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K–12 Education

Elementary and Secondary STEM Education

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This publication is part of the 2024 edition of the *Science and Engineering Indicators (Indicators)* suite of reports. *Indicators* is prepared under the guidance of the National Science Board by the National Science Foundation's National Center for Science and Engineering Statistics. The *Indicators* suite consists of a summary report called *The State of U.S. Science and Engineering*, more-detailed thematic reports with supporting data, and a data tool that provides state-level indicators.

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Executive Summary

Key takeaways:

- Average mathematics scores on a national assessment in 2022 were lower than scores in all previous assessment years going back to 2005 for fourth graders and going back to 2003 for eighth graders. These data indicate that mathematics achievement, which had already plateaued for the past decade, has now regressed approximately 20 years during the COVID-19 pandemic.
- National mathematics assessment results show a disproportionate impact of COVID-19 on students with already historically lower scores, with larger score declines for Black students, students eligible for free or reduced-price lunch, and students scoring in the 10th and 25th percentiles.
- The gap between students scoring in the highest (90th) and lowest (10th) percentiles on a national mathematics assessment widened to 105 points in 2022, the largest it has been since the assessment began. Students at the lowest end of the score distribution (those in the 10th percentile) posted scores that were 12 points lower in 2022 than in 2020, whereas those at the highest end of the score distribution (those in the 90th percentile) posted scores that were 3 points lower.
- At the regional level, national mathematics assessment results show that in 2022, eighth graders in the Northeast and Midwest scored higher than eighth graders in the South and West.
- A national mathematics assessment in 2022 shows that a third of fourth graders scored proficient or higher, while a quarter of eighth graders did so. These scores suggest low levels of proficiency at both grades and lower proficiency levels at higher grades.
- A pre-pandemic international assessment of mathematics and science in 2019 shows that eighth graders in the United States ranked about in the middle of education systems in countries with advanced economies. Several countries, such as Singapore and Japan, far outpace the United States.
- Analysis of student science, technology, engineering, and mathematics (STEM) coursetaking collected in 2019 in the pre-pandemic period shows that students are completing more mathematics and science courses than they have in the past.
- Although students are earning more mathematics credits in high school and completing more advanced courses than they had in earlier years, their scores on a national mathematics assessment have not improved over the same period.

Elementary and secondary education in mathematics and science is the foundation for student entry into postsecondary STEM majors and a wide variety of STEM-related occupations. Given the foundational nature of elementary and secondary STEM education, it is critical to understand how the COVID-19 pandemic has affected student learning. The COVID-19 pandemic led to unprecedented disruptions in K–12 education beginning in March 2020 and continuing through the 2021–22 school year. The abrupt switch to remote instruction for the majority of schools and students during this time substantially altered education and led to declines in student learning for almost all students. National mathematics assessment data released in 2022 by the National Assessment of Educational Progress (NAEP) show sharp declines in student mathematics performance compared with pre-pandemic scores, with average scores lower than those in all previous assessment years going back to 2005 for fourth graders and going back to 2003 for eighth graders.

National mathematics assessment results show a disproportionate impact of COVID-19 on students who were already behind before the pandemic, with high score declines for Black students, students eligible for free or reduced-price lunch, and students scoring in the lowest 10th percentile. A NAEP assessment shows that the average score for Black 9-year-old students in 2022 was 13 points lower than the average score for Black 9-year-old students in 2020. Students at the lowest end of the score distribution (those in the 10th percentile) posted scores that were 12 points lower in 2022 than in 2020, whereas those at the highest end of the score distribution (those in the 90th percentile) posted scores that were 3 points lower.

Research literature suggests that persistently lower scores for economically disadvantaged students and students from historically marginalized groups, including Black students, Hispanic students, and American Indian or Alaska Native students, may be correlated with educational and social inequities, including, but not limited to, schools with inadequate resources and less-qualified teachers, inadequate medical care, food insecurity, disproportionate disciplinary practices, lack of a social safety net, and exposure to trauma (Bowman, Comer, and Johns 2018; Carnevale et al. 2019; Hanushek 2023; Pearman 2020; Reardon, Kalogrides, and Shores 2019). Researchers also suggest that COVID-19 affected learning for these students to a greater degree because of such factors as food or housing insecurity, distracting workspaces, competing family care responsibilities, and lack of access to electronic devices or reliable Internet (EdWeek Research Center 2022; Haderlein et al. 2021; Kurtz et al. 2021).

COVID-19 has also impacted students' college readiness. From 2021 to 2022, the percentage of high school graduates reaching college readiness benchmarks dropped from 36% to 31% in mathematics and from 35% to 32% in science. A nationally representative survey of high school graduates in 2020 and 2021 revealed that the 2021 graduates changed their postsecondary plans at a higher rate than did graduates in 2020. The 2021 graduates reported higher rates of delaying or canceling their postsecondary plans to pursue more education and reported higher rates of using earnings from afterschool jobs to support their families rather than using them for college-related costs. Researchers have calculated the potential long-term impact on students' lifetime earnings resulting from learning disruptions and unfinished learning due to COVID-19. Their calculations suggest that lost income for the generation of students impacted by the pandemic could amount to more than $2 trillion (Kane et al. 2022).

Prior to the COVID-19 pandemic, federal and state policymakers, legislators, and educators had been working to broaden and strengthen STEM education at the elementary and secondary levels. Indicators presented here reveal some changes, such as high school students taking more mathematics and science courses than they had in previous decades. Other indicators have remained low, such as the percentage of students scoring at proficiency in mathematics and the percentage of high school students reaching college readiness benchmarks in STEM courses. In addition, demographic disparities in educational opportunities and performance have persisted. Internationally, the United States continued to rank in the middle of advanced economies in mathematics and science prior to the pandemic, with countries such as Singapore and Japan far outpacing the United States.

The use of assessment data and other educational indicators to understand the impact of disrupted learning and the success of educational interventions is critical as policymakers, school systems, state leaders, educators, and parents seek ways to support students who were affected by school-related closures and learning disruptions during the pandemic. Indicators in this report highlight the potential long-term impact of the pandemic on outcomes for elementary and secondary students in the United States.

Introduction

Developing science, technology, engineering, and mathematics (STEM) talent is a key component of the National Science Board's (NSB's) *Vision 2030* report, which outlines the Board's priorities for ensuring that by 2030, the United States has made "the investments needed to fuel an innovation economy and remain preeminent in science and engineering" (NSB 2020). Educating elementary and secondary youth and engaging them in STEM subjects is the foundation for developing STEM talent and ensuring that the United States fulfills NSB's vision. The indicators in this report provide insight into U.S. progress in reaching these goals and the substantial impact that the learning disruptions due to the COVID-19 pandemic have had on the potential for reaching these goals in the future.

Overall, this report suggests that the country has made some progress, with secondary students taking more mathematics and science courses than they had in previous decades and increasing parity in the percentage of students from different demographic groups who are taking STEM courses. Other indicators, however, suggest that the U.S. education system is not adequately preparing all students to succeed in STEM, with persistent disparities in achievement among students from different demographic groups, including Black and Hispanic students and students from low socioeconomic backgrounds. The indicators in this report also provide insight into the far-reaching effects of the COVID-19 pandemic on elementary and secondary students and the pandemic's disproportionate impact on certain groups of students.

The report begins with an analysis of student performance in mathematics in the pre- and post-pandemic periods, then moves to an analysis of U.S. student performance in mathematics and science in an international context prior to COVID-19. The report then pivots to consider student STEM preparation for post–high school activities, including high school STEM coursetaking before COVID-19 and the impact of COVID-19 on student readiness for college STEM coursetaking. All comparisons presented in this report are statistically significant at the 0.10 level of significance unless otherwise noted.

Student Learning in Mathematics and Science

The COVID-19 pandemic led to severe disruptions in K–12 student learning beginning with the abrupt switch to remote instruction for the majority of schools and students in March 2020. Specifically, in spring 2020, 77% of public schools reported that they transitioned to online remote instruction, and 83% of public school teachers reported that all or some of their classes were moved to online distance-learning formats (Berger et al. 2022). Schools began a slow transition back to in-person instruction during the 2020–21 school year, although only about half of fourth- and eighth-grade public school students attended full-time, in-person classes by the end of May 2021. That percentage had increased to nearly 100% by spring 2022 (National Center for Education Statistics [NCES] 2022).[1]

Assessment data released in 2022 by the National Assessment of Educational Progress (NAEP) show sharp declines in student mathematics performance compared with pre-pandemic scores.[2] These data also show a disproportionate negative impact of COVID-19 on assessment scores for students living in poverty and for students from historically marginalized racial and ethnic groups who are underrepresented in the STEM workforce. The use of assessment data to understand the impact of disrupted learning is critical as policymakers, school systems, state leaders, educators, and parents seek ways to support students who were affected by school-related closures and learning disruptions during the pandemic. This section of the report will focus on indicators related to the impact of COVID-19 on elementary and secondary students and an analysis of student performance in an international context in 2019 prior to the pandemic.

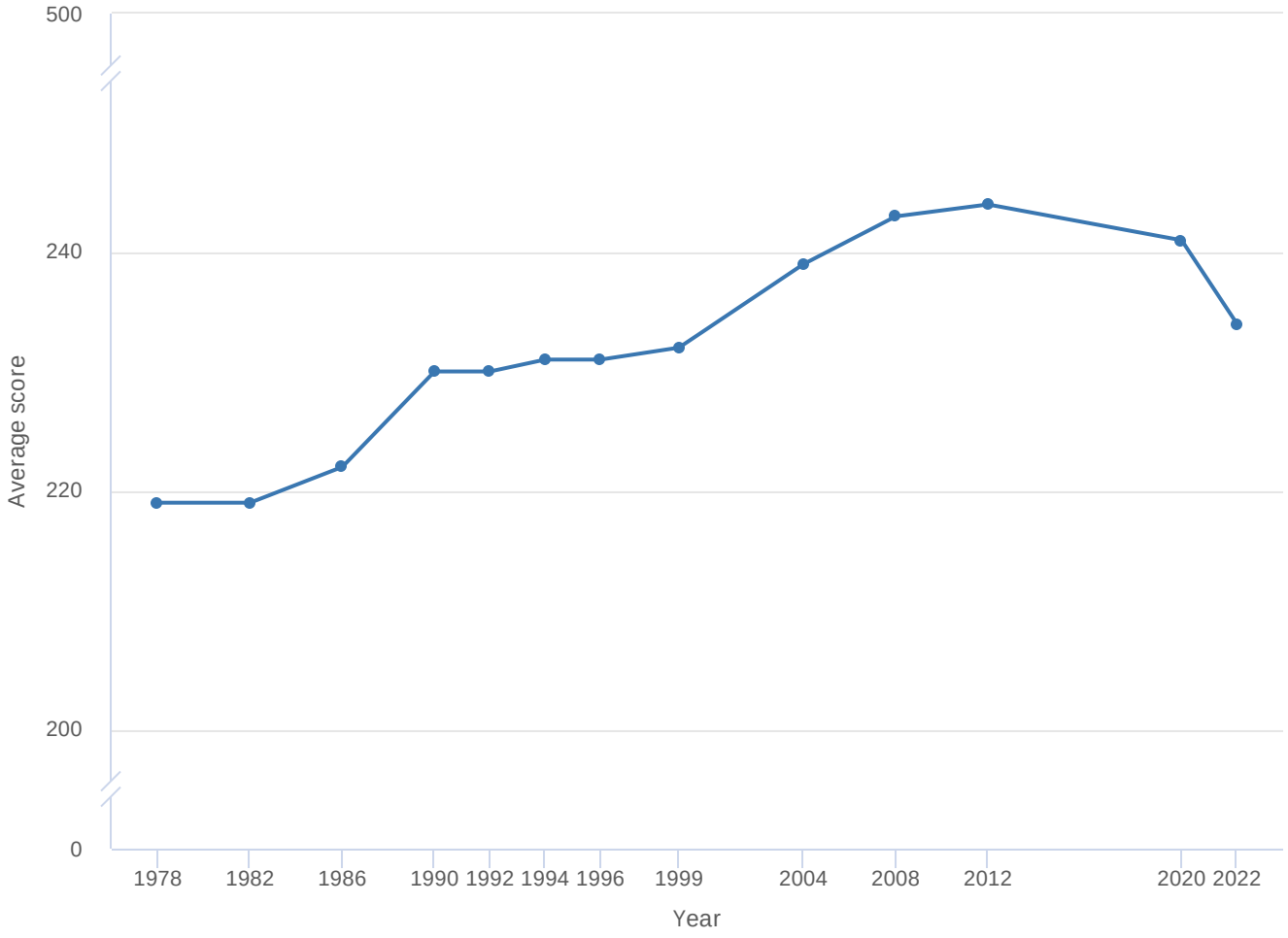
National Trends in K–12 Student Achievement

Overall Scores Declined in 2022 following Disrupted Learning in 2020

Assessment data indicate that the COVID-19 pandemic set national educational progress in mathematics back approximately 20 years in terms of point drops in NAEP assessment scores. The NAEP data collected in 2022 show sharp declines in fourth- and eighth-grade student mathematics performance compared with pre-pandemic scores.[3] The NAEP long-term trend (LTT) assessment in mathematics shows a 7-point drop among 9-year-old students from 2020 to 2022 (**Figure K12-1**). The main NAEP assessment in mathematics shows a 5-point drop among fourth graders and an 8-point drop among eighth graders from 2019 to 2022 (**Figure K12-2**). These average mathematics scores in 2022 are lower than scores going back to 2004 for 9-year-olds, 2005 for fourth graders, and 2003 for eighth graders.

Figure K12-1

Average scores of 9-year-old students on the NAEP long-term trend mathematics assessment: 1978–2022



NAEP = National Assessment of Educational Progress.

Note(s):
The scale for NAEP mathematics assessment scores is 0–500 for 9-year-old students.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 1978, 1982, 1986, 1990, 1992, 1994, 1996, 1999, 2004, 2008, 2012, 2020, and 2022 NAEP long-term trend mathematics assessments, National Center for Education Statistics.

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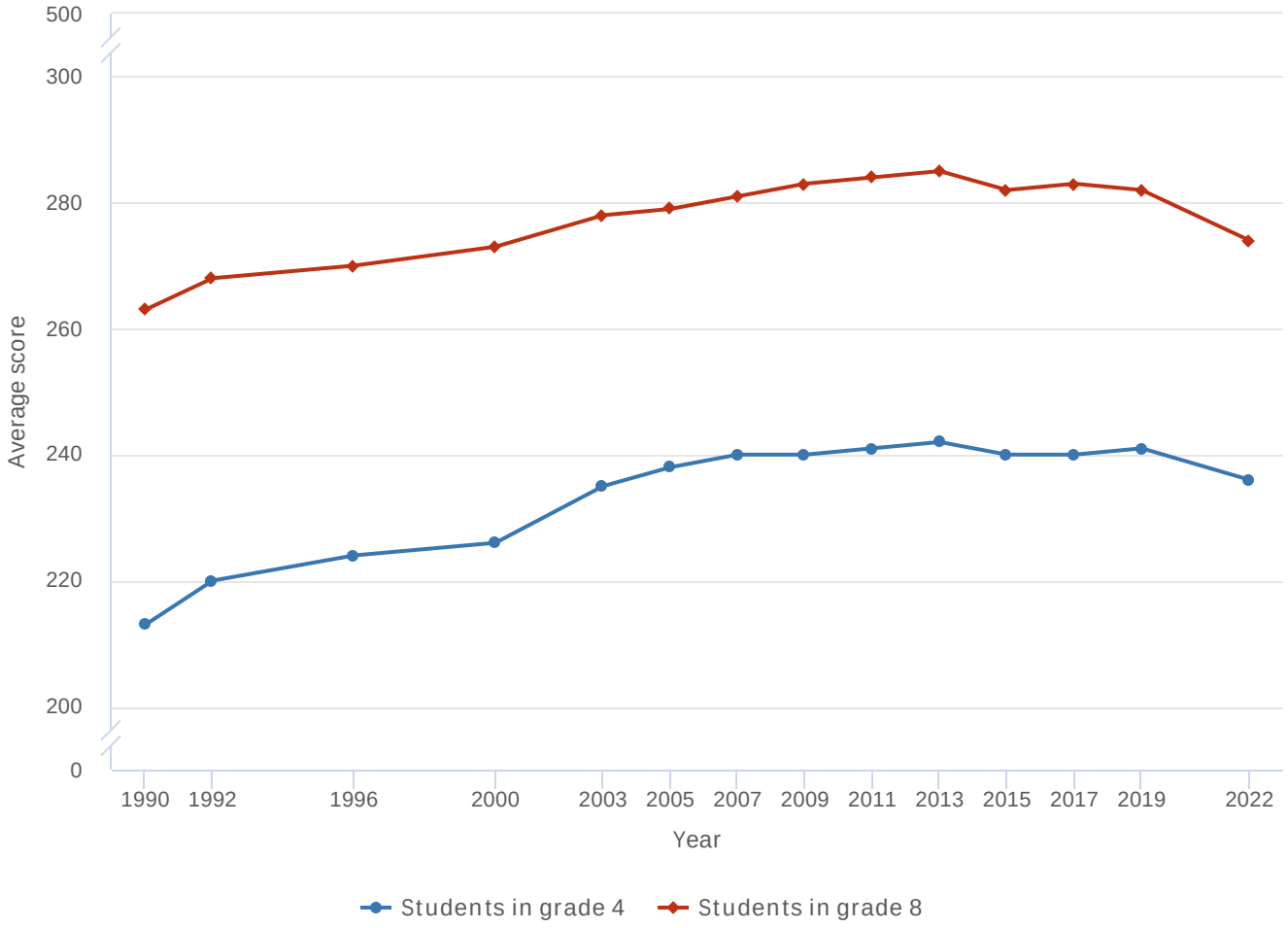
Figure K12-2

Average scores of students in grades 4 and 8 on the main NAEP mathematics assessment: 1990–2022



NAEP = National Assessment of Educational Progress.

Note(s):
The scale for NAEP mathematics assessment scores is 0–500 for grades 4 and 8.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 1990, 1992, 1996, 2000, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017, 2019, and 2022 main NAEP mathematics assessments, National Center for Education Statistics.

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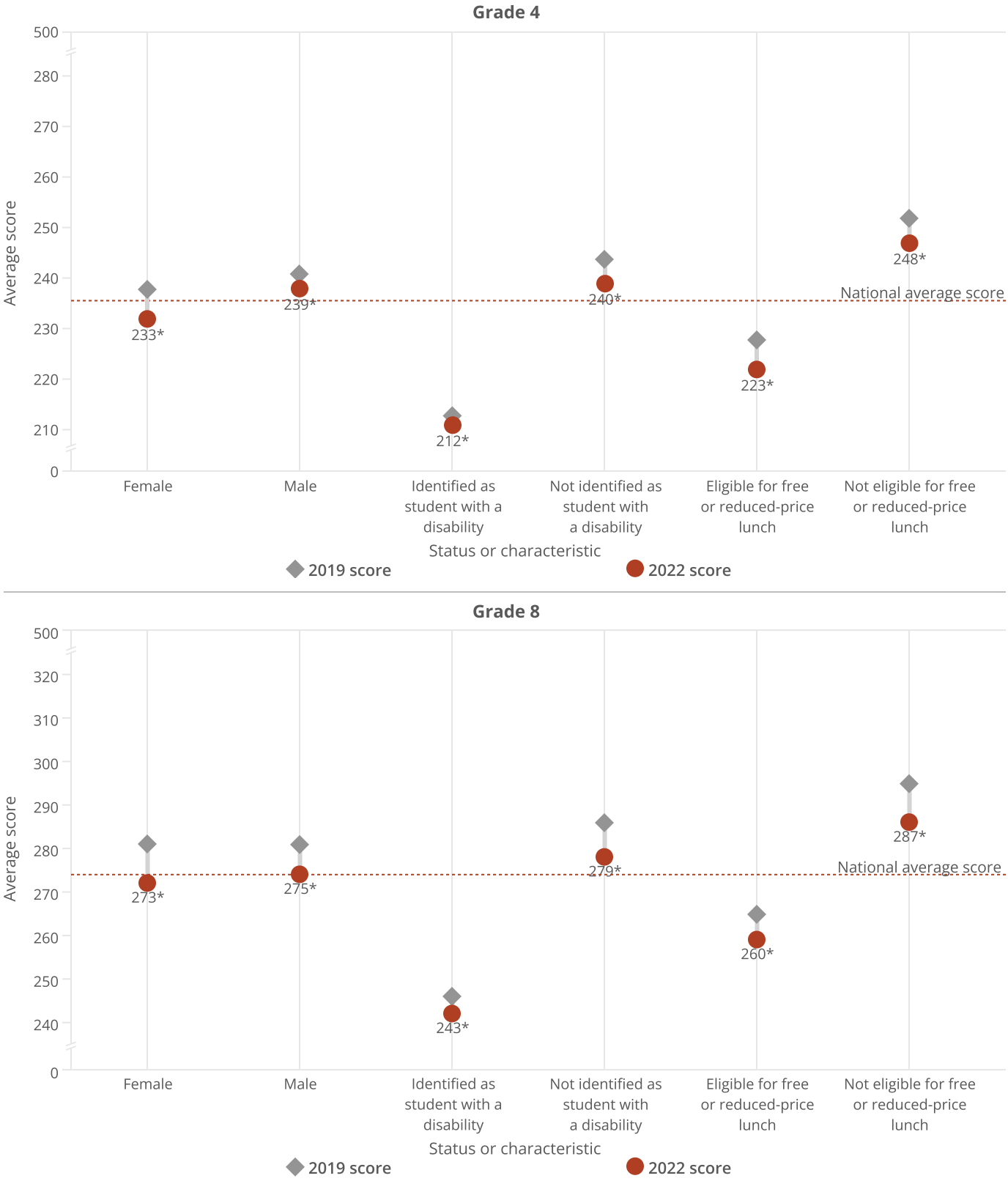
Score Differences, by Student Groups in Fourth and Eighth Grades in 2022

In addition to illustrating the differences in scores from 2019 to 2022, an examination of 2022 main NAEP scores reveals differences within student groups. Male students scored higher than female students in the fourth and eighth grades, with differences of 6 points in 2022 and 3 points in 2019, respectively (**Figure K12-3**). Students eligible for free or reduced-price lunch at both grade levels scored approximately 25 points lower than students not eligible for free or reduced-price lunch.[4] Score differences by race or ethnicity ranged from 42 points in fourth grade to 53 points in eighth grade, with Asian students at the high end and Black students at the low end of the distribution (**Figure K12-4**). An analysis of score differences by race or ethnicity within school lunch categories shows that these score differences exist regardless of lunch eligibility status (**Table K12-1**).

Figure K12-3

Average scores of students in grades 4 and 8 on the main NAEP mathematics assessment, by sex, disability status, and socioeconomic status: 2019 and 2022



***** = significantly different ($p < 0.10$) from 2019 score.

NAEP = National Assessment of Educational Progress.

Note(s):
The scale for NAEP mathematics assessment scores is 0–500 for grades 4 and 8.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 2019 and 2022 main NAEP mathematics assessments, National Center for Education Statistics.

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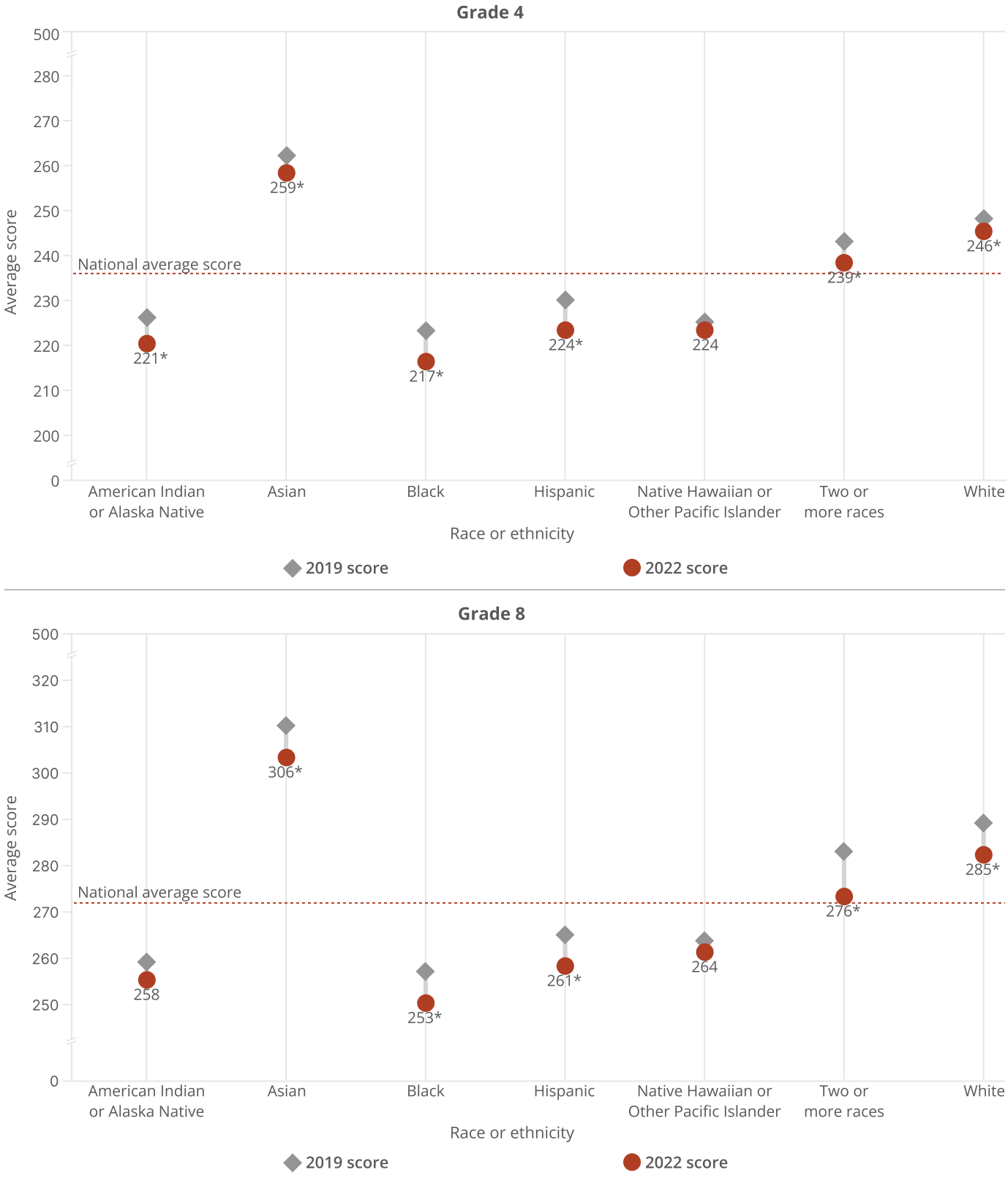
Figure K12-4

Average scores of students in grades 4 and 8 on the main NAEP mathematics assessment, by race or ethnicity: 2019 and 2022



* = significantly different ($p < 0.10$) from 2019 score.

NAEP = National Assessment of Educational Progress.

Note(s):
The scale for NAEP mathematics assessment scores is 0–500 for grades 4 and 8. Black includes African American. Hispanic includes Latino. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 2019 and 2022 main NAEP mathematics assessments, National Center for Education Statistics.

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Table K12-1

Average scores of students in grades 4 and 8 on the main NAEP mathematics assessment, by race or ethnicity and socioeconomic status: 2022

(Average score)

Student grade and race or ethnicity	Eligible for free or reduced-price lunch	Not eligible for free or reduced-price lunch
All students in grade 4	223	248
Race or ethnicity		
American Indian or Alaska Native	214	229
Asian	243	267
Black	212	230
Hispanic	219	235
Native Hawaiian or Pacific Islander	215	233
Two or more races	225	251
White	232	252
All students in grade 8	260	287
Race or ethnicity		
American Indian or Alaska Native	250	272
Asian	289	315
Black	248	264
Hispanic	257	271
Native Hawaiian or Pacific Islander	256	277
Two or more races	262	288
White	268	291

NAEP = National Assessment of Educational Progress.

Note(s):
The scale for NAEP mathematics assessment scores is 0–500 for grades 4 and 8. Black includes African American. Hispanic includes Latino. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 2022 main NAEP mathematics assessment, National Center for Education Statistics.

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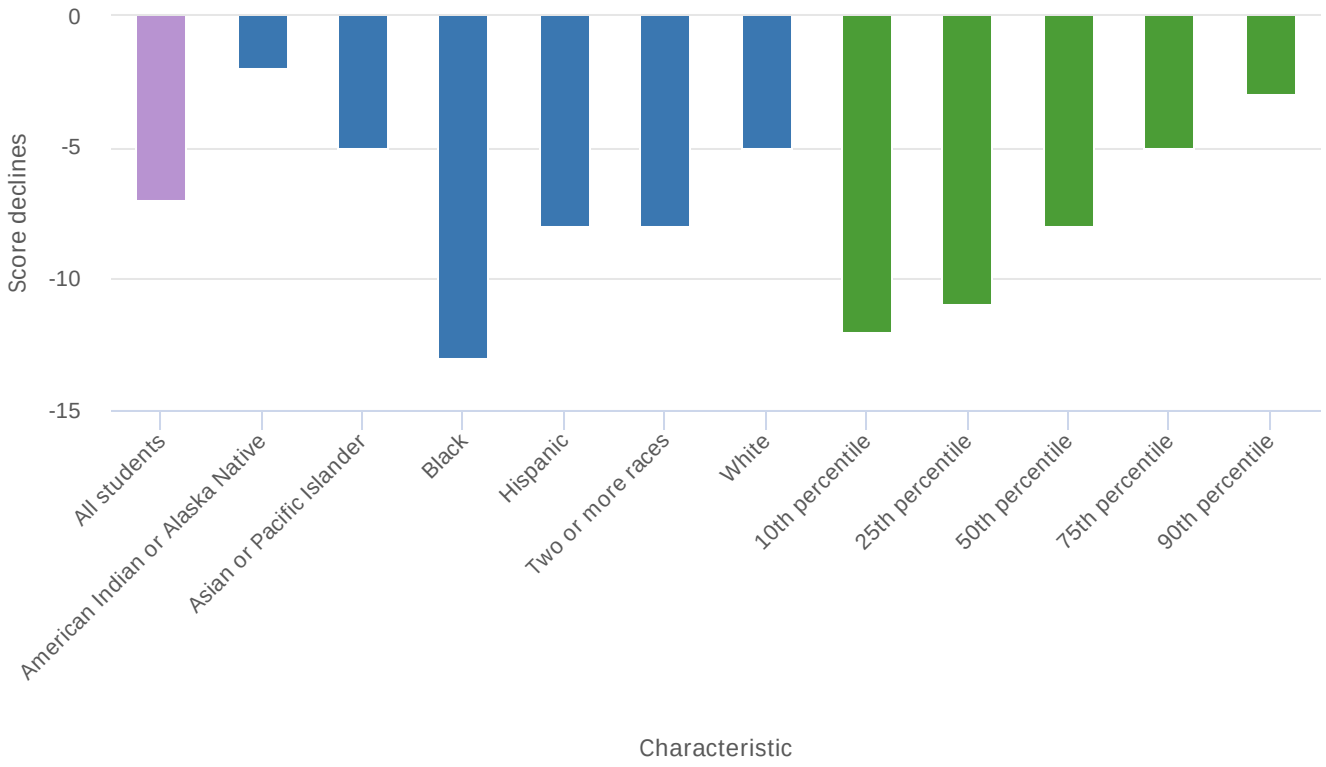
The substantial score differences among different student groups in the fourth and eighth grades highlight the existence of inequality and racial disparities in the nation's education system. Research literature suggests that persistently lower scores for economically disadvantaged students and students from historically marginalized groups, including Black students, Hispanic students, and American Indian or Alaska Native students, may be attributable to a variety of educational and social inequities, including (but not limited to) schools with inadequate resources and less-qualified teachers, inadequate medical care, food insecurity, disproportionate disciplinary practices, lack of a social safety net, and exposure to trauma (Bowman, Comer, and Johns 2018; Carnevale et al. 2019; Gordon and Reber 2021; National Academies of Sciences, Engineering, and Medicine [NASEM] 2019; Pearman 2020; Reardon, Kalogrides, and Shores 2019).

Disproportionate Impact of COVID-19 among Student Groups

Results from the 2022 NAEP LTT show that COVID-19 had a greater negative impact on outcomes for certain student groups, including Black students and Hispanic students, students eligible for free or reduced-price lunch, and students scoring in the 10th percentile on mathematics assessments. Students already at a disadvantage because of persistently lower scores are now farther behind because they had higher declines in 2022 than other students did. For example, the NAEP LTT shows that scores in 2022 dropped 13 points for Black 9-year-old students, 8 points for Hispanic 9-year-old students, and 5 points for White 9-year-old students compared with scores in 2020 (**Figure K12-5**). These declines in average scores resulted in a score gap of 33 points between White students and Black students (Table SK12-1). Similarly, the average score for students scoring in the 90th percentile dropped 3 points from 2020 to 2022, compared with a drop of 12 points for students scoring in the 10th percentile.[5] As a result, the gap between the 90th and 10th percentile scores widened to 105 points, the largest it has been since the assessment began. A review of publications about the effects of COVID-19 provides additional insight into the short- and long-term impacts on elementary and secondary students. (See sidebar **Impact of COVID-19 on K–12 Students**.)

Figure K12-5

Score declines for 9-year-old students on the NAEP long-term trend mathematics assessment, by race or ethnicity and percentile: 2020 and 2022



NAEP = National Assessment of Educational Progress.

Note(s):
Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 2020 and 2022 NAEP long-term trend mathematics assessments, National Center for Education Statistics.

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SIDEBAR

Impact of COVID-19 on K–12 Students

Many researchers have attempted to quantify the detrimental and differential impact of COVID-19 on the academic lives of K–12 students (Bauld 2022; Mineo 2022). Researchers' statistical models suggest that the impact of COVID-19 may be long lasting, with a domino effect of weeks to months of disrupted learning followed by months of learning recovery difficulties and, potentially, lifelong effects on students' academic and financial well-being (Fahle et al. 2022; Goldhaber, Kane, and McEachin 2021).

Analyses of MAP Growth assessment data from 5.4 million students from third grade through eighth grade before and during the pandemic-affected years (i.e., 2019–22) support the National Assessment of Educational Progress finding that students have missed significant amounts of learning as a result of the pandemic (Kuhfeld, Soland, and Lewis 2022). Specifically, NWEA found that mathematics test scores dropped by 0.20–0.27 standard deviations (SDs) from fall 2019 to fall 2021. In comparison, other major school disruptions, such as the 2005 Hurricane Katrina in New Orleans, resulted in a drop of 0.17 SDs. Even as students' scores returned to normal rates of growth in 2022, that would not be enough to make up for disrupted learning during the pandemic years (Kuhfeld, Soland, and Lewis 2022; Mervosh 2022; Sawchuk and Sparks 2020). NWEA suggests that above-average growth will be needed. NWEA estimates that if learning interventions are implemented to address learning declines, elementary school students may, on average, fully recover from pandemic learning disruptions in 3 years or more. NWEA projects that middle school students would need 5 years or more to recover, meaning that those students may not have enough time to recover before graduating high school.

The challenge of academically recovering from COVID-19 is further complicated by the exacerbation of existing structural inequities in the education system. Evidence indicates that COVID-19 disproportionally affected disadvantaged, systematically excluded students, including those students in high-poverty school districts, students with disabilities, Black students, and Hispanic students (Center on Reinventing Public Education [CRPE] 2022; Fahle et al. 2022; Goldhaber et al. 2022; Jones 2021; Kuhfeld, Soland, and Lewis 2022). Researchers are particularly concerned about high-poverty schools, where students have experienced considerably more disrupted learning than students in more resourced school environments. Additionally, these students are more likely to have experienced negative health, emotional, and financial impacts from the pandemic (Thorn and Vincent-Lancrin 2021; West and Lake 2021) and will need more significant funding and interventions to reach pre-pandemic learning levels.

Research suggests that the greater impact of COVID-19 on students in high-poverty schools is attributable to a variety of factors, including the complexity of remote learning's role in student performance during the pandemic. Most, if not all, students experienced a learning mode transition from in-person instruction to online learning during the onset of the pandemic (Berger et al. 2022; De Leon 2022). However, in an analysis of 2.1 million students across 10,000 schools in 49 states, students in high-poverty schools spent almost twice as much time (22 weeks) in fully remote learning environments than did those in high-income schools (13 weeks) (CRPE 2022). Goldhaber et al. (2022) suggest that these differences in remote learning experiences led to more disrupted learning and larger academic declines (as much as 50% more achievement declines in mathematics) for students in high-poverty schools.

The experiences of high school students impacted by COVID-19 who graduated in 2020 and 2021 also differed, with more substantial impacts noted for students graduating from high school in 2021 (Kurtz et al. 2021). Specifically, an EdWeek Research Center nationally representative survey of high-achieving high school graduates in 2020 and 2021 revealed that the 2021 graduates were more likely than their 2020 counterparts to delay or cancel their postsecondary plans to pursue more education and reported using earnings from afterschool jobs to support their family rather than using them for college-related costs. The 2021 high school graduates impacted by COVID-19 were also more concerned about their financial future than the 2020 graduates were. This concern aligns with the Organisation for Economic Co-operation and Development's and others' projections of the impact of COVID-19 disruptions on students' lifetime earnings.

Economists have estimated the effects of disrupted learning on students' lifetime earnings. One model suggests that the average K–12 student in the United States who experienced disrupted learning in 2020 will have approximately 6% lower lifetime earnings, which will have a substantial effect on income for the students themselves and on the U.S. economy as a whole (Hanushek 2023). Another statistical model suggests that each student affected by the pandemic may expect an average lifetime earning loss from approximately $20,000 to $45,000, resulting in an aggregate loss of from $900 billion to $1 trillion dollars for the U.S. economy (Kane et al. 2022). Given the unprecedented nature of the pandemic, it is important to note that these models suggest potential outcomes that could change if learning declines are reversed. If the mathematics achievement declines become permanent, then

income inequality between pandemic-affected cohorts and pre-pandemic cohorts is likely (Goldhaber et al. 2022). These economic forecasts have sparked conversations among policymakers, educators, and state legislators about the importance of learning recovery and how to fund these efforts. Researchers suggest that the funds should be used for learning recovery initiatives that are data informed and evidence based, including high-dose tutoring, summer enrichment, and extended school time (Bauld 2022; Jordan, DiMarco, and Toch 2022). Others suggest that funds should be used to reduce the technology disparities across student groups illuminated by the pandemic (Rodriguez and Ishmael 2022).

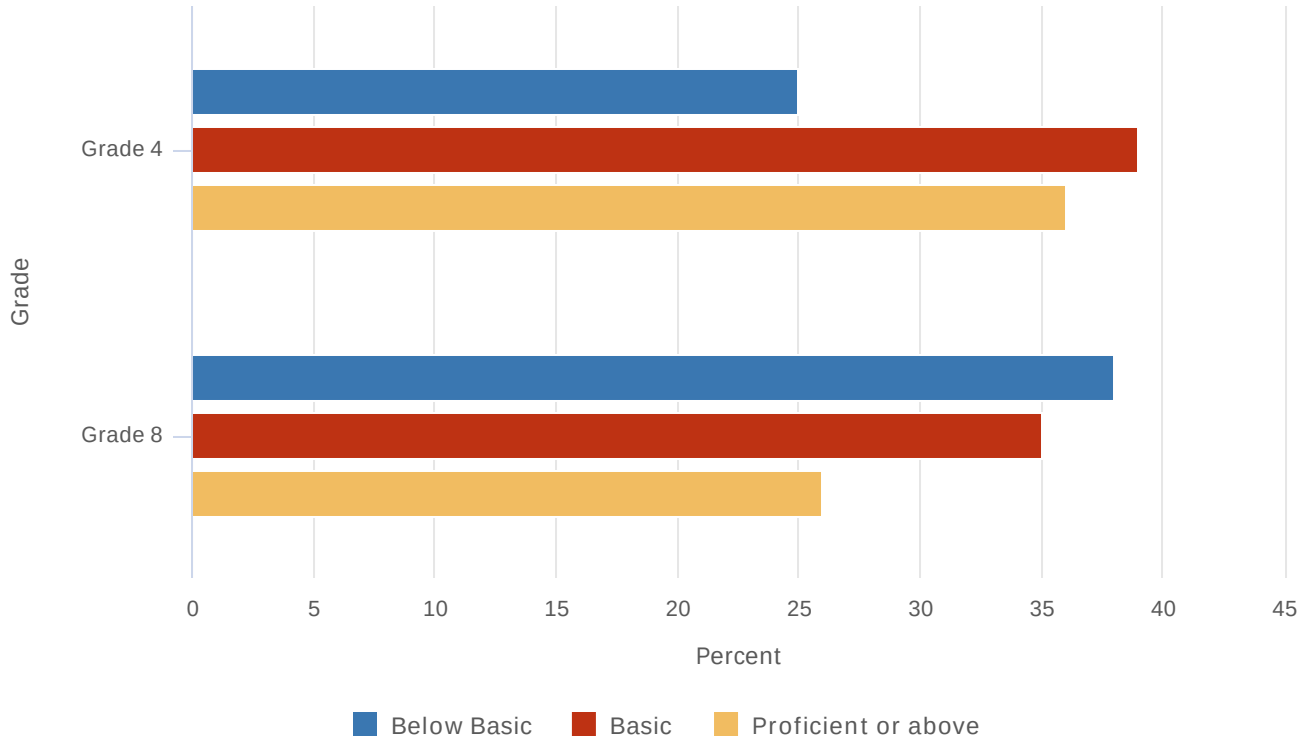
Analysis of NAEP Achievement Levels in 2019 and 2022

In addition to providing scale scores, the main NAEP also reports student performance in terms of achievement levels. The assessment's three achievement levels—NAEP Basic, NAEP Proficient, and NAEP Advanced—are measures of what students should know and be able to do at each grade level.[6] Unlike NAEP scale scores, which are not comparable across grade levels, NAEP achievement levels allow for comparison of student performance across grade levels. NAEP Proficient represents solid academic performance for each grade assessed. Students reaching this level have demonstrated competency over challenging subject matter. NAEP Proficient represents the goal for what all students should know.

In 2022, the percentage of students scoring NAEP Proficient or above declined to the lowest level since 2005 for fourth graders and since 2000 for eighth graders. In 2022, 36% of fourth graders and 26% of eighth graders scored NAEP Proficient or above, indicating that student performance is lower in higher grades (**Figure K12-6**). The percentages in 2022 represent drops of 5 percentage points for fourth graders and 7 percentage points for eighth graders compared with 2019 (Table SK12-3).

Figure K12-6

Students in grades 4 and 8 scoring at each NAEP achievement level in mathematics, by grade: 2022



NAEP = National Assessment of Educational Progress.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 2022 main NAEP mathematics assessment, National Center for Education Statistics.

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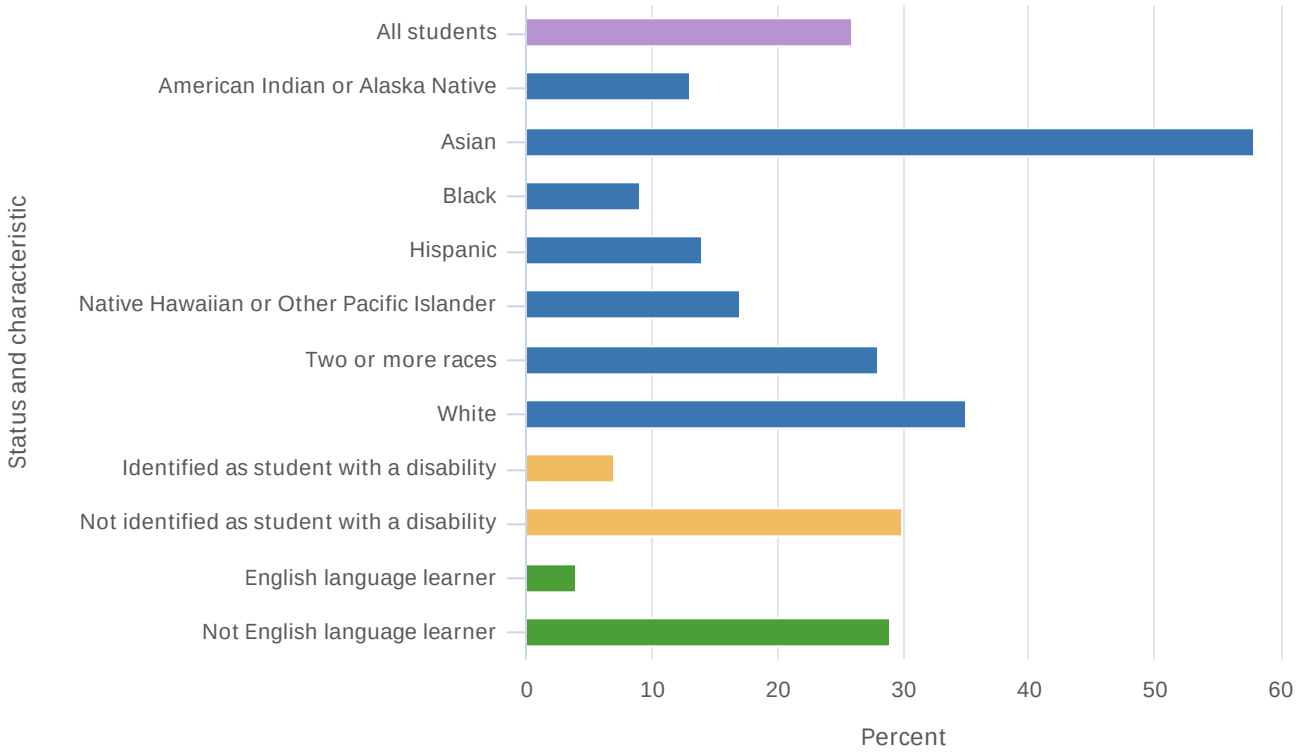
Comparison of proficiency levels by student characteristics shows that many student groups have low percentages of students scoring NAEP Proficient or above in mathematics. In 2022, 9% of Black eighth graders and 14% of Hispanic eighth graders scored NAEP Proficient or above (**Figure K12-7**). Lower percentages were seen for eighth graders identified as students with a disability at 7% and for eighth graders identified as English learners at 4%.

Figure K12-7

Students in grade 8 scoring NAEP Proficient or above in mathematics, by race or ethnicity, student disability status, and English language learner status: 2022



NAEP = National Assessment of Educational Progress.

Note(s):
Black includes African American. Hispanic includes Latino. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 2022 NAEP mathematics assessment, National Center for Education Statistics.

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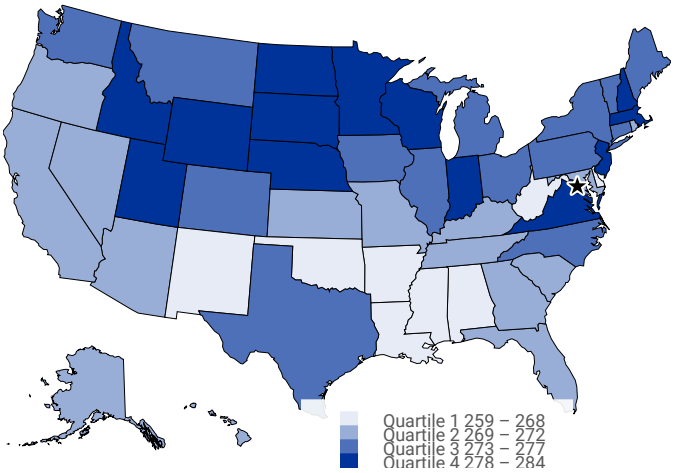
Geographic Analysis of NAEP Achievement Scores

Average student scores also varied by state. Average NAEP mathematics scores in 2022 for students in eighth grade ranged from 259 to 284 (**Figure K12-8**). Students in New Mexico, the District of Columbia, and West Virginia had the lowest average scores, whereas students in Massachusetts, Utah, and Idaho had average scores that were higher than average scores for students in 40 other states. At the regional level, students in the Northeast (278) and Midwest (277) scored higher than students in the West (273) and South (272) (Table SK12-2). NAEP also provides average scores for students in 26 urban districts across the United States.[7] In 2022, students in Charlotte had a higher average score than students in all urban districts except for San Diego. Students in Detroit had the lowest average score (**Figure K12-9**). Charlotte was the only district whose students scored significantly higher than the national average, whereas in 23 districts, including New York, Chicago, and Los Angeles, student scores were significantly lower than the national average score.

Figure K12-8

Average scores of students in grade 8 on the main NAEP mathematics assessment, by state: 2022



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, special tabulations (2022) of the 2022 main NAEP mathematics assessment, National Center for Education Statistics.

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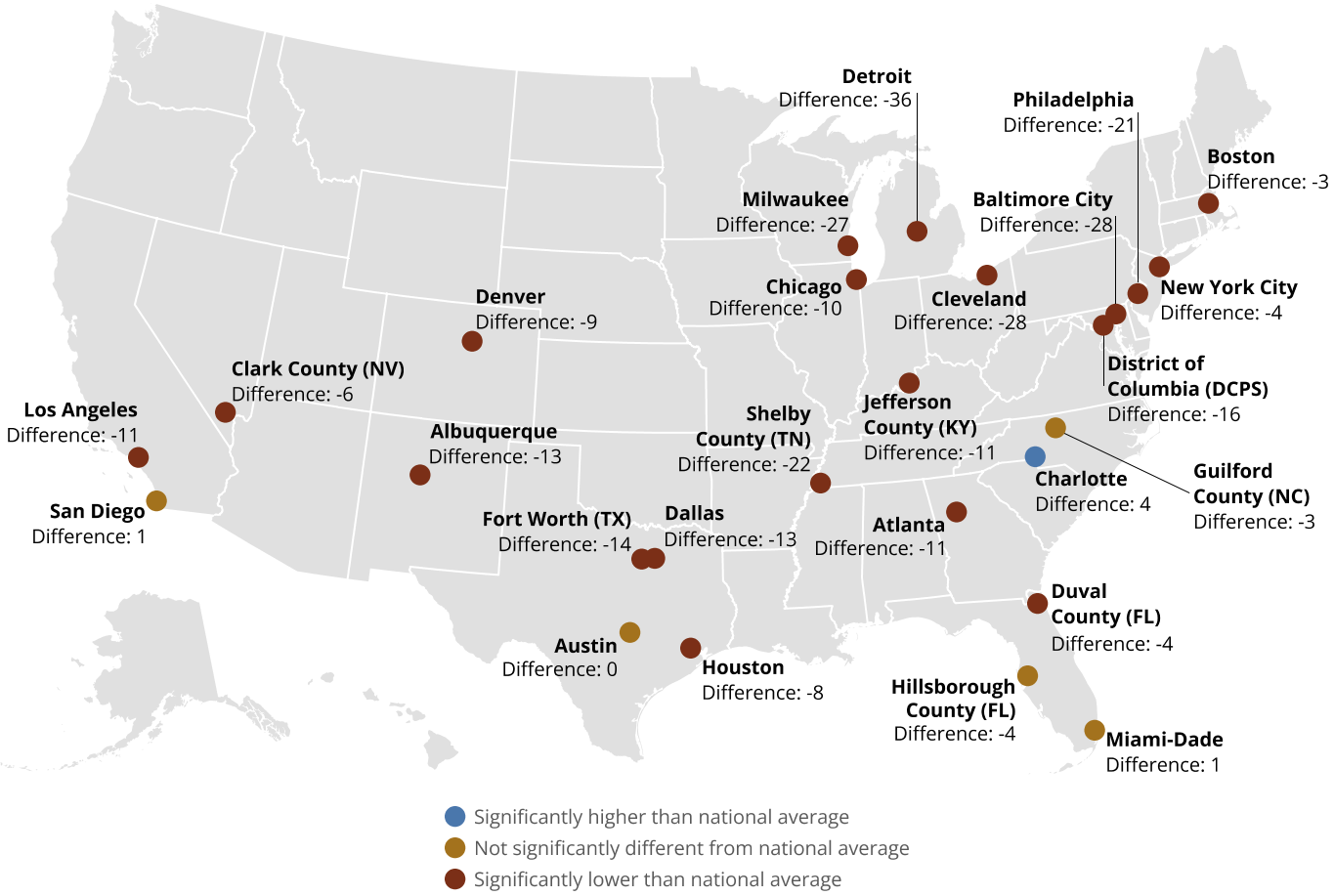
Figure K12-9

Comparison of average scores of students in grade 8 in urban school districts with national public average score on the main NAEP mathematics assessment: 2022



DCPS = District of Columbia Public Schools; NAEP = National Assessment of Educational Progress.

Note(s):
The scale for NAEP mathematics assessment scores is 0–500 for grade 8. The national average score of 273 is for national public schools only.

Source(s):
National Center for Science and Engineering Statistics, special tabulations (2022) of the 2022 main NAEP mathematics assessment, National Center for Education Statistics.

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International Comparisons of Mathematics and Science Performance

A nation's knowledge and skills in STEM derive from a foundation of elementary and secondary mathematics and science education. Assessing these skills in an international context allows policymakers and educators to assess the status and progress of STEM education in the competitive landscape of a rapidly changing global economy and to design approaches to improve STEM learning (Bush 2019; Committee on STEM Education 2018; Department of Education 2022). The Trends in International Mathematics and Science Study (TIMSS) provides data on the mathematics and science achievement of students in the United States and in a wide array of other countries.[8] TIMSS, conducted every 4 years beginning in 1995 (and, most recently, in 2019), assesses mathematics and science at the fourth and eighth grades.

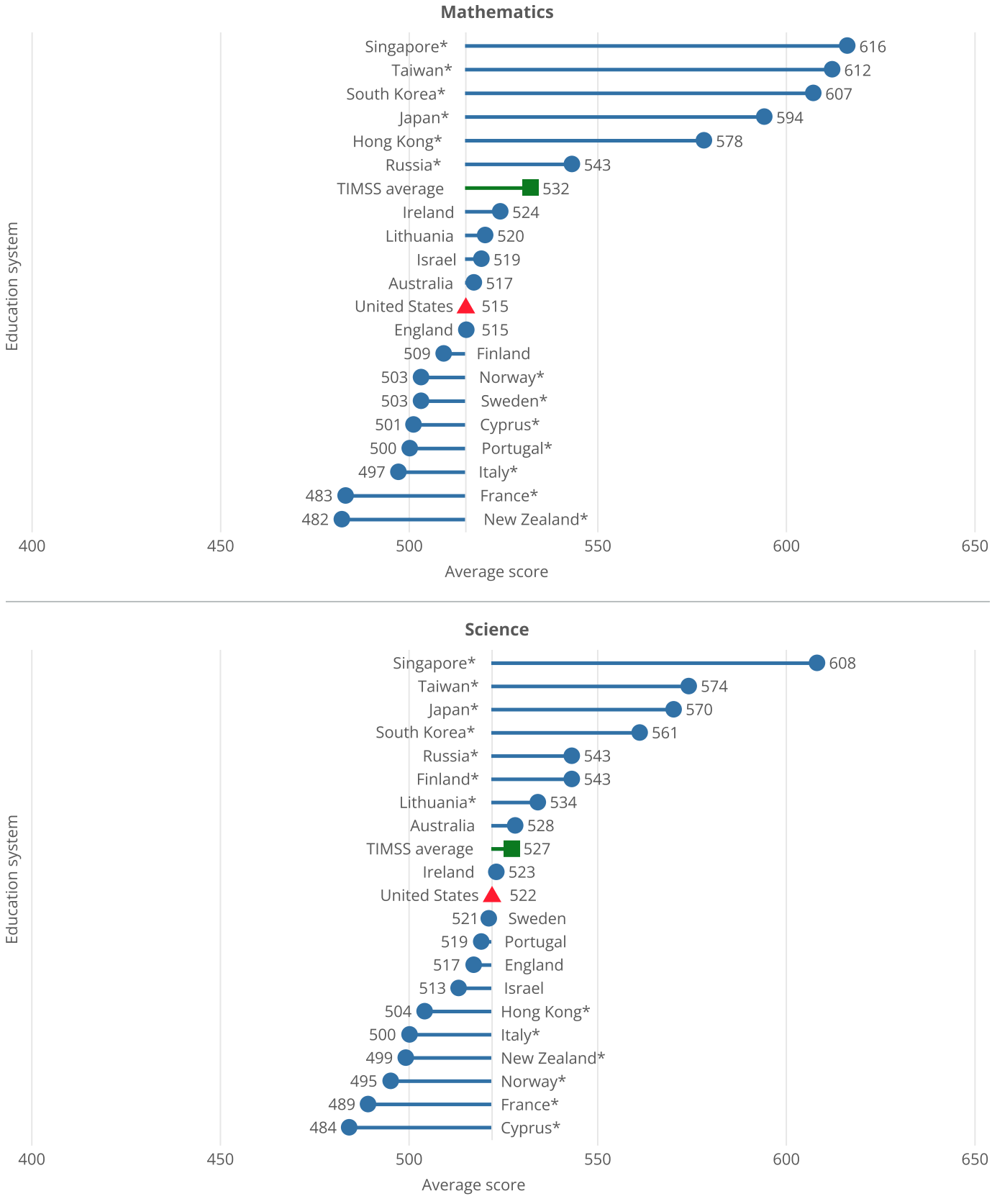
The analyses here focus on results for the United States and other advanced economies, as defined by the International Monetary Fund (IMF) (IMF 2022). The analyses also focus on the eighth-grade results. Another international assessment, the Programme for International Student Assessment (PISA), measures the performance of 15-year-old students in mathematics and science literacy every 3 years. *Indicators 2022* discusses the 2018 PISA results; new data were not available for the current *Indicators* report. (See the *Indicators 2022* report "[2022] **Elementary and Secondary STEM Education**," specifically the "**International Comparisons of Mathematics and Science Performance**" section.)

U.S. Performance in 2019

In general, U.S. eighth-grade students ranked in the middle of students from other advanced economies participating in TIMSS in 2019. Among 19 advanced economies that participated in TIMSS 2019 at the eighth-grade level,[9] the United States placed 7th in mathematics, with scores statistically similar to those of six other systems, including England, Finland, and Australia (**Figure K12-10**). Six systems, including Singapore and Taiwan, had average mathematics scores that were statistically higher than the U.S. score; seven systems, including Norway and Sweden, had scores that were statistically lower. U.S. eighth graders' average science scores placed them 8th among the 19 advanced economies, with scores statistically similar to those of six other systems. Seven systems, including Singapore and Taiwan, had average scores that were statistically higher than the U.S. score; six systems, including Hong Kong and France, had scores that were statistically lower.

Figure K12-10

Average scores of students in grade 8 on the TIMSS mathematics and science scales among participating advanced economies, by education system: 2019



* $p < 0.05$. Significantly different from the U.S. estimate at the 0.05 level of statistical significance.

TIMSS = Trends in International Mathematics and Science Study.

Note(s):
TIMSS participants include countries, which are complete, independent political entities, and non-national entities (e.g., Hong Kong). Advanced economies are based on the International Monetary Fund (IMF) designation of advanced economies (IMF 2022). IMF does not classify Russia as an advanced economy, but it is included in this analysis because it is a large economy with high levels of student achievement. Education systems are ordered by average mathematics score.

Source(s):
International Association for the Evaluation of Educational Achievement, TIMSS, 2019.

Science and Engineering Indicators

U.S. Performance over Time

U.S. performance has improved in mathematics since the first administration of TIMSS in 1995 (**Table K12-2**). At the fourth- and eighth-grade levels, U.S. students on average scored higher in mathematics in 2019 than in 1995. U.S. performance in science in 2019 has shown no statistically significant change compared with 1995 at either grade level.

Table K12-2

Average TIMSS mathematics and science scores of students in grades 4 and 8: 1995–2019

(Average score)

Grade and subject	1995	1999	2003	2007	2011	2015	2019
Grade 4 mathematics	518	NA	518	529	541	539	535
Grade 8 mathematics	492	502	504	508	509	518	515
Grade 4 science	542	NA	536	539	544	546	539
Grade 8 science	513	515	527	520	525	530	522

NA = not available; assessments were not given for grade 4 in 1999.

TIMSS = Trends in International Mathematics and Science Study.

Source(s):
International Association for the Evaluation of Educational Achievement, TIMSS, 1995, 1999, 2003, 2007, 2011, 2015, and 2019.

Science and Engineering Indicators

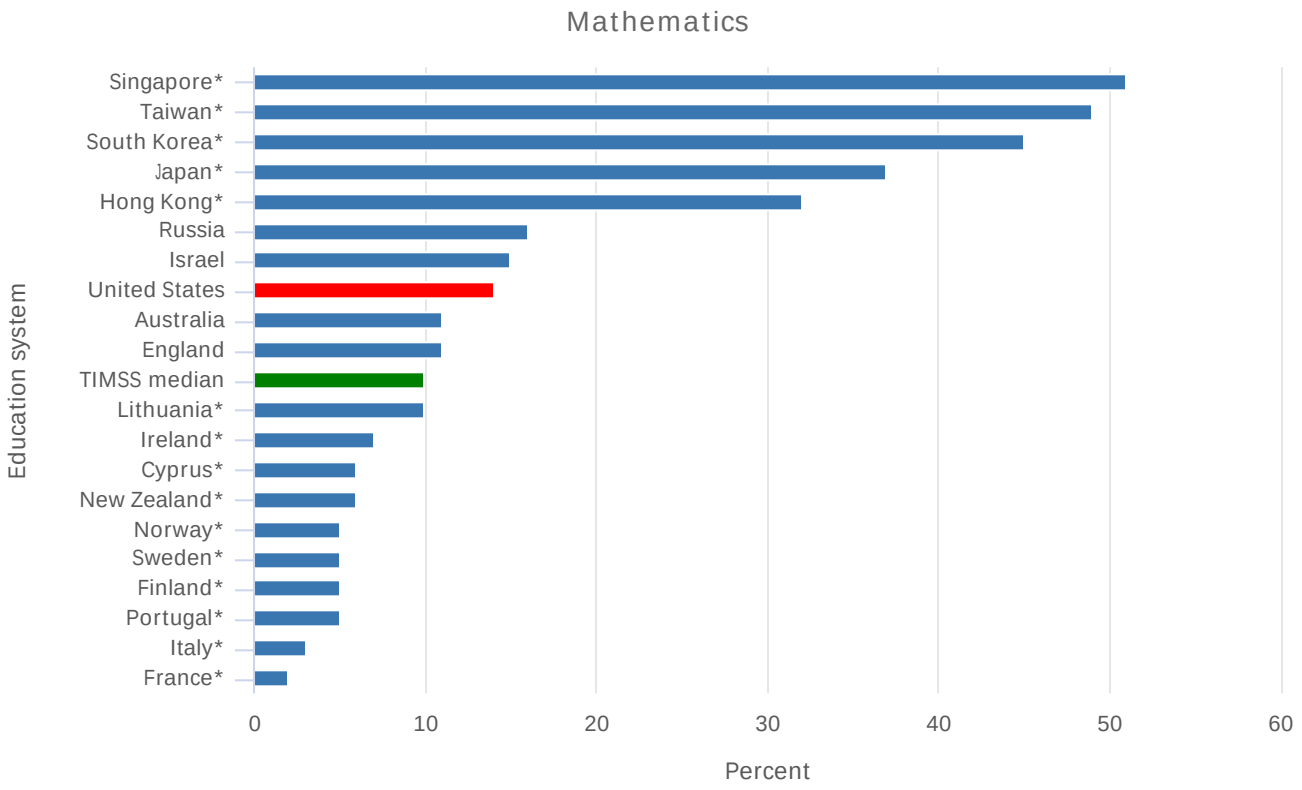
Percentage of Students Reaching TIMSS Advanced Benchmarks

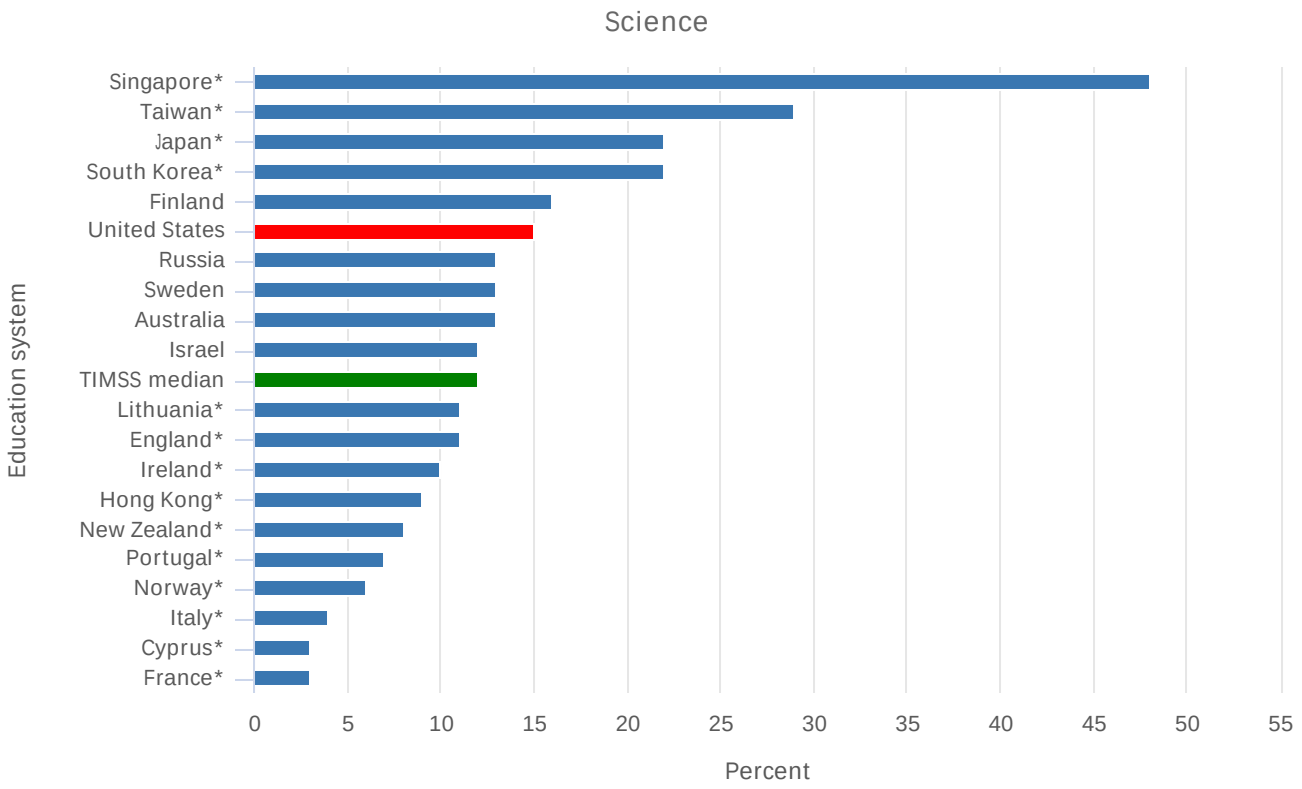
In addition to providing average scores across education systems and over time, TIMSS data also provide information on the percentage of students reaching defined benchmarks of performance. TIMSS designates four international benchmarks, each of which corresponds to a specific score on the 0–1,000 TIMSS scale: Low (400), Intermediate (475), High (550), and Advanced (625). Students scoring at or above a specific benchmark have demonstrated a specific set of skills and knowledge that enables a concrete interpretation of student performance at that level. For example, at the Advanced level in eighth-grade mathematics, students can "apply and reason in a variety of problem situations, solve linear equations, and make generalizations," including solving problems involving fractions, proportions, percentages; algebraic expressions; angles, areas, and surface areas; and data displays and statistical concepts such as mean and median. For more information on the TIMSS international benchmarks, see Mullis et al. (2020).

Approximately 15% of U.S. eighth graders reached the Advanced benchmark in mathematics and science, a considerably lower percentage than those in the top-scoring countries (**Figure K12-11**). Half of the eighth-grade students in Singapore and in Taiwan reached the Advanced benchmark in mathematics, compared with 14% of U.S. students. The U.S. percentage of eighth-grade students reaching the Advanced benchmark in mathematics was similar to those for Russia, Australia, and Israel. In science, Singapore outpaced all advanced economies in the percentage of eighth-grade students reaching the Advanced benchmark (48%), followed by the next closest, Taiwan, at 29%. The U.S. percentage of 15% at the Advanced benchmark in science was similar to those of Finland, Russia, Sweden, and Australia. The United States posted gains in the percentage of students scoring at or above Advanced between 2015 and 2019. During that time, the percentage of eighth-grade students reaching the Advanced benchmark increased from 10% to 14% in mathematics and from 12% to 15% in science (Table SK12-6).

Figure K12-11

Students in grade 8 reaching the TIMSS Advanced International Benchmark in mathematics and science among participating advanced economies, by education system: 2019





* $p < 0.05$. Significantly different from the U.S. estimate at the 0.05 level of statistical significance.

TIMSS = Trends in International Mathematics and Science Study.

Note(s):
TIMSS participants include countries, which are complete, independent political entities, and non-national entities (e.g., Hong Kong). Advanced economies are based on the International Monetary Fund (IMF) designation of advanced economies (IMF 2022). IMF does not classify Russia as an advanced economy, but it is included in this analysis because it is a large economy with high levels of student achievement. Education systems are ordered by the percentage of students reaching the Advanced International Benchmark in mathematics and science. For Norway, there are 9 years of formal schooling; this education system chose to administer TIMSS at a different grade than other education systems (8 years of formal schooling).

Source(s):
International Association for the Evaluation of Educational Achievement, TIMSS, 2019.

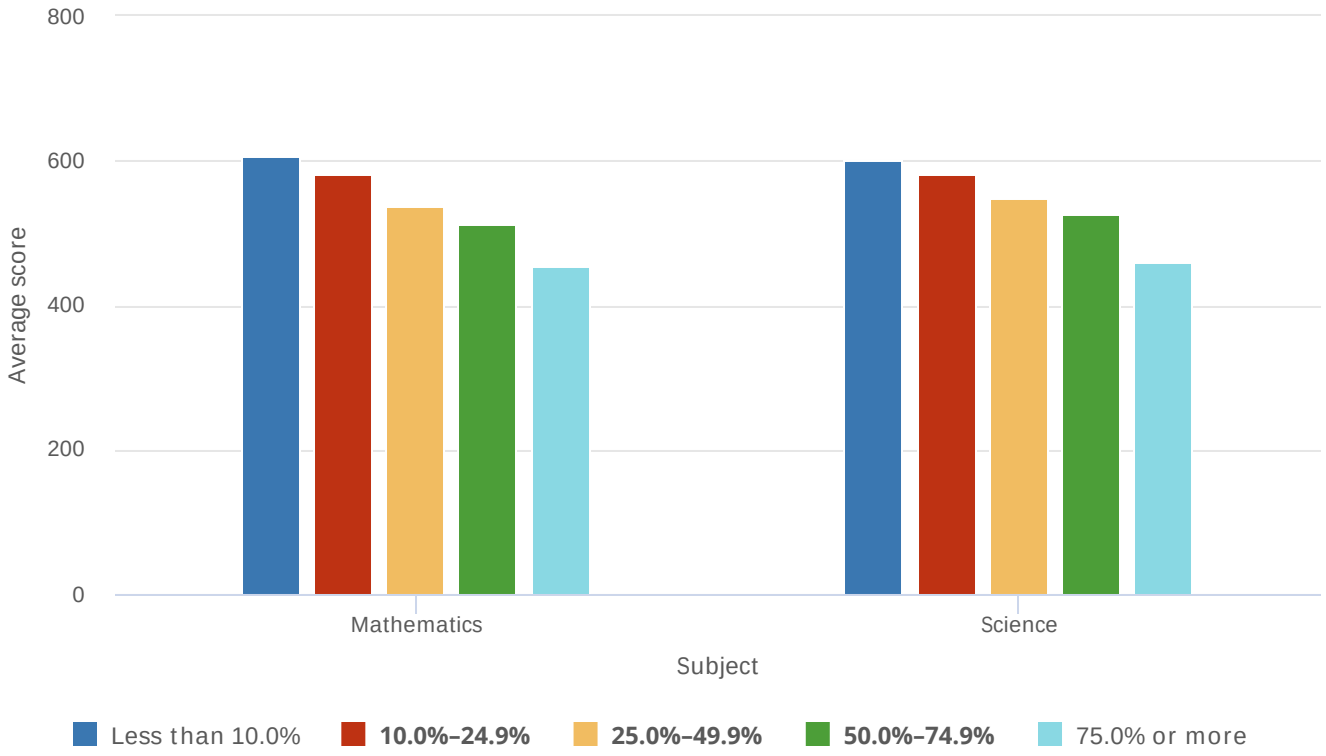
Science and Engineering Indicators

TIMSS Scores, by Student Groups

TIMSS data also provide insight into student performance by demographic groups in the United States, including by sex and by school percentages of students eligible for free or reduced-price lunch. In 2019, there was no statistical difference in the average mathematics or science scores of female and male eighth graders (Table SK12-9). Eighth-grade students in schools where more than 75% of students qualify for free or reduced-price lunch scored 454 in mathematics in 2019, compared with an average score of 606 for students at schools with less than 10% of students qualifying (**Figure K12-12**). The pattern for science is similar, with average scores of 460 and 602 at the respective high and low ends.

Figure K12-12

Average scores of U.S. students in grade 8 on the TIMSS mathematics and science scales, by school percentage of students eligible for free or reduced-price lunch: 2019



TIMSS = Trends in International Mathematics and Science Study.

Source(s):
International Association for the Evaluation of Educational Achievement, TIMSS, 2019.

Science and Engineering Indicators

Post–High School Transitions

Transition to Postsecondary Education

The U.S. education system strives to prepare every high school graduate for a career or for college, although studies suggest that more progress is needed in preparing students for these pathways after high school. Research shows that fewer than half of students may have the skills needed to succeed in college coursework or in the workforce (ACT, Inc. 2019; Cushing et al. 2019). In recent years, preparation for postsecondary education and work has also been substantially affected by the COVID-19 pandemic and its associated school disruptions. In addition to declines observed in student achievement at the elementary and middle school levels (Kuhfeld, Soland, and Lewis 2022; Schneider 2022), reports indicate that high school students were less prepared for college and less likely to enroll immediately in college compared with high school students before the pandemic (ACT, Inc. 2022; Harris and Chen 2022). At the same time, the long-term trend prior to the pandemic involved increasing academic coursetaking and performance in high school, which may serve as a bulwark against lasting learning achievement declines.

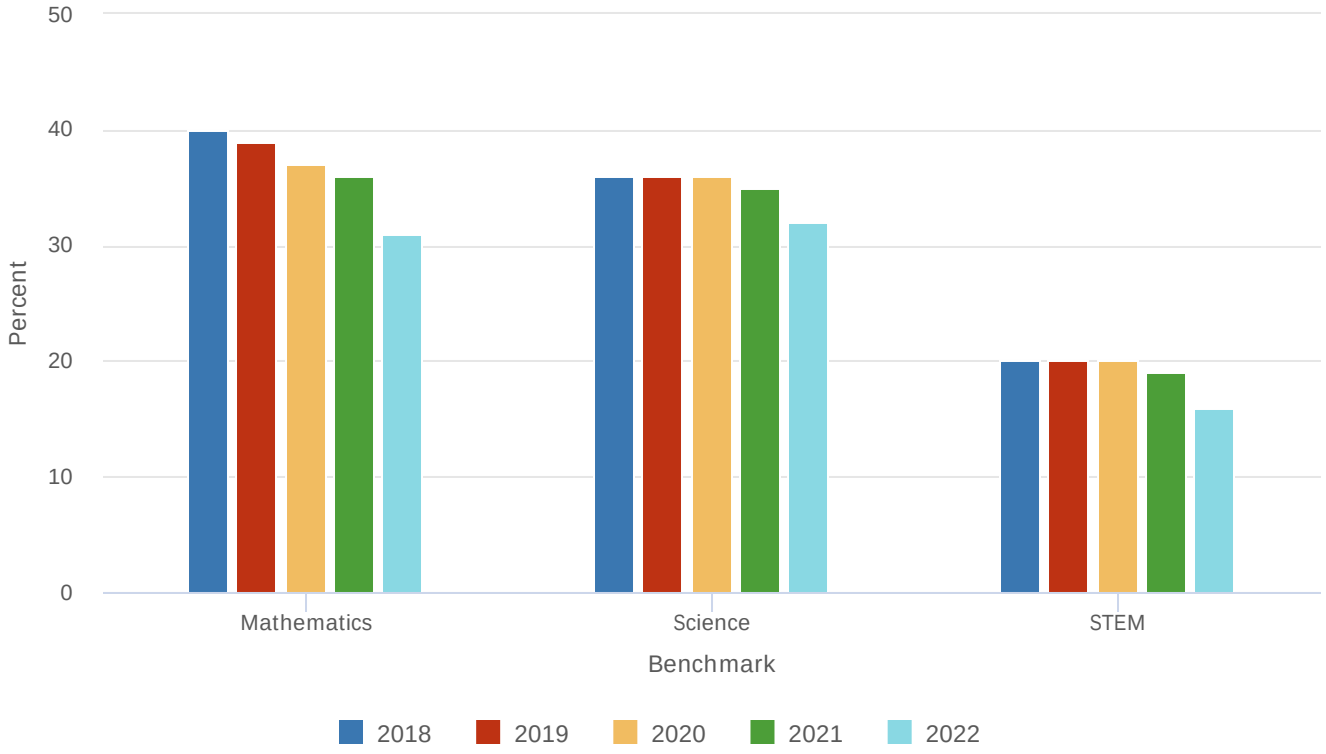
Readiness for College

The first step toward preparing for college requires graduating from high school. The national graduation rate for public high school students in 2019–20, the last year with federal data available, was 87%, the highest since the current measure was created in 2010–11 (NCES 2023). Initial research on whether graduation rates changed during the pandemic suggests that graduation rates in many states remained relatively stable in 2019–20, partly because schools relaxed graduation standards for students affected by the pandemic (Harris and Chen 2022). Rates began to dip in the 2020–21 school year, however, as students experienced the first full school year of disruptions caused by the pandemic. An analysis of state graduation rates showed declines in 20 of the 26 states that reported results in 2021 (Barnum, Belsha, and Wilburn 2022).

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, including attainment of nondegree credentials (Carnevale et al. 2020; NASEM 2017; NSB 2019). The ACT, a standardized college admissions test, provides information on the academic readiness of high school students for college, including the percentage of students reaching college readiness benchmarks in STEM subjects.[10] Along with recent NAEP results, the ACT scores indicate the impact of disrupted learning on student outcomes, with the percentage of students meeting STEM readiness benchmarks dropping from 2021 to 2022 (**Figure K12-13**). The percentage of graduates meeting each benchmark dropped from 36% to 31% in mathematics, from 35% to 32% in science, and from 19% to 16% in STEM (combined mathematics and science performance).[11] Low percentages of students reaching college readiness benchmarks declined further during the pandemic.

Figure K12-13

Students meeting ACT college readiness benchmarks in mathematics, science, and STEM: 2018–22



STEM = science, technology, engineering, and mathematics.

Note(s):
A benchmark is, specifically, the "minimum score needed to reach a 50% chance of obtaining a B or higher or a 75% chance of obtaining a C or higher in corresponding college courses." The STEM benchmark represents students' combined performance on the ACT mathematics and science tests.

Source(s):
ACT, Inc., 2022, *The ACT Profile Report—National: Graduating Class 2022*, available at https://www.act.org/content/dam/act/unsecured/documents/2022/2022-National-ACT-Profile-Report.pdf.

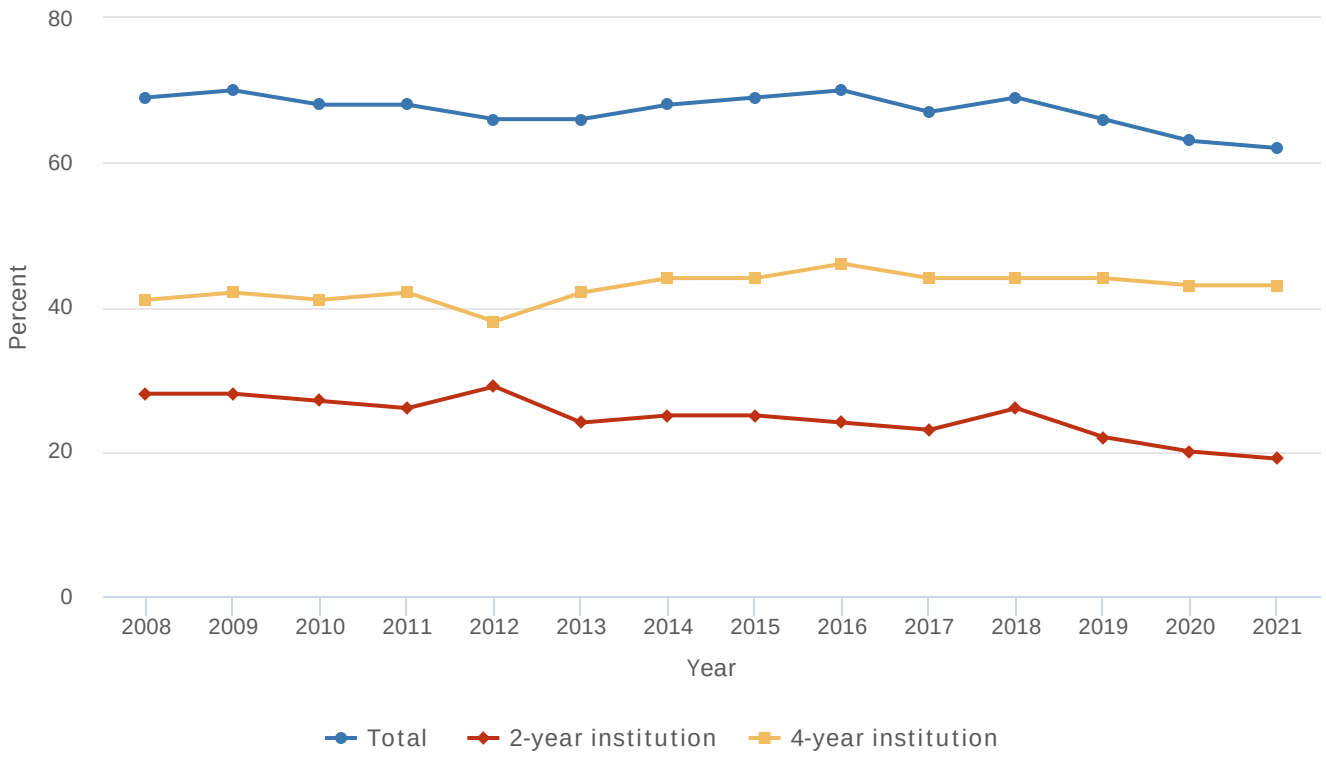
Science and Engineering Indicators

Immediate Enrollment in Postsecondary Education

Estimates from the Census Bureau's Current Population Survey indicate that about 62% of students who completed high school were enrolled in college by October 2021 (**Figure K12-14**).[12] This represents a drop of about 7 percentage points since 2018. Given that enrollment in 4-year institutions has remained stable since 2018, most of this change is due to a decline in enrollment rates at 2-year institutions. In 2021, 19% of high school completers were enrolled in a 2-year institution, compared with 26% in 2018.

Figure K12-14

Immediate college enrollment rates among high school completers, by institution type: 2008–21



Note(s):
The figure includes 16- to 24-year-old students who graduated from high school or completed a GED or other high school equivalency credential in each survey year. Immediate college enrollment rates are defined as rates of high school completers enrolled in college in October after completing high school earlier in the same calendar year. Percentages may not add to 100% because of rounding.

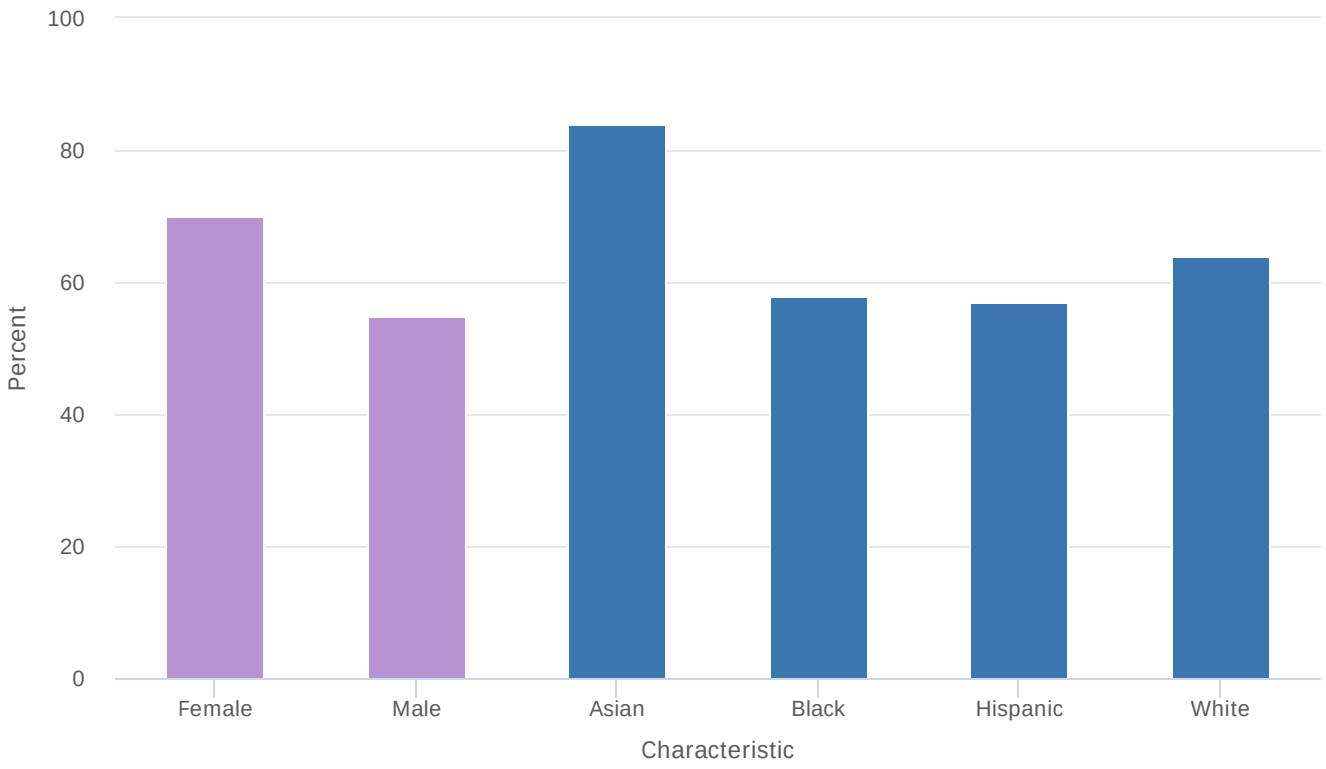
Source(s):
De Brey C, Snyder TD, Zhang A, Dillow SA, *Digest of Education Statistics: 2021,* NCES 2023-009, Tables 302.10 and 302.20, Department of Education, National Center for Education Statistics (2023). https://nces.ed.gov/programs/digest/current_tables.asp.

Science and Engineering Indicators

Immediate college enrollment rates in 2021 continued to show differences by student groups. Rates were higher for female students than for male students (70% and 55%, respectively) (**Figure K12-15**). Asian students enrolled at a substantially higher rate (84%) than students from other racial or ethnic groups, including White students (64%), Black students (58%), and Hispanic students (57%).

Figure K12-15

Immediate college enrollment rates among high school completers, by sex and race or ethnicity: 2021



Note(s):
The figure includes 16- to 24-year-old students who graduated from high school or completed a GED or other high school equivalency credential in 2021. Immediate college enrollment rates are defined as rates of high school completers enrolled in college in October after completing high school earlier in the same calendar year. Hispanic may be any race; race categories exclude Hispanic origin.

Source(s):
De Brey C, Snyder TD, Zhang A, Dillow SA, *Digest of Education Statistics: 2021,* NCES 2023-009, Tables 302.10 and 302.20, Department of Education, National Center for Education Statistics (2023). https://nces.ed.gov/programs/digest/current_tables.asp.

Science and Engineering Indicators

STEM Coursetaking in High School

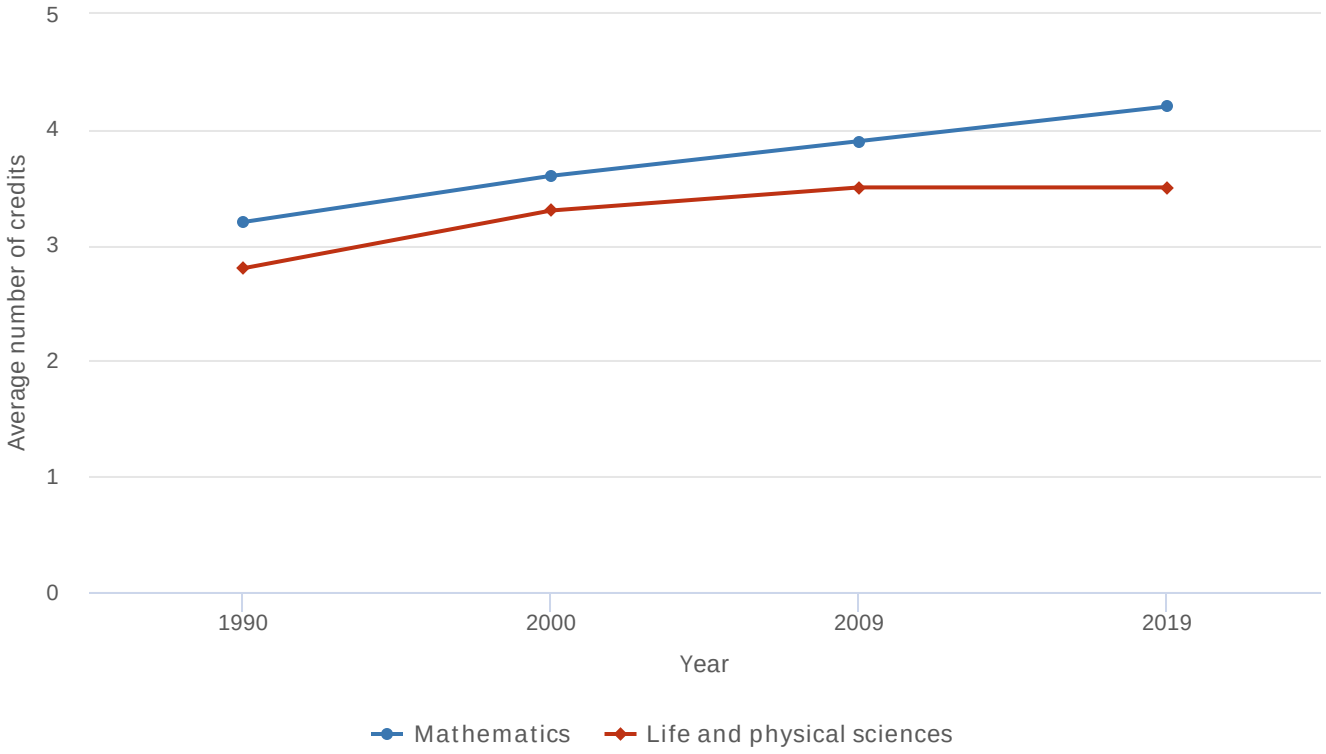
High school preparation in STEM subjects is the first step in ensuring that students are entering postsecondary education or the workforce with the STEM knowledge needed to be successful. This section reviews recent data on high school STEM coursetaking from the 2019 NAEP High School Transcript Study (HSTS) and shows that, prior to the pandemic, students were earning more credits in mathematics than at any other time in the past three decades.[13] Credits earned in science improved over the two decades from 1990 to 2009 but have remained stable since 2009.

Overall STEM Coursetaking in High School

The average number of credits earned by high school graduates grew from 1990 to 2019 (1.0 credit generally equals one year-long course). In 2019, graduates earned an average of 4.2 credits in mathematics and 3.5 in science, about 1.0 credit more than the average earned in 1990 (3.2 and 2.8, respectively) (**Figure K12-16**). Thus, students took approximately 1 full year more in mathematics and science coursework in 2019 than in 1990.

Figure K12-16

Average number of Carnegie credits earned by high school graduates, by academic course subject: 1990–2019



Note(s):
One Carnegie credit is defined as 120 hours of class instruction over the course of a secondary school year.

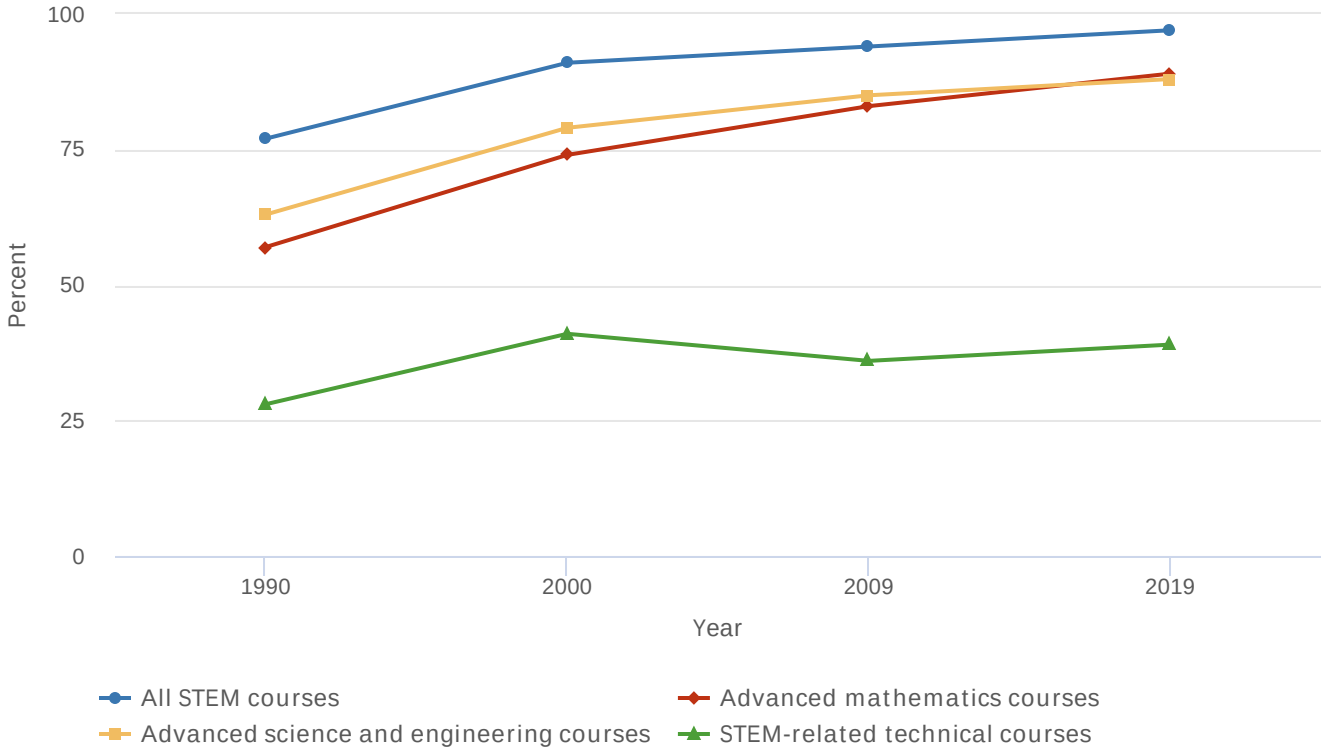
Source(s):
Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress High School Transcript Study, 1990, 2000, 2009, and 2019.

Science and Engineering Indicators

The percentage of high school graduates who earned credits in STEM courses has also increased since 1990 (**Figure K12-17**), with almost all graduates now earning some STEM credits. Between 1990 and 2019, the percentage of graduates earning credits in STEM grew from 77% to 97%. The data also show increases in other course types tracked by HSTS. For example, the percentage of graduates earning credits grew from 57% to 89% in advanced mathematics and from 63% to 88% in advanced science and engineering (S&E).

Figure K12-17

High school graduates who earned Carnegie credits in STEM courses, total and by STEM course type: 1990–2019



STEM = science, technology, engineering, and mathematics.

Note(s):
One Carnegie credit is defined as 120 hours of class instruction over the course of a secondary school year. Advanced mathematics covers courses in algebra II, trigonometry, precalculus and analysis, probability and statistics, and calculus. Advanced science and engineering covers courses in advanced environmental and earth science, advanced biology, chemistry, physics, and engineering. STEM-related technical covers courses in engineering and science technologies, health science and technology, and computer science.

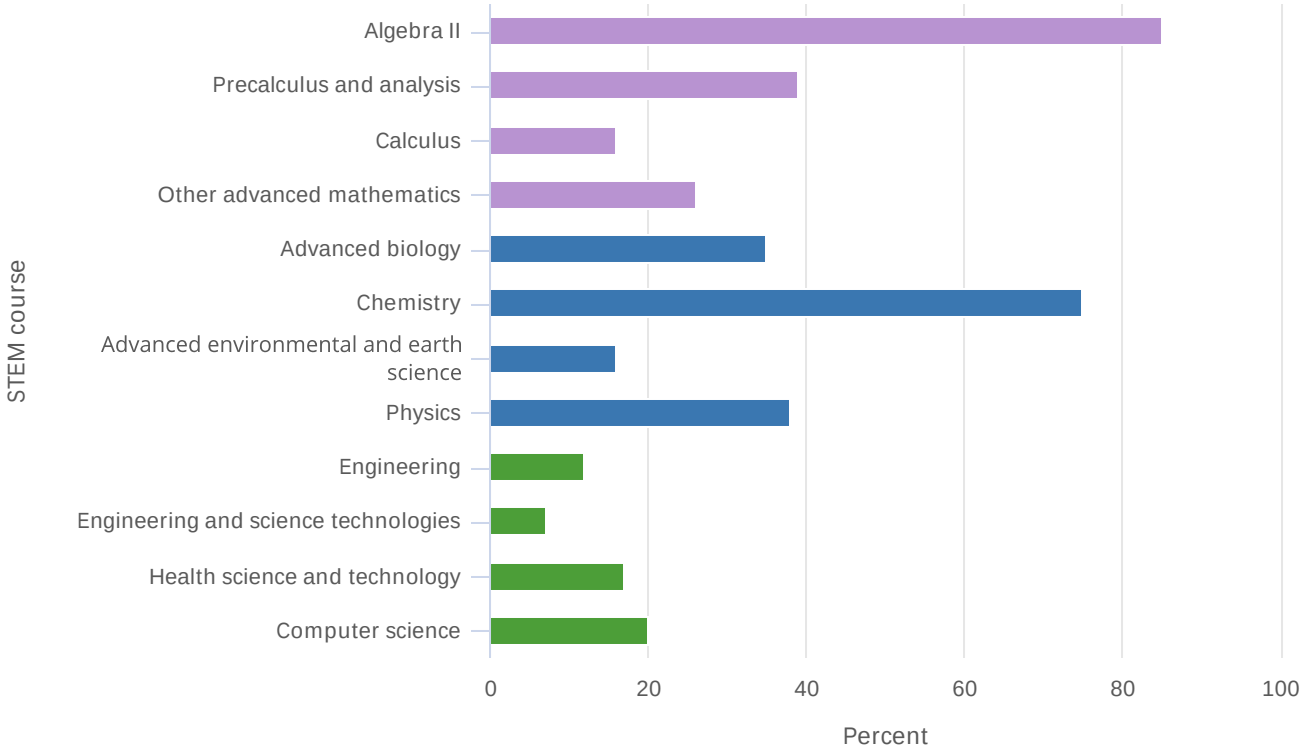
Source(s):
Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress High School Transcript Study, 1990, 2000, 2009, and 2019.

Science and Engineering Indicators

The percentage of graduates earning STEM credits in 2019 varied by course type (**Figure K12-18**). In advanced mathematics, algebra II was the most common course, completed by 85% of students. Calculus was the least common advanced mathematics course, with 16% of students completing it in 2019. In advanced S&E, chemistry was the most common course, with 75% of graduates earning a credit in it. Advanced biology and physics were the next most common, with about a third of students earning credits in those courses. Although the percentage of students earning a credit in engineering was low at 12%, it has increased from almost no students earning such credit in 1990 (Table SK12-10). Among STEM-related technical coursetaking in 2019, computer science was the most common course, with 20% of high school graduates completing it.

Figure K12-18

High school graduates who earned Carnegie credits in STEM advanced mathematics courses, advanced science and engineering courses, and STEM-related technical courses, by STEM course: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
One Carnegie credit is defined as 120 hours of class instruction over the course of a secondary school year. Advanced mathematics covers courses in algebra II, trigonometry, precalculus and analysis, probability and statistics, and calculus. Other advanced mathematics courses include primarily trigonometry and statistics and probability courses. Advanced science and engineering covers courses in advanced environmental and earth science, advanced biology, chemistry, physics, and engineering. Advanced biology courses include Advanced Placement (AP) and International Baccalaureate (IB) biology, physiology, anatomy, and genetics courses. Advanced environmental and earth science courses include AP or IB environmental science, college preparatory earth science, and various geology courses. STEM-related technical covers courses in engineering and science technologies, health science and technology, and computer science. Engineering and science technologies courses focus on instrumentation, equipment maintenance, and other technical tasks conducted in engineering and science-related occupations.

Source(s):
Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress High School Transcript Study, 2019.

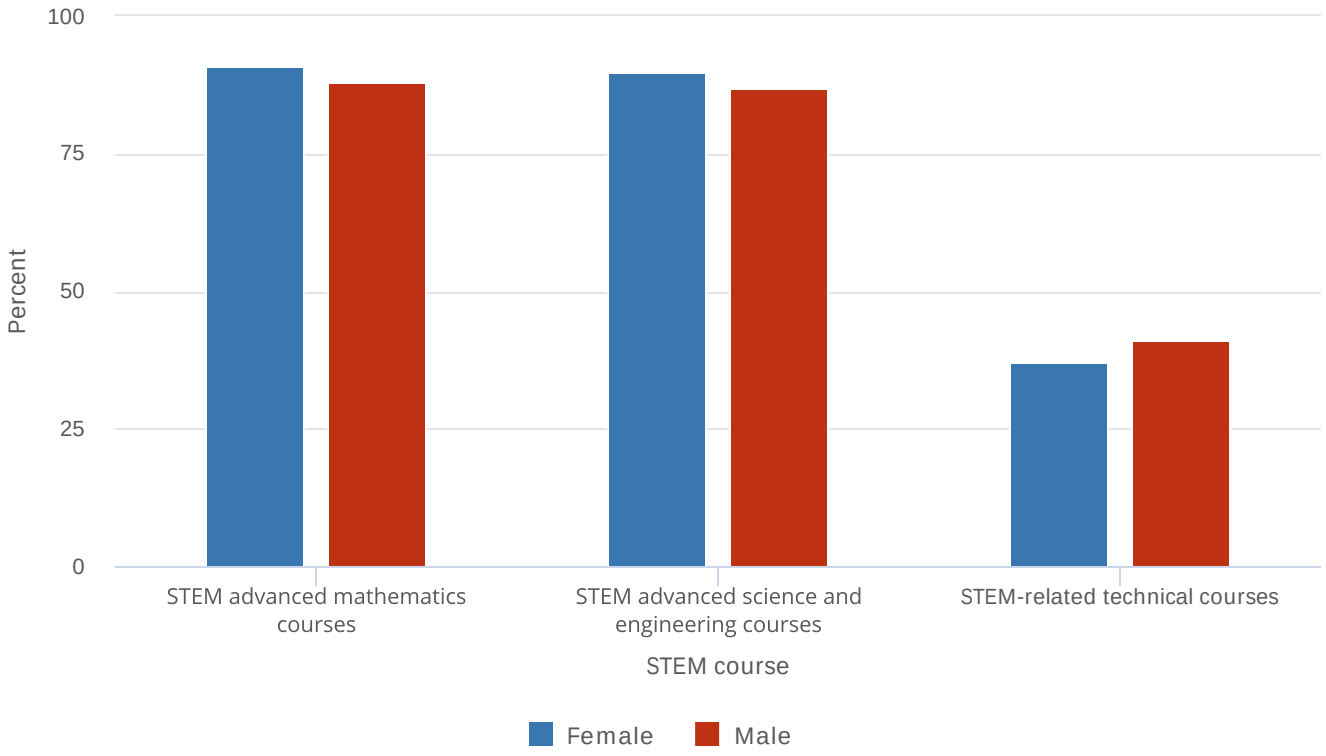
Science and Engineering Indicators

STEM Coursetaking in High School, by Sex and Race or Ethnicity

Although studies show that women are underrepresented in S&E occupations (National Center for Science and Engineering Statistics 2023), in 2019, female graduates earned credits in advanced mathematics and S&E courses at higher rates than men did. Male graduates earned more credits in STEM-related technical courses than women did (**Figure K12-19**).

Figure K12-19

High school graduates who earned Carnegie credits in STEM advanced mathematics courses, STEM advanced science and engineering courses, and STEM-related technical courses, by student sex: 2019



STEM = science, technology, engineering, and mathematics.

Note(s):
One Carnegie credit is defined as 120 hours of class instruction over the course of a secondary school year. Advanced mathematics covers courses in algebra II, trigonometry, precalculus and analysis, probability and statistics, and calculus. Advanced science and engineering covers courses in advanced environmental and earth science, advanced biology, chemistry, physics, and engineering. STEM-related technical covers courses in engineering and science technologies, health science and technology, and computer science.

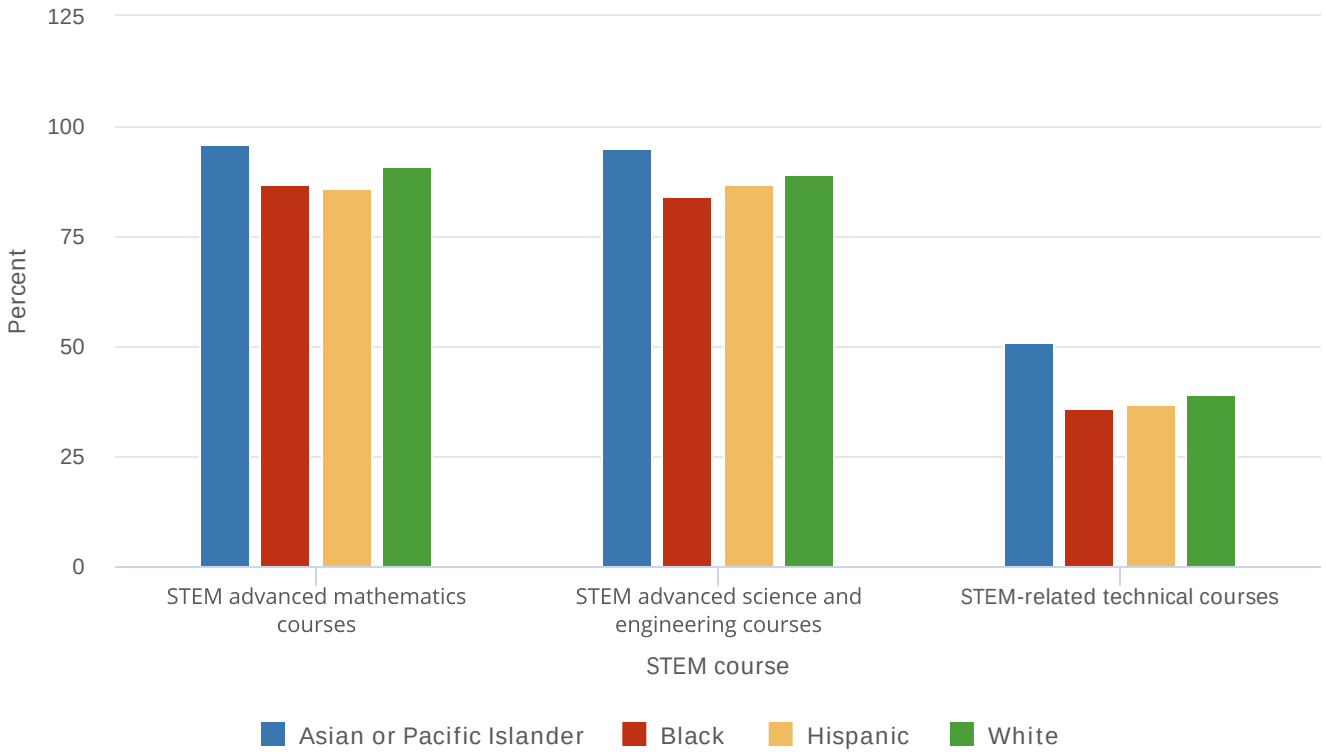
Source(s):
Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress High School Transcript Study, 2019.

Science and Engineering Indicators

As with male and female graduates, nearly all graduates from racial or ethnic groups earned credits in any STEM course in 2019 (Table SK12-11). Differences appear, however, when examining credits earned in specific courses. For example, 95% of Asian or Pacific Islander students earned credits in advanced S&E courses, compared with 89% of White students, 87% of Hispanic students, and 84% of Black students (**Figure K12-20**). Although parity has not yet been reached in STEM coursetaking among racial and ethnic groups, progress has been made since 1990 (**Figure K12-21**). For example, about 45% of Black graduates and 42% of Hispanic graduates earned credits in advanced mathematics in 1990, compared with 87% and 86%, respectively, of those graduates in 2019.

Figure K12-20

High school graduates who earned Carnegie credits in STEM advanced mathematics courses, STEM advanced science and engineering courses, and STEM-related technical courses, by student race or ethnicity: 2019



STEM = science, technology, engineering, and mathematics.

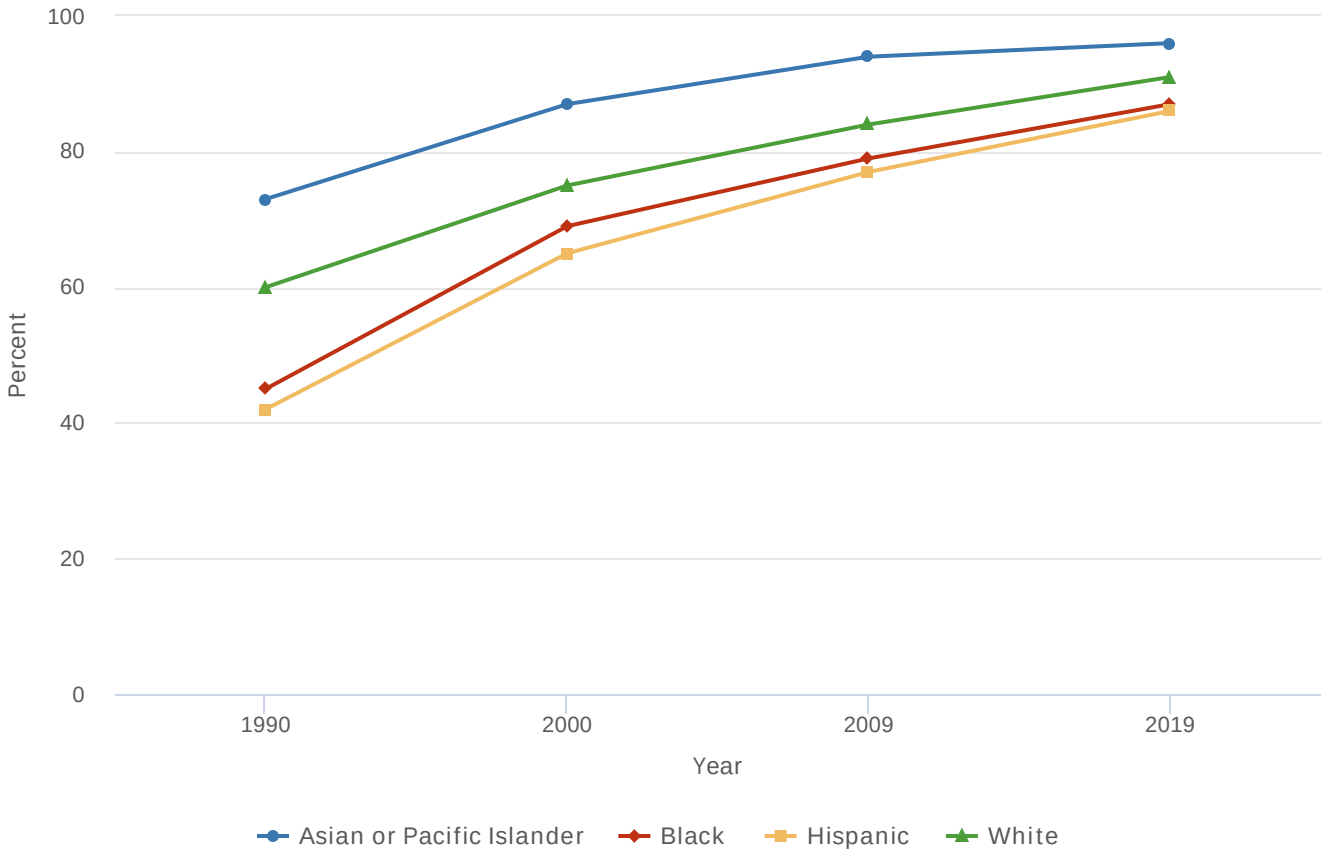
Note(s):
One Carnegie credit is defined as 120 hours of class instruction over the course of a secondary school year. Advanced mathematics covers courses in algebra II, trigonometry, precalculus and analysis, probability and statistics, and calculus. Advanced science and engineering covers courses in advanced environmental and earth science, advanced biology, chemistry, physics, and engineering. STEM-related technical covers courses in engineering and science technologies, health science and technology, and computer science. Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Hispanic may be any race; race categories exclude Hispanic origin. High School Transcript Study (HSTS) racial or ethnic group trend reporting does not include American Indian or Alaska Native or Other categories.

Source(s):
Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress HSTS, 2019.

Science and Engineering Indicators

Figure K12-21

High school graduates who earned Carnegie credits in STEM advanced mathematics courses, by student race or ethnicity: 1990–2019



STEM = science, technology, engineering, and mathematics.

Note(s):
One Carnegie credit is defined as 120 hours of class instruction over the course of a secondary school year. Advanced mathematics covers courses in algebra II, trigonometry, precalculus and analysis, probability and statistics, and calculus. Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Hispanic may be any race; race categories exclude Hispanic origin. High School Transcript Study (HSTS) racial or ethnic group trend reporting does not include American Indian or Alaska Native or Other categories.

Source(s):
Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress HSTS, 1990, 2000, 2009, and 2019.

Science and Engineering Indicators

Because the NAEP HSTS collects transcripts for students who participate in the 12th-grade main NAEP mathematics assessment, it is possible to compare changes in advanced mathematics coursetaking with changes in NAEP assessment scores. Such an examination shows that NAEP mathematics scores have not increased compared with 2005, although the percentage of students completing advanced mathematics courses has increased. The average NAEP mathematics score for 12th graders in 2019 was the same as the score in 2005 (Table SK12-2).

Conclusion

This report presents indicators of STEM elementary and secondary education and student learning and preparation for entry into STEM postsecondary majors and careers. Findings show that the COVID-19 pandemic set student achievement in mathematics back to levels last seen approximately 20 years ago. In addition, findings show that COVID-19 had a greater impact on students with already historically lower scores, with large score declines for Black and Hispanic students, students eligible for free or reduced-price lunch, and students scoring in the 10th and 25th percentiles. An analysis of education indicators related to COVID-19 suggests that learning disruptions caused by the pandemic could lead to reduced lifetime earnings for affected students.

A pre-pandemic international assessment in 2019 shows that eighth graders in the United States have mathematics and science scores that rank about in the middle of education systems in countries with advanced economies. Better international performance may be needed if the United States is to reach NSB's *Vision 2030* goal of remaining preeminent in S&E and leading global innovation. An analysis of high school coursetaking indicates that students are completing more STEM courses in high school than they had in prior decades, with almost all students earning credits equivalent to 4 years of mathematics and science. Despite these gains, student performance in mathematics has not improved for 12th graders compared with 2005, and less than a third of high school graduates are reaching college readiness benchmarks in STEM subjects.

The indicators presented in this report highlight issues in STEM education that may need to be addressed to ensure that all students have the opportunity to succeed in STEM. Implementing evidence-based interventions to address learning disruptions caused by the pandemic and ensuring that all students have equal access to quality STEM education are two areas to consider as the country strives to meet the NSB's *Vision 2030* goal of continuing to grow a strong STEM-capable workforce.

Glossary

Definitions

COVID-19: A contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

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

English language learner: An individual who, due to any of the reasons listed as follows, has sufficient difficulty speaking, reading, writing, or understanding the English language so as to be denied the opportunity to learn successfully in classrooms where the language of instruction is English or to participate fully in the larger U.S. society. Such an individual (1) was not born in the United States or has a native language other than English, (2) comes from environments where a language other than English is dominant, or (3) is an American Indian or Alaska Native and comes from environments where a language other than English has had a significant impact on the individual's level of English language proficiency.

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 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 socioeconomic status.

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.

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: Most data sources for this report use participation in the National School Lunch Program as an indicator of socioeconomic status.

Key to Acronyms and Abbreviations

HSTS: High School Transcript Study

IMF: International Monetary Fund

K–12: kindergarten through 12th grade

LTT: long-term trend

NAEP: National Assessment of Educational Progress

NASEM: National Academies of Sciences, Engineering, and Medicine

NCES: National Center for Education Statistics

NSB: National Science Board

NSLP: National School Lunch Program

PISA: Programme for International Student Assessment

S&E: science and engineering

STEM: science, technology, engineering, and mathematics

TIMSS: Trends in International Mathematics and Science Study

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Notes

1 These data are from the School Pulse Panel (**https://ies.ed.gov/schoolsurvey/spp/**), a study sponsored by the National Center for Education Statistics (NCES) to collect data on issues concerning the impact of the COVID-19 pandemic on students and staff in U.S. public primary, middle, high, and combined-grade schools. The Census Bureau conducts the School Pulse Panel on behalf of NCES.

2 This report focuses on mathematics data because new NAEP science data were not available at the time of publication. NAEP science data were last collected in 2019 and reported on in an NSF InfoByte released in May 2022 (Rotermund and Burke 2022). The next NAEP science data collection is scheduled for winter 2024 and will be administered to students in grade 8.

3 NAEP administered two mathematics assessments in 2022: the main NAEP and the NAEP long-term trend (LTT) assessment. Between January and March 2022, the main NAEP mathematics assessment was administered to representative samples of fourth- and eighth-grade students in the nation. Originally scheduled to be administered in spring 2021, the administration was delayed to 2022. The main NAEP is typically administered every 2 years, and mathematics results are available dating back to the first administration in 1990. The NAEP LTT assessment is designed to track long-term trends in student performance; it is administered every 4 years (rather than every 2 years) and is administered to students by age rather than grade level. The LTT has remained relatively unchanged since first administered in 1978, whereas the main NAEP assessment changes every decade or so to reflect curricular and framework changes. Last administered in 2020, the next LTT assessment was scheduled for 2024, but the National Center for Education Statistics added an assessment in 2022 to measure the impact of COVID-19 on student performance. Results from both NAEP assessments are reported as average scores on a 0–500 scale. Discussion of 12th-grade scores has not been included because no new data are available for 2022. Data through 2019 for 12th-grade students are available in Table SK12-2.

4 The National School Lunch 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 socioeconomic status.

5 The NAEP uses percentiles to indicate how students perform at different levels of the score distribution. A percentile is defined by the percentage of students scoring lower than a particular scale score. For example, if the 25th percentile score is 281, it means that 25% of the students scored below 281 and that 75% scored higher. NAEP reports scores at five selected percentiles to show the progress made by lower-performing (10th and 25th percentiles), middle-performing (50th percentile), and higher-performing (75th and 90th percentiles) students. Percentile changes over time help indicate trends in how students perform at higher and lower levels.

6 As provided by law, the Commissioner for Education Statistics has determined that the NAEP achievement levels are to be used on a trial basis and should be interpreted and used with caution. However, the Commissioner and the National Assessment Governing Board believe these performance standards are useful for understanding trends in student achievement. For information on NAEP achievement levels, see **https://nces.ed.gov/nationsreportcard/guides/scores_achv.aspx**. For information about NAEP sampling procedures, see **https://nces.ed.gov/nationsreportcard/tdw/sample_design/**.

7 In 2001, after discussion among the National Center for Education Statistics (NCES), the National Assessment Governing Board (Governing Board), and the Council of the Great City Schools (CGCS), Congress appropriated funds for a district-level NAEP assessment on a trial basis. A primary goal of the Trial Urban District Assessment (TUDA) is to focus attention on urban K–12 education and academic achievement in urban districts. In collaboration with NCES and CGCS, the Governing Board invites districts that meet certain selection criteria to volunteer to participate in TUDA. Selection

criteria are based on district size, percentages of African American or Hispanic students, and percentages of students eligible for the free or reduced-price lunch program. TUDA began in 2002 with six urban districts participating in the NAEP reading and writing assessments. In 2009, 18 districts participated in mathematics, reading, and science. Twenty-one districts participated in 2011, 2013, and 2015; 27 districts participated in 2017 and 2019; and 26 districts participated in 2022.

8 TIMSS 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 members include countries—defined as complete, independent political entities—and nonnational entities (e.g., Hong Kong). The term "education system" is used here to encompass both types of TIMSS participants; this should be kept in mind when comparing U.S. students' performance with that of their cross-national peers. In addition, the United States may be larger or more diverse than other participating education systems (e.g., Singapore, Japan), which may affect its rankings.

9 IMF classifies Russia as a developing economy, but it is included in the analysis of the tables and figures because it is a large economy with high levels of student achievement. For the purposes of this report, Russia is included in this interpretation of the data, including the rankings of the countries.

10 In 2022, over 1.3 million high school students took the ACT, a decrease from the more than 1.8 million graduates—52% of the U.S. high school graduating class—who took the ACT in 2019. Many colleges and universities waived the ACT and SAT during COVID-19, and many institutions have now made that waiver permanent. The ACT tests students in mathematics, science, and STEM, among other subjects. In addition to reporting average scores, ACT reports the percentage of students meeting benchmarks representing the minimum score needed for college readiness in that subject. Specifically, a benchmark is the minimum score needed to reach a 50% chance of obtaining a grade of B or higher or a 75% chance of obtaining a grade of C or higher in corresponding college courses. The STEM benchmark represents students' combined performance on the ACT mathematics and science tests.

11 Additional information about the percentage of students meeting college readiness benchmarks in STEM is available at **https://www.act.org/content/dam/act/unsecured/documents/2022/2022-National-ACT-Profile-Report.pdf**.

12 The immediate college enrollment rate includes 16- to 24-year-old students who graduated from high school or completed a GED or other high school equivalency credential in each survey year. Immediate college enrollment rates are defined as rates of high school completers enrolled in college in October after completing high school earlier in the same calendar year.

13 HSTS gathers and codes transcripts from a nationally representative sample of high school graduates who also took the NAEP mathematics and science assessments. The 2019 collection is the eighth wave of the study, which was last conducted in 2009 and first conducted in 1987. Data from 1990, 2000, 2009, and 2019—representing approximately decade-long spans—are presented here. HSTS defines STEM coursetaking as credit in advanced science (courses beyond basic biology), advanced mathematics (at algebra II or above), or STEM-related technical fields of engineering and science technology, health science and technology, and computer science.

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