
At any given time, the job market for new doctorate recipients will be better in some fields of study than in others. Though all fields tend to follow patterns that generally reflect overall trends in economic conditions, definite commitments at graduation are likely to be influenced by many factors.¹¹ In general, doctorate recipients in S&E fields tend to have robust postgraduation career prospects. The proportions of 2021 doctorate recipients in S&E with definite commitments at graduation, including postdoctoral study positions (postdocs), ranged from 68% in engineering to 79% in psychology. Proportions were highest in computer and information sciences and psychology (78% and 79%, respectively). In computer and information sciences, this proportion peaked in 2021; in psychology, this proportion remains close to its all-time high in 2020 ([figure 20](#)).

In all other S&E fields, the proportion of doctorate recipients with definite commitments was lower compared to 20 years ago. The largest decline in this period was in physical sciences (from 77% in 2001 to 71% in 2021), engineering (from 73% to 68%), and biological and biomedical sciences (from 73% to 69%).

Compared to 2019, before the pandemic started, the proportion of doctorate recipients with definite commitments in 2021 increased in all fields except in mathematics and statistics and in social sciences, which declined by 3.2 and 1.3 percentage points, respectively. The largest increases in this proportion between 2019 and 2021 were in geosciences, atmospheric sciences, and ocean sciences (5 percentage points), biological and biomedical sciences (4 percentage points), and physical sciences (4 percentage points). (For more details on the effects of the pandemic on definite commitments, see section "[Special focus: COVID-19 pandemic impacts on doctorate recipients.](#)")

In non-S&E fields, the proportion of doctorate recipients reporting definite commitments in 2021 was lower when compared to 2001 in all fields ([figure 21](#)). These fields had recovered from lows in 2014–16 but declined again after 2019 except in humanities and arts, where the proportion remained flat at about 59%.

Figure 20
Definite commitments among doctorate recipients, by S&E broad field: 2001–21



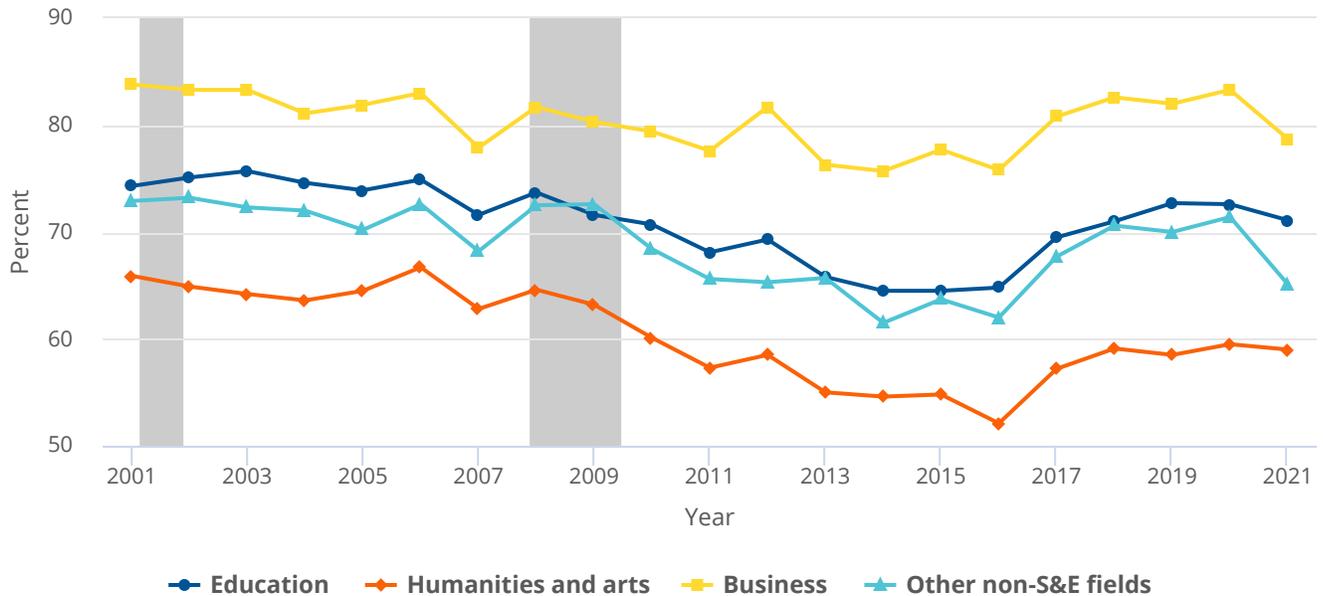
S&E = science and engineering.

Note(s):

Shaded areas in the graphic reflect recessions that occurred between March 2001 and November 2001 and between December 2007 and June 2009 (<http://www.nber.org/cycles/cyclesmain.html>). Definite commitment refers to a doctorate recipient who is either returning to predoctoral employment or has signed a contract (or otherwise made a definite commitment) for employment or postdoctoral study in the coming year. Percentages are based on the number of doctorate recipients who responded to the postgraduation status item.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 2-1.

Figure 21**Definite commitments among doctorate recipients, by non-S&E broad field: 2001–21**

S&E = science and engineering.

Note(s):

Shaded areas in the graphic reflect recessions that occurred between March 2001 and November 2001 and between December 2007 and June 2009 (<http://www.nber.org/cycles/cyclesmain.html>). Definite commitment refers to a doctorate recipient who is either returning to predoctoral employment or has signed a contract (or otherwise made a definite commitment) for employment or postdoctoral study in the coming year. Percentages are based on the number of doctorate recipients who responded to the postgraduation status item.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 2-1

First postgraduate position

Academic employment

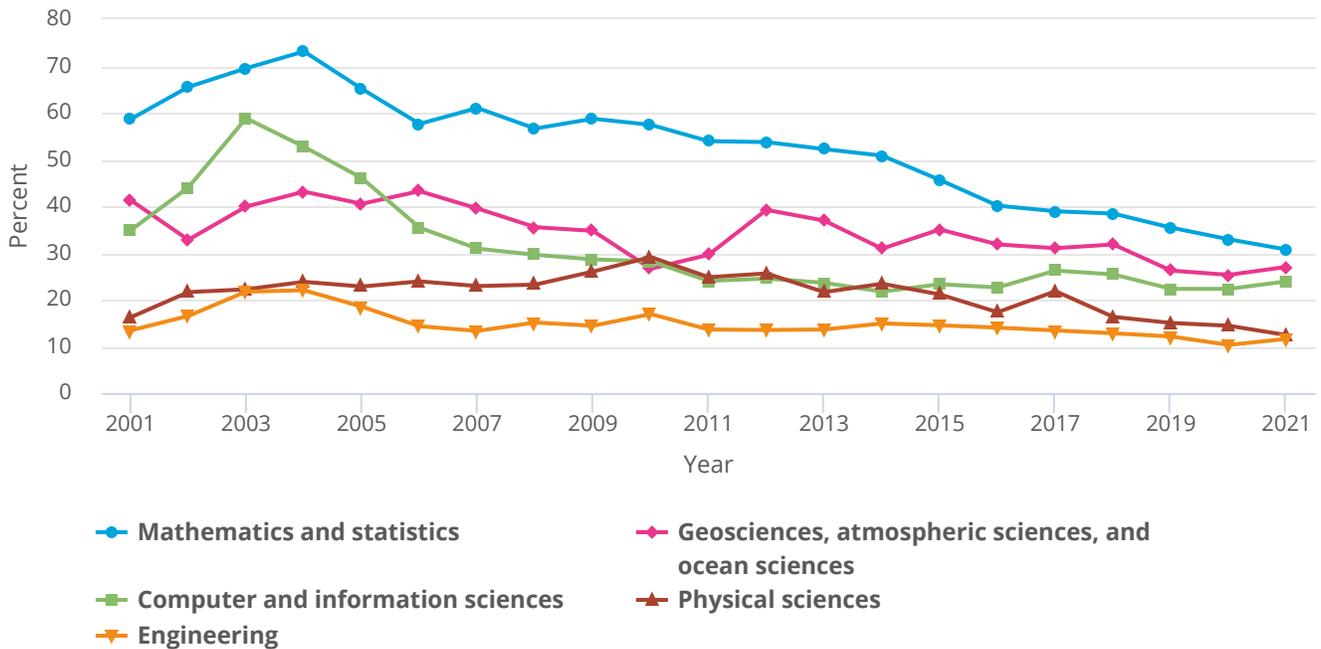
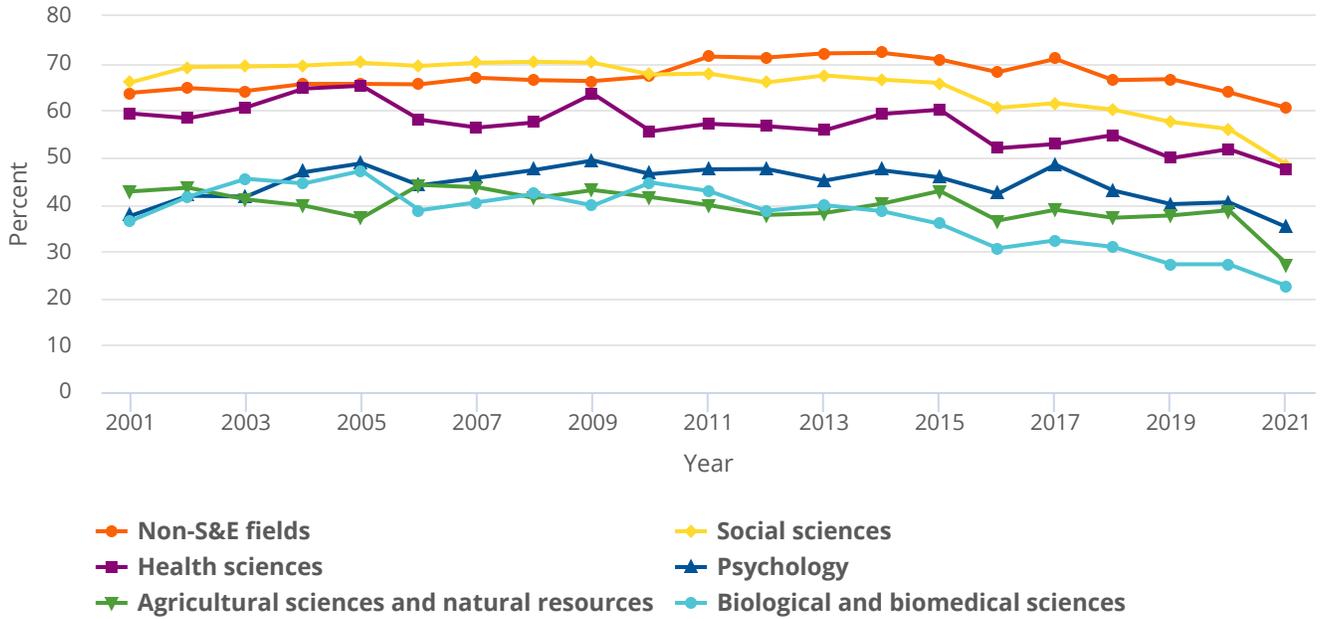
In 2021, 36% of doctorate recipients with definite non-postdoc employment commitments in the United States reported that their principal job would be in academe,¹² down from 48% in 2001.

The highest rates of non-postdoc academic employment commitments in 2021 were reported by doctorate recipients in non-S&E fields, particularly by those in humanities and arts and in other non-S&E fields (65% and 68%, respectively).¹³ The lowest rates were in engineering (12%) and in physical sciences (12%) (figure 22).

In the past 20 years, the rate of non-postdoc academic employment commitments declined in all S&E fields. The largest decline was in mathematics and statistics, from 59% in 2001 to 31% in 2021. Between 2019 and 2021, the rate of commitments for employment in academe declined in all S&E fields except in computer and information sciences (2 percentage-point increase) and in geosciences, atmospheric sciences, and ocean sciences (1 percentage-point increase). The largest declines in this period were in agricultural sciences and natural resources (10 percentage-point decline) and social sciences (9 percentage-point decline).

Figure 22

Definite non-postdoc employment commitments in academe in the United States, by broad field: 2001–21



S&E = science and engineering.

Note(s):

Definite employment commitment refers to a doctorate recipient who is either returning to predoctoral employment or has signed a contract (or otherwise made a definite commitment) for employment (excludes postdoctoral study) in the coming year. Percentages are based on the number of doctorate recipients who reported definite employment commitments (including those missing employer type) and plans to stay in the United States.

Source(s):

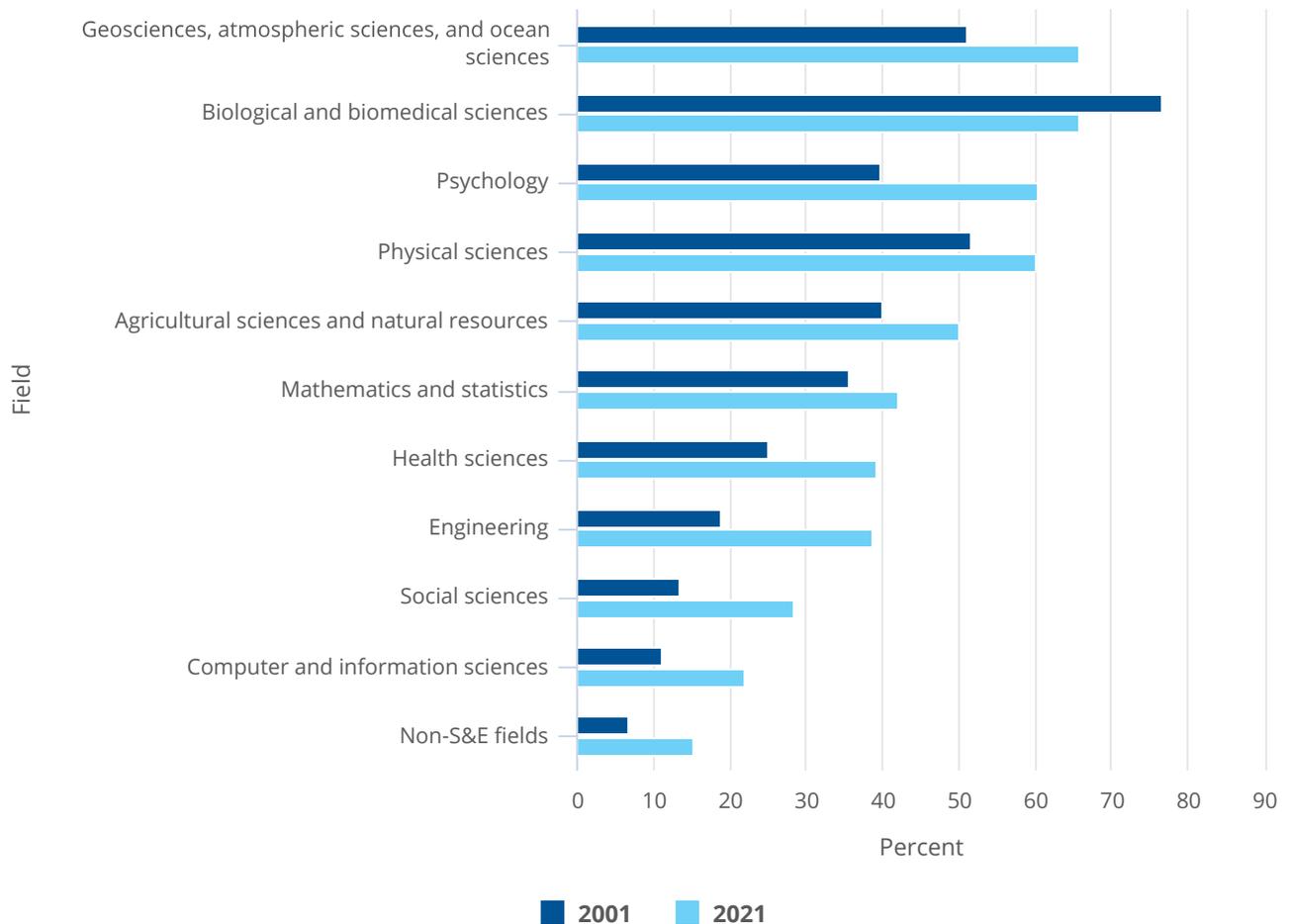
National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 2-6.

Postdoc positions

Historically, postdoc positions have been a customary part of the early career paths of doctorate recipients in biological and biomedical sciences; physical sciences; and geosciences, atmospheric sciences, and ocean sciences, making up over half of definite commitments. Since 2001, the postdoc rate in psychology increased and reached 60% in 2021, and agricultural sciences and natural resources postdoc rates also reached 50% in 2021. In the past 20 years, postdoc rates have also increased in mathematics and statistics, health sciences, engineering, social sciences, computer and information sciences, and non-S&E fields, though rates in these fields are not as high (figure 23).

Figure 23

U.S. postdoctorate rate for doctorate recipients, by broad field: 2001 and 2021



S&E = science and engineering.

Note(s):

Percentages are based on the number of doctorate recipients who reported definite commitments in the coming year, who reported whether their commitment was for employment or postdoctoral study, and who plan to live in the United States.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 2-3.

Between 2019 (before the pandemic started) and 2021, postdoc rates increased in all fields of study except biological and biomedical sciences, where it declined by 2 percentage points ([table C](#)). The largest increase was in geosciences, atmospheric sciences, and ocean sciences (7 percentage points).

Table C

U.S. postdoc rate for doctorate recipients, by broad field: 2019–21

(Percent)

Field	2019	2020	2021
Geosciences, atmospheric sciences, and ocean sciences	58.4	62.5	65.8
Biological and biomedical sciences	67.8	67.3	65.7
Psychology	58.6	60.1	60.4
Physical sciences	55.4	56.4	60.0
Agricultural sciences and natural resources	48.3	46.3	49.9
Mathematics and statistics	37.9	37.4	42.0
Health sciences	35.2	36.2	39.2
Engineering	34.8	36.0	38.6
Social sciences	24.5	24.8	28.4
Computer and information sciences	19.5	19.0	22.0
Non-S&E	12.3	12.7	15.3

S&E = science and engineering.

Note(s):

Percentages are based on the number of doctorate recipients who reported definite commitments in the coming year, who reported whether their commitment was for employment or postdoctoral study, and who plan to live in the United States.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 2-3.

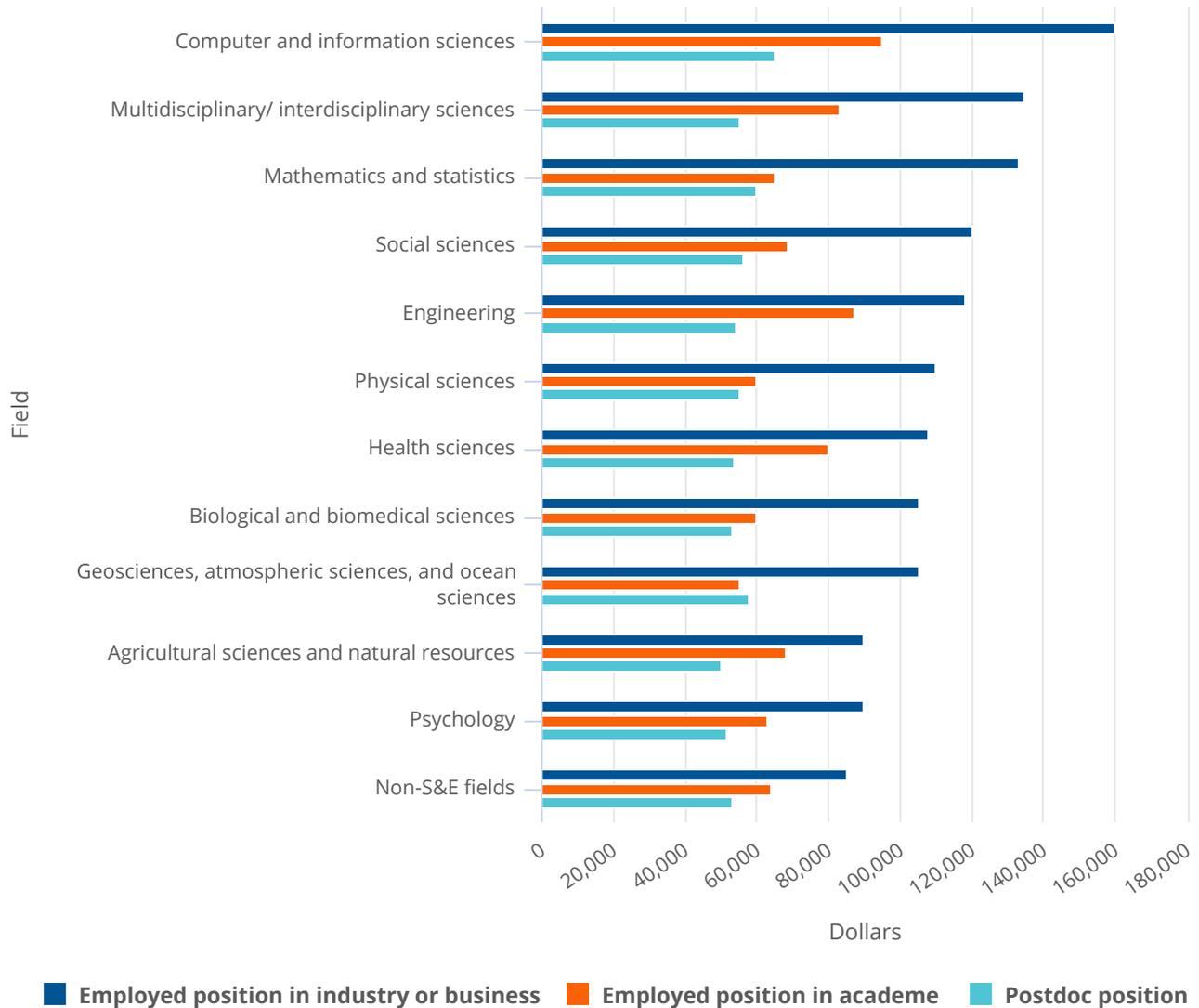
Median salaries

In 2021, doctorate recipients who had definite commitments for employment or a postdoc in the United States in the coming year reported basic annual salaries that varied by their doctorate field and the type of position to which they committed.

In every field, median expected salaries for doctorate recipients committing to jobs in industry and other nonacademic sectors¹⁴ were higher than those in postdocs and academe ([figure 24](#)). The median salaries for postdocs in most broad fields were relatively similar, ranging from \$50,000 to \$55,000. Postdocs in mathematics and statistics and in computer and information sciences were the exception, with respective median salaries of \$60,000 and \$65,000. Doctorate recipients in computer and information sciences reported the highest median academic salaries (\$95,000) and also the highest median salaries in industry positions (\$160,000).

Figure 24

Median annual salary of doctorate recipients with definite commitments in the United States, by position type and broad field: 2021



S&E = science and engineering.

Note(s):

Definite commitment refers to a doctorate recipient who is either returning to predoctoral employment or has signed a contract (or otherwise made a definite commitment) for employment or postdoctoral study in the coming year and plans to stay in the United States. Industry includes all nonacademic sectors, including self-employment, private for-profit and private nonprofit, and government.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 6-6 and table 6-7.

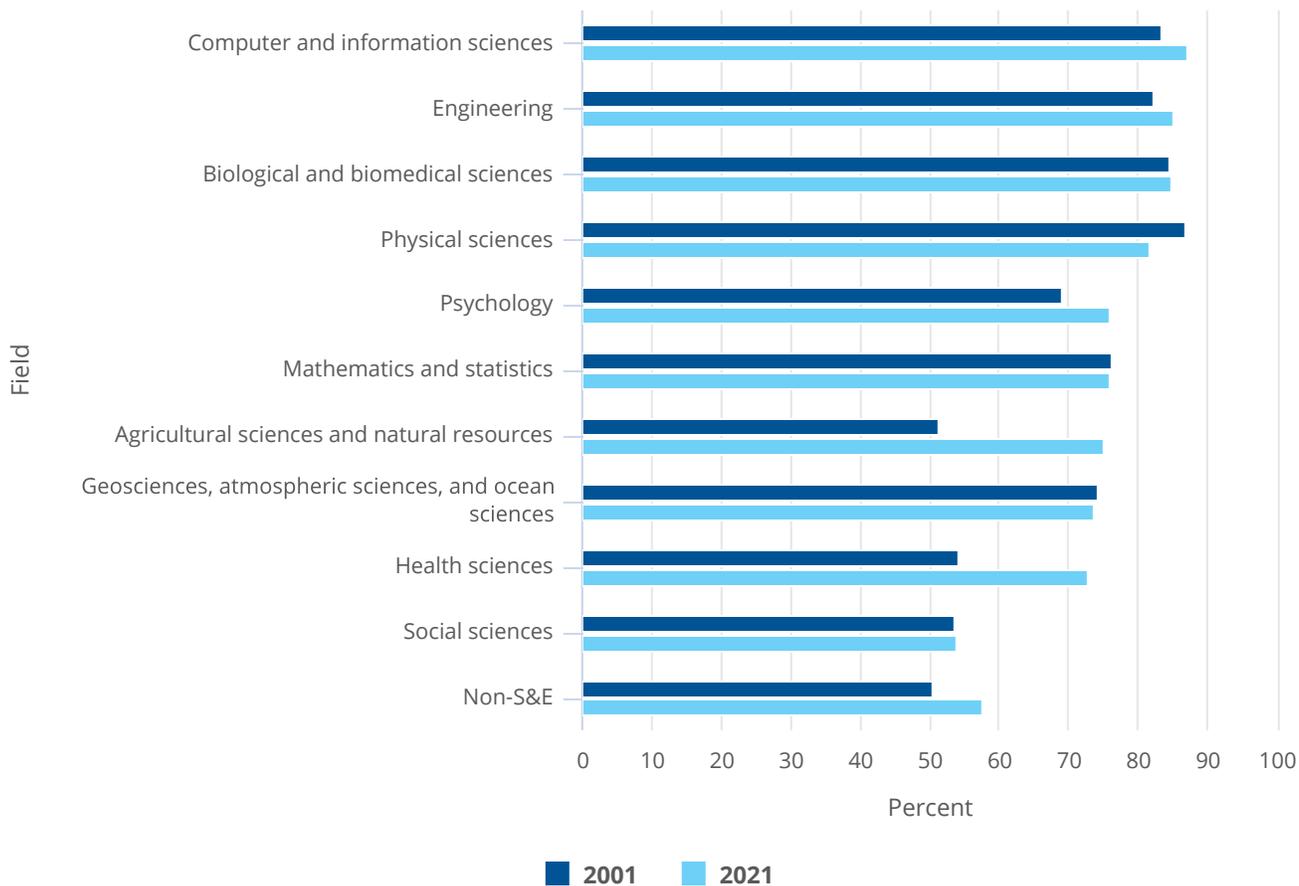
Temporary visa holders and postgraduation

In 2021, 80% of S&E temporary visa holder doctorate recipients with definite commitments reported that the location of their postdoc or employment position was in the United States, up from 76% in 2001.¹⁵ Expected stay rates were highest (above 80%) in computer and information sciences, engineering, biological and biomedical sciences, and

physical sciences and lowest in social sciences and non-S&E fields (54% and 58%, respectively). Between 2001 and 2021, expected stay rates increased the most in agricultural sciences and natural resources and in health sciences (figure 25).

Figure 25

Temporary visa holder doctorate recipients with definite commitments in the United States, by broad field: 2001–21



S&E = science and engineering.

Note(s):

See [appendix table SRA-1](#) for a listing of broad fields and their constituent subfields. Definite commitment refers to a doctorate recipient who is either returning to predoctoral employment or has signed a contract (or otherwise made a definite commitment) for employment or postdoctoral study in the coming year.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021. Related detailed table 6-3.

Since 2019, which was before the pandemic started, the proportion of temporary visa holder doctorate recipients with definite commitments in the United States declined by 4 percentage points in mathematics and statistics, by 3 percentage points in social sciences, and by 9 percentage points in non-S&E fields. It increased or stayed flat in all other fields.¹⁶

Special focus: COVID-19 pandemic impacts on doctorate recipients

The COVID-19 pandemic disrupted many aspects of the higher education and training of doctorate recipients. To measure the impacts of COVID-19 on new doctorate recipients' graduate experiences and postgraduation plans, a set of questions was designed, tested, and included as a new module in the 2021 Survey of Earned Doctorates (SED). Doctorate recipients were asked whether they experienced one of six impact areas as a result of the pandemic: delay in their doctoral degree completion timeline; disruption in their research; reduction or suspension of their doctoral studies; change in their immediate postgraduate employment or education plans; change in longer-term career plans or goals; or change in their plans about where to live in the year after graduation. Respondents were also asked to report any other changes to their graduate experience or career plans. The COVID-19 impact module was fielded 1 month after the start of data collection; therefore, only 42,301 of the 52,250 (81%) doctorate recipients in the 2021 survey responded to these questions. This section summarizes the data from this population.

Overall impacts of the pandemic on 2021 doctorate recipients

Doctorate recipients who graduated in the 2021 academic year encountered multiple challenges from the COVID-19 pandemic. The most frequent impact of COVID-19, mentioned by 48% of doctorate recipients, was a disruption of their research ([figure 26](#)). Doctorate recipients whose research was disrupted most frequently reported limited or no access to resources needed for research (84.6%), changes they had to make to their research plan (38% of them), and other kinds of disruptions (13%) ([table D](#)).¹⁷

Nearly 39% of doctorate recipients indicated the COVID-19 pandemic delayed the timeline for completing their doctoral degree.

In addition, doctorate recipients reported the pandemic affected both short-term and long-term plans. For example, 38% of doctorate recipients indicated their immediate postgraduation employment or education plans had changed. More than two-thirds of these doctorate recipients attributed these changes to limited job opportunities (70%), while 15% said they had to accept a less-desirable job, and 22% indicated they had changed plans in other ways ([table E](#)).¹⁸

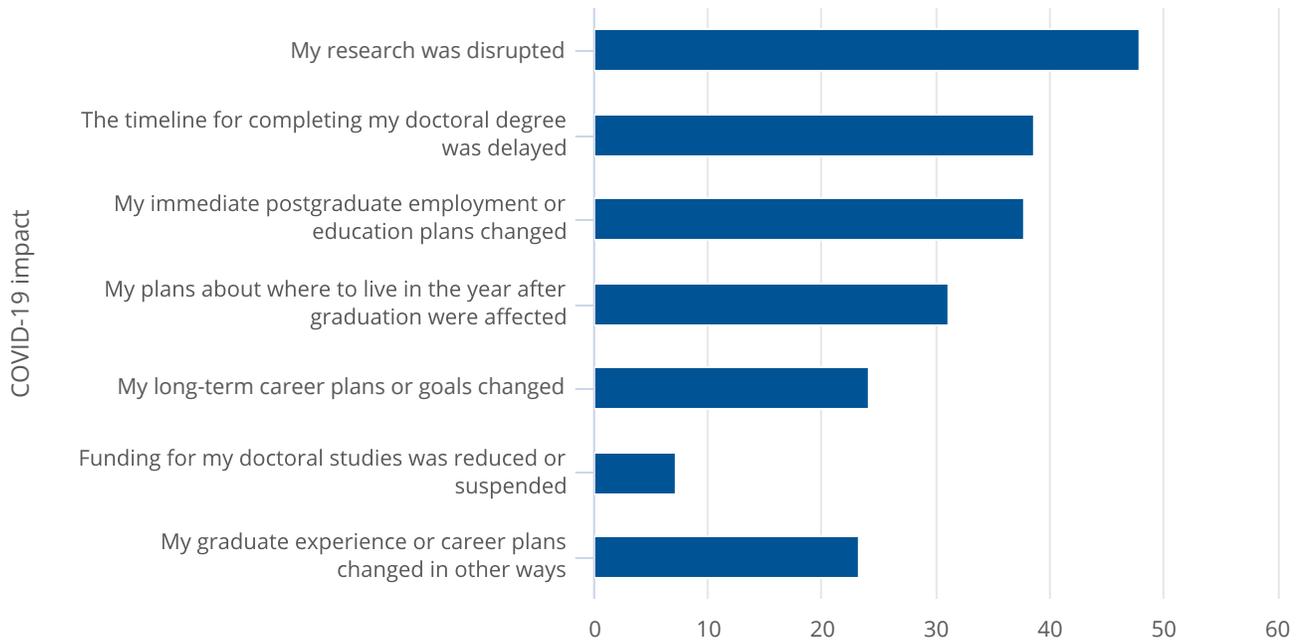
Over 31% of doctorate recipients said their plans about where to live in the year after graduation had been affected, and 24% said their long-term career plans or goals had changed ([figure 26](#)). Among the latter, half mentioned they had changed their long-term career plans or goals for a different type of job or field, 36% for a different type of employer, 17% for new opportunities, and 27% for other kinds of changes ([table F](#)).¹⁹

Only 7% of doctorate recipients said that the funding for their doctoral studies had been reduced or suspended.²⁰

Overall, more than three-quarters of doctorate recipients (77%) responding to the COVID-19 impact module reported their graduate experience and career plans were affected in at least one of these areas.²¹

Figure 26

COVID-19 pandemic impacts among doctorate recipients: 2021



Percent of doctorate recipients who responded to COVID-19 impact questions

Note(s):

Percentages are based on the number of doctorate recipients who responded to COVID-19 impact questions, which were added to the survey in June 2020 (42,301 respondents).

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

Table D

Doctorate recipients who said their research was disrupted as a result of COVID-19 pandemic, by type of disruptions: 2021

(Number and percent)

Type of disruption	Number and percent
My research was disrupted (number)	20,286
Limited or no access to resources (%)	84.6
Changed my research plan (%)	37.6
Disrupted in other ways (%)	12.5

Note(s):

Multiple responses allowed.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

Table E**Doctorate recipients who said "My immediate postgraduate employment or education plans changed" as a result of COVID-19 pandemic, by type of changes: 2021**

(Number and percent)

Type of change	Number and percent
My immediate postgraduate employment or education plans changed (number)	15,928
Limited job opportunities (%)	69.5
Had to accept a less-desirable job (%)	15.3
Changed plans in other ways (%)	22.2

Note(s):

Multiple responses allowed.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

Table F**Doctorate recipients who said "My long-term career plans or goals changed" as a result of COVID-19 pandemic, by type of changes: 2021**

(Number and percent)

Type of change	Number and percent
My long-term career plans or goals changed (number)	10,175
Different type of job or field (%)	49.5
Different type of employer (%)	36.0
New opportunities (%)	16.8
Changed plans in other ways (%)	27.3

Note(s):

Multiple responses allowed.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

COVID-19 pandemic impacts by doctorate field

The impact of COVID-19 varied by broad field. Doctorate recipients in fields where laboratories, equipment, and other facilities are indispensable—such as biological and biomedical sciences and physical sciences within S&E ([figure 27](#)) and visual and performing arts within non-S&E fields ([figure 28](#))—indicated their research was disrupted in higher proportions than doctorate recipients in other fields. In contrast, those in mathematics and statistics and computer and information sciences had the lowest reported proportions of research disruptions among all fields.

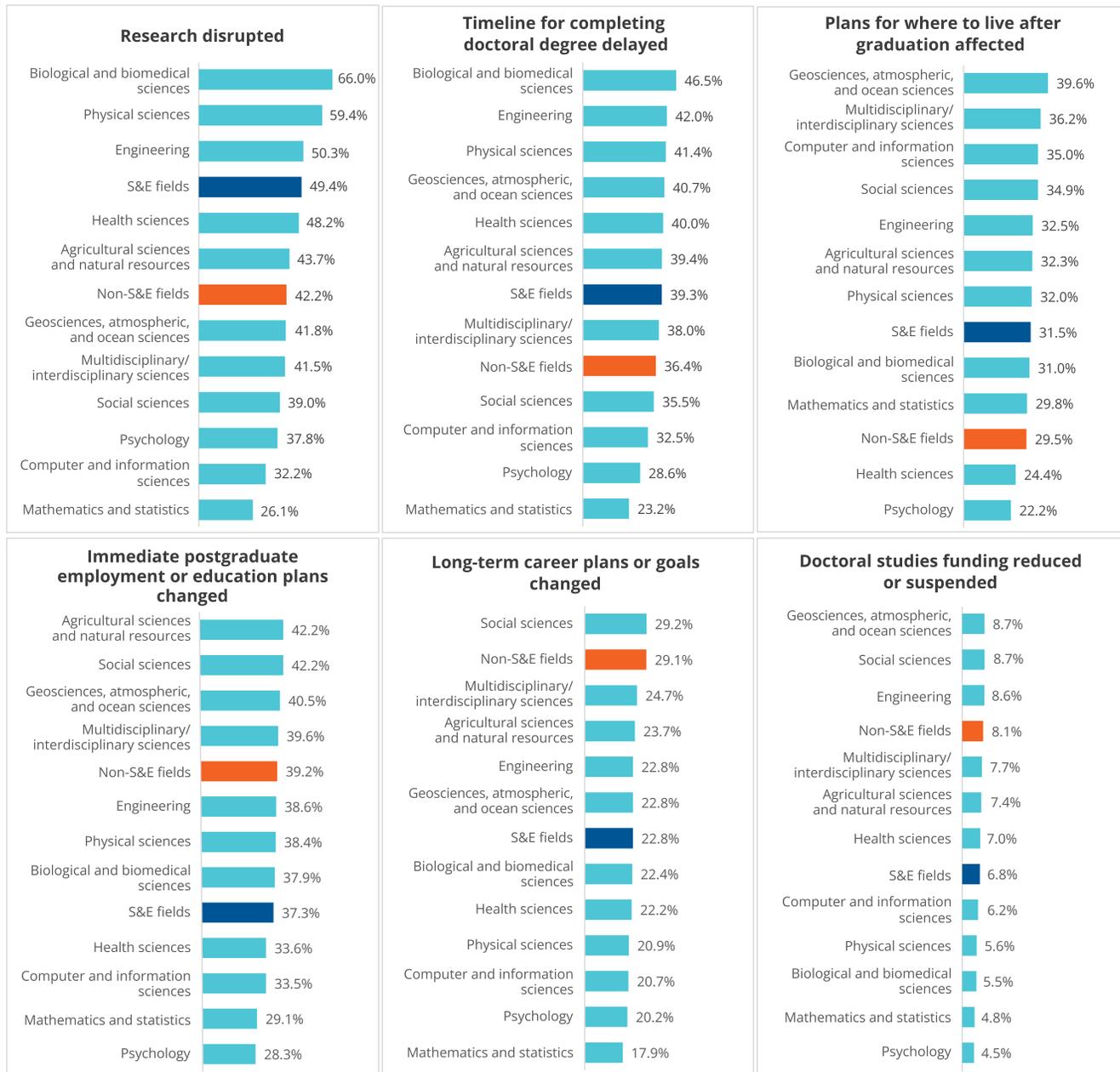
Doctorate recipients in biological and biomedical sciences indicated the timeline for completing their doctoral degree was delayed in higher proportions than those in most other S&E broad fields. In contrast, those in mathematics and statistics and in psychology saw their degree timeline delayed least frequently.

Nearly 40% of doctorate recipients in geosciences, atmospheric sciences, and ocean sciences said that their plans about where to live in the year after graduation were affected, compared to 22% of those in psychology and 24% in health sciences.

Doctorate recipients in psychology and those in mathematics and statistics were the least affected by the COVID-19 pandemic in terms of their immediate postgraduate employment or education plans or their long-term career plans or goals.

Figure 27

COVID-19 pandemic impacts among doctorate recipients, by broad field: 2021



S&E = science and engineering.

Note(s):

Percentages are based on the number of doctorate recipients who responded to COVID-19 impact questions, which were added to the survey in June 2020 (42,301 respondents).

Source(s):

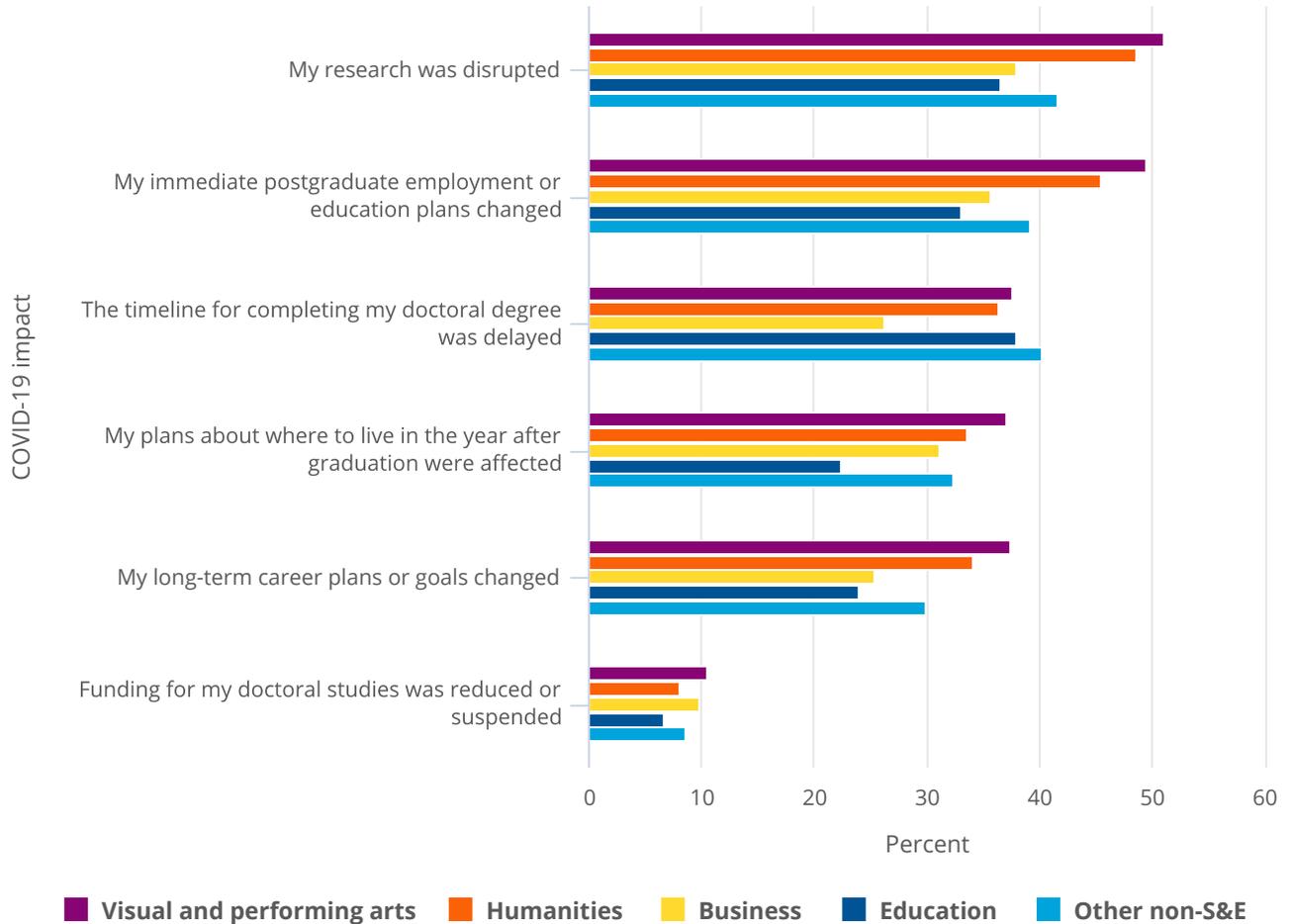
National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

Among non-S&E doctorate recipients, larger proportions in visual and performing arts and in humanities said their research had been disrupted by the pandemic compared with their counterparts in business, education, or other non-S&E fields (figure 28). A similar pattern is observed regarding the pandemic’s impact on their immediate postgraduate employment or education plans and their long-term career plans or goals.

Doctorate recipients in business were the least likely to say the timeline for completion of their studies had been delayed, compared with those in other non-S&E broad fields. Similarly, doctorate recipients in education were the least likely to say their plans about where to live in the year after graduation had been affected.

Figure 28

COVID-19 pandemic impacts among non-S&E doctorate recipients, by broad field: 2021



S&E = science and engineering.

Note(s):

Percentages are based on the number of non-S&E doctorate recipients who responded to COVID-19 impact questions, which were added to the survey in June 2020 (8,637 respondents).

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

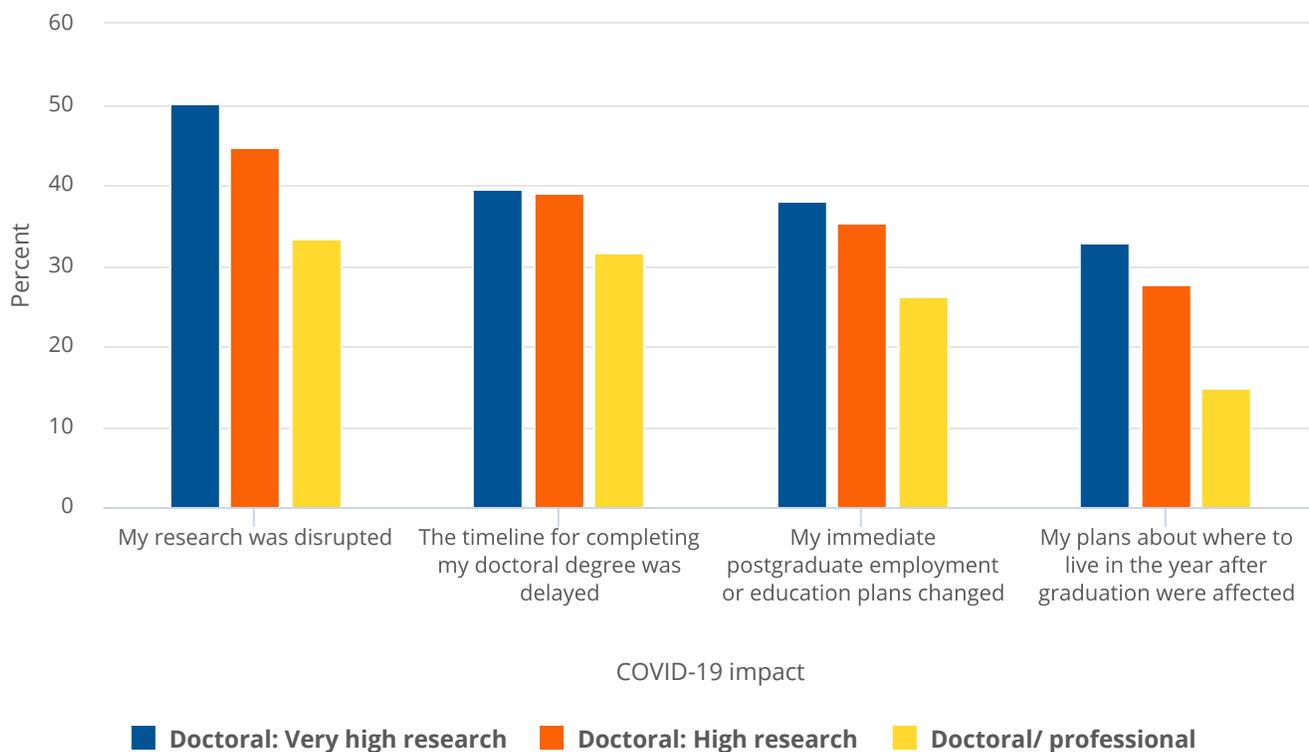
COVID-19 pandemic impacts by Carnegie classification of S&E doctorate recipients' institutions

Doctorate recipients who were earning their degree at higher research intensity institutions reported more impacts from the pandemic than their counterparts at doctoral/professional institutions ([figure 29](#)).

The largest differences by Carnegie classification of doctorate recipients' institutions had to do with research disruptions, change in immediate postgraduate employment or education plans, or effect on plans about where to live in the year after graduation.

Figure 29

Selected COVID-19 pandemic impacts among S&E doctorate recipients, by 2018 Carnegie Classification of doctorate institution: 2021



S&E = science and engineering.

Note(s):

Percentages are based on the number of S&E doctorate recipients who responded to COVID-19 impact questions, which were added to the survey in June 2020 (33,664 respondents). Impact areas shown are those with the largest differences by 2018 Carnegie classification.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

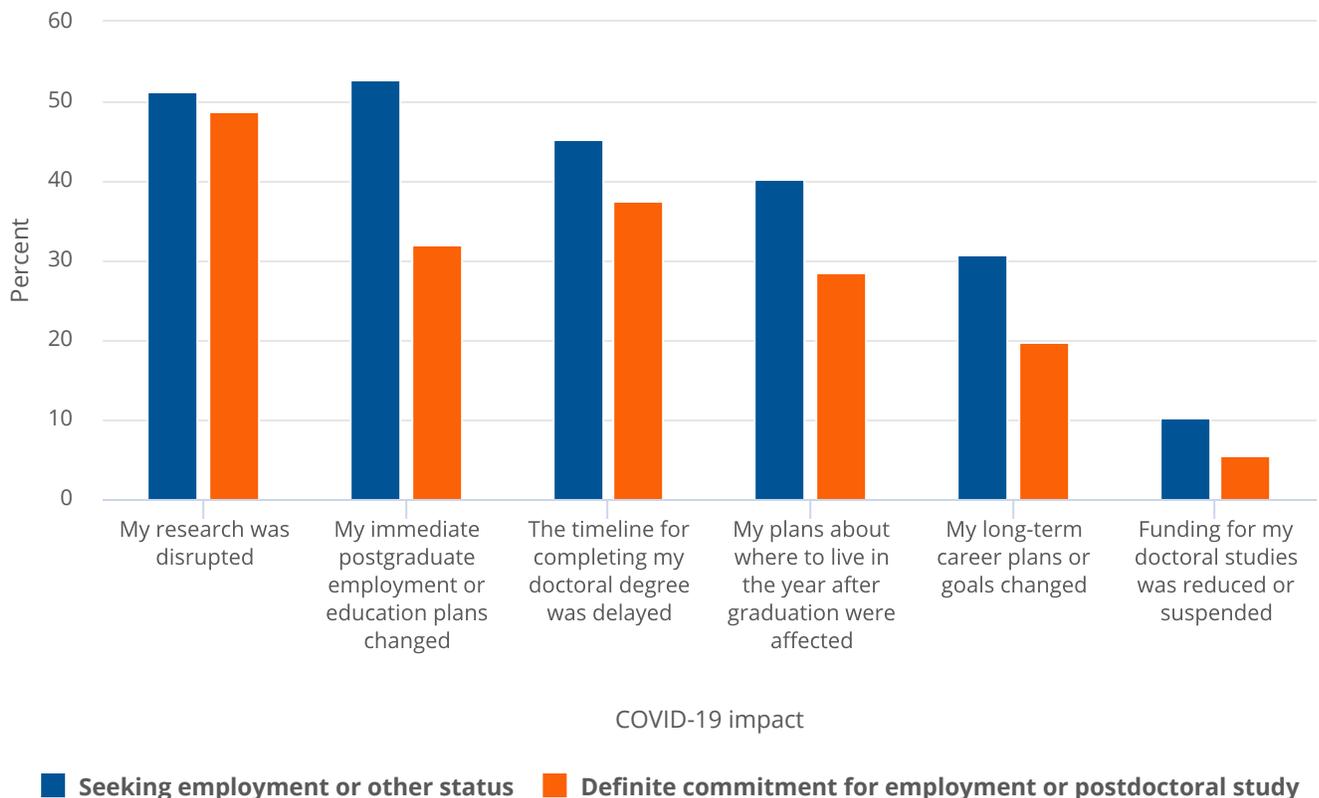
COVID-19 pandemic impacts on S&E doctorate recipients' postgraduation employment status and plans

Postgraduation status

S&E doctorate recipients who were still seeking employment felt the pandemic's impact more strongly than those who already had a definite commitment (**figure 30**). In particular, larger proportions of those still seeking employment than those with definite commitments stated that, as a result of the COVID-19 pandemic, their doctoral completion timeline was delayed, their immediate postgraduate employment or education plans had changed, their long-term career plans or goals had changed, or their plans about where to live in the year after graduation had been affected.

Figure 30

COVID-19 pandemic impacts among S&E doctorate recipients, by postgraduation employment status: 2021



Note(s):

Percentages are based on the number of S&E doctorate recipients who responded to COVID-19 impact questions, which were added to the survey in June 2020 (33,664 respondents). Seeking employment includes doctorate recipients negotiating an offer of employment with one or more specific organizations, seeking a position but currently have no offer of employment, and other status (enrolled in a full-time degree program, no plans to work or study, other). Definite commitment refers to a doctorate recipient who is either returning to predoctoral employment or has signed a contract (or otherwise made a definite commitment) for employment or postdoctoral study in the coming year.

Source(s):

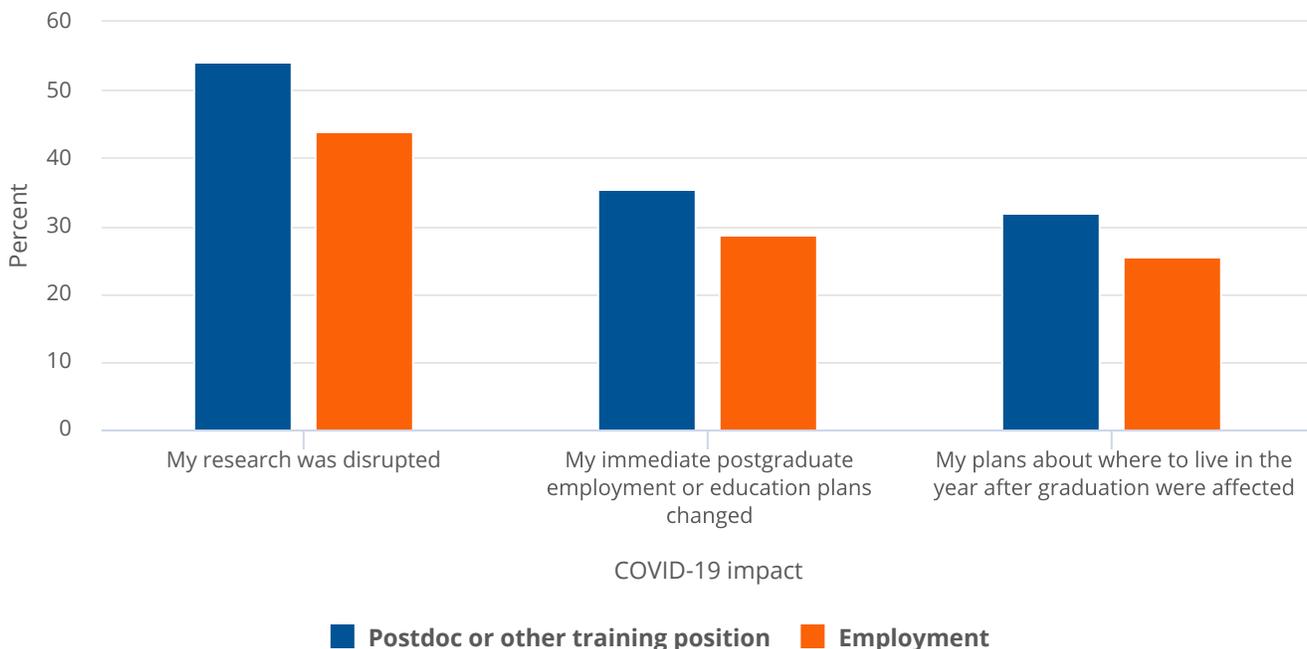
National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

Postgraduation employment plans

Among S&E doctorate recipients with definite commitments, larger proportions of those who had accepted postdocs or other training positions than those who had accepted other jobs said their research had been disrupted, their immediate postgraduate plans changed, or their plans about where to live in the year after graduation had been affected (figure 31).

Figure 31

Selected COVID-19 pandemic impacts among S&E doctorate recipients, by type of definite commitment: 2021



S&E = science and engineering.

Note(s):

Percentages are based on the number of S&E doctorate recipients who responded to COVID-19 impact questions, which were added to the survey in June 2020, and had definite commitments (23,726 respondents). Postdoc or other training position includes: postdoc fellowship (including postdoc research associateships), traineeships, internships or clinical residencies, and other training. Employment includes military service, other employment, and unspecified employment (including missing). Impact areas shown are those with the largest differences by type of definite commitment.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

COVID-19 pandemic impacts on S&E doctorate recipients by demographics

Overall, differences in the impacts of COVID-19 by field, type of institution, and postgraduation employment status and plans were more salient than differences by demographics. The largest differences by demographics were by citizenship status and by dependent status.

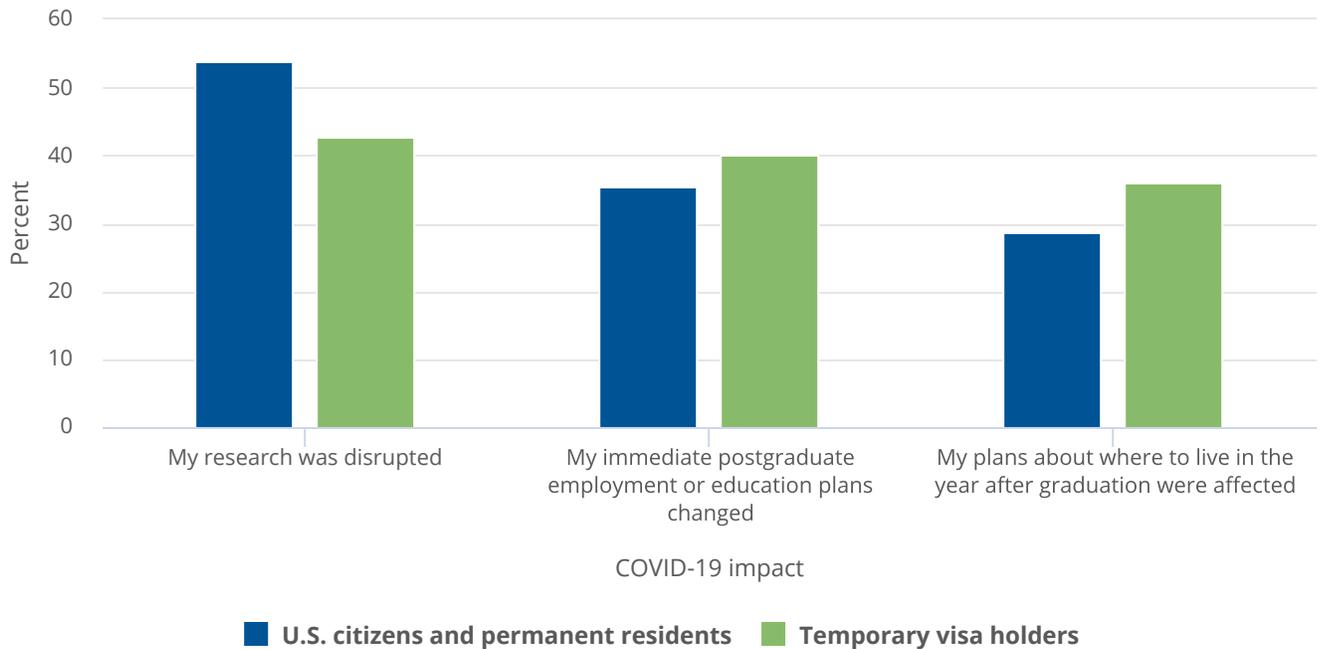
Citizenship

S&E doctorate recipients who were U.S. citizens or permanent residents said their research had been disrupted by the pandemic more frequently than did their temporary visa holder counterparts. In turn, larger proportions of temporary

visa holders than of U.S. citizens and permanent residents said their immediate postgraduate employment or education plans had changed or their plans about where to live in the year after graduation had been affected (figure 32).

Figure 32

Selected COVID-19 pandemic impacts among S&E doctorate recipients, by citizenship status: 2021



S&E = science and engineering.

Note(s):

Percentages are based on the number of U.S. citizen and permanent resident (20,330) and temporary visa holder (13,137) S&E doctorate recipients who responded to COVID-19 impact questions, which were added to the survey in June 2020. Impact areas shown are those with the largest differences by citizenship status.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

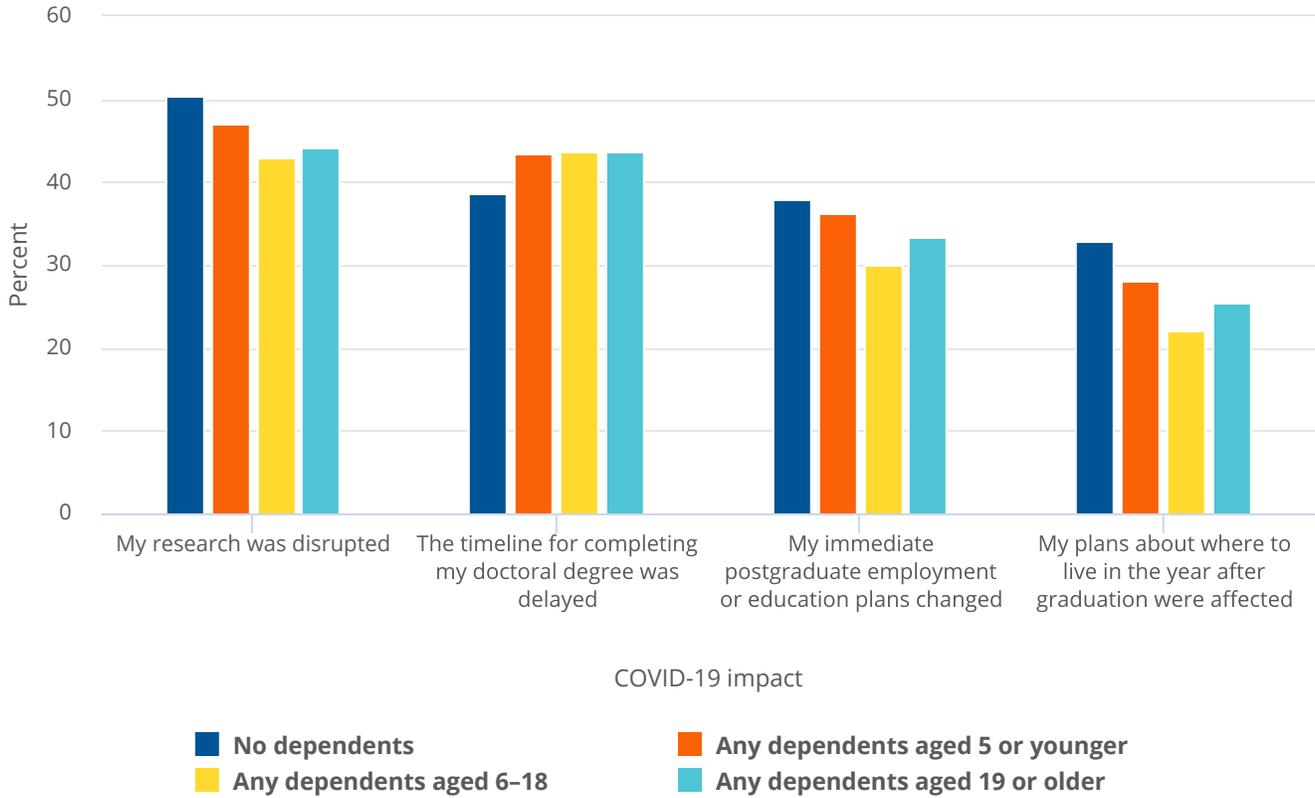
Dependent status

S&E doctorate recipients with no dependents and with dependents aged 5 or younger indicated their research was disrupted more frequently than those with dependents aged 6–18 and those with dependents aged 19 or older. In addition, S&E doctorate recipients with no dependents were the least likely to say COVID-19 affected their timeline for doctorate completion (figure 33).

Lower proportions of doctorate recipients with school-aged children (6–18 years old) than those with no dependents or with younger or older dependents indicated the pandemic impacted their immediate employment or education plans or their plans about where to live in the year after graduation.

Figure 33

Selected COVID-19 pandemic impacts among S&E doctorate recipients, by dependent status: 2021



S&E = science and engineering.

Note(s):

Percentages are based on the number of S&E doctorate recipients who responded to COVID-19 impact questions, which were added to the survey in June 2020 (33,664 respondents). Impact areas shown are those with the largest differences by dependent status.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

Glossary

Basic annual salary. Annual salary to be earned from the doctorate recipient's principal job in the next year, not including bonuses or additional compensation for summertime teaching or research.

Cumulative debt. The amount of debt, incurred both at the undergraduate level and the graduate level, owed by a doctorate recipient at the time the doctorate is awarded.

Definite commitment. A commitment, through a contract or other method, by doctorate recipients to accept employment or a postdoctoral study (postdoc) position in the coming year or to return to predoctoral employment.

Definite non-postdoc employment commitment. A definite commitment by doctorate recipients for employment (excludes postdocs) in the coming year.

Field. Beginning in 2021, the SED collects over 1,600 fields for reporting of field of research doctorate, using a modified version of the 2020 Classification of Instructional Programs (CIP)—compared to 334 fields collected in 2020 and previous years. The SED-CIP codes are then aggregated into 300 detailed field codes nested into 66 major fields and 16 broad fields and are used to report field of doctorate data in the detailed data tables.

To facilitate trend data comparisons, historical field data were estimated based on a crosswalk of the new 2021 SED-CIP codes to the SED field of study codes used in prior survey years. The trend data reported in this report uses 14 broad fields (excluding multidisciplinary/ interdisciplinary sciences)—10 S&E fields: agricultural sciences and natural resources; biological and biomedical sciences; computer and information sciences; engineering; geosciences, atmospheric sciences, and ocean sciences; health sciences; mathematics and statistics; physical sciences; psychology; social sciences; and 4 non-S&E fields: business, education, humanities and arts; and other non-S&E fields. (See "Field" under "Time series data changes" in the ["Data Source"](#) section.)

Graduate debt. The amount of debt from graduate-level education owed by a doctorate recipient at the time the doctorate is awarded.

NCSES. National Center for Science and Engineering Statistics.

Non-S&E. Non-science and engineering: Non-S&E broad fields used in trend data discussions in the first four recurring report themes are based on historical fields that included business; education; humanities and arts (combined); and other non-S&E fields, such as communications. The new SED taxonomy broad fields for 2021 report the humanities and the visual and performing arts fields separately, which is reflected in the special focus section on COVID-19 impacts.

Parental educational attainment. The highest level of education attained by either parent or guardian of a doctorate recipient.

Postdoctoral (postdoc) position. A temporary position primarily for gaining additional education and training in research, usually awarded in academe, industry, government, or a nonprofit organization.

Race and ethnicity. Doctorate recipients who report Hispanic or Latino heritage, regardless of racial designation, are counted as Hispanic or Latino, and those who do not answer the Hispanic or Latino ethnicity question are counted as "ethnicity not reported." Respondents who indicate that they are not Hispanic or Latino and indicate a single race are reported in their respective racial groups, except those indicating Native Hawaiian or Other Pacific Islander, who are included in "other race or race not reported." (See "Ethnicity and race" under "Time series data changes" in the ["Data Source"](#) section).

Research doctorate. A doctoral degree that is oriented toward preparing students to make original intellectual contributions in a field of study and that is not primarily intended for the practice of a profession. Research doctorates require the completion of a dissertation or equivalent project. In this report, the terms “doctorate” and “doctoral degree” are used to represent any of the research doctoral degrees covered by the survey. Professional doctoral degrees, such as the MD, DDS, JD, and PsyD, are not covered by the SED.

S&E. Science and engineering: S&E broad fields used in trend data discussions are based on 10 fields that include agricultural sciences and natural resources; biological and biomedical sciences; computer and information sciences; engineering; geosciences, atmospheric sciences, and ocean sciences; health sciences; mathematics and statistics; physical sciences; psychology; and social sciences. The broad fields used in trend data do not include multidisciplinary/interdisciplinary sciences, which is new in the SED field of study taxonomy in 2021.

Sources of financial support. Sources of financial support are grouped into the following five categories: fellowships (includes scholarships and dissertation grants); teaching assistantships; research assistantships (includes traineeships, internships, clinical residencies, and other assistantships); own resources (includes loans, personal savings, personal earnings, and earnings or savings of spouse, partner, or family); and other (includes employer reimbursements and support from non-U.S. sources).

Time to degree. The time elapsed from the start of any graduate school program to completion of the doctoral degree.

Underrepresented minority. Groups that are underrepresented in science and engineering, relative to their numbers in the U.S. population: American Indian or Alaska Native, Black or African American, and Hispanic or Latino.²²

Data source

The Survey of Earned Doctorates (SED) is the sole data source for *Doctorate Recipients from U.S. Universities: 2021*. The principal elements of the 2021 SED data collection are described in the sections that follow. More detailed information, including “Technical Notes” and related technical tables, are available at <https://nces.nsf.gov/sed/>.

Survey eligibility. The SED collects information on research doctorate recipients only. Research doctorates require the completion of a dissertation or equivalent project, are oriented toward preparing students to make original intellectual contributions in a field of study, and are not primarily intended for the practice of a profession. The 2021 SED recognized 18 distinct types of research doctorates. In 2021, 98% of research doctorate recipients earned the PhD.

The population eligible for the 2021 survey consisted of all individuals who received a research doctorate from an accredited U.S. academic institution in the 12-month period from 1 July 2020 to 30 June 2021.

Survey universe. The total universe consisted of 52,250 persons in 456 institutions that conferred research doctorates in academic year 2021.

Data collection. Institutional coordinators at each doctorate-awarding institution distributed the SED Web survey link to individuals receiving a research doctorate. The self-administered Web survey is the primary mode of SED completion. Nonrespondents were contacted by e-mail and mail to complete the Web survey. If the series of follow-up e-mails and mailings is unsuccessful, the survey contractor attempts to reach nonrespondents to complete an abbreviated survey by computer-assisted telephone interviewing. RTI International served as the 2021 SED data collection contractor on behalf of NCSES.

Survey response rates. In 2021, 91.5% of research doctorate recipients completed the survey. Limited records (field of study, doctoral institution, and sex) are constructed for nonrespondents from administrative records of the university—commencement programs, graduation lists, and other public records—and are included in the reported total of doctorate recipients. The survey response rates for 1980–2021 and the item response rates for 2010–20 are provided in table A-2 and table A-3 of the survey’s 2021 “Technical Notes.”

Time series data changes.

- *EdD program reclassification.* After a multiyear review of Doctor of Education (EdD) degree programs participating in the SED, 143 programs were reclassified from research doctorate to professional doctorate over the 2010–11 period. No additional reclassifications of EdD degree programs are planned. SED data are no longer being collected from graduates earning degrees from the reclassified EdD programs, and this has affected the reporting of the number of doctorates awarded by sex, citizenship, race, and ethnicity. **Figure 8** in this report shows the impact of the decline in number of doctoral degrees awarded in education from 2009 to 2011. Readers should note that the declines from 2009 to 2010 and from 2010 to 2011 are at least partly attributable to the EdD reclassification.²³
- *Field.* Beginning in 2021, field of doctorate data are collected using a modified version of the 2020 Classification of Instructional Programs (CIP) codes and reported using a new SED-specific taxonomy (table A-4). For more information about CIP codes, please see <https://nces.ed.gov/ipeds/cipcode/>. Adjustments to the 2020 CIP for the SED data collection (SED-CIP) included, among other changes, the addition of over 50 fields of study codes collected in the SED but not covered in the 2020 CIP. The SED-CIP now collects over 1,600 fields for field of study reporting, compared to the 334 field codes collected in 2020 SED and prior years. The SED-CIP codes collected are then aggregated into 300 detailed fields nested under 66 major fields and 16 broad fields, which are used for reporting in the 2021 detailed data tables. This field structure is aligned with the NCSES Taxonomy of Disciplines (TOD) to facilitate comparison with other NCSES surveys as well as with the Integrated Postsecondary Education Data System (IPEDS) Completions survey. To facilitate the trend data comparison with prior years, a crosswalk was created of the SED-CIP codes to the SED historical field of study, as shown in table A-6 of the 2021 “Technical

Notes.” Thus, the broad fields are estimates generated to facilitate the comparison of trend data collected using SED-CIP codes to those collected using the historical SED field. This results in generally comparable broad fields. For more details, see the 2021 “Technical Notes.”

Data license. Microdata from the Doctorate Records File (cumulative SED data file) may be obtained through a restricted-use data license. (See <https://nsf.gov/statistics/license/index.cfm>.)

Notes

- 1 For additional data on the race and ethnicity of doctorate recipients, see SED 2021 related detailed table 1-11.
- 2 The drop in the number of doctorate recipients in the field of education between 2009 and 2011 is at least partly attributable to the reclassification of Doctor of Education (EdD) programs. For details, see “Time series data changes” in the “**Data Source**” section.
- 3 For details about changes in the field of education between 2009 and 2011, see “Time series data changes” in the “**Data Source**” section.
- 4 For additional data by citizenship status of doctorate recipients, see SED 2021 related detailed table 1-6.
- 5 For additional data on the race and ethnicity of doctorate recipients, see SED 2021 related detailed table 1-8.
- 6 For details on non-S&E fields, see SED 2021 related detailed table 1-11.
- 7 For additional data on the field of education, humanities and arts, and other non-S&E fields, see SED 2021 related detailed table 1-4.
- 8 For a detailed discussion on other aspects of education-related debt, see “**Education-Related Debt**” in National Center for Science and Engineering Statistics (NCSES). 2019. *Doctorate Recipients from U.S. Universities 2018*. NSF 20-301. Available at <https://ncses.nsf.gov/pubs/nsf20301/report>.
- 9 For more data on the primary sources of financial support of doctorate recipients by field, see **figure 16** in this report and SED 2021 related detailed table 4-1.
- 10 Within non-S&E, education is the field with the longest median time to degree (11.7 years from graduate school entry to doctorate in 2021). For more data, see SED 2021 related detailed table 1-12.
- 11 For details on the growth of the S&E workforce, see National Science Board. 2021. *The STEM Labor Force of Today: Scientists, Engineers and Skilled Technical Workers. Science and Engineering Indicators 2022*. NSB-2021-2. Available at <https://ncses.nsf.gov/pubs/nsb20212>.
- 12 For data on doctorate recipients with definite postgraduation employment commitments in academia, see SED 2021 related detailed table 2-7.
- 13 For data on definite postgraduation employment commitments in the United States in non-S&E fields, see SED 2021 related detailed table 2-6.
- 14 Industry includes all nonacademic sectors, including self-employment, private for-profit and private nonprofit, and government.
- 15 For data on temporary visa holder doctorate recipients with definite postgraduation commitments by field, see SED 2021 related detailed table 6-3.
- 16 National Science for Science and Engineering Statistics, special tabulations (2022) of the 2021 Survey of Earned Doctorates.
- 17 Doctorate recipients were allowed to provide multiple responses as to how their research was disrupted.
- 18 Doctorate recipients were allowed to provide multiple responses as to how their postgraduation employment or education plans changed.
- 19 Doctorate recipients were allowed to provide multiple responses as to how their long-term career plans or goals changed.

20 The proportion of doctorate recipients who mentioned their funding was reduced or suspended did not vary by the primary source of funding reported by the doctorate recipient (special tabulation).

21 NCSES, special tabulations (2022) of the 2021 SED.

22 For detailed data on underrepresented minorities, see National Center for Science and Engineering Statistics. 2021. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2021*. NSF 21-321. Alexandria, VA: National Science Foundation. Available at <https://nces.nsf.gov/pubs/nsf21321/>.

23 For more details on the declines in education between 2009 and 2011, see SED 2021 related detailed table 1-3 and **SED 2018** table 13.

Appendix

Table SRA-1

SED aggregated fields and their constituent fields in the report figures and tables: 2021

(Field)

Aggregated field name and constituent fields
Science and engineering
Agricultural sciences and natural resources
Agricultural sciences
Agricultural and horticultural plant breeding
Agricultural economics
Agronomy and crop science
Animal nutrition
Animal science, poultry or avian
Animal sciences, other
Food science
Food science and technology, other
Horticulture science
Plant pathology/ phytopathology (agricultural sciences)
Plant sciences, other
Soil chemistry/ microbiology
Soil sciences, other
Natural resources and conservation
Environmental science
Fishing and fisheries sciences/ management
Forest sciences and biology
Forest/ forest resources management
Forestry, other
Natural resource/ environmental policy
Natural resources/ conservation
Natural resources/ environmental economics (agricultural sciences)
Wildlife/ range management
Agricultural sciences/ natural resources, general
Agricultural sciences/ natural resources, other
Biological and biomedical sciences
Anatomy
Bacteriology
Biochemistry (biological sciences)
Bioinformatics
Biomedical sciences
Biometrics and biostatistics
Biophysics (biological sciences)
Biotechnology
Botany/ plant biology
Cancer biology
Cell/ cellular biology and histology
Computational biology
Developmental biology/ embryology
Ecology
Endocrinology
Entomology
Environmental toxicology
Epidemiology

Table SRA-1**SED aggregated fields and their constituent fields in the report figures and tables: 2021**

(Field)

Aggregated field name and constituent fields
Evolutionary biology
Genetics/ genomics, human and animal
Immunology
Microbiology
Molecular biology
Molecular medicine
Neurosciences and neurobiology
Nutrition sciences
Parasitology
Pathology, human and animal
Pharmacology, human and animal
Physiology, human and animal
Plant genetics
Plant pathology and phytopathology (biological sciences)
Plant physiology
Structural biology
Toxicology
Virology
Wildlife biology
Zoology
Biological/ biomedical sciences, general
Biological/ biomedical sciences, other
Computer and information sciences
Computer science
Information science and systems
Computer and information sciences, general
Computer and information sciences, other
Engineering
Aerospace, aeronautical, and astronautical engineering
Bioengineering and biomedical engineering
Chemical engineering
Civil engineering
Electrical, electronics, and communications engineering
Industrial and manufacturing engineering
Materials science engineering
Mechanical engineering
Other engineering
Agricultural engineering
Communications engineering
Computer engineering
Engineering management and administration
Engineering mechanics
Engineering physics
Engineering science
Environmental/ environmental health engineering
Geotechnical and geoenvironmental engineering
Metallurgical engineering
Nuclear engineering
Ocean engineering

Table SRA-1

SED aggregated fields and their constituent fields in the report figures and tables: 2021

(Field)

Aggregated field name and constituent fields
Operations research (engineering)
Petroleum engineering
Polymer and plastics engineering
Robotics
Structural engineering
Systems engineering
Transportation and highway engineering
Engineering, general
Engineering, other
Geosciences, atmospheric sciences, and ocean sciences
Atmospheric science and meteorology
Atmospheric chemistry and climatology
Atmospheric physics and dynamics
Meteorology
Atmospheric science/ meteorology, general
Atmospheric science/ meteorology, other
Geological sciences
Geochemistry
Geology
Geomorphology and glacial geology
Geophysics and seismology
Mineralogy and petrology
Paleontology
Stratigraphy and sedimentation
Geological and earth sciences, general
Geological and earth sciences, other
Ocean and marine sciences
Hydrology and water resources
Marine biology and biological oceanography
Marine sciences
Oceanography, chemical and physical
Ocean/ marine sciences, other
Health sciences
Environmental health
Gerontology (health sciences)
Health and behavior
Health services research
Health systems administration
Kinesiology/ exercise science
Medical physics/ radiological science
Nursing science
Oral biology/ oral pathology
Pharmaceutical sciences
Public health
Rehabilitation/ therapeutic services
Speech-language pathology and audiology
Veterinary sciences
Health sciences, general
Health sciences, other

Table SRA-1**SED aggregated fields and their constituent fields in the report figures and tables: 2021**

(Field)

Aggregated field name and constituent fields
Mathematics and statistics
Algebra
Analysis and functional analysis
Applied mathematics
Computational mathematics
Computing theory and practice
Geometry/ geometric analysis
Logic
Number theory
Operations research (mathematics)
Statistics (mathematics)
Topology/ foundations
Mathematics/ statistics, general
Mathematics/ statistics, other
Physical sciences
Astronomy and astrophysics
Astronomy
Astrophysics
Astronomy and astrophysics, other
Chemistry
Analytical chemistry
Chemical biology
Inorganic chemistry
Medicinal chemistry
Organic chemistry
Physical chemistry
Polymer chemistry
Theoretical chemistry
Chemistry, general
Chemistry, other
Physics
Acoustics
Applied physics
Atomic/ molecular/ chemical physics
Biophysics (physics)
Condensed matter/ low-temperature physics
Elementary particle physics
Nuclear physics
Optics and photonics
Plasma/ high-temperature physics
Polymer physics
Physics, general
Physics, other
Psychology
Behavioral analysis
Clinical psychology
Cognitive neuroscience
Cognitive psychology and psycholinguistics
Community psychology

Table SRA-1**SED aggregated fields and their constituent fields in the report figures and tables: 2021**

(Field)

Aggregated field name and constituent fields
Counseling
Developmental and child psychology
Educational psychology (psychology)
Experimental psychology
Family psychology
Health and medical psychology
Human development and family studies
Industrial and organizational psychology
Marriage and family therapy/ counseling
Neuropsychology/ physiological psychology
Personality psychology
Psychometrics and quantitative psychology
School psychology (psychology)
Social psychology
Psychology, general
Psychology, other
Social sciences
Anthropology
Anthropology, cultural
Anthropology, general
Anthropology, physical and biological
Economics
Econometrics
Natural resources/ environmental economics (social sciences)
Other economics
Political science and government
Sociology
Other social sciences
American/ U.S. studies
Applied linguistics
Archaeology (social sciences)
Area/ ethnic/ cultural studies
Criminal justice and corrections
Criminology
Demography/ population studies
Gender and women's studies
Geography
Gerontology (social sciences)
Health policy analysis
History, science and technology and society
International relations/ affairs
Linguistics
Public policy analysis
Statistics (social sciences)
Urban studies/ affairs
Urban, city, community and regional planning
Social sciences, general
Social sciences, other
Non-science and engineering

Table SRA-1

SED aggregated fields and their constituent fields in the report figures and tables: 2021

(Field)

Aggregated field name and constituent fields
Business management and administration
Accounting
Business administration and management
Business/ managerial economics
Finance
Hospitality, food service and tourism management
Human resources development
International business/ trade/ commerce
Management information systems/ business statistics
Marketing management and research
Operations research (business)
Organizational behavior
Business management/ administration, general
Business management/ administration, other
Education
Education administration
Educational administration and supervision
Educational and human resource studies/ development
Educational leadership
Urban education and leadership
Education research
Counseling education/ counseling and guidance
Curriculum and instruction
Educational assessment/ testing/ measurement
Educational policy analysis
Educational psychology (education)
Educational statistics/ research methods
Educational/ instructional media design
Educational/ instructional technology
Higher education evaluation and research
International education
Learning sciences
School psychology (education)
Social/ philosophical foundations of education
Special education
Teacher education
Adult and continuing teacher education
Elementary teacher education
Pre-elementary/ early childhood teacher education
Secondary teacher education
Teaching fields
Agricultural education
Art education
Bilingual and multilingual education
English as a second or foreign language
English education
Family and consumer/ human science education
Foreign languages education
Health education

Table SRA-1**SED aggregated fields and their constituent fields in the report figures and tables: 2021**

(Field)

Aggregated field name and constituent fields
Literacy and reading education
Mathematics education
Music education
Nursing education
Physical education and coaching
Science education
Social science education
Teacher education and professional development, other
Other education
Workforce education and development
Education, general
Education, other
Humanities and arts
Foreign languages and literature
Arabic language and literature
Chinese language and literature
French language and literature
Germanic language and literature
Italian language and literature
Japanese language and literature
Latin American languages and literature
Russian language and literature
Spanish language and literature
Foreign languages and literatures, other
History
African history
American history (U.S. and Canada)
Asian history
European history
Latin American history
Middle/ Near East history
History, general
History, other
Letters
American literature (U.S. and Canada)
Classics
Comparative literature
Creative writing
English language
English literature (British and Commonwealth)
Rhetoric and composition
Speech and rhetorical studies
Letters, general
Letters, other
Other humanities and arts
African American studies/ literature/ history
Archaeology (humanities)
Art history/ criticism/ conservation
Bible/ biblical studies

Table SRA-1**SED aggregated fields and their constituent fields in the report figures and tables: 2021**

(Field)

Aggregated field name and constituent fields
Dance
Drama/ theater arts/ performance studies
Ethics
Film/ cinema/ media studies
Jewish/ Judaic studies
Music
Music performance
Music theory and composition
Music, other
Musicology/ ethnomusicology
Philosophy
Religion/ religious studies
Theology/ religious education
Humanities, general
Humanities, other
Other non-science and engineering
Communication
Communication research
Communication theory
Film, radio, TV and digital communication
Mass communication/ media studies
Communication, general
Communication, other
Non-science and engineering fields nec
Architecture/ environmental design
Family/ consumer sciences/ human sciences
Law
Library science
Parks/ sports/ recreation/ leisure/ fitness
Public administration
Social work
Other fields nec

nec = not elsewhere classified; SED = Survey of Earned Doctorates.

Note(s):

Beginning in 2021, a modified version of the 2020 Classification of Instructional Programs (CIP) codes was used in the survey data collection; the new broad, major, and detailed fields were used in tables reporting only the most recent data year. The historical fields used to compare the 2021 data with prior years were constructed using the SED-CIP code crosswalk in SED 2021 related detailed table A-6. Therefore, the field of doctorate data in 2021 may not be comparable to prior years; see the "Technical Notes" for more information.

Source(s):

National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2021.

Acknowledgments and citation

Acknowledgments

The Survey of Earned Doctorates (SED) is conducted and sponsored by the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation (NSF) and co-sponsored by the National Institutes of Health (NIH), Department of Education (ED), and National Endowment for the Humanities (NEH). These federal agencies gratefully acknowledge the support and assistance of graduate deans and their staff, registrars, dissertation officers, and other administrators who participate in the SED effort and contribute to its success. Appreciation is also extended to the new research doctorate recipients who completed the 2021 survey.

NCSES's Jaquelina Falkenheim authored and oversaw preparation of this summary report, and Kelly Kang (NCSES) oversaw the preparation of all detailed data tables and technical notes, under the leadership of Emilda B. Rivers, NCSES Director; Vipin Arora, NCSES Deputy Director; John Finamore, NCSES Chief Statistician; and Amy Burke, Science, Technology, and Innovation Analysis Program Director. Wan-Ying Chang (NCSES) advised on statistical issues. Other NCSES staff who contributed to this report include Elizabeth Grieco, Kelly Phou, and Karen White. Jock Black (NCSES) reviewed this report.

Under NCSES contract, staff at RTI International conducted the 2021 survey and played a valuable role in the resulting publications. The following staff provided especially notable contributions: Caren Arbeit, Peter Einaudi, Patricia Green, Jamie Friedman, Jonathan Gordon, Jane Griffin, Ruth Heuer, and Robert Steele.

Catherine Corlies and Rajinder Raut (NCSES) coordinated this report's publication process, including the management of its edit and development of its digital platform. Christine Hamel and Tanya Gore (NCSES) conducted composition review. OmniStudio, Inc., designed the cover. Staff at Penobscot Bay Media, LLC (PenBay Media) created the report site. Devi Mishra (NCSES) provided data processing support.

Suggested citation

National Center for Science and Engineering Statistics, National Science Foundation. 2022. *Doctorate Recipients from U.S. Universities: 2021*. NSF 23-300. Alexandria, VA. Available at <https://nces.gov/pubs/nsf23300>.

Contact author

Author

Jaquelina Falkenheim
Senior Analyst
NCSES
Tel: (703) 292-7798
E-mail: jfalkenh@nsf.gov

NCSES

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

<https://nces.nsf.gov/pubs/nsf23300>



NATIONAL
ENDOWMENT
FOR THE
HUMANITIES



NSF 23-300