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K–12 Education

Elementary and Secondary Mathematics and Science Education

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

Table of Contents

List of Tables

List of Figures

Executive Summary

Key takeaways:

- Internationally, the United States ranks in the middle of 19 advanced economies in producing high-achieving science, technology, engineering, and mathematics (STEM) students, with such education systems as Singapore, Taiwan, and South Korea outpacing the United States.
- Nationally, U.S. students' achievement in mathematics has improved in the last three decades. Most of that improvement, however, occurred in the first two decades. In science, U.S. students' achievement scores improved by 4 points between 2009 and 2015.
- In technology and engineering literacy, U.S. student performance has improved since 2014, when the first national assessment in this subject area was administered.
- The data show differences in achievement scores across STEM subjects by socioeconomic status (SES) and by race or ethnicity. Differences by sex are smaller but still present, although female students outscore male students on assessments of technology and engineering literacy.
- High school STEM achievement and coursetaking can facilitate STEM-related postsecondary education and employment. For example, among students who enter the workforce directly after high school, those who have taken STEM-related career and technical education courses are more likely than others to enter skilled technical jobs.

Elementary and secondary education in mathematics and science is the foundation for student entry into postsecondary STEM majors as well as a wide variety of STEM-related occupations. Federal and state policymakers, legislators, and educators are working to broaden and strengthen STEM education at the K–12 level. These efforts include promoting elementary grade participation in STEM, raising overall student achievement, increasing advanced high school coursetaking, reducing performance gaps among demographic groups, and improving college and career readiness in mathematics and science.

The indicators in this report present a mixed picture of the status and progress of elementary and secondary mathematics and science education in the United States. Internationally, the United States ranks in the middle of advanced economies in producing high-achieving STEM students. Education systems such as Singapore, Taiwan, South Korea, and Japan outpace the United States in producing students at or above the 90th percentile in mathematics and science achievement scores.

Nationally, students' achievement in mathematics has improved in the last three decades. However, most of that improvement occurred in the first two decades; and large achievement gaps among demographic groups continue to be present. In science, U.S. students' achievement scores improved by 4 points between 2009 and 2015, the last time science was assessed. In technology and engineering literacy, U.S. student performance has improved since 2014, when the first national assessment designed to measure achievement in technology and engineering was administered.

The data show achievement gaps by students' race or ethnicity and SES (and, to a smaller extent, by sex) in U.S. student performance in STEM subjects. These performance differences are observed in assessments as early as kindergarten and persist throughout elementary school and into middle school and high school. For example, in a national cohort of elementary school children, the mathematics score gap between low- and high-SES students was 9 points at the beginning of kindergarten and 13 points in the spring of fifth grade. Scores for low-SES students in a national cohort of eighth graders were 29 points lower than scores for high-SES students. Gaps between white and black and Hispanic students showed similar patterns. Asian students score higher than white students on most measures.

High school STEM achievement and coursetaking can facilitate STEM-related postsecondary education and employment. Students who perform well in mathematics and science in high school are more likely to declare a postsecondary STEM major. The majority of U.S. high school students enroll in postsecondary education immediately after graduation from high school; enrollment patterns, however, differ by demographic groups. For example, black students and students from less advantaged socioeconomic groups enroll at lower rates than their peers. These demographic differences suggest unequal access to higher education and to the opportunities it gives students. Among students who enter the workforce directly after high school, those who take STEM-related career and technical education courses are more likely than others to enter skilled technical jobs. Preparing students for entry into skilled technical jobs is important: these jobs utilize science, engineering, and technical knowledge, and workers in these jobs earn more than workers with a comparable level of education at other jobs.

Taken as a whole, the findings in this report suggest that the United States has yet to achieve the goal of providing high-quality elementary and secondary mathematics and science education for all students. Given the importance of the K–12 STEM pipeline and the opportunities available to students who excel in STEM subjects, it is important to continue to focus on efforts that will increase the number and diversity of students interested in STEM and broaden opportunities for those students to succeed and thrive in STEM.

Introduction

This report provides a portrait of K–12 science, technology, engineering, and mathematics (STEM) education in the United States. It examines pre-college mathematics and science learning and how that learning affects postsecondary and career outcomes. It also compares U.S. student performance with that of other nations. Data sources include the U.S. Department of Education's National Center for Education Statistics (NCES) and other public sources.

This report focuses on overall patterns in STEM education and notes variations in STEM access and performance by students' socioeconomic status (SES), race or ethnicity, and sex. STEM education can provide historically underrepresented populations with pathways for obtaining good jobs and a higher standard of living, if they can access these opportunities (Committee on STEM Education 2018; Doerschuk et al. 2016; Leadership Conference Education Fund 2015; Noonan 2017b; Wang and Degol 2016).[1] Data in this report reveal access and achievement gaps in STEM education across the K–12 spectrum. With few exceptions, the data show strong associations between SES and STEM achievement levels, early and ongoing differences among racial or ethnic groups, and some differences in male and female student achievement. These results are consistent across many measures, including tests of different students across time, tests that follow specific age cohorts, immediate college enrollment rates, and choice of postsecondary STEM majors.

In *Charting a Course for Success: America's Strategy for STEM Education*, the federal government presented its 5-year strategic plan for STEM education (Committee on STEM Education 2018). The plan envisions a future where all Americans have lifelong access to high-quality STEM education and suggests that high-quality K–12 STEM education is essential if the United States is to meet its goal of being a global leader in STEM literacy, innovation, and employment. It identifies improving STEM education and removing barriers to participation in STEM careers, especially for women and other underrepresented groups, as key goals for STEM efforts in this country. The data presented in this report provide information about the current state of U.S. K–12 STEM education and how the United States measures up to these goals.

There are three main sections in this report. The first presents indicators of U.S. students' performance in STEM subjects in elementary and secondary school. It begins with an analysis of elementary school students' growth in mathematics and science knowledge from kindergarten through fifth grade. Next, it presents national trends in mathematics, science, and technology and engineering literacy assessment scores. The section then examines U.S. student performance in an international context. The second section focuses on teacher certification and experience.

The third section focuses on transitions from high school to postsecondary education or directly into the workforce. It presents national data on Advanced Placement (AP) coursetaking. It then examines immediate college enrollment after high school and students' choice to major in a STEM subject in college. It concludes by examining the transition to the skilled technical workforce (STW) for students who enter the workforce immediately following high school.

Data sources are described in each section of the report. Whenever a comparative statistic is cited, it is statistically significant at the 0.05 probability level, unless otherwise noted.

Student Learning in Mathematics and Science

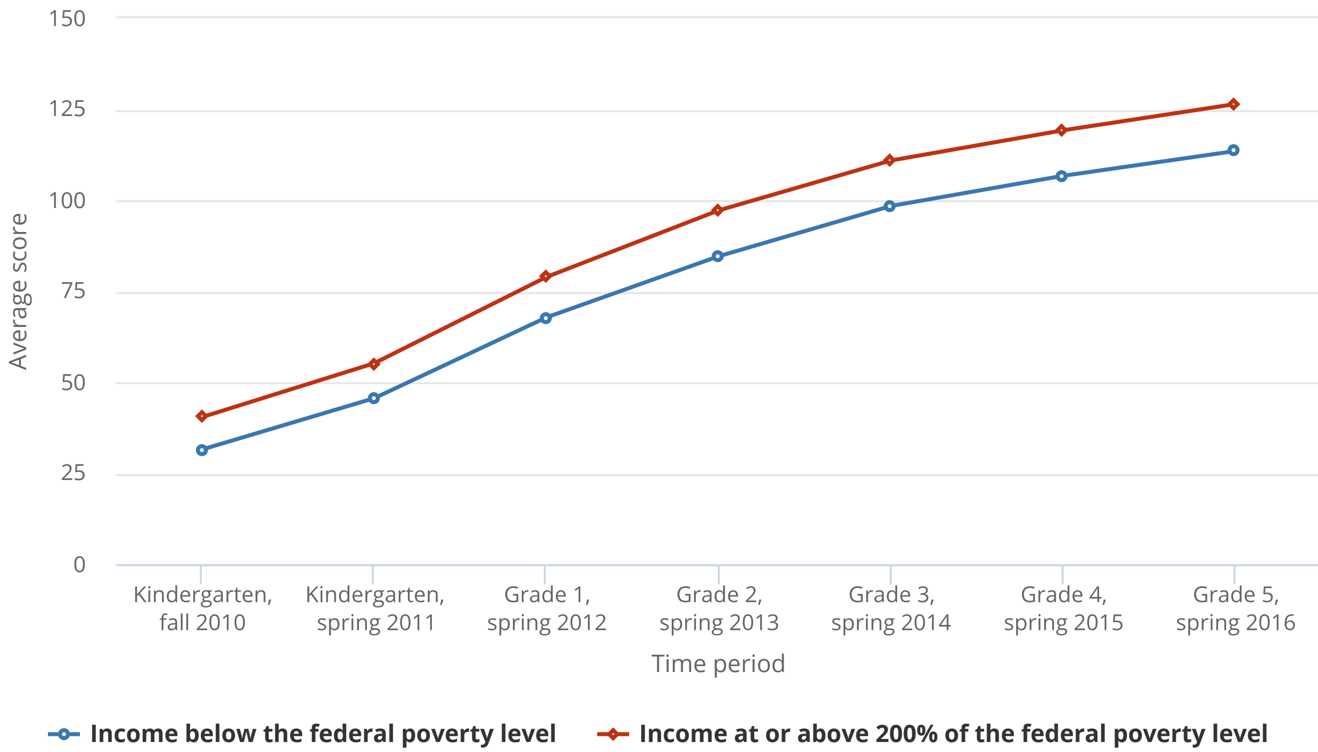
Policymakers, legislators, and educators in the United States strive to increase academic achievement for *all* students. Education reform efforts focus on improving the performance of low-achieving students and on increasing the number and diversity of high-achieving students (Estrada et al. 2016; Museus 2011). Policymakers view proficiency in STEM fields as vital to the nation's economic growth and emphasize improving student learning in STEM disciplines as a result (Atkinson and Mayo 2010; Committee on STEM Education 2018; Noonan 2017a; Peri, Shih, and Sparber 2015). This section presents indicators of U.S. students' performance in STEM subjects in elementary and secondary school, beginning with students' performance in mathematics and science from kindergarten through fifth grade. Next, it presents trends in mathematics performance for eighth graders from 1990 to 2017 and summarizes performance on science and technology and engineering assessments. Finally, it examines U.S. achievement in an international context and explores the certification and experience of eighth grade mathematics teachers.

Mathematics and Science Knowledge in the Early Grades

Children begin learning STEM-related material as soon as they enter school, and their early experience and achievement in mathematics and science may affect their attitudes about, and confidence in, STEM subjects for the rest of their school careers (Maltese and Tai 2010; McClure et al. 2017). However, students typically do not begin schooling on an equal footing: kindergarten assessments reveal differences in mathematics and science achievement by SES and race or ethnicity and some of these gaps persist as students' schooling continues (Friedman-Krauss, Barnett, and Nores 2016; García 2015). Research suggests a variety of factors contribute to the early gaps among demographic groups, including less access to informal learning opportunities and high-quality preschool (García and Weiss 2017). In a national sample of elementary school children, the mathematics score gap between low- and high-SES students was 9 points at the beginning of kindergarten and 13 points in the spring of fifth grade (**Figure 1-1**). The gap between white and black students was 7 points at the beginning of kindergarten and 16 points in the spring of fifth grade, and the gap between white and Hispanic students was 8 points in kindergarten and 10 points in fifth grade (**Figure 1-2**). Asian students scored slightly higher than white students in mathematics both in kindergarten and fifth grade.

FIGURE 1-1

Average mathematics assessment test scores of children who were in kindergarten for the first time during the 2010–11 school year and in grade 5 during the 2015–16 school year, by family poverty level



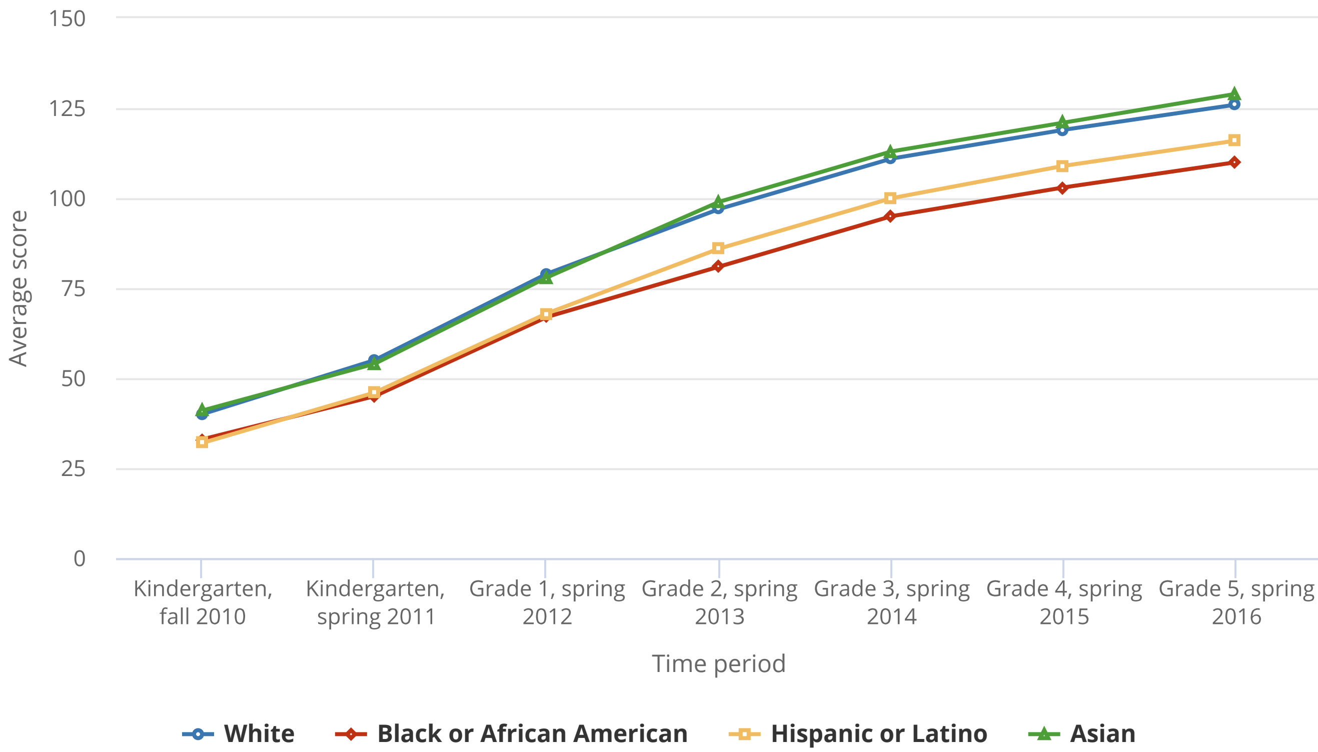
Note(s)
The possible range of scores for the mathematics assessment was 0–159. The fall kindergarten mathematics scores have a mean of 36.8 and a standard deviation of 11.23, and the spring grade 5 mathematics scores have a mean of 121.4 and a standard deviation of 15.90. Poverty status is based on 2010 U.S. Census poverty thresholds, which identify incomes determined to meet household needs, given family size. For example, in 2010, a family of two was below the poverty threshold if its income was lower than $14,220.

Source(s)
Mulligan GM, McCarroll JC, Flanagan KD, and McPhee C, *Findings From the Fifth-Grade Round of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011),* NCES 2019-130 (2019). See Table S1-1.

Science and Engineering Indicators

FIGURE 1-2

Average mathematics assessment test scores of children who were in kindergarten for the first time during the 2010–11 school year and in grade 5 during the 2015–16 school year, by race or ethnicity



Note(s)
The possible range of scores for the mathematics assessment was 0–159. The fall kindergarten mathematics scores have a mean of 36.8 and a standard deviation of 11.23, and the spring grade 5 mathematics scores have a mean of 121.4 and a standard deviation of 15.90. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s)
Mulligan GM, McCarroll JC, Flanagan KD, and McPhee C, *Findings From the Fifth-Grade Round of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011),* NCES 2019-130 (2019). See Table S1-1.

Science and Engineering Indicators

The patterns for science achievement gaps were largely similar to those of mathematics (**Table 1-1**). The science score gap between low- and high-poverty students was 7 points in kindergarten and 10 points in fifth grade (**Figure 1-3**). White students' science scores were higher than black and Hispanic students' scores in both kindergarten (by 6 points and 7 points, respectively) and fifth grade (by 11 points and 7 points, respectively), although the gap between Hispanic and white students did not change during that time, remaining at 7 points (**Figure 1-4**). Unlike patterns seen in mathematics, Asian students' science scores were lower than those of white students in kindergarten (32 versus 37); by fifth grade, however, Asian students had caught up to white students, with both groups scoring 78 points.

TABLE 1-1

Average mathematics and science assessment test scores of children who were in kindergarten for the first time during the 2010–11 school year and in grade 5 during the 2015–16 school year, by child and family characteristics

(Average score)

	Mathematics		Science	
Child and family characteristic	**Kindergarten, fall 2010**	**Grade 5, spring 2016**	**Kindergarten, spring 2011**	**Grade 5, spring 2016**
All children	36.8	121.4	34.4	74.7
Sex				
Male	37.1	122.4	34.5	75.2
Female	36.5	120.3	34.3	74.2
Race or ethnicity[a]				
White	39.5	125.9	37.1	77.9
Black or African American	32.7	110.3	31.1	66.9
Hispanic or Latino	32.0	115.7	30.1	70.6
Asian	41.0	128.7	32.1	77.8
Native Hawaiian or Other Pacific Islander	36.0	123.4	31.7	72.5
American Indian or Alaska Native	34.4	121.2	35.7	74.2
More than one race	38.6	122.5	36.8	77.3
Family poverty status in fall 2010[b]				
Income below the federal poverty level	31.5	113.5	30.2	68.9
Income at or above 200% of the federal poverty level	40.4	126.4	37.0	78.4

[a] Hispanic may be any race; race categories exclude Hispanic origin.

[b] Poverty status is based on 2010 U.S. Census poverty thresholds, which identify incomes determined to meet household needs, given family size. For example, in 2010, a family of two was below the poverty threshold if its income was lower than $14,220.

Note(s)

Mathematics was first assessed in kindergarten in fall 2010. Science was first assessed in kindergarten in spring 2011. The possible range of scores for the mathematics assessment was 0–159. The fall kindergarten mathematics scores have a mean of 36.8 and a standard deviation of 11.23, and the spring fifth-grade mathematics scores have a mean of 121.4 and a standard deviation of 15.90. The possible range of scores for the science assessment was 0–100. The spring kindergarten science scores have a mean of 34.4 and a standard deviation of 7.28, and the spring grade 5 science scores have a mean of 74.7 and a standard deviation of 11.76.

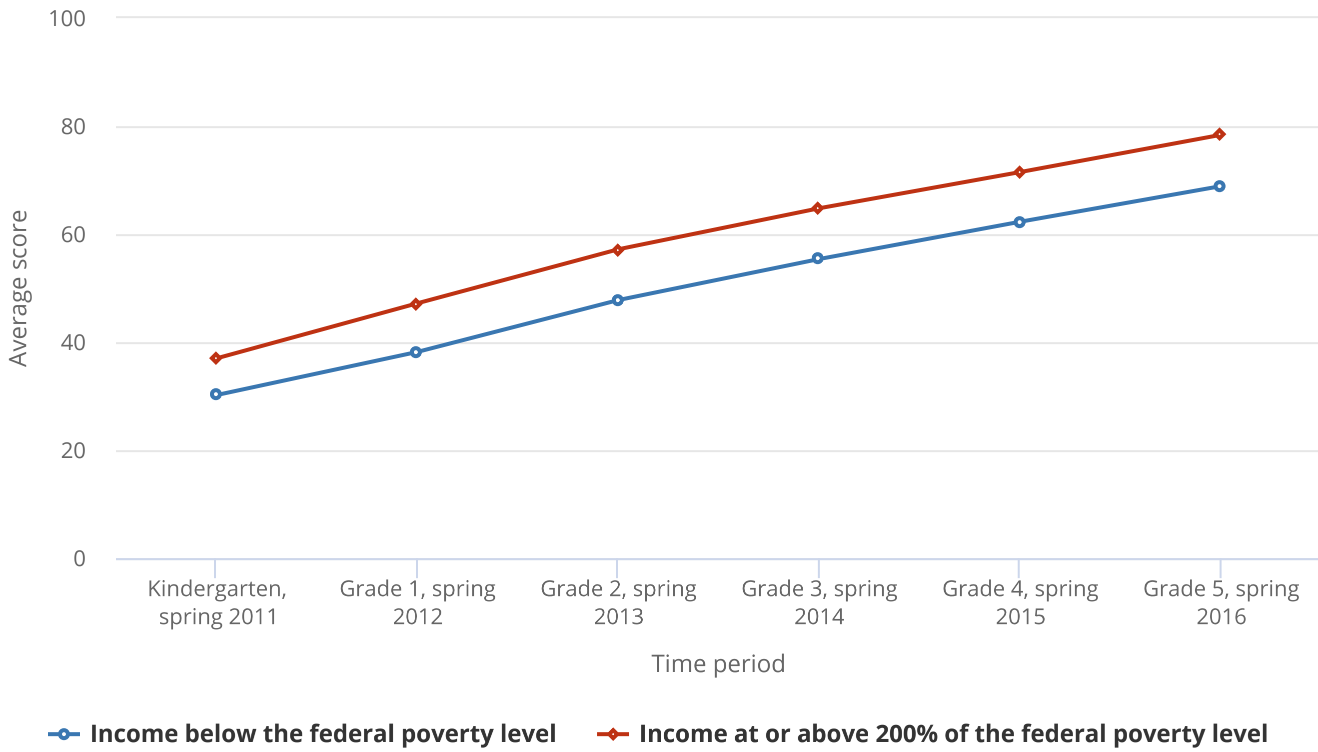
Source(s)

Mulligan GM, McCarroll JC, Flanagan KD, and McPhee C, *Findings From the Fifth-Grade Round of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011)*, NCES 2019-130 (2019). See Table S1-1.

Science and Engineering Indicators

FIGURE 1-3

Average science assessment test scores of children who were in kindergarten for the first time during the 2010–11 school year and in grade 5 during the 2015–16 school year, by family poverty level



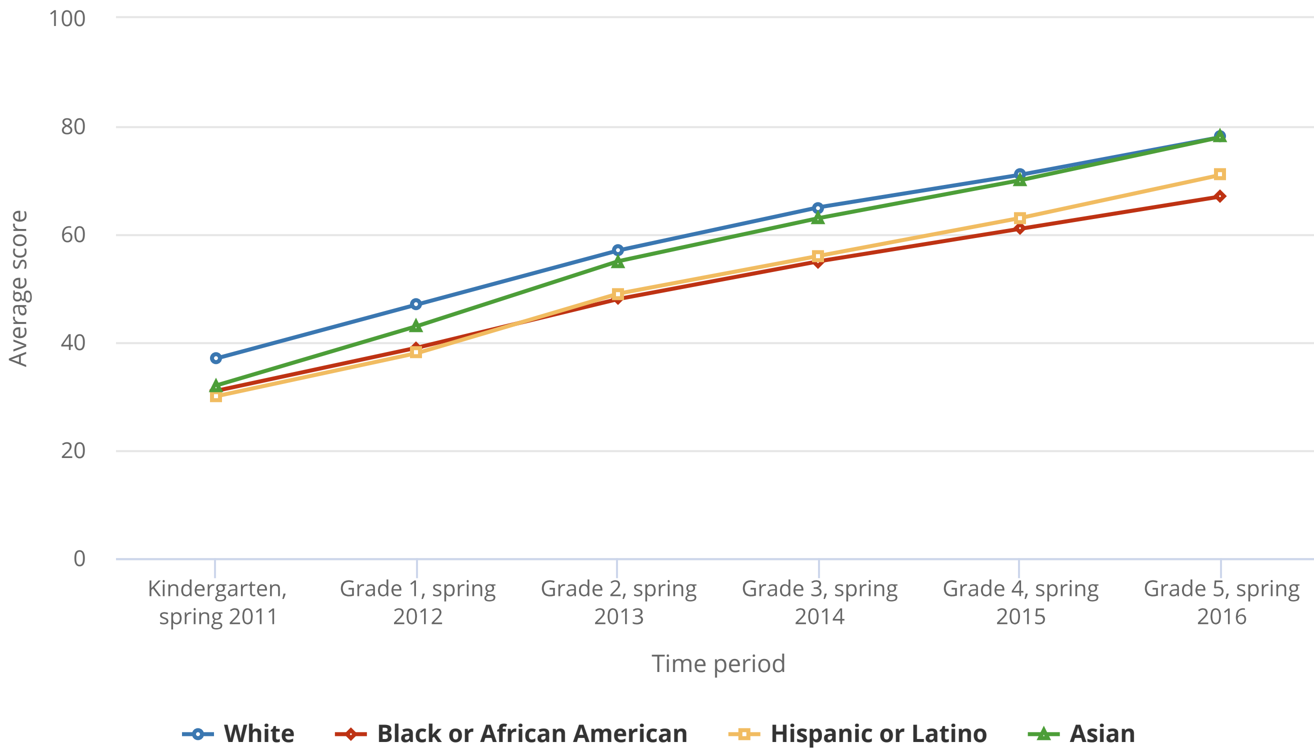
Note(s)
The possible range of scores for the science assessment was 0–100. The spring kindergarten science scores have a mean of 34.4 and a standard deviation of 7.28, and the spring grade 5 science scores have a mean of 74.7 and a standard deviation of 11.76. Poverty status is based on 2010 U.S. Census poverty thresholds, which identify incomes determined to meet household needs, given family size. For example, in 2010, a family of two was below the poverty threshold if its income was lower than $14,220.

Source(s)
Mulligan GM, McCarroll JC, Flanagan KD, and McPhee C, *Findings From the Fifth-Grade Round of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011)*, NCES 2019-130 (2019). See Table S1-1.

Science and Engineering Indicators

FIGURE 1-4

Average science assessment test scores of children who were in kindergarten for the first time during the 2010–11 school year and in grade 5 during the 2015–16 school year, by race or ethnicity



Note(s)
The possible range of scores for the science assessment was 0–100. The spring kindergarten science scores have a mean of 34.4 and a standard deviation of 7.28, and the spring grade 5 science scores have a mean of 74.7 and a standard deviation of 11.76. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s)
Mulligan GM, McCarroll JC, Flanagan KD, and McPhee C, *Findings From the Fifth-Grade Round of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011),* NCES 2019-130 (2019). See Table S1-2.

Science and Engineering Indicators

These mathematics and science test results come from the Early Childhood Longitudinal Study, Kindergarten Class of 2010-11 (ECLS-K:2011), a nationally representative, longitudinal study of children's development, early learning, and school progress. ECLS-K:2011 assessed mathematics and science knowledge and skills in a cohort of kindergarteners and followed them through fifth grade.[2] Data were first collected in fall 2010 from approximately 18,200 kindergarten students who were followed and tested each year through spring 2016. Results are reported as scale scores, which are used for comparisons among demographic groups and for capturing growth over time. Students' mathematics and science assessment results cannot be compared with each other because scales are developed independently for each academic subject.

ECLS-K:2011 used 2010 U.S. Census poverty thresholds to identify students' SES. Low-SES students are those whose families have incomes below the federal poverty level, and high-SES students are those whose families have incomes at or above 200% of the federal poverty level. The most recent available ECLS-K:2011 data revealed that fifth graders who were from high-SES families in kindergarten scored higher than students from lower-SES families by approximately 13 points in mathematics (126 versus 114) and approximately 10 points in science (78 versus 69) (**Table 1-1**).[3] Significant discrepancies were also seen by race or ethnicity and sex. White fifth grade students had an average score of 126 on the mathematics assessment, compared with scores of 129 for Asian students, 110 for black students, and 116 for Hispanic students. Fifth grade male students' scores were slightly higher than female students' scores in mathematics (122 versus 120). There was no statistical difference between male and female students' fifth grade scores in science.

National Trends in K–12 Student Achievement

Patterns of student achievement in grade 8 largely mirror those in kindergarten and fifth grade, based on the demographic characteristics discussed in this report. This section focuses on grade 8 results, which in turn are similar to those for grade 12 (results for grades 4, 8, and 12 can be seen in Table S1-3). This section presents estimates from the National Assessment of Educational Progress (NAEP), the largest nationally representative and continuing assessment of what America's students know and can do in various subject areas. After examining eighth grade performance in 2017 and over time, the section provides a brief summary of student performance in science, last assessed in 2015, and then discusses the results from the 2018 technology and engineering assessment.

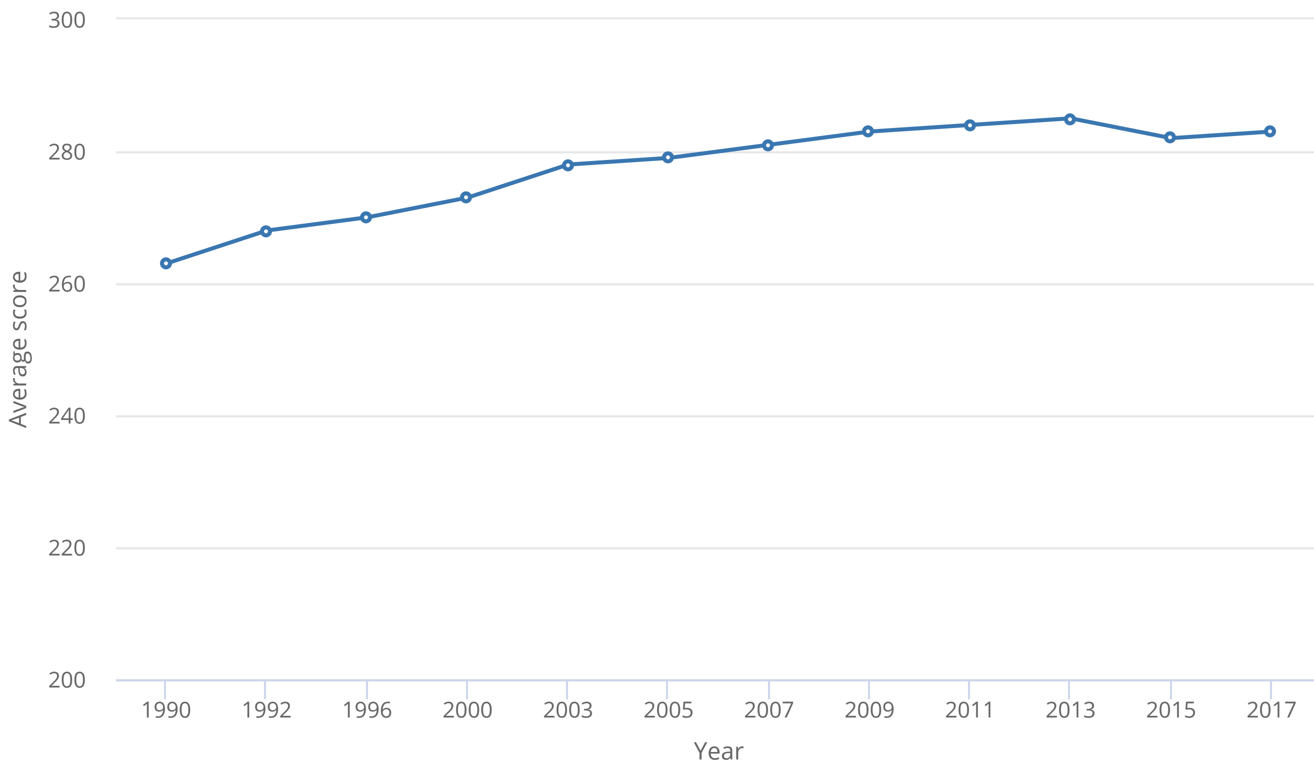
NAEP reports student performance in two ways: scale scores, and student achievement levels.[4] Regarding scale scores, NAEP states that "a statistically significant scale score that is higher or lower in comparison to an earlier assessment year is reliable evidence that student performance has changed" (NAEP 2018). Although mathematics was assessed for both fourth and eighth graders in 2017, this section focuses on eighth graders' results because the patterns of performance are similar for both grade levels. Results for grades 4, 8, and 12 can be seen in Table S1-3. The *Science and Engineering Indicators* **State Indicators data tool** provides NAEP performance and proficiency data for students in each state.

Mathematics Performance of Grade 8 Students: Average Scores

Average mathematics scores for eighth graders have trended upward since 1990, but improvement has slowed in the past decade (**Figure 1-5**). Before 2007, the average score increased 16 points, from 263 points in 1990 to 279 points in 2005. The average NAEP mathematics score for eighth graders was 281 in 2007 and 283 in 2017. The 2017 score represents a slight decline from the 2013 score of 285 (**Table 1-2**).[5]

FIGURE 1-5

Average NAEP mathematics scores of students in grade 8: 1990–2017



NAEP = National Assessment of Educational Progress.

Note(s)
The scale for NAEP mathematics assessment scores is 0–500 for grade 8.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 1990–2017 NAEP mathematics assessments, National Center for Education Statistics, Department of Education. See Table S1-3.

Science and Engineering Indicators

TABLE 1-2

Average scores of students in grade 8 on the NAEP mathematics assessment, by student characteristics: 1990–2017

(Average score)

Student characteristic	1990	1992	1996	2000	2003	2005	2007	2009	2011	2013	2015	2017
All students in grade 8	263	268	270	273	278	279	281	283	284	285	282	283
Sex												
Male	263	268	271	274	278	280	282	284	284	285	282	283
Female	262	269	269	272	277	278	280	282	283	284	282	282
Race or ethnicity[a]												
White	270	277	281	284	288	289	291	293	293	294	292	293
Black or African American	237	237	240	244	252	255	260	261	262	263	260	260
Hispanic or Latino[b]	246	249	251	253	259	262	265	266	270	272	270	269
Asian or Pacific Islander	275	290	s	288	291	295	297	301	303	306	306	310
American Indian or Alaska Native	s	s	s	259	263	264	264	266	265	269	267	267
More than one race	s	260	s	270	280	280	285	286	288	288	285	287

TABLE 1-2

Average scores of students in grade 8 on the NAEP mathematics assessment, by student characteristics: 1990–2017

(Average score)

Student characteristic	1990	1992	1996	2000	2003	2005	2007	2009	2011	2013	2015	2017
Parents' highest education[c]												
Did not finish high school	242	249	250	253	257	259	263	265	265	267	265	265
Graduated from high school	255	257	260	261	267	267	270	270	271	270	268	267
Some education after high school	267	271	277	277	280	280	283	284	285	285	282	281
Graduated from college	274	281	281	286	288	290	292	295	295	296	294	294
Unknown	241	252	252	254	259	260	263	264	265	266	263	264
Socioeconomic status[d]												
Eligible for free or reduced-price lunch	NA	NA	250	253	259	262	265	266	269	270	268	267
Not eligible for free or reduced-price lunch	NA	NA	277	283	287	288	291	294	296	297	296	296
Student disability status[e]												
Has a disability	s	s	231	230	242	245	246	249	250	249	247	247
Does not have a disability	s	s	273	276	282	283	285	287	288	289	287	288
English language learner status[e]												
English language learner	s	s	226	234	242	244	246	243	244	246	246	246
Not English language learner	s	s	272	274	279	281	283	285	286	287	284	285
Percentiles[f]												
10th percentile	215	221	221	223	230	231	235	236	237	237	235	233
25th percentile	239	243	245	249	254	255	258	259	260	261	258	256
50th percentile	264	269	273	275	279	280	283	284	285	286	283	283
75th percentile	288	294	297	300	303	304	306	308	309	310	308	310
90th percentile	307	315	316	320	323	324	327	329	329	331	329	333

NA = not available; s = suppressed for reasons of confidentiality and/or reliability.

NAEP = National Assessment of Educational Progress.

[a] Other racial and ethnic groups are included in the rows for All students in grade 8 but are not shown separately in the table.

[b] Hispanic may be any race; race categories exclude Hispanic origin.

[c] Parents' highest level of education is defined by the highest level reported by eighth graders and twelfth graders for either parent. Fourth graders were not asked to indicate their parents' highest level of education because their responses in previous studies were highly variable, and a large percentage of them chose the "I don't know" option.

[d] NAEP uses eligibility for the federal National School Lunch Program (NSLP) as a measure of socioeconomic status. NSLP is a federally assisted meal program that provides low-cost or free lunches to eligible students. It is often referred to as the free or reduced-price lunch program. Information on students' eligibility for free or reduced-price lunch was first collected in 1996.

[e] From 1996 on, students with a disability and English language learners were allowed to use testing accommodations (e.g., extended time, one-on-one testing, bilingual dictionary). More information about testing accommodation is available at **https://nces.ed.gov/nationsreportcard/about/inclusion.asp**.

[f] A percentile is a score location below which a specified percentage of the population falls.

Note(s)

The scale for NAEP mathematics assessment scores is 0–500 for grade 8. From 1996 on, data shown here are for students allowed to use testing accommodations.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 1990–2017 NAEP mathematics assessments, National Center for Education Statistics, Department of Education.

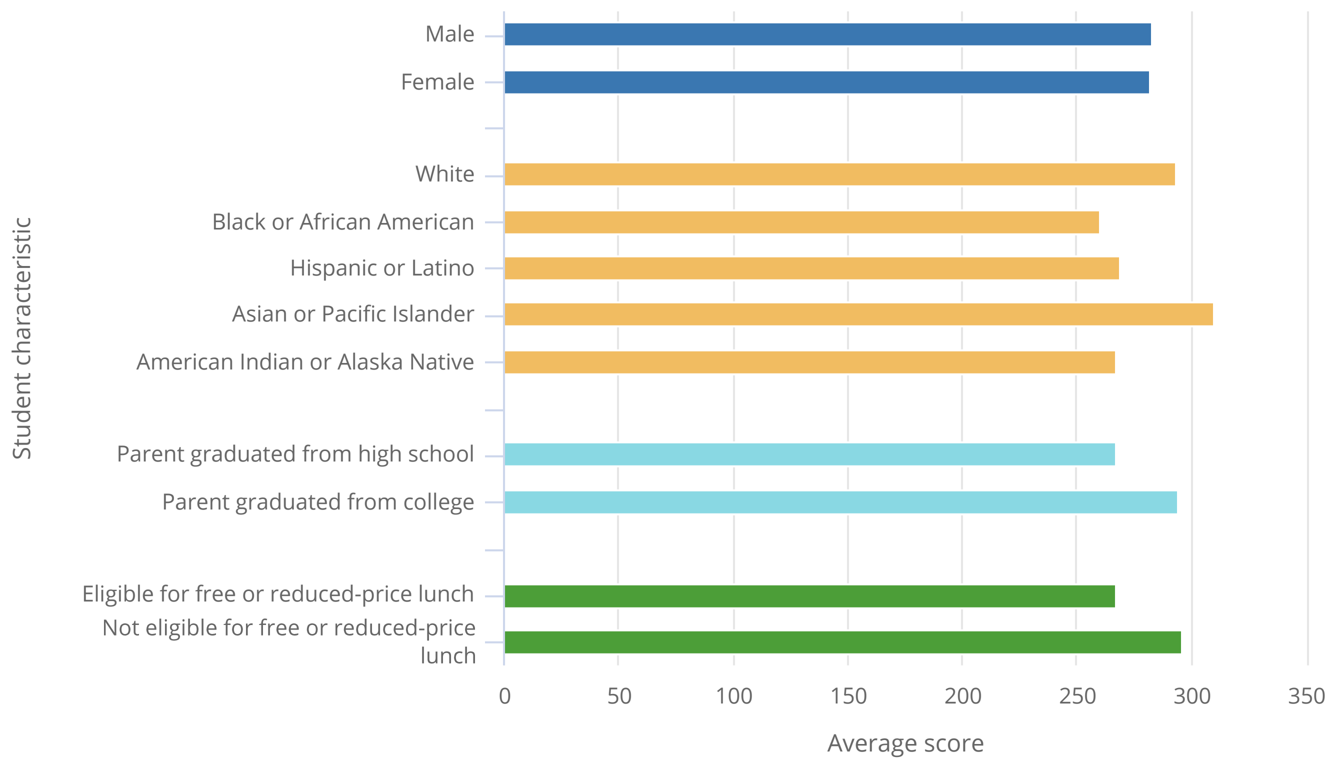
Science and Engineering Indicators

NAEP mathematics scores in 2017 varied widely by student demographic characteristics, including race or ethnicity and SES, as indicated by a student's eligibility for the National School Lunch Program (NSLP).[6] In 2017, low-SES eighth graders (those eligible for free or reduced-price lunch) scored below their high-SES peers by 29 points (267 versus 296) (**Figure 1-6**). Since 1996, the gap between low- and high-SES eighth graders' scores has consistently been from 26 to 30 points (**Figure 1-7**).

Scores also varied by race or ethnicity and sex. Among groups defined by race or ethnicity, Asian or Pacific Islander students achieved the highest average score, 310 points, in 2017 (**Figure 1-6**). In comparison, white students scored an average of 293 points, higher than black students' average of 260 points and Hispanic students' average of 269 points. Male students slightly outscored female students in 2017, with 283 points for male students versus 282 points for female students. (Although small, the difference is statistically significant.)

FIGURE 1-6

Average scores of students in grade 8 on the NAEP mathematics assessment, by student characteristics: 2017



NAEP = National Assessment of Educational Progress.

Note(s)
The scale for NAEP mathematics assessment scores is 0–500 for grade 8. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2017 NAEP mathematics assessment, National Center for Education Statistics, Department of Education. See Table S1-3.

Science and Engineering Indicators

FIGURE 1-7

Average NAEP mathematics scores of students in grade 8, by eligibility for National School Lunch Program: 1996–2017

NAEP = National Assessment of Educational Progress.

Note(s)
NAEP uses eligibility for the federal National School Lunch Program (NSLP) as a measure of socioeconomic status. NSLP is a federally assisted meal program that provides low-cost or free lunches to eligible students. It is sometimes referred to as the free or reduced-price lunch program. Information on students' eligibility for free or reduced-price lunch was first collected in 1996. The scale for NAEP mathematics assessment scores is 0–500 for grade 8.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 1996–2017 NAEP mathematics assessments, National Center for Education Statistics, Department of Education.

Science and Engineering Indicators

Mathematics Performance of Grade 8 Students: Achievement Levels

The National Assessment Governing Board (NAGB), an independent board that sets policy for NAEP, has developed three achievement levels, which are determined by score ranges that indicate students' achievement relative to expected achievement for each grade level. These score levels are: *basic*—partial mastery of knowledge and skills; *proficient*—solid academic performance at grade level; and *advanced*—superior academic performance. NAGB suggests that these levels are subject to refinement, and the results should be interpreted with caution.[7]

In 2017, about one-third (34%) of eighth graders scored at or above the proficient level in mathematics (Table S1-4), a slight but statistically significant decrease since 2013 (when 36% of students scored at that level). Demographic differences in students' proficiency levels are similar to those noted in the discussion of scale scores. For example, 48% of high-SES eighth graders scored at or above proficiency, compared with 18% of low-SES students. In addition, 62% of Asian or Pacific Islander students scored at or above proficient, compared with 44% of white students, 13% of black students, and 20% of Hispanic students. Finally, 35% of male students scored at or above proficient, compared with 33% of female students.

Science Performance of Grade 8 Students: Average Scores

Science was most recently assessed in 2015; thus, updated data are not available for this edition of *Science and Engineering Indicators*.[8] *Indicators 2018* presents a detailed discussion of 2015 NAEP science achievement results (NSB ***Indicators 2018***: **National Trends in K–12 Student Achievement**).The average score for eighth grade students was about 4 points higher in 2015, compared with the previous science assessment in 2009. Socioeconomic and demographic patterns seen in grade 8 NAEP science performance in 2015 are largely similar to the patterns seen in 2017 mathematics performance.

Technology and Engineering Performance of Grade 8 Students

NAEP administered the first Technology and Engineering Literacy (TEL) assessment for eighth graders in 2014 and again in 2018. Eighth grade students scored 2 points higher in TEL overall in 2018 compared with 2014 (152 versus 150) (**Table 1-3**).[9] Female students scored higher than male students by 5 points in 2018 (155 versus 150) and by 2 points in 2014 (151 versus 149[10]). As in 2014, white and Asian students scored higher than black and Hispanic students in 2018, with scores of 169 for Asian students, 163 for white students, 139 for Hispanic students, and 132 for black students. The TEL score gap between students eligible for free or reduced-price lunch and those not eligible did not change significantly from 2014 (28 points) to 2018 (26 points). Patterns for NAEP TEL student achievement levels (percentage scoring proficient or above) were similar to those for average scores (Table S1-5).

TABLE 1-3

Average scores of students in grade 8 on the NAEP technology and engineering literacy assessment, by student characteristics: 2014 and 2018

(Average score)

Student characteristic	2014	2018
All students in grade 8	150	152
Sex		
Male	149	150
Female	151	155
Race or ethnicity[a]		
White	160	163
Black or African American	128	132
Hispanic or Latino[b]	138	139
Asian or Pacific Islander	159	169
American Indian or Alaska Native	146	133
More than one race	154	157
Socioeconomic status[c]		
Eligible for free or reduced-price lunch	135	138
Not eligible for free or reduced-price lunch	163	164

NAEP = National Assessment of Educational Progress.

[a] Other racial and ethnic groups are included but are not shown separately.

[b] Hispanic may be any race; race categories exclude Hispanic origin.

[c] NAEP uses eligibility for the federal National School Lunch Program (NSLP) as a measure of socioeconomic status. NSLP is a federally assisted meal program that provides low-cost or free lunches to eligible students. It is sometimes referred to as the free or reduced-price lunch program.

Note(s)

The scale for NAEP technology and engineering literacy assessment scores is 0–300.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2014 and 2018 NAEP Technology and Engineering Literacy assessment, National Center for Education Statistics, Department of Education.

Science and Engineering Indicators

NAEP TEL also asked students about technology and engineering coursetaking in grade 8. In 2018, 57% of students at grade 8 reported that they had taken or were taking at least one of the following technology- or engineering-related classes: industrial technology; engineering; classes that involve learning to use, program, or build computers; or any other type of technology-related class.[11] The percentage of students who reported taking a technology- or engineering-related class in 2018 was 5 percentage points higher compared to 2014.

Students who reported taking at least one technology- or engineering-related class in 2018 had a higher TEL score on average than those who reported not taking any technology- or engineering-related classes.

International Comparisons of Mathematics and Science Performance

Governments view their population's STEM education levels and skills as national resources and use them to assess their status in a broader international context. In the United States, policymakers and educators aim to produce more high-achieving STEM students to ensure that the United States has the knowledge and skills needed to innovate in a rapidly changing world economy and remain a world leader in STEM fields (Chatterji 2018; Committee on STEM Education 2018). The Trends in International Mathematics and Science Study (TIMSS) provides data on the mathematics and science achievement of U.S. students compared to that of students in other advanced economies, as defined by the International Monetary Fund (IMF) (IMF 2018). TIMSS, conducted every 4 years beginning in 1995 and most recently in 2015, is sponsored by the International Association for the Evaluation of Educational Achievement (IEA), an international nonprofit organization consisting of research institutions and government research agencies from member countries and economies. The IEA member countries include countries—defined as complete, independent political entities—and non-national entities (e.g., Hong Kong). The term *education systems* is used here to acknowledge that not all TIMSS participants are countries, and this should be kept in mind when comparing U.S. students' performance with that of their peers in other education systems. Also, the United States may be larger or more diverse than other participating education systems (e.g., Singapore, Japan), which may affect its rankings.

Another international assessment, the Program for International Student Assessment (PISA), measures the performance of 15-year-old students in science and mathematics literacy every 3 years. *Indicators 2018* discusses the 2015 PISA results; new data were not available in time for the current *Indicators* report (NSB ***Indicators 2018***: **International Comparisons of Mathematics and Science Performance**).

Average Scores

Among 19 advanced economies participating in TIMSS for grade 8 in 2015,[12] the United States placed ninth in both mathematics and science, when examining average scores. In 2015, the average score for U.S. eighth graders was 518 for mathematics (**Table 1-4**) and 530 for science (**Table 1-5**). Singapore was the highest-scoring country in both mathematics and science, with scores of 621 and 597, respectively.

TABLE 1-4

Average TIMSS mathematics scores of students in grade 8 and percentage of students in the highest and lowest percentiles among participating developed economies, by education system: 2015

(Average score and percent)

Education system	Mean score		Percentage of student scores							
			Below 5th percentile		Below 10th percentile		At or above 90th percentile		At or above 95th percentile	
Participating developed economy, total	**534**	*	**5.0**		**10.0**		**10.0**		**5.0**	
Singapore	621	*	0.7	*	1.9	*	40.7	*	23.2	*
Taiwan	599	*	2.7	*	5.1	*	32.5	*	19.4	*
South Korea	606	*	0.9	*	2.1	*	30.7	*	17.8	*
Japan	586	*	1.7	*	3.7	*	23.5	*	13.6	*
Hong Kong	594	*	1.5	*	3.1	*	22.7	*	10.8	*
Russia	538	*	3.6	*	8.3	*	7.8	*	3.2	
Israel	511		12.9	*	19.7	*	7.1	*	2.8	
United States	**518**		**6.5**		**12.5**		**4.9**		**1.8**	
England	518		4.9		11.5		4.6		1.3	
Australia	505	*	8.4		15.5		3.3		1.1	
New Zealand	493	*	12.1	*	20.5	*	3.0	*	1.0	
Canada	527	*	3.0	*	7.0	*	2.8	*	0.7	*
Ireland	523		4.6		8.9	*	2.7	*	0.7	*
Lithuania	511		6.3		12.5		2.4	*	0.7	*
Slovenia	516		3.5	*	8.8	*	2.2	*	0.6	*
Norway	512		4.5	*	9.9	*	1.7	*	0.5	*
Malta	494	*	13.3	*	20.2	*	1.6	*	0.3	*
Italy	494	*	8.2		16.0	*	1.1	*	0.2	*
Sweden	501	*	6.5		13.7		1.0	*	0.2	*

* = estimate is significantly different from U.S. estimate at the 0.05 level of statistical significance.

TIMSS = Trends in International Mathematics and Science Study.

Note(s)

Education systems are listed in descending order by the percentage of students scoring at or above the 90th percentile. TIMSS participants include both countries, which are complete, independent political entities, and non-national entities (e.g., Hong Kong). Developed economies are based on the International Monetary Fund (IMF) designation of advanced economies (Table A, pg. 132 in *World Economic Outlook: Challenges to Steady Growth*, 2018). IMF classifies Russia as a developing economy, but it is included in this analysis because it is a large economy with high levels of student achievement.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2015 TIMSS; Mullis IVS, Martin MO, Foy P, and Hooper M, *TIMSS 2015 International Results in Mathematics* (2016).

Science and Engineering Indicators

TABLE 1-5

Average TIMSS science scores of students in grade 8 and percentage of students in highest and lowest percentiles among participating developed economies, by education system: 2015

(Average score and percent)

Education system	Mean score		Percentage of student scores							
			Below 5th percentile		Below 10th percentile		At or above 90th percentile		At or above 95th percentile	
Participating developed economy, total	**532**		**5.0**		**10.0**		**10.0**		**5.0**	

TABLE 1-5

Average TIMSS science scores of students in grade 8 and percentage of students in highest and lowest percentiles among participating developed economies, by education system: 2015

(Average score and percent)

Education system	Mean score		Percentage of student scores							
			Below 5th percentile		Below 10th percentile		At or above 90th percentile		At or above 95th percentile	
Singapore	597	*	2.4	*	4.9	*	34.0	*	21.5	*
Taiwan	569	*	3.3	*	6.3	*	20.2	*	10.9	*
Japan	571	*	1.6	*	3.8	*	17.9	*	9.5	*
South Korea	556	*	2.4	*	5.8	*	13.6	*	7.4	*
Slovenia	551	*	2.7	*	6.2	*	12.2	*	6.2	*
Russia	544	*	3.3	*	7.5	*	10.1		5.2	
England	537		4.6		10.2		10.0		5.1	
Israel	507	*	15.2	*	22.3	*	8.8		4.6	
United States	**530**		**6.0**		**11.6**		**8.0**		**3.7**	
Hong Kong	546	*	3.3	*	6.2	*	7.7		3.4	
Sweden	522		7.9		13.3		7.0		3.0	
New Zealand	513	*	10.6	*	18.2	*	7.0		3.5	
Ireland	530		5.8		10.8		6.8		3.1	
Lithuania	519		6.4		13.2		5.0	*	2.2	*
Malta	481	*	20.4	*	28.8	*	4.9	*	2.4	*
Australia	512	*	8.7	*	15.6	*	4.9	*	2.1	*
Canada	526		3.8	*	8.8	*	4.2	*	1.6	*
Norway	509	*	7.9		15.3	*	3.8	*	1.6	*
Italy	499	*	9.7	*	18.2	*	2.5	*	0.9	*

* = estimate is significantly different from U.S. estimate at the 0.05 level of statistical significance.

TIMSS = Trends in International Mathematics and Science Study.

Note(s)

Education systems are listed in descending order by the percentage of students scoring at or above the 90th percentile. TIMSS participants include both countries, which are complete, independent political entities, and non-national entities (e.g., Hong Kong). Developed economies are based on the International Monetary Fund (IMF) designation of advanced economies (Table A, pg. 132 in *World Economic Outlook: Challenges to Steady Growth*, 2018). IMF classifies Russia as a developing economy, but it is included in this analysis because it is a large economy with high levels of student achievement.

Source(s)

National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2015 TIMSS; Martin MO, Mullis IVS, Foy P, and Hooper M, *TIMSS 2015 International Results in Science* (2016).

Science and Engineering Indicators

For a detailed examination of U.S. average scores and demographic differences among U.S. students from TIMSS 2015, see NSB ***Indicators 2018***: **Mathematics Performance of U.S. Students in Grades 4 and 8 on TIMSS**.

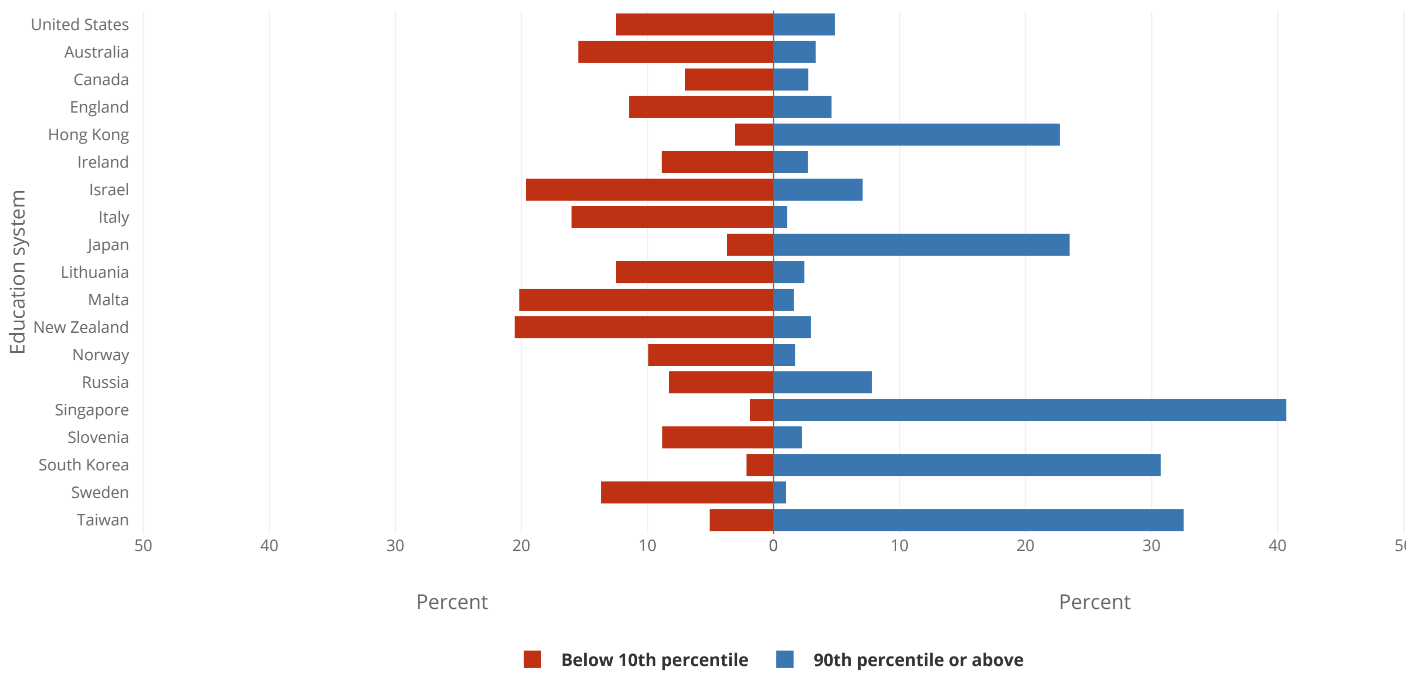
Comparison of High and Low Percentile Groupings

In addition to providing the opportunity to rank advanced economies by average scores, TIMSS data also allow for analysis of the distribution of scores within and across countries. Large percentages of students scoring at the high end of a distribution (e.g., scores at or above the 90th percentile) indicate the presence of higher-achieving students in that education system, whereas large percentages at the low end of a distribution (e.g., scores below the 10th percentile) indicate the presence of lower-achieving students.

Using a database of only student scores in the 19 advanced economies that participated in TIMSS 2015, this report estimates high (90th and 95th) and low (5th and 10th) percentile cut scores across all students in these specific education systems (referred to as the aggregate high or low percentile scores); then, the report examines the percentage of students in each of these advanced economies who scored above the aggregate cut scores for the higher-achievement group (i.e., above the aggregate 95th and 90th percentiles) and lower achievement group (i.e., below the aggregate 5th and 10th percentiles). For example, 41% of Singapore's student scores in mathematics were in the aggregate 90th percentile group, whereas only 5% of the U.S. student scores were in that group (**Figure 1-8**). Other education systems with relatively large percentages of students scoring at or above the aggregate 90th percentile include Taiwan (33%), South Korea (31%), Japan (23%), and Hong Kong (23%).

FIGURE 1-8

Students in grade 8 with TIMSS mathematics test scores in the highest and lowest percentiles among participating developed economies, by education system: 2015



TIMSS = Trends in International Mathematics and Science Study.

Note(s)
TIMSS participants include both countries, which are complete, independent political entities, and non-national entities (e.g., Hong Kong). Developed economies are based on the International Monetary Fund (IMF) designation of advanced economies (Table A, pg. 132 in *World Economic Outlook: Challenges to Steady Growth*, 2018). IMF classifies Russia as a developing economy, but it is included here because it is a large economy with high levels of student achievement.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2015 TIMSS; Mullis IVS, Martin MO, Foy P, and Hooper M, *TIMSS 2015 International Results in Mathematics* (2016).

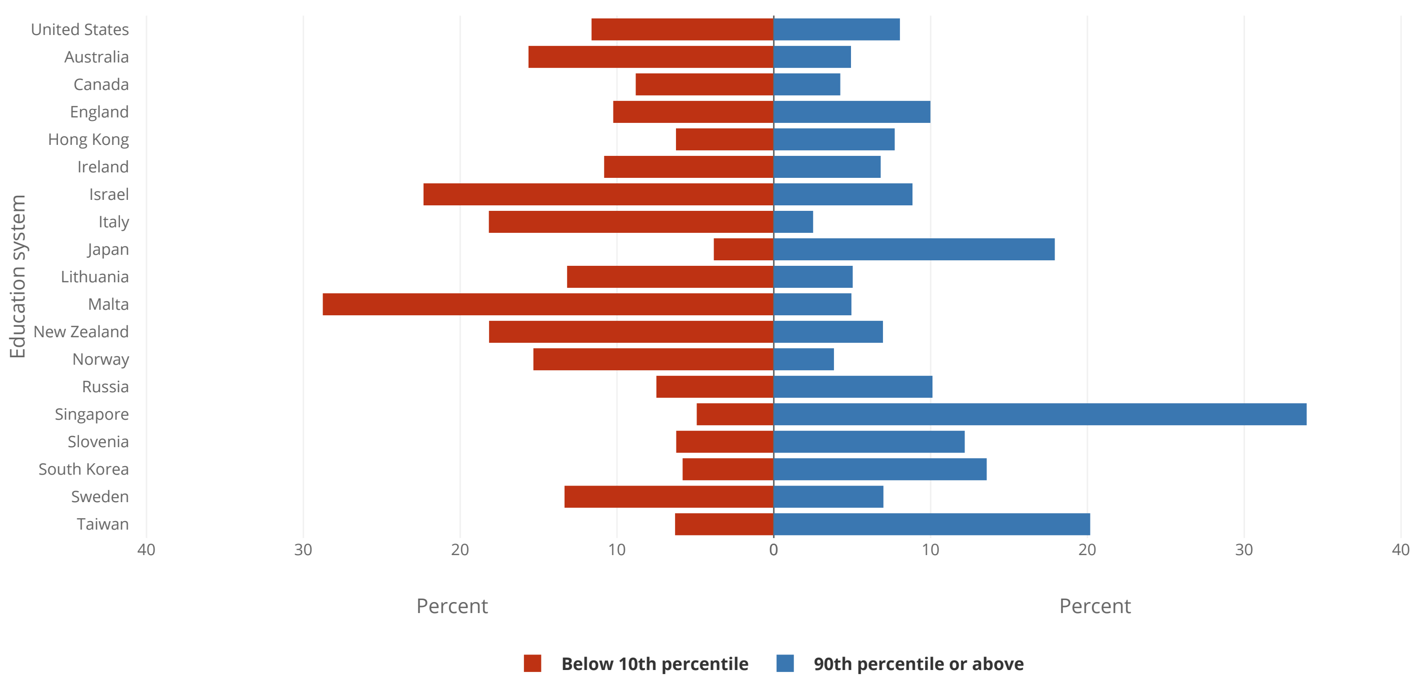
Science and Engineering Indicators

Singapore, Taiwan, South Korea, Japan, and Hong Kong far outpaced the rest of the advanced economies in producing student scores at or above the aggregate 90th percentile in mathematics. The next closest are Russia at 8% and Israel at 7%. Overall, the United States placed eighth in terms of the percentage of student scores at or above the aggregate 90th percentile in mathematics. Education systems with the lowest percentage of student scores at this level include Italy and Sweden, with just 1% of their student scores in that range. In some cases, the United States achieved lower average scores than other advanced economies but produced a higher percentage of scores at or above the aggregate 90th percentile. For example, Canada had a higher average mathematics score on TIMSS than the United States (527 versus 518) but a lower percentage of student scores at or above the aggregate 90th percentile (3% versus 5%) (**Table 1-4**).

Similarly, in science, the United States ranked in the middle (9 out of 19) when examining the percentages of student scores in advanced economies at or above the 90th percentile. In the United States, 8% of students scored at or above the 90th percentile in science (**Figure 1-9**), compared with 34% of students in Singapore, 20% in Taiwan, 18% in Japan, and 14% in South Korea. Italy (3%) and Norway (4%) produced the lowest percentages of student scores at or above the 90th percentile. Hong Kong had a higher mean science score than the United States (546 versus 530), but 8% of both education systems' students scored at or above the 90th percentile (**Table 1-5**).

FIGURE 1-9

Students in grade 8 with TIMSS science scores in the highest and lowest percentiles among participating developed economies, by education system: 2015



TIMSS = Trends in International Mathematics and Science Study.

Note(s)
TIMSS participants include both countries, which are complete, independent political entities, and non-national entities (e.g., Hong Kong). Developed economies are based on the International Monetary Fund (IMF) designation of advanced economies (Table A, pg. 132 in *World Economic Outlook: Challenges to Steady Growth*, 2018.). IMF classifies Russia as a developing economy, but it is included here because it is a large economy with high levels of student achievement.

Source(s)
National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of the 2015 TIMSS; Martin MO, Mullis IVS, Foy P, and Hooper M, *TIMSS 2015 International Results in Science* (2016).

Science and Engineering Indicators

Looking at percentages of student scores in the lowest 10th percentile shows which advanced economies have relatively larger percentages of student scores at the low end of mathematics achievement. In the United States, 13% of students scored at or below the aggregate 10th percentile, compared with just 2% of students in Singapore and South Korea (**Figure 1-8**). New Zealand, Malta, and Israel produced the largest percentage of student scores below the aggregate 10th percentile, approximately 20%. Again, examination of percentiles yields information not available from examining average scores alone. The average scores for the United States and Israel, for example, were not significantly different, but Israel produced a higher percentage of student scores below the 10th percentile than the United States did (20% and 13%, respectively).

Science results for the United States were similar to those observed in mathematics for student scores below the 10th percentile: 12% of U.S. students scored below the 10th percentile, compared with 4% in Japan and 5% in Singapore (**Figure 1-9**). Israel and Malta produced the largest percentage of student scores at the low end of science achievement, with 22% and 29%, respectively, of their student scores below the 10th percentile.

Teachers of Mathematics

Teachers play an essential role in student learning, and it is important that all students have access to qualified and effective teachers (Darling-Hammond 2000). Such factors as teacher certification, years of teaching experience, and a degree in the subject taught vary widely across student demographic groups, and highly qualified teachers are less prevalent at schools with high-minority and high-poverty populations (Imazeki and Goe 2009; Rahman et al. 2017; Rice 2013). This section uses data from NAEP 2015 to report on the qualifications and experience of eighth grade mathematics teachers in U.S. public schools. Teachers of students participating in NAEP assessments responded to survey questions about their state certification, years of experience, and field of postsecondary education.[13] A recent NCES report, *Certification Status and Experience of U.S. Public School Teachers* (Rahman et al. 2017), presents the data summarized herein.

In 2015, 90% of eighth grade students in public schools had a mathematics teacher with state certification (**Table 1-6**). Eighth grade students at high-minority-enrollment schools were less likely to be taught mathematics by certified mathematics teachers. In schools with high percentages of minority students (i.e., with a minority enrollment of 75% or more), 84% of mathematics teachers were certified in mathematics, compared with 92% of teachers at schools with less than 75% minority enrollment. The percentage of certified mathematics teachers also varied by eligibility for NSLP, with those students less likely to have a certified mathematics teacher (88%) compared with their non-eligible peers (92%).

TABLE 1-6

Public school students in grade 8 who have teachers with state certification, more than 5 years of teaching experience, or a degree in mathematics, by student and school characteristics: 2015

(Percent)

Student and school characteristics	State teacher certification	More than 5 years teaching experience	Degree in mathematics
All students	89.6	75.3	82.4
School minority enrollment			
Less than 75%	91.7	77.5	83.7
75% or more	83.5	69.0	78.7
National School Lunch Program student status[a]			
Not eligible	91.7	78.4	85.0
Eligible	87.8	72.5	80.3

[a] NAEP uses eligibility for the federal National School Lunch Program as a measure of socioeconomic status. The program is a federally assisted meal program that provides low-cost or free lunches to eligible students. It is often referred to as the free or reduced-price lunch program.

Note(s)

State teacher certification indicates that the teacher holds a regular or standard teaching certificate that is valid in the state in which he or she is currently teaching. Years of teaching experience include all years worked as an elementary or secondary school teacher. A degree in mathematics indicates that the teacher has an undergraduate or graduate major or minor in mathematics.

Source(s)

Rahman T, Fox MA, Ikoma S, and Gray L, *Certification Status and Experience of U.S. Public School Teachers: Variations Across Student Subgroups*, NCES 2017-056 (2017).

Science and Engineering Indicators

About 75% of all eighth graders had a mathematics teacher with more than 5 years of teaching experience in 2015, ranging from 69% of students in schools with high-minority enrollment to 78% of students in schools with low-minority enrollment. The percentage of the NSLP-eligible eighth graders who had a mathematics teacher with more than 5 years of teaching experience (73%) was lower than the percentage of non-eligible students (78%). In 2015, about 82% of all eighth graders had a teacher with a degree in mathematics, ranging from 79% of students at high-minority-enrollment schools and 84% of students at low-minority-enrollment schools.

The **State Indicators data tool** provides additional information about teachers at the state level.

Post–High School Transitions

The U.S. educational system strives to prepare every high school graduate for a career or for college, although more progress needs to be made in ensuring that students are ready for the demands of college or the workforce (Achieve Inc. 2016; ACT 2018; NCEE 2013; Pellegrino and Hilton 2012). This section begins with a discussion of the transition to postsecondary education and then provides information on those individuals who transition directly from high school into the workforce, specifically the STW.

Transition to Postsecondary Education

Over the past decades, U.S. high school graduation rates have been rising steadily, reaching 84% in 2016 (McFarland et al. 2018). Although high school completion represents a major milestone for adolescents, most of today's fastest-growing, well-paying jobs—especially those in STEM fields—require at least some postsecondary education (Carnevale et al. 2018; Hinojosa et al. 2016; Hout 2012). In addition, students who enter postsecondary education immediately after high school are more likely to persist and attain a degree compared to students who delay their enrollment (Bozick and DeLuca 2005). Given the importance of postsecondary education and the higher completion rates for those who enter immediately after high school, this section focuses on indicators related to U.S. students' transition from high school to postsecondary education. It presents information about AP coursetaking, in which students can earn college credits for courses taken in high school. It then presents national data on trends in immediate college enrollment after high school and examines the relationship between high school mathematics and science preparation and the decision to major in STEM fields at the postsecondary level.

Participation in the Advanced Placement Program

The AP program is one of the largest and most well-known programs offering high school students the opportunity to take college-level courses. Other such opportunities include the International Baccalaureate (IB) program, which also offers college-level courses to high school students, and dual enrollment, in which students enroll in college courses while in high school. AP, IB, and dual enrollment programs all offer students the opportunity to take rigorous courses while in high school. Research has shown that rigorous high school coursework is associated with positive academic and postsecondary outcomes (Long, Conger, and Iatarola 2012; Warne et al. 2015). Specific data about STEM coursetaking in dual enrollment and IB programs are not currently available, so this section focuses on AP coursetaking.[14]

The AP program, administered by the College Board, offered college-level courses to high school students in 38 different subjects in 2018, including 12 courses in mathematics and science, although access to these courses varies by high school (GAO 2018). Students must earn a score of at least 3 or higher out of 5 on an AP exam to be eligible to earn college credits. Between 2007 and 2017, the number of U.S. public high school graduates who took at least one AP exam increased from 691,437 (24% of the students in the class of 2007) to 1,174,554 (38% of the students in the class of 2017); 23% of the students in the class of 2017 earned a score of 3 or higher (College Board 2018). Although the College Board has made progress in ensuring equal access to AP courses and exams, research shows that underrepresented minority students do not have equal access to these courses (Kolluri 2018). In addition, black students earn a 3 or higher on AP exams at lower rates than their white and Asian peers (College Board 2018). College Board research shows that black students represented 14% of the students in the class of 2017 but only 4% of the students who earned a score of 3 or higher. In contrast, white students and Hispanic students were equally represented in the population and in the percentage of students earning a 3 or higher, at approximately 56% and 23%, respectively (College Board 2018).

Analysis of the Advanced Placement Program in SEI 2018

Indicators 2018 indicated that among STEM AP courses, calculus AB was the most common exam, taken by 308,000 students in 2016, with 60% earning a 3 or higher. Rates of students earning a 3 or higher for the mathematics and science exams in 2016 ranged from a low of 40% for physics 1 to a high of 81% for calculus BC (NSB ***Indicators 2018***: **Participation and Performance in the Advanced Placement Program**). Mathematics and science AP exam taking in 2016 varied by students' sex. Although the students who took calculus AB, statistics, and chemistry exams were about evenly split by sex, male students predominated at advanced levels—for example, male students represented more than 70% of all advanced physics exam takers in 2016. The **State Indicators data tool** provides additional information about AP coursetaking at the state level.

Enrollment in Postsecondary Education

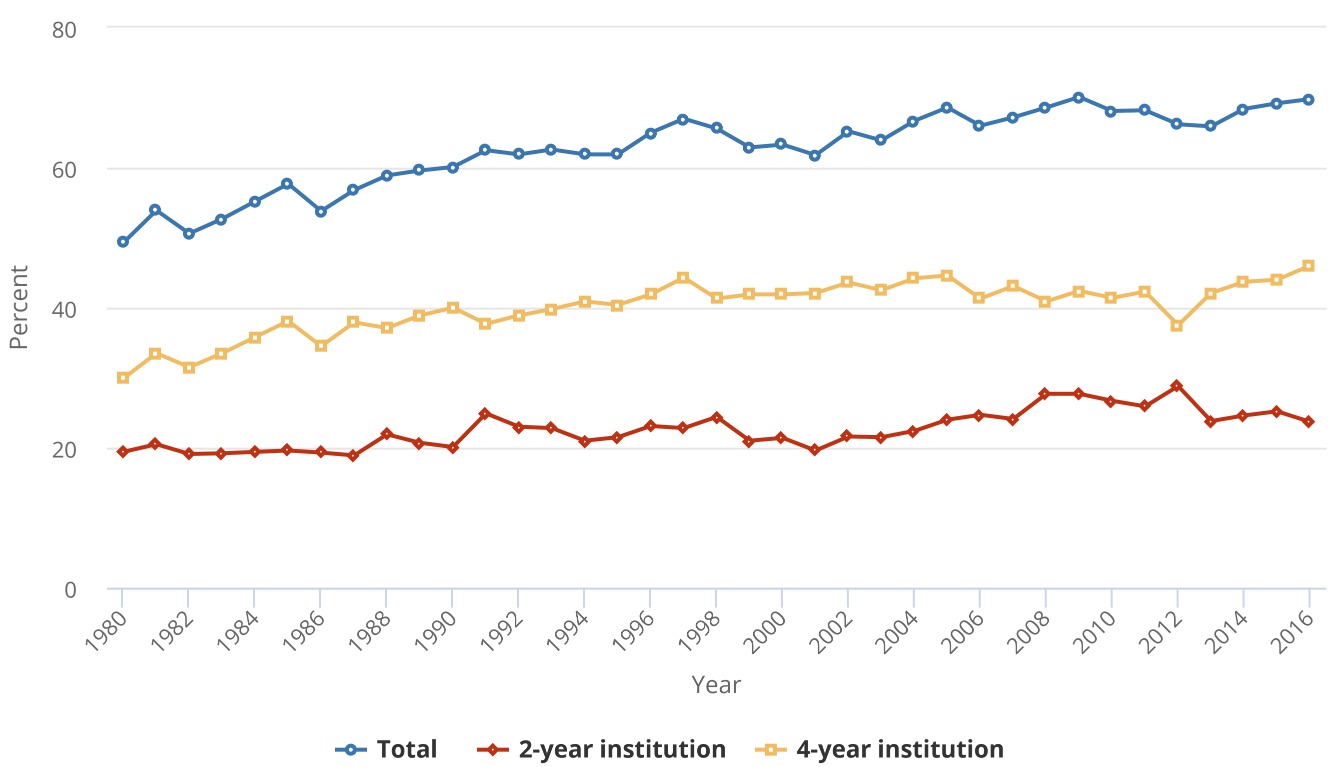
After completing high school, the majority of students go directly into postsecondary education (Dalton, Ingels, and Fritch 2018). Of the 3.1 million students who completed high school or a General Educational Development (GED) in 2016, some 2.2 million (70%) enrolled in a 2- or 4-year college by the following October (McFarland et al. 2018).[15]

According to data from the Current Population Survey, immediate college enrollment rates have increased over time (NCES 2019). Between 1980 and 2016, the percentage of high school graduates making an immediate transition to college increased from 49% to 70% (**Figure 1-10**). In addition, immediate enrollment rates rose faster between 1980 and 2016 for 4-year institutions (from 30% to 46%) than 2-year institutions (from 19% to 24%).

Despite these increases, enrollment gaps among demographic groups have persisted over time (Table S1-6). In 2016, students from high-income families enrolled at a considerably higher rate in postsecondary education than students from low- and middle-income families (83% versus 65% for both low- and middle-income families) (**Figure 1-11**). White and Hispanic students enrolled at a higher rate than black students (70% for white and 68% for Hispanic students versus 58% for black students), and Asian students had the highest immediate enrollment rate overall (86%).

FIGURE 1-10

Immediate college enrollment rates among high school graduates, by institution type: 1980–2016



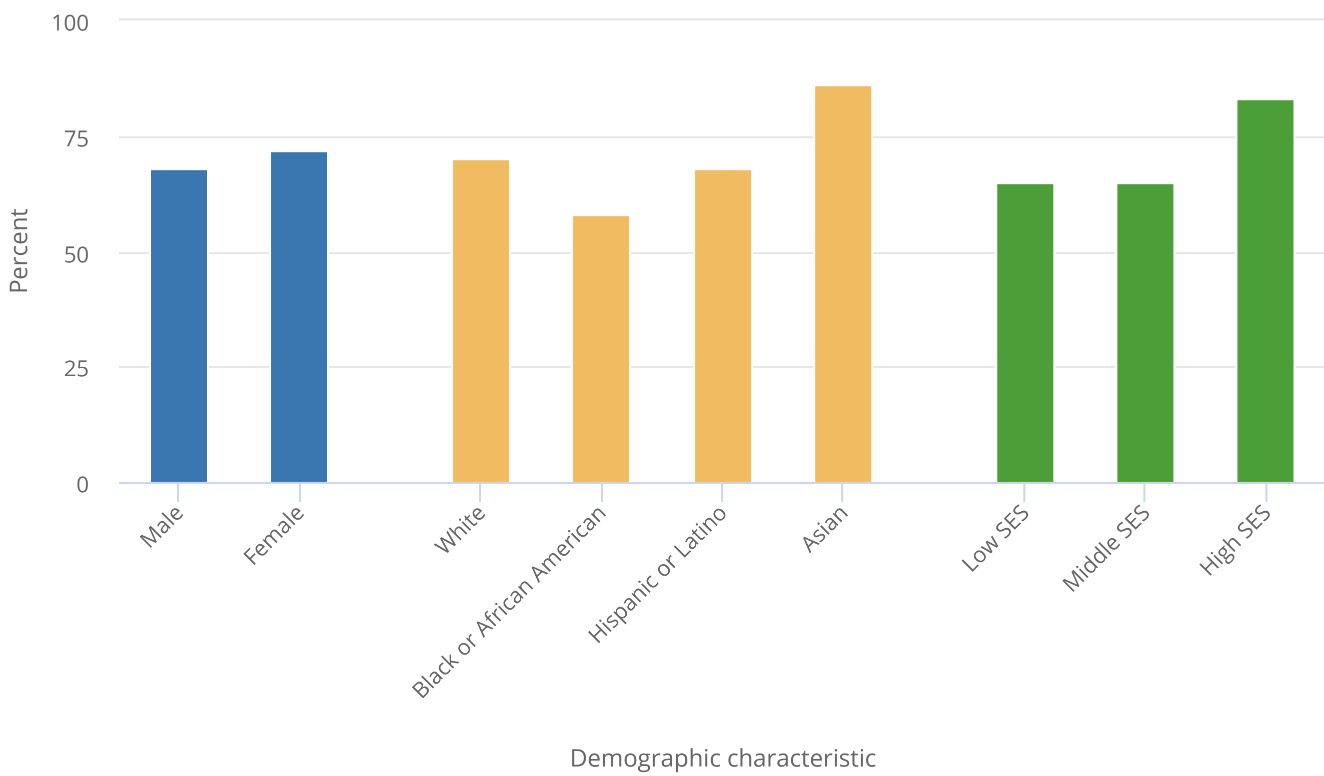
Note(s)
The figure includes students ages 16–24 who completed high school in each survey year. Immediate college enrollment rates are defined as rates of high school graduates enrolled in college in October after completing high school. Before 1992, high school graduates referred to those who had completed 12 years of schooling. As of 1992, high school graduates are those who have received a high school diploma or equivalency certificate. Detail may not add to total due to rounding.

Source(s)
McFarland J, Hussar B, Wang X, Zhang J, Wang K, Rathbun A, Barmer A, Forrest Cataldi E, and Bullock Mann F, *The Condition of Education 2018,* NCES 2018-144 (2018), Tables 302.10, 302.20, 302.30. See Table S1-6.

Science and Engineering Indicators

FIGURE 1-11

Immediate college enrollment rates among high school graduates, by demographic characteristics: 2016



SES = socioeconomic status.

Note(s)
The figure includes students ages 16–24 who completed high school prior to October 2016. Immediate college enrollment rates are defined as rates of high school graduates enrolled in college in October after completing high school. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s)
McFarland J, Hussar B, Wang X, Zhang J, Wang K, Rathbun A, Barmer A, Forrest Cataldi E, and Bullock Mann F, *The Condition of Education 2018,* NCES 2018-144 (2018), Tables 302.10, 302.20, 302.30. See Table S1-6.

Science and Engineering Indicators

Declaration of Postsecondary STEM Major

With the goals of maintaining global competitiveness and enhancing capacity for innovation, U.S. policymakers have called for increasing the number and diversity of students pursuing postsecondary degrees and careers in STEM fields (Allen-Ramdial and Campbell 2014; Committee on STEM Education 2018; Hanson and Slaughter 2017). This has focused attention on the STEM pipeline and how to move more students into and through it (Gottfried and Bozick 2016). Research has shown that high school coursetaking and achievement in mathematics and science are related to students' choice of a postsecondary STEM major and, therefore, are essential components of the STEM pipeline (Bottia et al. 2015; Lichtenberger and George-Jackson 2013). Research also shows that female students and black and Hispanic students are less likely to declare postsecondary STEM majors and less likely to attain STEM degrees (Riegle-Crumb, King, and Irizarry 2019; Wang and Degol 2016).

This section uses national data from the High School Longitudinal Study of 2009 (HSLS:09) to explore how high school mathematics and science preparation is related to students' declaration of STEM majors in college. Examining how high school factors are associated with the choice of a postsecondary STEM major helps policymakers and educators understand the formation of the STEM pipeline leading into college.

HSLS:09 is a longitudinal study of a nationally representative sample of approximately 20,000 students who were first surveyed in fall 2009 as ninth graders and were surveyed again in 2012, 2013, and then again approximately 3 years after most had completed high school, in 2016. In addition, their high school transcripts were collected in 2013. HSLS:09 data allow researchers to examine high school coursetaking and grades relative to postsecondary choices, such as declaration of a STEM major.[16]

Overall, 41% of students in the HSLS:09 cohort declared a STEM major as of 2016 (**Table 1-7**). Declaration of a STEM major varied by several demographic characteristics, including race or ethnicity, parents' education, and family socioeconomic status (**Figure 1-12**). Asian students (54%) were more likely than white (41%), black (40%), and Hispanic (42%) students to declare a STEM major. In addition, students whose parents had completed a bachelor's degree (45%) were more likely than students whose parents had completed high school or less (39%) to declare a STEM major, and students in the highest socioeconomic quintile (46%) were more likely than students in the lowest quintile to declare a STEM major (40%).

TABLE 1-7

Students in grade 9 in fall 2009 who had enrolled in postsecondary education by the end of 2013 and declared a STEM major for their most recent undergraduate degree or certificate, by selected demographic characteristics, and mathematics and science preparation in high school: 2016

(Percent)

Demographic characteristic and mathematics and science preparation	Students who had enrolled in postsecondary education by the end of 2013		
	STEM major, total	Mathematics, science, computer science, and engineering	Social science and psychology
Total	41.5	30.8	11.2
Demographic characteristic			
Sex			
Male	43.6	34.1	10.0
Female	39.7	28.1	12.1
Race or ethnicity[a]			
White	40.9	31.7	9.9
Black or African American	39.6	27.5	12.0
Hispanic or Latino	42.2	28.0	14.5
Asian	54.2	42.8	12.0
Other	38.7	28.8	10.3
Highest level of parents' education[b]			
High school or less	38.7	27.7	11.6
Some college or associate's degree	37.9	28.7	9.4

TABLE 1-7

Students in grade 9 in fall 2009 who had enrolled in postsecondary education by the end of 2013 and declared a STEM major for their most recent undergraduate degree or certificate, by selected demographic characteristics, and mathematics and science preparation in high school: 2016

(Percent)

Demographic characteristic and mathematics and science preparation	Students who had enrolled in postsecondary education by the end of 2013		
	STEM major, total	Mathematics, science, computer science, and engineering	Social science and psychology
Bachelor's or higher degree	44.7	33.7	11.6
Family socioeconomic status in quintile			
Lowest fifth	39.7	26.2	14.2
Middle three-fifths	39.2	29.9	9.8
Highest fifth	46.3	34.6	12.4
Mathematics preparation			
Mathematics achievement test score in quintile			
Lowest fifth	26.1	19.8	6.7
Middle three-fifths	36.4	25.7	11.1
Highest fifth	54.2	42.6	12.5
Highest mathematics coursetaking			
Algebra 1 or below or none	19.7	13.5	6.1
Geometry	31.7	23.6	8.1
Algebra 2 or trigonometry	31.1	20.5	10.8
Precalculus or statistics	41.1	29.0	12.5
Calculus or AP/IB mathematics	54.8	45.4	10.4
GPA in mathematics			
Less than 2.50	32.3	23.0	9.5
2.50–2.99	40.2	27.7	12.7
3.00–3.49	46.5	33.3	14.0
3.50 or higher	55.3	46.2	10.1
AP/IB mathematics credits			
0 credits	37.3	26.6	10.9
0.01–1.00 credit	51.5	40.6	12.2
More than 1.00 credit	67.5	57.8	11.2
Dual-enrollment mathematics credits			
0 credits	41.0	30.2	11.2
0.01–1.00 credit	48.3	38.4	10.0
More than 1.00 credit	55.9	47.2	10.4
Science preparation			
Highest science coursetaking			
General science or none[c]	33.9	23.0	11.0
Specialty science[d]	38.1	28.5	10.0
Advanced or AP/IB science	55.5	43.8	12.9
GPA in science			
Less than 2.50	30.7	22.2	8.6
2.50–2.99	39.2	28.1	11.3
3.00–3.49	46.4	32.6	14.7
3.50 or higher	53.8	43.7	11.1
AP/IB science credits			
0 credits	36.5	26.2	10.6
0.01–1.00 credit	53.0	39.9	14.7
More than 1.00 credit	70.3	61.2	10.4
Dual enrollment science credits			
0 credits	40.7	30.1	11.2
0.01–1.00 credit	63.0	49.7	13.3

TABLE 1-7

Students in grade 9 in fall 2009 who had enrolled in postsecondary education by the end of 2013 and declared a STEM major for their most recent undergraduate degree or certificate, by selected demographic characteristics, and mathematics and science preparation in high school: 2016

(Percent)

Demographic characteristic and mathematics and science preparation	Students who had enrolled in postsecondary education by the end of 2013		
	STEM major, total	Mathematics, science, computer science, and engineering	Social science and psychology
More than 1.00 credit	62.6	56.8	6.8

AP/IB = Advanced Placement/International Baccalaureate; GPA = grade point average; STEM = science, technology, engineering, and mathematics.

[a] Other includes American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, and respondents having origins in more than one race. Hispanic may be any race; race categories exclude Hispanic origin.

[b] The highest level of education achieved by either of the parents or guardians in a two-parent household or by the only parent or guardian in a one-parent household.

[c] General science includes earth science; general life or physical science; first-year biology, chemistry, and physics; integrated and unified science; and general science courses such as origins of science and scientific research and design.

[d] Specialty science includes courses such as geology, botany, zoology, and independent studies in biology, chemistry, or physics.

Note(s)

STEM major considers both first and second majors declared by students for their most recent undergraduate degree or certificate. Estimates for mathematics, science, computer science, and engineering majors and social science and psychology majors do not add to total because some students declared majors in both areas. Columns do not add to 100% because each category represents the percentage of all students in that category who declared a STEM major. Social science courses study human society and social relationships and include such courses as anthropology, economics, political science, and sociology.

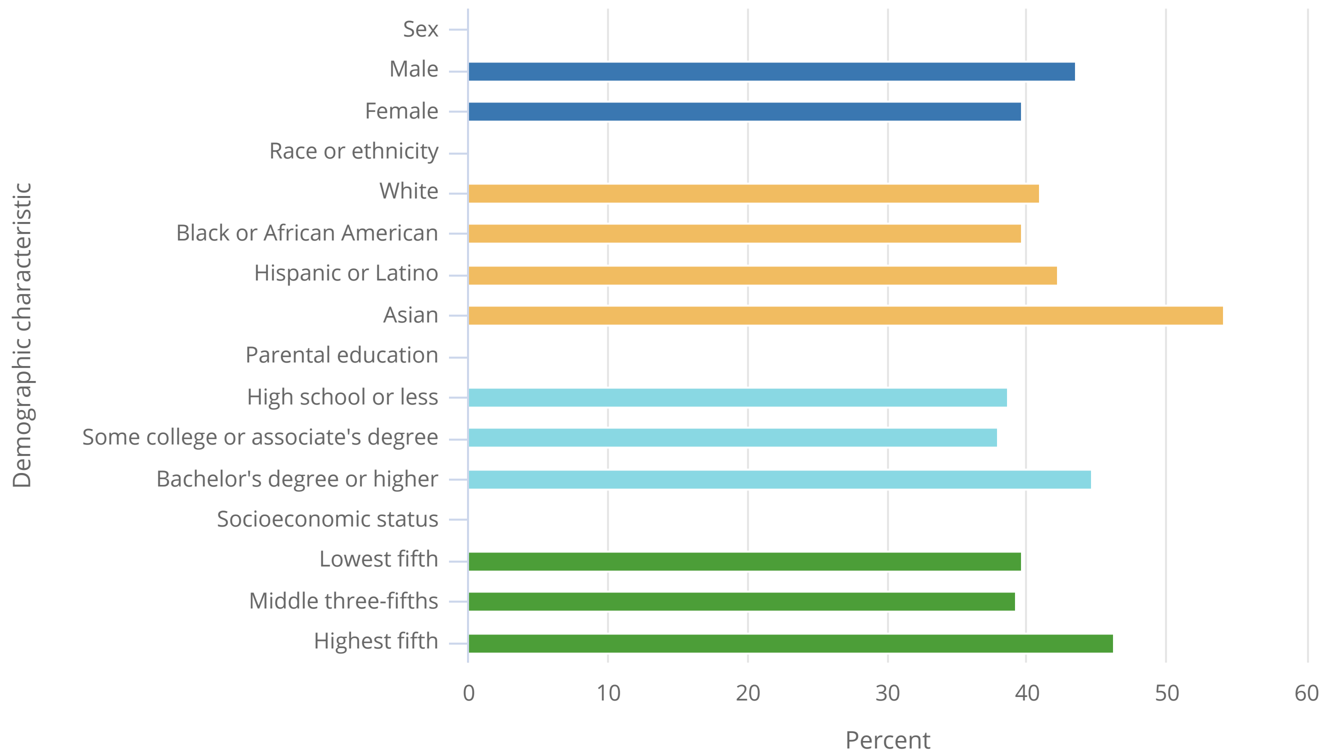
Source(s)

Radford AW, Fritch LB, Leu K, and Duprey M, *High School Longitudinal Study of 2009 (HSLS:09) Second Follow-Up: A First Look at Fall 2009 Ninth-Graders in 2016,* NCES 2018-139 (2018); National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of HSLS: 09, National Center for Education Statistics, Department of Education.

Science and Engineering Indicators

FIGURE 1-12

Students in grade 9 in fall 2009 who had enrolled in postsecondary education by the end of 2013 and declared a STEM major for their most recent undergraduate degree or certificate, by selected demographic characteristics: 2016



STEM = science, technology, engineering, and mathematics.

Note(s)
STEM major considers both first and second majors declared by students for their most recent undergraduate degree or certificate. Hispanic may be any race; race categories exclude Hispanic origin. Parental education is the highest level of education achieved by either of the parents or guardians in a two-parent household or by the only parent or guardian in a one-parent household.

Source(s)
Radford AW, Fritch LB, Leu K, and Duprey M, *High School Longitudinal Study of 2009 (HSLS:09) Second Follow-Up: A First Look at Fall 2009 Ninth-Graders in 2016,* NCES 2018-139 (2018); National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of HSLS:09, National Center for Education Statistics, Department of Education.

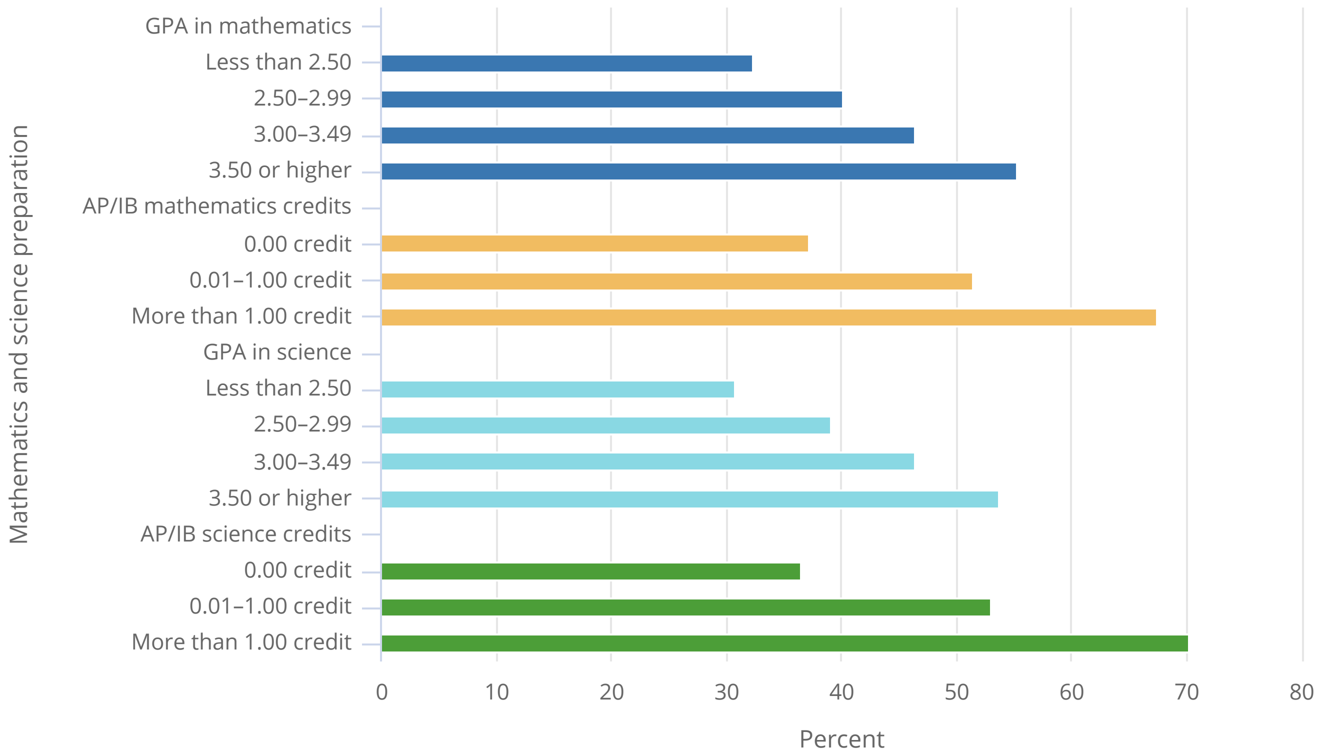
Science and Engineering Indicators

Higher levels of mathematics and science achievement in high school (as measured by grade point average [GPA]) and preparation (as measured by coursetaking) were associated with declaration of a STEM major in postsecondary education (**Figure 1-13**). For example, 55% of students who earned a GPA of 3.5 or higher in high school mathematics declared a postsecondary STEM major, compared with 46% of students with a mathematics GPA in the 3.00–3.49 range, 40% of students with a mathematics GPA in the 2.50–2.99 range, and 32% of students with a mathematics GPA under 2.50. Similar patterns were observed for science GPA.

Students with advanced coursetaking in mathematics and science, as measured by the number of credits earned in AP or IB mathematics or science courses, were more likely to declare a postsecondary STEM major. Fully 70% of students who earned more than one AP or IB science credit declared a postsecondary STEM major,[17] and 67% of students who earned more than one AP or IB mathematics credit did so. In comparison, 37% of students who did not earn any credit in AP or IB science or mathematics declared a postsecondary STEM major.

FIGURE 1-13

Students in grade 9 in fall 2009 who had enrolled in postsecondary education by the end of 2013 and declared a STEM major for their most recent undergraduate degree or certificate, by mathematics and science preparation in high school: 2016



AP/IB = Advanced Placement/International Baccalaureate; GPA = grade point average; STEM = science, technology, engineering, and mathematics.

Note(s)
STEM major considers both first and second majors declared by students for their most recent undergraduate degree or certificate.

Source(s)
Radford AW, Fritch LB, Leu K, and Duprey M, *High School Longitudinal Study of 2009 (HSLS:09) Second Follow-Up: A First Look at Fall 2009 Ninth-Graders in 2016,* NCES 2018-139 (2018); National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of HSLS:09, National Center for Education Statistics, Department of Education.

Science and Engineering Indicators

Transition to the Skilled Technical Workforce

Approximately 28% of fall 2009 ninth graders did not immediately enroll in postsecondary education after high school graduation (Radford et al. 2018). Of those high school graduates, 85% worked for pay since leaving high school, and of those who worked for pay, 14% entered STW occupations (Table S1-7 and Table S1-8). STW occupations are those that employ significant levels of science and engineering (S&E) expertise and technical knowledge but do not necessarily require a 4-year degree for entry.[18] The *Indicators 2020* forthcoming report “Science and Engineering Labor Force” provides an expanded STW discussion, whereas the present report focuses on what can be learned from the HSLS:09 data.[19]

Workers in skilled technical occupations made up about 12% of the U.S. workforce in 2014 (Rothwell 2016). This STW plays an important role in the labor market, and STW jobs are seen as a viable pathway into the middle class (Rothwell 2015). Research by the National Academies of Sciences, Engineering, and Medicine (2017) suggests that the current U.S. market does not have enough skilled technical workers to meet employer demand, and policymakers and educators are figuring out how to adequately prepare students who are not pursuing bachelor's degrees for skilled technical jobs. The National Academies of Sciences report indicates that students follow a variety of pathways into skilled technical jobs: some enter directly after high school, while others pursue postsecondary certifications, associate's degrees, or similar levels of education. Still others earn certifications on the job or pursue further education while employed.

This section draws on data from HSLS:09 to examine the school-to-workforce transition among fall 2009 ninth graders who entered the job market after leaving high school without enrolling in postsecondary education. It discusses their participation in STW versus non-STW jobs (as of 3 years after leaving high school), including earnings patterns and the association between occupational choices and high school STEM courses. This STW analysis shows that STEM-related career and technical education participation has a stronger association with post–high school transitions to the STW than mathematics or science courses (**Table 1-8**).[20] STEM-related career and technical education is significantly associated with whether students entered STW jobs. The STW workforce in this cohort is made up primarily of men—79% of students who entered the STW were male, and 21% were female (**Table 1-9**). In comparison, 59% of students who entered the job market directly after high school were male, and 41% were female. The racial and ethnic distribution of the STW also differs from the overall distribution of those entering the workforce, with white students more likely to hold an STW job (58% in the STW versus 47% overall) and black and Hispanic students less likely to do so (10% versus 16% and 15% versus 25%, respectively).[21]

TABLE 1-8

Distribution of occupation and median standardized hourly wage for current or most recent job of students in grade 9 in fall 2009 who had not enrolled in postsecondary education and had worked for pay since leaving high school, by mathematics and science preparation in high school: 2016

(Percent and dollars per hour)

Mathematics and science preparation	Occupation (%)		Median standardized hourly wage ($)[a]	
	STW	Non-STW	Most recent STW job	Most recent non-STW job
Mathematics preparation				
Mathematics achievement test score				
Lowest fifth	13.0	87.0	9.86	9.90
Middle three-fifths	13.9	86.1	11.04	9.95
Highest fifth	13.1	86.9	s	9.88
Highest mathematics course taken				
Algebra 1 or below or none	11.0	89.0	10.49	9.96
Geometry	15.3	84.7	9.95	9.50
Algebra 2 or trigonometry	12.5	87.5	11.13	9.87
Precalculus or higher	15.6	84.4	10.41	9.96
GPA in mathematics				
Less than 2.50	13.4	86.6	10.45	9.95
2.50–2.99	16.4	83.6	11.08	9.82
3.00 or higher	12.3	87.7	14.21	9.96
Science preparation				
Highest science course taken				
General science or none	13.1	86.9	10.98	9.95
Specialty science	13.2	86.8	10.58	9.87
Advanced or AP/IB science	22.4	77.6	s	9.73
GPA in science				
Less than 2.50	13.8	86.2	10.76	9.94
2.50–2.99	14.4	85.6	12.18	9.90

TABLE 1-8

Distribution of occupation and median standardized hourly wage for current or most recent job of students in grade 9 in fall 2009 who had not enrolled in postsecondary education and had worked for pay since leaving high school, by mathematics and science preparation in high school: 2016

(Percent and dollars per hour)

Mathematics and science preparation	Occupation (%)		Median standardized hourly wage ($)[a]	
	STW	Non-STW	Most recent STW job	Most recent non-STW job
3.00 or higher	9.8	90.2	s	9.97

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

AP/IB: Advanced Placement or International Baccalaureate; GPA = grade point average; STW = skilled technical workforce.

[a] Earnings reported in a format other than dollars per hour (e.g., dollars per month or per year) were standardized to dollars per hour.

Note(s)

About 28% of students in grade 9 in fall 2009 had not enrolled in postsecondary education as of February 2016.

Source(s)

Radford AW, Fritch LB, Leu K, and Duprey M, *High School Longitudinal Study of 2009 (HSLS:09) Second Follow-Up: A First Look at Fall 2009 Ninth-Graders in 2016,* NCES 2018-139 (2018); National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of HSLS: 09, National Center for Education Statistics, Department of Education.

Science and Engineering Indicators

TABLE 1-9

Distribution of occupation and median standardized hourly wage for current or most recent job of students in grade 9 in fall 2009 who had not enrolled in postsecondary education and had worked for pay since leaving high school, by selected demographic characteristics: 2016

(Percent and dollars per hour)

Demographic characteristic	Occupation (%)		Median standardized hourly wage ($)[a]	
	Total	STW	Most recent STW job	Most recent non-STW job
Total	100.0	100.0	10.97	9.95
Sex				
Male	59.4	78.9	11.17	9.98
Female	40.6	21.1	9.92	9.24
Race or ethnicity[b]				
White	46.6	57.6	11.78	9.95
Black or African American	16.4	10.0	s	9.43
Hispanic or Latino	24.7	14.7	10.02	9.98
Asian	1.5	1.1	s	9.91
Other	10.8	16.7	9.16	9.30
Highest level of parents' education[c]				
High school or less	58.8	57.5	10.25	9.95
Some college or associate's degree	22.7	25.4	11.79	9.70
Bachelor's or higher degree	18.5	17.1	11.77	9.93
Family socioeconomic status in quintile				
Lowest fifth	30.6	31.6	9.93	9.86
Middle three-fifths	62.9	61.8	11.07	9.90
Highest fifth	6.5	6.7	s	9.97

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

STW = skilled technical workforce.

[a] Earnings reported in a format other than dollars per hour (e.g., dollars per month or per year) were standardized to dollars per hour.

[b] Other includes American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, and respondents having origins in more than one race. Hispanic may be any race; race categories exclude Hispanic origin.

[c] The highest level of education achieved by either of the parents or guardians in a two-parent household or by the only parent or guardian in a one-parent household.

Note(s)

About 28% of students in grade 9 in fall 2009 had not enrolled in postsecondary education as of February 2016.

Source(s)

Radford AW, Fritch LB, Leu K, and Duprey M, *High School Longitudinal Study of 2009 (HSLS:09) Second Follow-Up: A First Look at Fall 2009 Ninth-Graders in 2016,* NCES 2018-139 (2018); National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of HSLS: 09, National Center for Education Statistics, Department of Education.

Science and Engineering Indicators

STW jobs generally pay more than non-STW jobs (Rothwell 2016). The median hourly wage for STW jobs for the analyzed group (i.e., 3 years out of high school) was about $1.00 higher than that for non-STW jobs ($10.97 versus $9.95 per hour) (**Table 1-9**). In STW jobs, male employees earned more than female employees ($11.17 versus $9.92 per hour), and white employees ($11.78) earned more than Hispanic employees ($10.02). Although high school mathematics achievement and highest mathematics course taken were not associated with whether students entered STW jobs (**Table 1-8**), mathematics achievement was associated with higher earnings in STW jobs. The median hourly wage for students who had a GPA above 3.0 in high school mathematics ($14.21) was higher than the median hourly wage for students who earned a high school mathematics GPA less than 2.50 ($10.45). High school science achievement and highest science course taken were not associated with differences in hourly wages for STW jobs.

The majority of U.S. high school students take career and technical education courses consisting of STEM- and non-STEM-related courses (Snyder, de Brey, and Dillow 2016). These courses are designed to provide students with the knowledge and skills needed for the workplace and may help students transition to the workforce or to postsecondary programs (Dougherty 2016; Kemple and Willner 2008). For high school students who entered the job market without enrolling in postsecondary education, not all career and technical education courses were related to STW entry and earnings (**Table 1-10**), but participation in STEM-related career and technical education courses, such as manufacturing and engineering, was related to entry and earnings.

TABLE 1-10

Distribution of occupation and median standardized hourly wage for current or most recent job of students in grade 9 in fall 2009 who had not enrolled in postsecondary education and had worked for pay since leaving high school, by career and technical education preparation in high school: 2016

(Percent and dollars)

	Occupation (%)		Median standardized hourly wage ($)[a]	
CTE preparation	**STW**	**Non-STW**	**Most recent STW job**	**Most recent non-STW job**
CTE coursetaking				
Number of CTE credits earned[b]				
None	10.3	89.7	11.18	9.61
0.01–1.00	12.5	87.5	9.94	9.97
1.01–2.00	14.2	85.8	9.94	9.50
2.00 or more	14.7	85.3	11.31	9.96
Whether students earned credits in specific CTE area				
Computer and information sciences				
No	14.0	86.0	10.99	9.95
Yes	13.1	86.9	10.46	9.93
Communication and audio/ video technology				

TABLE 1-10

Distribution of occupation and median standardized hourly wage for current or most recent job of students in grade 9 in fall 2009 who had not enrolled in postsecondary education and had worked for pay since leaving high school, by career and technical education preparation in high school: 2016

(Percent and dollars)

CTE preparation	Occupation (%)		Median standardized hourly wage ($)[a]	
	STW	Non-STW	Most recent STW job	Most recent non-STW job
No	14.3	85.7	10.38	9.96
Yes	11.1	88.9	12.19	9.87
Business and marketing				
No	14.1	85.9	10.98	9.62
Yes	12.5	87.5	10.39	9.98
Manufacturing				
No	12.4	87.6	10.99	9.86
Yes	24.5	75.5	9.92	10.20
Engineering and technology				
No	12.5	87.5	10.96	9.95
Yes	20.9	79.1	10.61	9.96
Health care sciences				
No	14.2	85.8	10.63	9.95
Yes	7.6	92.4	s	9.85
Public, protective, and government services				
No	13.5	86.5	10.96	9.95
Yes	14.7	85.3	s	9.59
Human services				
No	13.9	86.1	10.97	9.96
Yes	11.1	88.9	9.12	8.82
Hospitality and tourism				
No	13.5	86.5	10.91	9.96
Yes	14.4	85.6	10.11	9.40
Architecture and construction				
No	12.6	87.4	10.52	9.80
Yes	18.8	81.2	11.29	9.91
Agriculture, food, and natural resources				
No	12.2	87.8	10.53	9.95
Yes	19.8	80.2	11.00	9.97
Transportation, distribution, and logistics				
No	13.0	87.0	10.48	9.93
Yes	19.8	80.2	12.45	10.40

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

CTE = career and technical education; STW = skilled technical workforce.

[a] Earnings reported in a format other than dollars per hour (e.g., dollars per month or per year) were standardized to dollars per hour.

[b] CTE credits are credits earned in computer and information sciences; communication and audio/video technology; business and marketing; manufacturing; engineering and technology; health care sciences; public, protective, and government services; human services; hospitality and tourism; architecture and construction; agriculture, food, and natural resources; and transportation, distribution, and logistics.

Note(s)

About 28% of students in grade 9 in fall 2009 had not enrolled in postsecondary education as of February 2016.

Source(s)

Radford AW, Fritch LB, Leu K, and Duprey M, *High School Longitudinal Study of 2009 (HSLS:09) Second Follow-Up: A First Look at Fall 2009 Ninth-Graders in 2016,* NCES 2018-139 (2018); National Center for Science and Engineering Statistics, National Science Foundation, special tabulations (2018) of HSLS: 09, National Center for Education Statistics, Department of Education.

Science and Engineering Indicators

For example, students who earned career and technical education credits in manufacturing were more likely than students who did not earn these credits to have an STW job (25% versus 12%), as were students who earned career and technical education credits in engineering and technology (21% versus 13%); architecture and construction (19% versus 13%); agriculture, food, and natural resources (20% versus 12%); and transportation, distribution, and logistics (20% versus 13%). In addition, earning credits in transportation, distribution, and logistics was associated with higher earnings within STW jobs ($12.45 versus $10.48).

Conclusion

This report presented indicators of K–12 STEM education from a variety of sources and across the spectrum of K–12 education. It explored mathematics and science performance beginning in kindergarten and continuing through fifth grade. It examined achievement for eighth graders, both nationally and internationally, in mathematics and science as well as technology and engineering. It discussed STEM coursetaking in high school and examined how high school preparation is related to choosing STEM majors in college or transitioning directly into skilled technical jobs. The findings presented here suggest that the United States still has work to do to ensure that (1) all students have equal access to STEM opportunities; (2) STEM achievement continues to improve; and (3) the United States is globally competitive in K–12 STEM education outcomes. The analyses presented here also suggest that K–12 STEM education plays a critical role in introducing students to STEM topics and preparing them to enter STEM majors and jobs.

Internationally, TIMSS data show that the United States ranks in the middle of advanced economies in producing high-performing mathematics and science students and is behind several education systems such as Singapore, Taiwan, and South Korea. Nationally, data from ECLS-K:2011 indicate that achievement gaps by socioeconomic status and race or ethnicity are present as early as kindergarten and gaps for some racial and ethnic groups do not lessen over the course of schooling. NAEP data indicate that mathematics performance for eighth graders has plateaued in the past decade, and performance gaps based on SES and race or ethnicity have persisted over time. NAEP science scores show that eighth graders improved their science performance between 2009 and 2015, the last time science was assessed. In addition, the report highlights that eighth graders have improved their technology and engineering literacy performance since 2014, and there is no male-female achievement gap in that arena. Also, the percentage of high school students immediately enrolling in college after high school continues to rise, and the enrollment rates for Hispanic and white students are now equal.

Finally, the data reveal that high school preparation matters for later STEM outcomes in postsecondary education and the workforce; the topics of higher education and the labor force are further discussed in the *Indicators 2020* report "**Higher Education in Science and Engineering**" and forthcoming report "Science and Engineering Labor Force." Taking advanced mathematics and science courses in high school is associated with a greater likelihood of declaring STEM majors, and students who take STEM technical education courses earn higher wages in skilled technical jobs directly out of high school.

Charting a Course for Success: America's Strategy for STEM Education, the federal government's 5-year strategic plan for STEM education, offers a plan for STEM education to address the inequities highlighted in this report.

Glossary

Definitions

Advanced Placement (AP): Courses that teach college-level material and skills to high school students who can earn college credits by demonstrating advanced proficiency on a final course exam. The College Board develops curricula and exams for AP courses, available for a wide range of academic subjects.

Elementary school: A school that has no grades higher than grade 8.

GED (General Educational Development) certificate: This award is received after successfully completing the GED test. The GED program, sponsored by the American Council on Education, enables individuals to demonstrate that they have acquired a level of learning comparable with that of high school graduates.

High school: A school that has at least one grade higher than grade 8 and no grade in K–6.

High school completer: An individual who has been awarded a high school diploma or an equivalent credential, including a GED certificate.

High school diploma: A formal document regulated by the state certifying the successful completion of a prescribed secondary school program of studies. In some states or communities, high school diplomas are differentiated by type, such as an academic diploma, a general diploma, or a vocational diploma.

Middle school: A school that has any of grades 5–8, no grade lower than grade 5, and no grade higher than grade 8.

National School Lunch Program (NSLP): Established by President Truman in 1946, the NSLP program is a federally assisted meal program operated in public and private nonprofit schools and residential childcare centers. To be eligible for free lunch, a student must be from a household with an income at or below 130% of the federal poverty guideline; to be eligible for reduced-price lunch, a student must be from a household with an income between 130% and 185% of the federal poverty guideline. Student eligibility for this program is a commonly used indicator of family poverty.

Postsecondary education: The provision of a formal instructional program with a curriculum designed primarily for students who have completed the requirements for a high school diploma or its equivalent. These programs include those with an academic, vocational, or continuing professional education purpose and exclude vocational and adult basic education programs.

Poverty (official measure): The U.S. Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is in poverty. If the total income for a family or unrelated individual falls below the relevant poverty threshold, then the family (and every individual in it) or unrelated individual is considered in poverty.

Scale score: Scale scores place students on a continuous achievement scale based on their overall performance on the assessment. Each assessment program develops its own scales.

Socioeconomic status (SES): Data sources for this report use family income measures based on U.S. Census Bureau poverty thresholds or participation in the National School Lunch Program as indicators of socioeconomic status. Data drawn from the High School Longitudinal Study of 2009 use a composite variable that includes parent education and occupation plus family income to determine socioeconomic status levels.

Key to Acronyms and Abbreviations

AP: Advanced Placement

ECLS-K:2011: Early Childhood Longitudinal Study, Kindergarten Class of 2010-11
GED: General Educational Development

GPA: grade point average

HSLS:09: High School Longitudinal Study of 2009

IB: International Baccalaureate

IEA: International Association for the Evaluation of Educational Achievement

IMF: International Monetary Fund

K–12: kindergarten through 12th grade

NAEP: National Assessment of Educational Progress

NAGB: National Assessment Governing Board

NCES: National Center for Education Statistics

NSF: National Science Foundation

NSLP: National School Lunch Program

PISA: Program for International Student Assessment

S&E: science and engineering

SES: socioeconomic status

STEM: science, technology, engineering, and mathematics

STW: skilled technical workforce

TEL: Technology and Engineering Literacy

TIMSS: Trends in International Mathematics and Science Study

References

Achieve Inc. 2016. *The College and Career Readiness of U.S. High School Graduates*. Washington, DC. Available at **https://www.achieve.org/files/CCRHSGradsMarch2016.pdf**. Accessed 13 November 2018.

ACT. 2018. *The Condition of College and Career Readiness 2018*. Iowa City, IA. Available at **https://www.act.org/content/dam/act/unsecured/documents/cccr2018/National-CCCR-2018.pdf**. Accessed 13 November 2018.

Allen-Ramdial SAA, Campbell AG. 2014. Reimagining the Pipeline: Advancing STEM Diversity, Persistence, and Success. *BioScience* 64(7):612–18. Available at **https://doi.org/10.1093/biosci/biu076**.

Atkinson RD, Mayo M. 2010. *Refueling the U.S. Innovation Economy: Fresh Approaches to Science, Technology, Engineering and Mathematics (STEM) Education*. Washington, DC: Information Technology and Innovation Foundation. Available at **https://itif.org/publications/2010/12/07/refueling-us-innovation-economy-fresh-approaches-stem-education**. Accessed 13 November 2018.

Bottia MC, Stearns E, Mickelson RA, Moller S, Parker AD. 2015. The Relationships among High School STEM Learning Experiences and Students' Intent to Declare and Declaration of a STEM Major in College. *Teachers College Record* 117(3):n3. Available at **https://eric.ed.gov/?id=EJ1056740**.

Bozick R, DeLuca S. 2005. Better Late Than Never? Delayed Enrollment in the High School to College Transition. *Social Forces* 84(1):531–54. Available at **https://doi.org/10.1353/sof.2005.0089**. Accessed 13 November 2018.

Carnevale AP, Strohl J, Ridley N, Gulish A. 2018. *Three Educational Pathways to Good Jobs: High School, Middle Skills, and Bachelor's Degree*. Washington, DC: Georgetown University Center on Education and the Workforce.

Chatterji AK. 2018. Innovation and American K–12 Education. *Innovation Policy and the Economy* 18(1):27–51.

College Board. 2018. *Class of 2017 Data Overview*. Available at **https://reports.collegeboard.org/archive/2017/ap-program-results/class-2017-data**. Accessed 13 November 2018.

Committee on STEM Education. 2018. *Charting a Course for Success: America's Strategy for STEM Education*. Washington, DC: National Science and Technology Council. Available at **https://eric.ed.gov/?id=ED590474**. Accessed 31 May 2019.

Dalton B, Ingels SJ, Fritch L. 2018. *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcript Study: A First Look at Fall 2009 Ninth-Graders in 2013*. NCES 2015-037rev. Washington, DC: National Center for Education Statistics, Department of Education.

Darling-Hammond L. 2000. Teacher Quality and Student Achievement. *Education Policy Analysis Archives 8*(1):1–44.

Doerschuk P, Bahrim C, Daniel J, Kruger J, Mann J, Martin C. 2016. Closing the Gaps and Filling the STEM Pipeline: A Multidisciplinary Approach. *Journal of Science Education and Technology* 25(4):682–95.

Dougherty SM. 2016. *Career and Technical Education in High School: Does It Improve Student Outcomes*? Washington, DC: Thomas B. Fordham Institute.

Estrada M, Burnett M, Campbell AG, Campbell PB, Denetclaw WF, Gutiérrez CG, Hurtado S, John GH, Matsui J, McGee R, Okpodu CM, Robinson TJ, Summer MF, Werner-Washburne M, Zavla M. 2016. Improving Underrepresented Minority Student Persistence in STEM. *CBE—Life Sciences Education* 15(3):es5.

Fink J, Jenkins D, Yanagiura T. 2017. *What Happens to Students Who Take Community College "Dual Enrollment" Courses in High School?* New York: Community College Research Center, Teachers College, Columbia University. Available at **https://ccrc.tc.columbia.edu/media/k2/attachments/what-happens-community-college-dual-enrollment-students.pdf**. Accessed 4 June 2019.

Friedman-Krauss A, Barnett WS, Nores M. 2016. *How Much Can High-Quality Universal Pre-K Reduce Achievement Gaps?* Washington, DC: Center for American Progress.

García E. 2015. *Inequalities at the Starting Gate: Cognitive and Noncognitive Skills Gaps Between 2010–2011 Kindergarten Classmates*. Washington, DC: Economic Policy Institute.

García E, Weiss E. 2017. *Education Inequalities at the School Starting Gate: Gaps, Trends, and Strategies to Address Them*. Washington, DC: Economic Policy Institute.

Gottfried MA, Bozick R. 2016. Supporting the STEM Pipeline: Linking Applied STEM Course-taking in High School to Declaring a STEM Major in College. *Education Finance and Policy* 11(2):177–202.

Hanson GH, Slaughter MJ. 2017. High-skilled Immigration and the Rise of STEM Occupations in US Employment. *In* Hulten CR, Ramey VA, editors, *Education, Skills, and Technical Change: Implications for Future US GDP Growth,* pp. 465–99. Chicago: University of Chicago Press.

Harwell M, LeBeau B. 2010. Student Eligibility for a Free Lunch as an SES Measure in Education Research. *Educational Researcher* 39(2):120–31. Available at **http://www.jstor.org/stable/27764564**. Accessed 13 November 2018.

Hinojosa T, Rapaport A, Jaciw A, Zacamy J. 2016. *Exploring the Foundations of the Future STEM Workforce: K–12 Indicators of Postsecondary STEM Success*. REL 2016-122. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southwest. Available at **https://files.eric.ed.gov/fulltext/ED565641.pdf**. Accessed 13 November 2018.

Hout M. 2012. Social and Economic Returns to College Education in the United States. *Annual Review of Sociology* 38:379–400.

Imazeki J, Goe L. 2009. *The Distribution of Highly Qualified, Experienced Teachers: Challenges and Opportunities.* TQ Research & Policy Brief. Washington, DC: National Comprehensive Center for Teacher Quality.

International Monetary Fund (IMF). 2018. *World Economic Outlook: Challenges to Steady Growth.* Washington, DC. **https://www.imf.org/~/media/Files/Publications/WEO/2018/October/English/main-report/Text.ashx?la=en**. Accessed 7 March 2019.

Kemple J, Willner C. 2008. *Career Academies: Long-Term Impacts on Labor Market Outcomes, Educational Attainment, and Transitions to Adulthood.* New York: MDRC.

Kolluri S. 2018. Advanced Placement: The Dual Challenge of Equal Access and Effectiveness. *Review of Educational Research* 88(5):671–711. Available at **https://doi.org/10.3102%2F0034654318787268**. Accessed 13 November 2018.

Leadership Conference Education Fund. 2015. *Advancing Equity through More and Better STEM Learning*. Washington, DC. Available at **http://civilrightsdocs.info/pdf/reports/2015/STEM-report-WEB.pdf**. Accessed 13 November 2018.

Lichtenberger E, George-Jackson C. 2013. Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans. *Journal of Career and Technical Education* 28(1):19–38. Available at **https://files.eric.ed.gov/fulltext/EJ1043177.pdf**. Accessed 13 November 2018.

Long MC, Conger D, Iatarola, P. 2012. Effects of High School Course-taking on Secondary and Postsecondary Success. *American Educational Research Journal* 49(2):285–322.

Maltese AV, Tai RH. 2010. Eyeballs in the Fridge: Sources of Early Interest in Science. *International Journal of Science Education* 32(5):669–85.

Martin MO, Mullis IVS, Foy P, Hooper M. 2016. *TIMSS 2015 International Results in Science.* Chestnut Hill, MA: Boston College, TIMSS & PIRLS International Study Center. Available at **http://timssandpirls.bc.edu/timss2015/international-results/**. Accessed 15 March 2019.

McClure ER, Guernsey L, Clements DH, Bales SN, Nichols J, Kendall-Taylor N, Levine MH. 2017. *STEM Starts Early: Grounding Science, Technology, Engineering, and Math Education in Early Childhood*. New York: Joan Ganz Cooney Center at Sesame Workshop.

McFarland J, Hussar B, Wang X, Zhang J, Wang K, Rathbun A, Barmer A, Forrest Cataldi E, Bullock Mann F. 2018. *The Condition of Education 2018*. NCES 2018-144. Washington, DC: National Center for Education Statistics, Department of Education. Available at **https://nces.ed.gov/pubs2018/2018144.pdf**. Accessed 14 March 2019.

Mulligan GM, McCarroll JC, Flanagan KD, McPhee C. 2019. *Findings from the Fifth-Grade Round of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011).* NCES 2019-130. Washington, DC: National Center for Education Statistics, Department of Education. Available at **https://nces.ed.gov/pubs2019/2019130.pdf**. Accessed 15 March 2019.

Mullis IVS, Martin MO, Foy P, Hooper M. 2016. *TIMSS 2015 International Results in Mathematics.* Chestnut Hill, MA: Boston College, TIMSS & PIRLS International Study Center. Available at **http://timssandpirls.bc.edu/timss2015/international-results/**. Accessed 15 March 2019.

Museus SD, Palmer RT, Davis RJ, Maramba D, editors. 2011. Racial and Ethnic Minority Student Success in STEM Education: Special Issue. *ASHE Higher Education Report* 36(6). Hoboken, NJ: John Wiley & Sons.

National Academies of Sciences, Engineering, and Medicine. 2017. *Building America's Skilled Technical Workforce*. Washington, DC: National Academies Press.

National Assessment of Educational Progress (NAEP). 2018. *Scale Scores and Achievement Levels.* Available at **https://nces.ed.gov/nationsreportcard/guides/scores_achv.aspx**. Accessed 13 November 2018.

National Center for Education Statistics (NCES), Department of Education. *High School Longitudinal Study of 2009 (HSLS: 09).* Available at **https://nces.ed.gov/surveys/hsls09/**. Accessed 1 February 2019.

National Center for Education Statistics (NCES), Department of Education. 2019. *Immediate College Enrollment Rate*. Available at **https://nces.ed.gov/programs/coe/indicator_cpa.asp**. Accessed 12 March 2019.

National Center on Education and the Economy (NCEE). 2013. *What Does It Really Mean to Be College and Work Ready? The Mathematics Required of First Year Community College Students*. Washington, DC. Available at **http://www.ncee.org/wp-content/uploads/2013/05/NCEE_MathReport_May20131.pdf**. Accessed 13 November 2018.

National Science Board (NSB), National Science Foundation. 2018. *Science and Engineering Indicators 2018.* NSB-2018-1. Alexandria, VA. Available at **https://www.nsf.gov/statistics/2018/nsb20181/**.

Noonan R. 2017a. *STEM Jobs: 2017 Update*. ESA Issue Brief #02-17. Washington, DC: Office of the Chief Economist, Economics and Statistics Administration, U.S. Department of Commerce. Available at **https://www.commerce.gov/sites/default/files/migrated/reports/stem-jobs-2017-update.pdf**. Accessed 13 November 2018.

Noonan R. 2017b. *Women in STEM: 2017 Update*. ESA Issue Brief #06-17. Washington, DC: Office of the Chief Economist, Economics and Statistics Administration, U.S. Department of Commerce. Available at **https://www.commerce.gov/sites/default/files/migrated/reports/women-in-stem-2017-update.pdf**. Accessed 13 November 2018.

Pellegrino J, Hilton M. 2012. *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*. Washington, DC: National Academies Press. Available at **https://www.nap.edu/catalog/13398/education-for-life-and-work-developing-transferable-knowledge-and-skills**. Accessed 13 November 2018.

Peri G, Shih K, Sparber C. 2015. STEM Workers, H1-B Visas, and Productivity in US Cities. *Journal of Labor Economics* 33(S1):S225–55. Available at **https://www.journals.uchicago.edu/doi/10.1086/679061**. Accessed 13 November 2018.

Radford AW, Fritch LB, Leu K, Duprey M. 2018. *High School Longitudinal Study of 2009 (HSLS:09) Second Follow-Up: A First Look at Fall 2009 Ninth-Graders in 2016*. NCES 2018-139. Washington, DC: National Center for Education Statistics, Department of Education. Available at **https://nces.ed.gov/pubs2018/2018139.pdf**. Accessed 13 March 2019.

Rahman T, Fox MA, Ikoma S, Gray L. 2017. *Certification Status and Experience of U.S. Public School Teachers: Variations across Student Subgroups.* NCES 2017-056. Washington, DC: National Center for Education Statistics, Department of Education.

Rice JK. 2013. Learning from Experience? Evidence on the Impact and Distribution of Teacher Experience and the Implications for Teacher Policy. *Education Finance and Policy* 8(3):332–48.

Riegle-Crumb C, King B, Irizarry Y. 2019. Does STEM Stand Out? Examining Racial/Ethnic Gaps in Persistence across Postsecondary Fields. *Educational Researcher* 48(3):133–44. Available at **https://doi.org/10.3102/0013189X19831006**.

Rothwell J. 2015. *Defining Skilled Technical Work*. Washington, DC: National Academies Board on Science, Technology, and Economic Policy. Available at **https://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_167744.pdf**. Accessed 14 March 2019.

Rothwell J. 2016. Defining Skilled Technical Work. *Issues in Science and Technology* 33(1).

Shivji A, Wilson S. 2019. *Dual Enrollment: Participation and Characteristics. Data Point.* NCES 2019-176. Washington, DC: National Center for Education Statistics, Department of Education. Available at **https://nces.ed.gov/pubs2019/2019176.pdf**. Accessed 4 June 2019.

Snyder TD, de Brey C, Dillow SA. 2016. *Digest of Education Statistics 2014*. NCES 2016-006. Washington, DC: National Center for Education Statistics, Department of Education.

Trends in International Mathematics and Science Study (TIMSS) & Progress in International Reading Literacy Study (PIRLS) International Study Center. 2016. *TIMSS 2015 and TIMSS Advanced 2015 International Results.* Chestnut Hill, MA. Available at **http://timssandpirls.bc.edu/timss2015/international-results/**. Accessed 15 March 2019.

U.S. Government Accountability Office (GAO). 2018. *Public High Schools with More Students in Poverty and Smaller Schools Provide Fewer Academic Offerings to Prepare for College*. GAO-19-8. Washington, DC. Available at **https://www.gao.gov/assets/700/694961.pdf**. Accessed 29 May 2019.

Wang MT, Degol JL. 2016. Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions. *Educational Psychology Review* 28:1–22.

Warne RT, Larsen R, Anderson B, Odasso AJ. 2015. The Impact of Participation in the Advanced Placement Program on Students' College Admissions Test Scores. *Journal of Educational Research* 108(5):400–16.

Notes

1 Historically underrepresented groups are not equally represented in STEM; their representation in STEM is smaller than their representation in the U.S. population and has been so over time. These groups include women, blacks, Hispanics, and American Indians or Alaska Natives, among others.

2 The ECLS-K sample is not nationally representative of all fifth graders. Statistics cited here are nationally representative of the population of students who were first-time kindergarteners in the 2010–11 school year and who were in fifth grade in 2016. It does not include students who may have repeated or skipped a grade.

3 Family poverty level was determined in spring 2011 when students were in kindergarten. Family income data were not collected in subsequent years of the study.

4 Scale scores convert the total number of correct answers (raw score) to a standardized score, which allows comparison of test scores across different editions of the test over time. Scale scores are used for comparative purposes among demographic groups and to examine changes in scores over time.

5 The scale for the main NAEP mathematics assessment is 0–500 for grade 8. In 2017, 80% of students scored between 233 and 333 (**Table 1-2**).

6 Student eligibility for a free lunch program is a less-than-perfect measure of SES (Harwell and LeBeau 2010).

7 NAGB, as directed by NAEP legislation, has developed achievement levels for NAEP since 1990. A broadly representative panel of teachers, education specialists, and the public helps to define and review achievement levels. As provided by law, the achievement levels are to be used on a trial basis and should be interpreted and used with caution until the NCES commissioner determines that the levels are reasonable, valid, and informative to the public. This determination will be based on a congressionally mandated, rigorous, and independent evaluation. More information about NAEP achievement levels is available at **https://nces.ed.gov/nationsreportcard/achievement.aspx**.

8 NAEP administered a new science assessment beginning in 2009 to keep pace with advances in both science and cognitive research, the growth in national and international science assessments, advances in innovative assessment approaches, and the need to incorporate accommodations so that the widest possible range of students could be fairly assessed. This assessment was not comparable to prior assessments administered beginning in 1996. As a result, it is not possible to report long-term trends for science achievement.

9 Although technology and engineering are important aspects of STEM, they receive less coverage in this report because of the lack of national data sources covering these topics. The NAEP TEL assessment began providing national data for eighth graders when it was first administered in 2014.

10 Actual scores for male and female students in 2014 were 148.6 and 151.4, respectively, a difference of 2.8 points, which rounds up to 3 points.

11 NAEP TEL data are available at **https://www.nationsreportcard.gov/tel/student-questionnaires/**.

12 Although the IMF does not include Russia among the world's advanced economies, this analysis includes it because it is a large economy with high levels of student achievement and high levels of science and technology capability. Other countries with high and rising levels of science and technology capability, such as India or China, are not included because they do not participate in the TIMSS assessment.

13 The teachers of the eighth grade students participating in the NAEP mathematics assessments were asked to complete a teacher questionnaire (see **https://nces.ed.gov/nationsreportcard/bgquest.aspx**). Because the sampling for the teacher questionnaires was based on participating students, the responses to a particular teacher questionnaire do not necessarily represent all teachers of that subject at that grade level in the nation. It is important to note that in all NAEP reports, the student is the unit of analysis, even when information from the teacher or school questionnaire is being reported.

14 For more information about dual enrollment, see Shivji and Wilson (2019) and Fink, Jenkins, and Yanagiura (2017).

15 This rate, known as the immediate college enrollment rate, is defined as the annual percentage of high school completers aged 16–24, including GED recipients, who enroll in 2- or 4-year colleges by the October after high school completion.

16 The analysis presented here is restricted to students who had enrolled in postsecondary education by December 2013, which captures students who had been enrolled in postsecondary education for up to 3 years after high school. This analysis uses NSF's definition of STEM majors, which includes mathematics, natural sciences, engineering, computer and information sciences, psychology, economics, sociology, and political science. Students are considered to have declared a STEM major if the first or second major field of study they most recently reported was a STEM field.

17 Credits refers to Carnegie credits. A Carnegie credit is equivalent to a 1-year academic course taken one period a day, 5 days a week.

18 The STW definition used here is a combination of the NCSES S&E and S&E-related occupations and a list of occupations obtained following the methodology presented in Jonathan Rothwell's *Defining Skilled Technical Work* prepared for the National Academies Board on Science, Technology, and Economic Policy project on "The Supply Chain for Middle-Skilled Jobs: Education, Training, and Certification Pathways" in 2015 (Rothwell 2015).

19 The sample includes both students who earned a diploma or a GED before leaving high school and those who did not.

20 NCES defines career and technical education as courses at the high school level that focus on the skills and knowledge required for specific jobs or fields of work.

21 The STW section uses a significance level of 0.1 when testing comparisons. Because of smaller sample sizes, there are larger standard errors, which may cause comparisons to not be significant at the 0.05 level used in the other sections of this report. NCSES accepts comparisons at the 0.1 level, particularly when findings are of substantive interest to policymakers, educators, and the public.

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