United States

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Introduction

Overview of Education System

Public education refers to the system by which federal, state, and local governments in the United States provide funding and oversight for free public schools for all children from kindergarten through Grade 12. In the United States, decision-making regarding public education policies and practices is decentralized and distributed across different levels of government.[1] The federal government's role is primarily limited to advocating for education policies and reform initiatives at a national level, enforcing federal civil rights laws, and collecting education information and statistics. State governments assume full control over most aspects of education at the preprimary, primary, and secondary levels, including policy regarding standards, curricula, and assessments; setting teacher certification requirements; and deciding how federal and state funding should be spent. In most states, decisions are made by state departments and boards of education. Although the degree of decision-making authority between state and local governments differs across states, local school districts typically have considerable autonomy, allowing for localized decision-making responsive to their communities' specific needs.[2]

States have autonomy in shaping academic standards, selecting student assessment instruments, and establishing teacher licensure and certification requirements. Typically, states establish a statewide curricular framework and allow local school districts to customize their curricula. States also have the authority to enact policies (including policies on graduation requirements and student discipline) and define the roles and responsibilities of local school boards that govern primary and secondary public schools. School districts are often led by a superintendent responsible for policy implementation and budget management and include an elected or appointed school board that provides oversight. Policies enacted at the district level are generally consistent across all schools within a district but can vary from district to district.

In the 2021–2022 academic year, there were about 13,300 public school districts in the United States.[3] The U.S. Department of Defense Education Activity (DoDEA) also provides public education for children of military personnel living in select locations, with eight districts located across 11 foreign countries, 7 states, and 2 territories.[4] Parents can also choose to enroll their children in charter or magnet schools, which are public schools exempt from certain

state and local regulations. In 2019, approximately 71% of 5- to 17-year-olds in kindergarten through 12th grade attended regular public schools; 17% attended public charter or magnet schools;[a] 9% attended private schools; and 3% participated in a guardian-directed education program, or homeschooling.[5] Although the age at which students start school varies by state, children typically begin kindergarten at age 5. In 2021, 86% of 5-year-olds were enrolled in school.[6] Kindergarten, although free, is not compulsory in most states. In addition, 12 states and the District of Columbia offer students free public prekindergarten (preprimary).[7] Most states require school attendance at ages 6 or 7 until ages 16 to 19. Free universal public education ends when a student graduates from high school (i.e., finishes Grade 12). The maximum age at which students are offered free education also varies among states.[8]

Although the federal government has a limited role, it can leverage its ability to allocate federal funding to impact state education policy and practice. In 1965, the federal government mandated equal access to education for all students as a condition for receiving federal funding with the Elementary and Secondary Education Act (ESEA). Similarly, states must comply with the requirements under the Individuals with Disabilities Education Act (IDEA) to receive federal funds for special education services. In 2002, ESEA was reauthorized as the No Child Left Behind Act (NCLB), which linked federal funding to performance indicators and accountability measures, such as student achievement measured annually via mandated standardized tests. The Every Student Succeeds Act (ESSA) replaced the NCLB in 2015. Although ESSA has maintained mandatory standardized assessments,[b] it allows states to develop their own accountability systems and use other measures of student achievement. The federal government can also require states to report education data to receive federal funding; the ESEA and IDEA include provisions that mandate collecting and reporting education data. The federal government provides recommendations and resources for data collection, suggested indicators for school success, and a 4-year strategic plan. In recent years, these efforts have focused on promoting equity and access by supporting a diverse educator workforce and strengthening student learning. Examples include the National Academies of Sciences, Engineering, and Medicine[c] (NASEM) 2019 consensus report, *Monitoring Educational Equity*,[9] which highlights key indicators for examination of equity between population groups, and the Department of Education's *Fiscal Years 2022–2026 Strategic Plan*, which highlights goals and objectives to promote equity.[10]

The United States does not have a national curriculum in science or mathematics. However, national frameworks created through coordinated efforts across states provide shared standards that states can adopt or adapt. The 2009 Common Core State Standards (CCSS) provide standards for English language arts and mathematics, and the 2013 Next Generation Science

a A public charter school is a publicly funded school that is typically governed by a group or organization under a legislative contract—a charter—with the state, the district, or another entity. A magnet school is a public school or education center that offers a special curriculum capable of attracting students of different racial/ethnic backgrounds outside of traditional school boundaries.

b The frequency of standardized assessments under ESSA varies by grade level and subject.

c The federal government incorporated NASEM under a congressional charter as a nonprofit, nongovernmental organization to provide research and advisory services for issues of public and government interest.

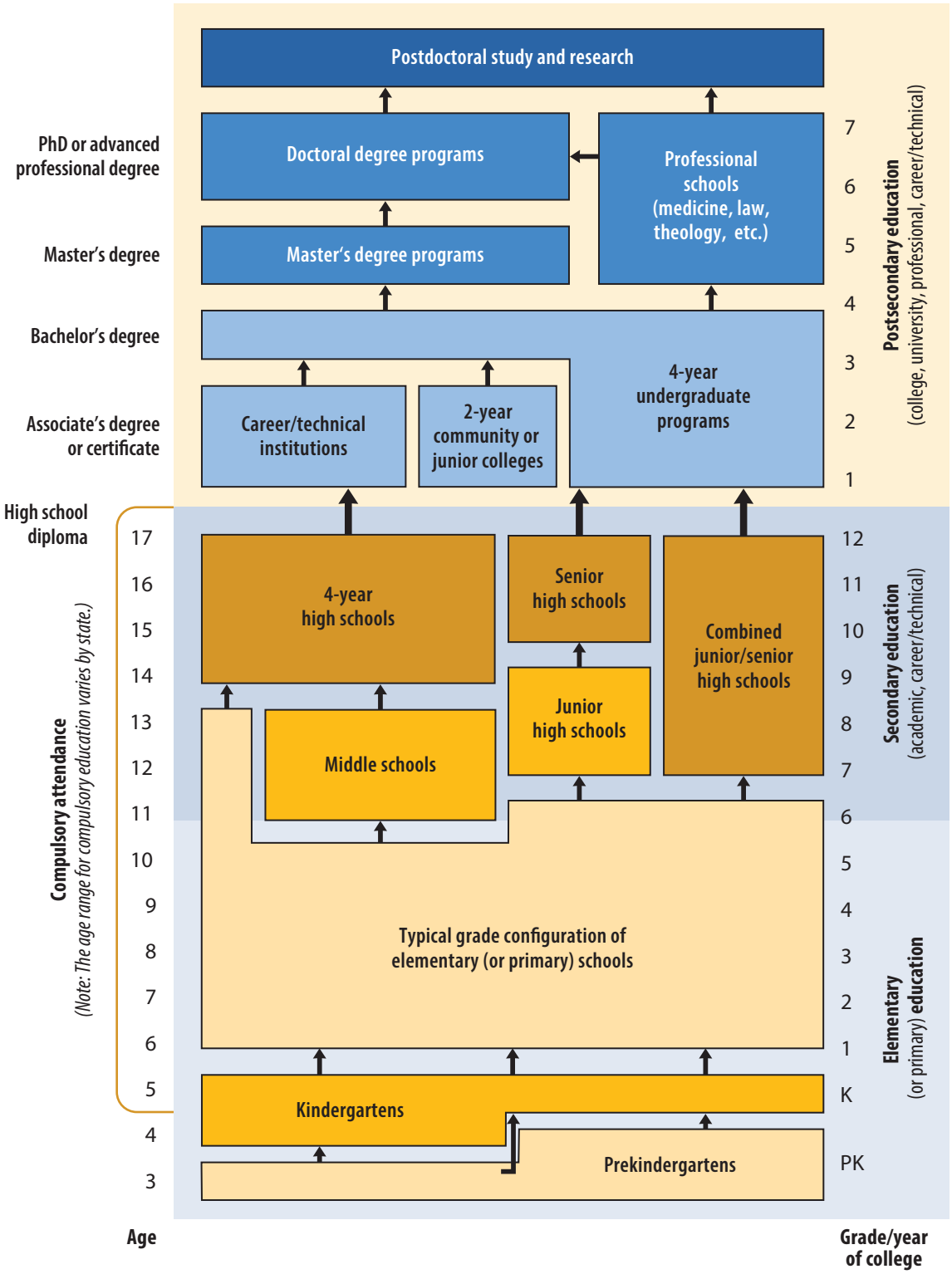
Standards (NGSS) provide standards for science.[d] Initially, 46 states, the District of Columbia, and DoDEA adopted the CCSS; however, several states have since modified or replaced the standards with state-specific standards. As of 2020, an estimated 35 states, the District of Columbia, and DoDEA fully or partially use the CCSS in mathematics for their state.[e,11] While various states are revising their standards, approximately 44 states, the District of Columbia, and DoDEA have adopted the NGSS or developed their standards based on the NGSS or recommendations in the National Research Council (NRC) framework (on which the NGSS are based).[12] In the United States, there is no standardized universal mathematics or science track. A variety of public magnet schools exist that offer specialized academic programs or curricula focused on mathematics and science. Over half (53%) of the magnet schools that receive federal grants through the Magnet Schools Assistance Program focus on science, technology, engineering, mathematics (STEM), and art.[13] In addition, a number of STEM-focused secondary schools prepare students for postsecondary STEM majors and careers in the STEM field.[14]

Grades are organized by school districts into primary or elementary schools (kindergarten and Grades 1 to 4, 1 to 5, or 1 to 6), middle or junior high schools (from Grades 5, 6, or 7 to 8 or 9), and high schools or secondary schools (Grades 9 to 12 or 10 to 12). Prekindergarten or preschool programs are primarily the responsibility of the state and local governments. Children between ages 3 and 5 from low- and moderate-income families who meet federal eligibility requirements have access to locally designed center- or home-based early learning services through federal Head Start funds.[15] When students finish high school (Grade 12), free universal public education ends. Students can continue their education after high school by enrolling in public or private universities, community colleges, or vocational and technical schools (see Exhibit 1).

d The CCSS are specific mathematics and English language arts standards for kindergarten through Grade 12 (K–12) developed by the National Governors Association Center for Best Practices and the Council of Chief State School Officers. The NGSS are science standards for K–12 developed by a consortium of states, the National Science Teachers Association, the American Association for the Advancement of Science, and Achieve Inc.

e Since 2019, 12 states have revised their state standards in mathematics. States typically allow between 3 and 5 years for full implementation of new standards following state approval of the standards.

Exhibit 1: Structure of the U.S. Education System



Note: The grade configurations shown are not the only possible routes of educational attainment. For example, some areas of study permit entering a doctoral program directly out of an undergraduate program.

Source: de Brey, C., Zhang, A., & Duffy, S. (2021). *Digest of education statistics 2021* (NCES 2023–009). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Use and Impact of TIMSS

The United States has participated in TIMSS since 1995. In 2002, the U.S. Congress enacted the Education Sciences Reform Act (ESRA), which recognizes TIMSS as a valuable data source for monitoring U.S. students, comparing U.S. students against their international peers, and evaluating education policy. ESRA provides support for continued national and state participation in TIMSS.[f] Participation has influenced U.S. education policies and practices by allowing the United States to monitor the performance of its education systems and benchmark against other countries. One way to assess public use of TIMSS data and results is by looking at the number of people who search for TIMSS information on the National Center for Education Statistics (NCES) website, the primary U.S. Department of Education Internet source for information on TIMSS. In 2022, the number of visits to the NCES website for information about TIMSS averaged over 9,500 per month.[16]

Results from TIMSS provide data on U.S. students' performance in a global context, highlighting areas where students in other countries outperform or underperform U.S. students.[17] Historically, TIMSS has been a resource for identifying high-performing countries and using their curricula to inform the development of U.S. mathematics and science frameworks for the CCSS, NGSS, and the National Assessment of Educational Progress (NAEP).[18,19,20,21] Experts incorporated standards and strategies shown to promote student success into U.S. approaches to mathematics and science education. In addition, a review of performance on TIMSS (Grades 4 and 8) and TIMSS Advanced (Grade 12) provides a better understanding of how students develop foundational knowledge in key topics around physics and algebra and subsequently how educators can identify specific needs in the curriculum.[22]

Results from TIMSS also offer valuable information that education leaders can use to further understand student performance and reform state standards and curricula.[23] Current research shows considerable overlap among the TIMSS frameworks and the Common Core State Standards for Mathematics (CCSSM)/NGSS, enabling education leaders to interpret TIMSS results along with other sources of information (e.g., statewide assessment results) to deepen their understanding of student achievement.[24] In addition, if states participate in TIMSS as separate entities, administrators can use TIMSS to gather representative data specific to the students in their state and education contexts and can then compare their students' performance with the performance of students in other states and countries. Since the first administration of TIMSS in 1995, 18 states have participated as separate entities in one or more assessment years.[25] In 2011, NCES initiated a NAEP–TIMSS linking study that used data from NAEP and the nine participating states in TIMSS 2011 to predict TIMSS scores for an additional 43 U.S. states and entities. The report, published in 2013, enabled states to compare their students' performance with that of students internationally.[26]

Finally, TIMSS tracks trends over time and highlights differences in mathematics and science achievement across student groups (e.g., gender and race/ethnicity). Findings from TIMSS have

f See https://www.govinfo.gov/content/pkg/COMPS-747/pdf/COMPS-747.pdf for more information.

been cited in relation to federal STEM policy initiatives and priority-setting for grant funding, particularly concerning achievement gaps across student groups.[27,28] Research using TIMSS results from 2015 shows fourth- and eighth-grade achievement differences by students' racial/ethnic and gender statuses in the United States.[29] TIMSS results from 2019 highlighted the widening achievement gap between low- and high-performing students in mathematics and science in the United States, mirroring NAEP results from the same time frame and bringing further attention to these trends.[30] The United States was the only country with a widening score gap between high- and low-performing students at both grades in both mathematics and science between 2011 and 2019. This gap increase can be attributed to a decrease in low-performing students' scores at both grades and an increase in high-performing students' scores in eighth grade.[31,32] In 2022, the U.S. Department of Education introduced an equity action plan to promote student achievement and tackle persistent education disparities exacerbated by the pandemic in underserved communities.[33]

The Mathematics Curriculum in Primary and Lower Secondary Grades

In the United States, curriculum standards for mathematics vary across individual states, though the 2009 creation of the CCSSM resulted in increased commonality in both content and mathematical practices across states. The National Governors Association and the Council of Chief State School Officers (CCSSO) coordinated the effort to bring greater focus and coherence to teaching mathematics. The CCSSM provide recommendations for what mathematics students should understand and be able to do starting in kindergarten and continuing through high school. In addition, the CCSSO developed a list of tools, resources, and practices to help states implement the CCSS.[34] While there is variation in mathematics standards among states, the majority of the states in the United States implement standards based on the CCSSM.[35,36,37] States can be classified into three groups: 35 states that fully adopted the standards or are implementing a revised version of the standards, 12 states that initially adopted the standards but later reversed their decisions, and 4 states that never adopted the CCSSM.[g,38] Although the CCSSM are guidelines for states in developing their curriculum frameworks and do not prescribe a particular curriculum or instruction method, they have widely influenced mathematics education in the United States, particularly in elementary grades.[39]

The CCSSM emphasize a balance between two dimensions of mathematics education: (1) mathematical content to be taught at each grade within key areas (e.g., number, algebra, measurement, geometry, and data), and (2) mathematical practices that mathematics educators at all levels should seek to cultivate in their students. These mathematical practices are the

g States that fully adopted or implemented a revised version include Arkansas, California, Colorado, Connecticut, Delaware, Hawaii, Idaho, Illinois, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Washington, Wisconsin, Wyoming, and the District of Columbia. States that initially adopted the standards but later reversed their decisions include Alabama, Arizona, Florida, Georgia, Indiana, Kentucky, Louisiana, Missouri, Oklahoma, South Carolina, Tennessee, and West Virginia. States that never adopted the CCSSM include Alaska, Nebraska, Texas, and Virginia.

processes and skills that students need to develop and draw upon to succeed in mathematics, including the following:

- making sense of problems and persevering in solving them
- reasoning abstractly and quantitatively
- constructing viable arguments and critiquing the reasoning of others
- modeling with mathematics
- using appropriate tools strategically
- attending to precision
- looking for and making use of structure
- looking for and expressing regularity in repeated reasoning

The CCSSM do not dictate instructional practices or materials to address the needs of students well above or well below grade-level expectations.[40] In addition, local education entities determine policies around mathematics course selection and enrollment; e.g., in 2019, 85% of eighth graders attended schools that offered Algebra I classes to students.[41]

Exhibits 2 and 3 reflect the mathematics topics generally included in state standards at or before the two TIMSS grades (4 and 8), though topics covered may vary by state and grade level. Because of the decentralized approach to mathematics standards, the exhibits highlight topics listed in the TIMSS 2023 Curriculum Questionnaire, included in the CCSSM, and covered in the state standards of five states with large populations of kindergarten to Grade 8 students (California, Florida, Massachusetts, New York, and Texas). Exhibit 2 includes topics commonly covered in kindergarten through Grade 4. Exhibit 3 includes topics commonly covered in Grades 6 through 8.[h] The topics listed are not exhaustive of current grade-level standards across the United States, and individual states may also provide detailed grade-level instructional benchmarks, approaches to learning, and instructional resource material.

h Responses are based on the topics provided in the TIMSS 2023 Curriculum Questionnaire and content covered in the following states: California (https://www.cde.ca.gov/be/st/ss/documents/ccssmathstandardaug2013.pdf), Florida (https://www.fldoe.org/academics/standards/subject-areas/math-science/mathematics/), Massachusetts (https://www.doe.mass.edu/frameworks/math/2017-06.pdf), New York (https://www.nysed.gov/sites/default/files/programs/curriculum-instruction/nys-next-generation-mathematics-p-12-standards.pdf), Texas (https://tea.texas.gov/academics/curriculum-standards/teks-review/texas-essential-knowledge-and-skills), and the CCSSM (https://www.nctm.org/uploadedFiles/Standards_and_Positions/Common_Core_State_Standards/Math_Standards.pdf).

Exhibit 2: Mathematics Curriculum Topics Covered Through Fourth Grade

Area of Mathematics	Topic
Number	• recognize place value of numbers up to six digits, including representations of numbers and comparing numbers • add and subtract up to four-digit numbers • multiply and divide up to three-digit numbers • solve problems using odd and even numbers, multiples, factors of numbers, rounding numbers • combine two or more properties of numbers or operations • find the missing number or operation in a number sentence • match or write expressions or number sentences to represent problem situations that may involve unknowns • match, describe, or use relationships in a well-defined pattern • describe a fraction as part of a whole or collection; connect different representations of fractions (words, numbers, and models); compare the size of fractions; add and subtract simple fractions with like denominators • connect different representations of decimals; compare and order decimals and relate decimals to fractions
Measurement and Geometry	• measure, estimate, add, and subtract lengths (millimeters, centimeters, meters, kilometers) • add and subtract mass, volume, and time; select appropriate types and sizes of units and read scales • determine perimeters of polygons, areas of rectangles, and areas of shapes covered with squares or partial squares • recognize and draw parallel and perpendicular lines, right angles, and angles smaller or larger than a right angle; compare the relative size of angles • use elementary properties, including line symmetry, to describe and create common two-dimensional shapes • use elementary properties to describe three-dimensional shapes (cubes, rectangular solids, cones, cylinders, and spheres) and the differences among them
Data	• read data from tables, pictographs, and bar graphs • create or complete tables, pictographs, and bar graphs • interpret and use data to answer questions that go beyond directly reading data displays

Note: Curriculum topics listed in this exhibit are based on the TIMSS 2023 Curriculum Questionnaire at Grade 4, the CCSSM for Grades K to 4, and the elementary state curriculum frameworks through Grade 4 in California, Florida, Massachusetts, New York, and Texas in place during the 2022–2023 academic year. The topics listed are not exhaustive, as curriculum frameworks vary by state.

Exhibit 3: Mathematics Curriculum Topics Covered in Sixth Through Eighth Grade

Area of Mathematics	Topics
Number	• irrational numbers • multiples, factors, and prime numbers • add, subtract, multiply, and divide with negative numbers • compare and order fractions and decimals • add, subtract, multiply, and divide with fractions and decimals • combine two or more properties of numbers or operations to solve a problem • ratios and proportions • find percentages; convert between percentages and fractions or decimals
Algebra	• find the value of an expression or formula given values of variables • simplify and compare algebraic expressions • write expressions to represent problems • solve linear equations and inequalities • interpret and generate representations of linear functions in tables, graphs, or words • interpret and generate representations of simple nonlinear functions in tables, graphs, or words
Measurement and Geometry	• recognize and draw different types of angles and lines • recognize two-dimensional shapes and use their properties (e.g., circles, triangles) • the Pythagorean theorem • geometric dilations, translations, reflections, and rotations • recognize three-dimensional shapes and use their geometric properties
Data and Probability	• use random sampling to make inferences about a population • interpret data from one or more sources (e.g., make comparisons, draw conclusions) • organize and represent data in appropriate figures or tables to help answer questions • summarize data using the mean and median, and recognize the effect of spread • determine theoretical and empirical probability for simple events • determine theoretical and empirical probability for compound events

Note: Curriculum topics listed in this exhibit are based on the TIMSS 2023 Curriculum Questionnaire at Grade 8, the CCSSM for Grades 6 to 8, and the middle school state curriculum frameworks in California, Florida, Massachusetts, New York, and Texas in place during the 2022–2023 academic year. The topics listed are not exhaustive, as curriculum frameworks vary by state.

The Science Curriculum in Primary and Lower Secondary Grades

In the United States, curriculum standards for science vary across individual states, though 44 states, the District of Columbia, and DoDEA have partially or fully adopted the 2013 NGSS. The NGSS are based on the recommendations in *A Framework for K–12 Science Education*, published by the NRC of the nonprofit, nongovernmental NASEM in 2012.[42] The NGSS were developed through a collaborative, state-led process involving teachers, scientists, and leaders in science education from around the country. During the 2021–2022 academic year, 64% of K–12 teachers in the United States reported that their school implemented NGSS standards or standards similar to the NGSS. The NGSS focus on three-dimensional learning, where students are expected to use (1) science and engineering practices and (2) crosscutting concepts to engage with (3) disciplinary core ideas that can be used to explain how or why the natural world operates as it does or to solve technological problems. This approach aims to ensure that students can work with information by building models, designing investigations, sharing ideas, and using evidence. The NGSS give equal emphasis to scientific inquiry and engineering design practices, and students are expected not only to learn content but also to understand and develop the methods of scientists and engineers.

Science and engineering practices include the following processes and approaches to understanding science concepts:

- asking questions (for science) and defining problems (for engineering)
- developing and using models
- planning and carrying out investigations
- analyzing and interpreting data
- using mathematics and computational thinking
- constructing explanations (for science) and designing solutions (for engineering)
- engaging in argument from evidence
- obtaining, evaluating, and communicating information

The NGSS list and describe learning goals or performance expectations by grade level for elementary students through Grade 5 and by grade span for middle (Grades 6 to 8) and high school (Grades 9 to 12) students. States, districts, and teachers make curricular and instructional decisions, adopting or adapting these learning goals locally. In a nationally representative sample of K–12 teachers in the United States, 47% of elementary teachers and 62% of middle grades teachers reported regularly using science curriculum materials they created themselves in 2021–2022. Typically, the science curriculum follows a trajectory in which students begin studying inquiry-based science in lower elementary school, focusing on observations and explanations related to familiar natural phenomena. Science in elementary school covers core concepts in engineering design and life, physical, and Earth and space sciences, which build progressively across the grades. Science and engineering practices are also a component of the NGSS at each grade level. In middle school, students study science in more depth, and the specific science courses that are taught vary across states, districts,

and schools. Many schools teach integrated science courses in middle school that cover core concepts from across life, physical, and Earth and space sciences that progress across the grades, although some place more emphasis on certain content areas at different grade levels. Other schools teach separate courses in the content domains starting in middle school (e.g., life science, physical science, and Earth and space sciences), although the order of these courses varies. In middle school, students are expected to integrate science and engineering practices through quantitative applications, constructing arguments, and evaluating solutions.

Exhibits 4 and 5 reflect the science topics generally included in state standards at or before the two TIMSS grades (4 and 8), though topics covered may vary by state and grade level. Because of the decentralized approach, the exhibits highlight topics listed in the TIMSS 2023 Curriculum Questionnaire, included in the NGSS, and covered in the state standards of five states with large populations of kindergarten to Grade 8 students (California, Florida, Massachusetts, New York, and Texas). Exhibit 4 includes topics commonly covered in kindergarten through Grade 4; Exhibit 5 includes topics commonly covered in Grades 6 through 8. The topics listed are not exhaustive of the current grade-level standards across the United States, and individual states may also provide detailed grade-level instructional benchmarks, approaches to learning, and instructional resource material.

Exhibit 4: Science Curriculum Topics Covered Through Fourth Grade

Area of Science	Topics
Life Science	• differences between living and nonliving things; what living things require to live • physical and behavioral characteristics of major groups of living things (e.g., birds, mammals, plants) • functions of major structures in plants and animals (e.g., bones, lungs, stem, leaves) • stages of life cycles; differences among the life cycles of common plants and animals (e.g., frogs, butterflies, flowering plants) • inheritance and reproductive strategies (e.g., plants producing many seeds, mammals caring for their young) • inherited and acquired characteristics in plants and animals • physical features of plants and animals that help them survive in their environment • responses of plants and animals to changes in environmental conditions • relationships in simple food chains • the positive and negative impacts of humans on the environment • plants and animals in common habitats (e.g., desert, forest, grassland) • ways of promoting human health and preventing the transmission of common communicable diseases*

*These topics refer to National Health Education Standards for Grades 1 through 8 and are not included in the NGSS or state science standards.

Exhibit 4: Science Curriculum Topics Covered Through Fourth Grade (Continued)

Area of Science	Topics
Physical Science	• solids, liquids, gases, and their characteristics • physical properties as a basis for classifying matter (e.g., mass, volume, ability to conduct heat) • magnetic attraction and repulsion • physical changes observed in everyday life (e.g., dissolving, crushing) • chemical changes observed in everyday life (e.g., decaying, burning) • common sources of energy (e.g., the Sun, wind, oil, gas) • common phenomena related to the behavior of light (e.g., shadows, reflections) • sound as a phenomenon of vibrations • wave properties • energy transfer (e.g., energy flows by sound, light, heat, and electric currents) • electricity and simple electrical circuits • familiar forces and the motion of objects (e.g., gravity, friction)
Earth and Space Sciences	• physical characteristics of Earth (e.g., fresh and salt water, air) • Earth's renewable and nonrenewable resources • changes in Earth's surface over time • fossils and what they show about Earth's history • how weather can vary across geographic locations and seasons • weather-related hazards • the Moon, Sun, and stars and related patterns observed on Earth (e.g., day and night, seasons)
Engineering Design	• definition of simple design problems • development and comparison of design solutions • product and process testing

Note: Curriculum topics listed in this exhibit are based on the TIMSS 2023 Curriculum Questionnaire at Grade 4, the NGSS through Grade 4, and the state curriculum frameworks up to Grade 4 in California, Florida, Massachusetts, New York, and Texas in place during the 2022–2023 academic year. The topics listed are not exhaustive, as curriculum frameworks vary by state.

Exhibit 5: Science Curriculum Topics Covered in Sixth Through Eighth Grade

Area of Science	Topics
Life Science (Biology)	• differences among major taxonomic groups of organisms (e.g., plants, fungi, reptiles, insects) • structures and functions of major organ systems in humans; how these compare to other organisms • how animals respond to internal and external changes to maintain stable body conditions (e.g., increased heart rate during exercise, sweating in heat) • structures in plants and animal cells and their functions • photosynthesis and cellular respiration • life cycles and patterns of development in different types of organisms (e.g., mammals, birds) • DNA and inheritance in plants and animals • variation and natural selection • fossils as evidence for changes in life on Earth over time • flow of energy through ecosystems (e.g., producers, consumers, decomposers) • cycling of water, oxygen, and carbon in ecosystems • relationships among populations of organisms in an ecosystem (e.g., competition, predation, symbiosis) • positive and negative impacts of human behavior on the environment • diet, exercise, and other lifestyle choices for promoting human health* • health promotion and disease prevention guidelines and recommendations for healthy behaviors*
Physical Science (Chemistry)	• matter is composed of different types of atoms and molecules and molecules are composed of atoms in particular arrangements • elements, compounds, and mixtures • separation of mixtures • physical and chemical properties of matter (e.g., boiling point, flammability) • use of physical and chemical properties to classify matter (e.g., metals, nonmetals) • characteristics of chemical changes (e.g., production of a new substance, color change) • conservation of matter and release/absorption of energy in chemical reactions

*These topics refer to National Health Education Standards for Grades 6 through 8 and are not included in the NGSS or state science standards.

Exhibit 5: Science Curriculum Topics Covered in Sixth Through Eighth Grade (Continued)

Area of Science	Topics
Physical Science (Physics)	• motion of particles in solids, liquids, and gases • changes in states of matter (e.g., melting, condensation) • forms of energy and energy transformation (e.g., kinetic, potential, thermal) • thermal energy transfer and thermal conductivity of metals • properties of light (e.g., speed, transmission through media) • properties of sound (e.g., amplitude, frequency) • conductors and movement of electricity through circuits • properties of permanent magnets and electromagnets • concepts related to motion (e.g., speed, acceleration) • common forces and their characteristics (e.g., strength, direction) • effects of forces (e.g., floating, sinking, water pressure)
Earth and Space Science	• Earth's structure and physical characteristics (e.g., crust, mantle, distribution of water) • makeup of Earth's atmosphere (i.e., nitrogen, oxygen, water vapor, carbon dioxide) • geological processes that have shaped Earth's surface (the rock cycle, formation of fossil fuels) • Earth's water cycle • differences between weather and climate and evidence for climate change • management of Earth's resources (e.g., advantages and disadvantages of different energy sources, methods of waste management) • land and water use (e.g., importance of conservation) • observable phenomena on Earth resulting from the movements of Earth and the Moon (e.g., seasons, tides, eclipses) • the role of the Sun in the solar system (i.e., provides light/heat to planets and their moons) • composition, scale, and motions of the solar system
Engineering Design	• definition of design problem criteria and constraints • evaluation and redesign of design solutions • iterative testing and optimization

Note: Curriculum topics listed in this exhibit are based on the TIMSS 2023 Curriculum Questionnaire at Grade 8, the NGSS through Grade 8, and the middle school state curriculum frameworks in California, Florida, Massachusetts, New York, and Texas in place during the 2022–2023 academic year. The topics listed are not exhaustive, as curriculum frameworks vary by state.

Teacher Professional Development Requirements and Programs

Individual states have the authority to determine professional development requirements for practicing mathematics and science teachers in Grades 4 and 8. States often require continuing professional development to renew teacher licenses.[i] The exact number of hours of professional development required for licensure renewal varies by state. When new standards are introduced and implemented in states, teachers are often offered professional development opportunities.

Typically, opportunities for professional development are organized by the local school district. These opportunities can take many forms, including the following:

- in-service professional development days throughout the academic year
- coaching and mentoring provided by instructional coaches
- professional learning communities in which teachers share best practices
- short-term intensive workshops
- summer institutes
- specialized training for teachers of advanced courses
- online learning opportunities
- university courses in science content and pedagogy, including the potential to earn additional college degrees

The number of online and blended learning opportunities for teachers' professional development has increased over the last 10 years, particularly since 2020.[43] In academic year 2021–2022, approximately 93% of K–12 teachers reported engaging in collaborative learning with other teachers at least once during the school year, 85% reported participating in professional development workshops or training at least once a year, and 48% reported receiving coaching.[44] The majority of district/school leaders (62%) reported that professional development opportunities in mathematics focused on using or adapting teachers' existing mathematics curriculum materials.[45] In addition, 81% of district leaders reported that recommendations from educators in the district are a major consideration when selecting external professional learning opportunities for mathematics instruction.[46] In 2018, the majority of schools (66%) reported that locally offered professional development workshops focused on deepening teachers' understanding of the state science standards, and roughly half of schools reported using teacher workdays throughout the school year for professional development related to science.[47]

The National Council of Teachers of Mathematics and National Science Teacher Association play a vital role in supporting educators' professional development. These organizations provide professional learning and teaching resources, organize conferences, and advocate for equitable and research-based mathematics and science instruction.

i All public school teachers must be licensed by the state where they teach. See https://www.ecs.org/50-state-comparison-teacher-license-reciprocity/ for more detail on licensing.

In 2022, the U.S. Department of Education highlighted teacher professional development as a way to limit teacher attrition, enhance teaching effectiveness, and improve student learning, outlining six priorities in the strategic plan that would guide funding for competitive grant programs.[48] Priority 3 emphasizes the importance of recruiting and retaining a diverse educator workforce to address high turnover in the field. Under Priority 3, organizations, institutions, and individuals providing teachers with job-embedded, culturally responsive, accessible support and professional development opportunities will have a higher chance of receiving funding. These opportunities can include specialized professional development for teachers who work with English learners and children with disabilities.

Monitoring Student Progress in Mathematics and Science

All states require standardized tests to be administered to students in elementary, middle, and high school. Under ESSA, states are required to test students in mathematics once a year in Grades 3 through 8 and once in high school and report the assessment results. States may choose their own annual state-required tests. In 2021, 14 states used common assessments for mathematics that were developed by state consortia, including Smarter Balanced and the Partnership for Assessment of Readiness for College and Careers.[49] The remaining states used their own assessments, which sometimes included items from other state testing programs or consortia.[50] Most teachers also conduct benchmark assessments of student progress at multiple time points during the school year using tests provided by a school or district.[51] In science, states must test their students at least once in each of three grade bands: Grades 3 through 5, Grades 6 through 9, and Grades 10 through 12. As with mathematics, states may choose their own tests. There are no assessment consortia specifically for science; however, 14 states are collaborating to design and implement science assessments.[52]

Although there is no nationally required examination that has consequences for individual students, the congressionally mandated NAEP conducts regular assessments of representative samples of students in Grades 4, 8, and 12 in mathematics, science, and sometimes other subjects.[53] Results from NAEP are separate from other accountability systems used in states and schools but are used to monitor national- and state-level progress. Under ESSA (2015), states are required to participate in and report results from the biennial NAEP mathematics and reading assessments in Grades 4 and 8 in order to receive federal funds. Participation in the mathematics assessment at Grade 12 and the science assessments at all three grades is optional.

Additional data collections supported through federal funds provide important information for monitoring student progress in mathematics and science. The National Science Foundation releases *Science & Engineering Indicators* using data from a variety of sources (federal agencies, national surveys, and international organizations) to provide information on the U.S. science and engineering enterprise, including enrollment trends, student performance, teacher preparation, and curriculum related to STEM education at the elementary and secondary school levels.[54] In response to the COVID-19 pandemic, NCES initiated the School Pulse Panel in the

2021–2022 academic year to collect vital information about public education on a monthly basis, and the agency has continued to expand this effort to provide data on topics that have relevance for federal policymakers, stakeholders within the U.S. Department of Education, public school leaders, and the general public.[55]

Standardized testing also plays a role in high school graduation and the admission process for postsecondary institutions. In 2023, 34 states required students to complete some combination of state standardized tests, final benchmark assessments, Advanced Placement tests, and college entrance exams developed and administered by private organizations (e.g., the SAT or ACT) as a requirement for high school graduation.[56] In addition, 22 states currently use the SAT/ACT college entrance exam, developed and administered by private organizations, as the high school indicator for ESSA accountability.[57] In 2021, 89% of institutions participating in the online common application system made standardized testing optional for postsecondary admissions.[58]

There is no nationally mandated grading system across the United States. The most commonly used grading system entails the assignment of "letter grades," with letters representing the possible range of achievement categories (e.g., "A" represents the top category and "F" represents the bottom category). Generally, individual institutions or faculty members decide which grading system to use.[59] High schools typically calculate an average of the letter grades earned in school—called a grade point average, or GPA—using a scale of 0 to 4.0 or 0 to 5.0. Grade reports are often issued each quarter, or approximately every 9 weeks. Semester grades and yearly grades are also given in most districts. Usually, only final grades representing students' overall performance in courses for the entire school year appear on a middle school or high school transcript. In cases in which students are identified as having special needs, schools are responsible for providing regular educational progress reports to parents.[60]

Special Initiatives in Mathematics and Science Education

In 2018, the 5-year Federal STEM Education Strategic Plan created a national strategy to advance STEM education and guide federal investments and efforts to increase participation in STEM, specifically among underrepresented groups.[61] The plan outlined strong foundations for STEM literacy, with goals to increase diversity, equity, and inclusion in STEM and to prepare the STEM workforce for the future. Since then, federal agencies have invested in research, teacher training, and program development to enhance STEM literacy and diversity in the STEM workforce. Agencies have also engaged in outreach events, working groups, and communities of practice to share resources and best practices. In 2022, the Raise the Bar: STEM Excellence for All Students initiative was introduced to strengthen STEM education and provide opportunities for STEM education to all students. The initiative focuses on three key goals: (1) ensuring that all students excel in rigorous STEM learning; (2) developing and supporting STEM educators; and (3) strategically investing in STEM education using federal, state, and local funds.[62] In response to the COVID-19 pandemic, Congress passed several bills

that provided states with $190 billion via the Elementary and Secondary School Emergency Relief (ESSER) fund to address the effects of the pandemic on education. Approximately $19 billion of the funding is flexible, allowing states to use the money for any authorized educational activity. State education agencies used these funds to support schools and districts in their pandemic relief and recovery efforts. Approximately $1.16 billion of ESSER funds was used to address unequal access to technology and the Internet (e.g., to purchase laptops and mobile hotspots).[63,64] Districts also used ESSER funds to provide after-school programs and tutoring to address the loss of learning for students not meeting current grade-level mathematics and science standards.[65] The federal government also provided guidance to states on how federal funds could be used to provide access to high-quality STEM programs and resources, with advice on purchasing STEM materials, improving mathematics and science assessments, and providing educators with professional development on STEM teaching.[66]

There are several initiatives to promote science through sustainability education in U.S. schools. The U.S. Department of Education's Green Ribbon Schools program recognizes schools demonstrating sustainable practices that save costs, promote health, and enhance performance.[67] Several environmental nonprofit entities sponsor programs, including the U.S. Green Building Council's Center for Green Schools and the National Wildlife Federation's EcoSchools USA program. These organizations engage in advocacy efforts to shape policies that support green building initiatives and provide resources, tools, and support for schools to engage in sustainable practices and educate students on environmental stewardship.[68,69] The Environmental Protection Agency administers the Environmental Education Grants Program to fund projects that promote environmental literacy and provide professional learning opportunities for educators to enhance their skills in delivering environmental education.[70] Several states have also developed or are developing Environmental Literacy Plans that establish objectives, goals, and strategies for integrating environmental education in schools.[71]

Federal and state policies also address the needs of low-achieving students. For example, ESSA contains provisions to close achievement gaps among student subgroups, including ethnic and racial groups, students with disabilities, and economically disadvantaged students. ESSA also requires states to identify and provide comprehensive support and improvement strategies for schools that score lowest on several measures of student success. Based on these provisions, states identify local schools where specific groups of students are consistently underperforming. Together, school leaders, local district leaders, and state education leaders develop targeted supports that may include root cause analyses, improvement plans, and input from key actors to support student growth through the use of evidence-based interventions. States are required to set ambitious goals to close these gaps and to allocate resources and support to schools that need assistance in achieving their objectives.[72]

Suggested Reading

U.S. Department of Education. (n.d.). *Data & statistics*. Retrieved from https://www.ed.gov/rschstat/landing.jhtml?src=rt

U.S. Department of Education. (n.d.). *ED initiatives*. Retrieved from https://www.ed.gov/about/inits/ed/index.html?src=ln

U.S. Department of Education. (n.d.). *Laws & guidance: Overview*. Retrieved from https://www2.ed.gov/policy/landing.jhtml?src=pn

References

1 U.S. Department of Education. (n.d.). *Laws & guidance: Overview*. Retrieved from https://www2.ed.gov/policy/landing.jhtml?src=pn

2 Kober, N., & Rentner, D. S. (2020). *History and evolution of public education in the US*. Center on Education Policy. https://files.eric.ed.gov/fulltext/ED606970.pdf

3 de Brey, C., Zhang, A., & Duffy, S. (2021). *Number of public school districts and public and private elementary and secondary schools: Selected school years, 1869-70 through 2021-22*. Digest of Education Statistics 2021 (National Center for Education Statistics 2023-009, table 214.10). Retrieved from https://nces.ed.gov/programs/digest/d22/tables/dt22_214.10.asp

4 DoDEA. (n.d.). *DoDEA schools worldwide*. Retrieved from https://www.dodea.edu/about/about-dodea/dodea-schools-worldwide

5 de Brey, C., Zhang, A., & Duffy, S. (2021). *Percentage distribution of students ages 5 through 17 attending kindergarten through 12th grade, by school type or participation in homeschooling and selected child, parent, and household characteristics: Selected years, 1999 through 2019*. Retrieved from https://nces.ed.gov/programs/digest/d21/tables/dt21_206.20.asp

6 National Center for Education Statistics. (2022). *Percentage of 3- to 5-year-old children enrolled in school, by age and selected child and family characteristics: 2010 through 2021*. Retrieved from https://nces.ed.gov/programs/digest/d22/tables/dt22_202.20.asp

7 Fischer, A. (2021). *State information request: States with universal pre-K*. Education Commission of the States. https://www.ecs.org/wp-content/uploads/State-Info-Request-States-With-Universal-Pre-K.pdf

8 Education Commission of the States. (2020). *Free and compulsory school age requirements*. Retrieved from https://reports.ecs.org/comparisons/free-and-compulsory-school-age-requirements-all

9 National Academies of Sciences, Engineering, and Medicine. (2019). *Monitoring educational equity*. The National Academies Press. https://doi.org/10.17226/25389

10 U.S. Department of Education. (2022). *Fiscal years 2022–2026 strategic plan*. https://www2.ed.gov/about/reports/strat/plan2022-26/strategic-plan.pdf

11 EdGate. (2020). *United States standards*. Retrieved from https://edgate.com/standards/us-state-map

[12] National Science Teaching Association. (n.d.). *Science standards*. Retrieved from https://ngss.nsta.org/About.aspx

[13] U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. (2021). *Drawing across school boundaries: How federally funded magnet schools recruit and admit students*. https://ies.ed.gov/ncee/pubs/2021003/pdf/2021003.pdf

[14] SRI International. (2008). *STEM high schools: Specialized science technology engineering and mathematics secondary schools in the U.S*. https://www.sri.com/wp-content/uploads/2022/04/STEM_Report1_bm08.pdf

[15] U.S. Department of Health and Human Services, Administration for Children and Families, Office of Head Start. (2023). *Head start services*. Retrieved from https://www.acf.hhs.gov/ohs/about/head-start

[16] Xie, H., & Tsokodayi, Y. (2022). *International activities program assessment division: Web usage statistics through December 2022* [Unpublished report]. National Center for Education Statistics, U.S. Department of Education.

[17] U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. (2021). *TIMSS 2019 U.S. highlights web report* (NCES 2021-021). Retrieved from https://nces.ed.gov/timss/results19/index.asp

[18] Common Core State Standards Initiative. (n.d.). *Myths vs. facts*. Retrieved from https://www.thecorestandards.org/about-the-standards/myths-vs-facts/

[19] Next Generation Science Standards. (n.d.). *Next generation science standards*. Retrieved from https://www.nextgenscience.org/

[20] U.S. Department of Education, National Assessment Governing Board. (2019). *Science framework for the 2019 national assessment of educational progress*. https://www.nagb.gov/content/dam/nagb/en/documents/publications/frameworks/science/2019-science-framework.pdf

[21] U.S. Department of Education, National Assessment Governing Board. (2021). *Mathematics framework for the 2026 national assessment of educational progress*. https://www.nagb.gov/content/dam/nagb/en/documents/publications/frameworks/mathematics/2026-math-frameowork/NAEP-2026-Mathematics-Framework-Combined.pdf

[22] Neidorf, T., Arora, A., Erberber, E., Tsokodayi, Y., & Mai, T. (2020). *Student misconceptions and errors in physics and mathematics: Exploring data from TIMSS and TIMSS advanced* (Vol. 9, p. 165). International Association for the Evaluation of Educational Achievement. https://files.eric.ed.gov/fulltext/ED601925.pdf

[23] U.S. Department of Education, National Center for Education Statistics. (2013). *U.S. states in a global context: Results from the 2011 NAEP-TIMSS linking study* (NCES 2013-460). https://nces.ed.gov/nationsreportcard/subject/publications/studies/pdf/2013460.pdf

[24] Dalton, B., Olivarez-Durden, S., & Herget, D. (2022). *Comparing key features of TIMSS and U.S. state assessments: A guide for education leaders and policymakers*. RTI International. https://surveys.nces.ed.gov/Timss/Content/pdf/ComparingTIMSSandStateAssess.pdf

[25] U.S. Department of Education. (n.d.). *TIMSS participating countries*. Retrieved from https://nces.ed.gov/timss/participation.asp

[26] U.S. Department of Education, National Center for Education Statistics. (2013). *U.S. states in a global context: Results from the 2011 NAEP-TIMSS linking study* (NCES 2013-460). https://nces.ed.gov/nationsreportcard/subject/publications/studies/pdf/2013460.pdf

[27] Taylor, J. A., Kowalski, S. M., Askinas, K. M., & Watson, K. (2023). Analyzing funding patterns in science education research: Establishing a baseline for improved monitoring of research to advance science education. *Social Sciences & Humanities Open*, *7*(1), 100445. Retrieved from https://www.sciencedirect.com/science/article/pii/S2590291123000505

[28] Broer, M., Bai, Y., & Fonseca, F. (2019). *Socioeconomic inequality and educational outcomes: Evidence from twenty years of TIMSS* (1st ed.). Springer Nature. Retrieved from https://doi.org/10.1007/978-3-030-11991-1

[29] Moon, C. Y., & Larke, P. (2020). An analysis of U.S. TIMSS 2015 mathematics achievement by content domains across gender and ethnicity. *International Journal of Arts and Social Science*, *3*(3), 323–334. https://www.ijassjournal.com/2020/V3I3/41465751111.pdf

[30] Wilburn, G., Cramer, B., & Walton, E. (2019). *The great divergence: Growing disparities between the nation's highest and lowest achievers in NAEP mathematics and reading between 2009 and 2019*. National Center for Education Statistics at IES. Retrieved from https://nces.ed.gov/nationsreportcard/blog/mathematics_reading_2019.aspx

[31] Stephens, M., Erberber, E., Tsokodayi, Y., & Fonseca, F. (2022). *Changes between 2011 and 2019 in achievement gaps between high- and low-performing students in mathematics and science: International results from TIMSS*. National Center for Education Statistics at IES. https://nces.ed.gov/pubs2022/2022041.pdf

[32] Miller, D. C., & Fonseca, F. T. (2021). An average is just an average: What do we know about countries' low- and high-performing students in mathematics? In A. Wilmers and S. Jornitz (Eds.), *International perspectives on school settings, education policy and digital strategies: A transatlantic discourse in education research* (pp. 195–219). Verlag Barbara Budrich. https://shop.budrich.de/wp-content/uploads/2021/03/9783847416609-1.pdf

[33] U.S. Department of Education. (2022). *2022 agency equity plan related to Executive Order 13985*. https://www2.ed.gov/documents/equity/2022-equity-plan.pdf

[34] Council of Chief State School Officers. (n.d.). *Tools and resources for standards implementation*. Retrieved from https://ccsso.org/tools-and-resources-standards-implementation

[35] Allensworth, E., Cashdollar, S., & Gwynne, J. (2021). Improvements in math instruction and student achievement through professional learning around the Common Core State Standards in Chicago. *AERA Open*, *7*, https://doi.org/10.1177/2332858420986872

[36] Gao, N., & Lafortune, J. (2019). *Common core state standards in California: Evaluating local implementation and student outcomes*. Public Policy Institute of California.

[37] Rentner, D. S., & Kober, N. (2014). *Common core state standards in 2014: Districts' perceptions, progress, and challenges*. Center on Education Policy.

[38] EdGate. (2020). *United States standards*. Retrieved from https://edgate.com/standards/us-state-map

[39] Doan, S., Eagan, J., Grant, D., Kaufman, J. H., & Setodji, C. M. (2022). *American instructional resources surveys: 2022 technical documentation and survey results* (tables 2.141 and 2.14b). RAND Corporation. Retrieved from https://www.rand.org/pubs/research_reports/RRA134-14.html

[40] Common Core State Standards Initiative. (n.d.). *Common core state standards for mathematics* (Understanding mathematics, p. 4). https://learning.ccsso.org/wp-content/uploads/2022/11/ADA-Compliant-Math-Standards.pdf

[41] de Brey, C., Zhang, A., & Duffy, S. (2021). *Percentage of 4th-, 8th-, and 12th-graders whose school reported offering selected classes and percentage of 8th-graders whose schools reported having students who take high school math classes, by selected student and school characteristics: 2015, 2017, and 2019*. Retrieved from https://nces.ed.gov/programs/digest/d19/tables/dt19_225.75.asp?current=yes

[42] National Research Council. (2012). *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas*. National Academies Press.

[43] Meyer, A., Kleinknecht, M., & Richter, D. (2023). What makes online professional development effective? The effect of quality characteristics on teachers' satisfaction and changes in their professional practices. *Computers and Education*, *200*, 104805. https://doi.org/10.1016/j.compedu.2023.104805

[44] Doan, S., Eagan, J., Grant, D., Kaufman, J. H., & Setodji, C. M. (2022). *American instructional resources surveys: 2022 technical documentation and survey results* (table 2.42). RAND Corporation. Retrieved from https://www.rand.org/pubs/research_reports/RRA134-14.html

[45] Doan, S., Eagan, J., Grant, D., Kaufman, J. H., & Setodji, C. M. (2022). *American instructional resources surveys: 2022 technical documentation and survey results* (table 3.18). RAND Corporation. Retrieved from https://www.rand.org/pubs/research_reports/RRA134-14.html

[46] American School District Panel. (n.d.). *Spring 2023 survey results: Math in the district*. Retrieved from https://www.americanschooldistrictpanel.org/survey-results/2023-spring.html

[47] Banilower, E. R., Smith, P. S., Malzahn, K. A., Plumley, C. L., Gordon, E. M., & Hayes, M. L. (2018). *Report of the 2018 NSSME+*. Horizon Research, Inc. Retrieved from https://horizon-research.com/NSSME/2018-nssme/research-products/reports/technical-report

[48] U.S. Department of Education. (2022). *Fiscal years 2022–2026 strategic plan*. https://www2.ed.gov/about/reports/strat/plan2022-26/strategic-plan.pdf

[49] U.S. Department of Education. (2021). *Mapping state proficiency standards onto the NAEP scales: Results from the 2019 NAEP reading and mathematics assessments, technical notes*. https://nces.ed.gov/nationsreportcard/subject/publications/studies/pdf/2021036a.pdf

[50] Education Advanced. (2022). *List of standardized tests by state*. Retrieved from https://educationadvanced.com/resources/blog/list-of-standardized-tests-by-state/

[51] Doan, S., Eagan, J., Grant, D., Kaufman, J. H., & Setodji, C. M. (2022). *American instructional resources surveys: 2022 technical documentation and survey results* (table 2.48). RAND Corporation. Retrieved from https://www.rand.org/pubs/research_reports/RRA134-14.html

[52] Center for Standards, Assessment, & Accountability. (2023). *Spotlight: Science assessment item collaborative*. Retrieved from https://csaa.wested.org/spotlight/science-assessment-item-collaborative

[53] National Assessment Governing Board. (n.d.). *About NAEP*. Retrieved from https://www.nagb.gov/naep/about-naep.html

[54] National Science Board. (n.d.). *The state of U.S. science and engineering 2022*. Retrieved from https://ncses.nsf.gov/pubs/nsb20221/

[55] U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. (n.d.). *School pulse panel 2021–22 and 2022–23*. Retrieved from https://ies.ed.gov/schoolsurvey/spp/

[56] Education Commission of the States. (2023). *High school graduation requirements 2023: Which assessments are required?* Retrieved from https://reports.ecs.org/comparisons/high-school-graduation-requirements-2023-11

[57] Education Commission of the States. (2021). *50-state comparison: States' school accountability systems*. Retrieved from https://www.ecs.org/50-state-comparison-states-school-accountability-systems/

[58] Freeman, M., Magouirk, P., & Kajikawa, T. (2021). *Applying to college in a test-optional admissions landscape: Trends from common app data*. https://s3.us-west-2.amazonaws.com/ca.research.publish/Research+briefs+2020/20210908_Paper4_TestOptional.pdf

[59] Gogol, F. (2023). *The U.S. grading system: A guide for international students*. Retrieved from https://www.stilt.com/blog/2021/09/the-u-s-grading-system-a-guide-for-international-students/

[60] Council of Chief State School Officers. (2020). *ESSA: Key provisions and implications for students with disabilities*. https://oese.ed.gov/files/2020/10/essa_key_provisions_implications_for_swd-final_0.pdf

[61] National Science and Technology Council. (2018). *Charting a course for success: America's strategy for STEM education*. https://www.nasa.gov/sites/default/files/atoms/files/stem-education-strategic-plan-2018.pdf

[62] U.S. Department of Education. (2022). *U.S. Department of Education launches new initiative to enhance STEM education for all students*. Retrieved from https://www.ed.gov/news/press-releases/us-department-education-launches-new-initiative-enhance-stem-education-all-students

[63] Office of Elementary and Secondary Education. (2023). *American rescue plan elementary and secondary school emergency relief funds (ARP ESSER): State and local educational agency (lea)/school district plans*. Retrieved from https://oese.ed.gov/offices/education-stabilization-fund/elementary-secondary-school-emergency-relief-fund/stateplans/

[64] Council of Chief State School Officers. (2023). *The road to recovery: How states are using federal relief funds to strengthen and expand high-quality digital learning*. Retrieved from https://learning.ccsso.org/how-states-are-using-federal-relief-funds-to-strengthen-and-expand-high-quality-digital-learning

[65] Council of Chief State School Officers. (n.d.). *States leading: How state education agencies are leveraging the ESSER set-aside*. Retrieved from https://learning.ccsso.org/states-leading-how-state-education-agencies-are-leveraging-the-esser-set-aside

[66] Marten, C. (2022). *Key policy letters signed by the education secretary or deputy secretary*. U.S. Department of Education. Retrieved from https://www2.ed.gov/policy/gen/guid/secletter/221206.html

[67] U.S. Department of Education. (2023). *U.S. Department of Education green ribbon schools*. Retrieved from https://www2.ed.gov/programs/green-ribbon-schools/index.html

[68] National Wildlife Federation. (n.d.). *A sustainable future begins at every EcoSchool*. Retrieved from https://www.nwf.org/eco-schools-us

[69] U.S. Green Building Council. (n.d.). *Mission and vision*. Retrieved from https://www.usgbc.org/about/mission-vision

[70] United States Environmental Protection Agency. (2022). *Environmental education (EE) grants*. Retrieved from https://www.epa.gov/education/grants

[71] North American Association for Environmental Education. (2019). *State environmental literacy plans*. https://cdn.naaee.org/sites/default/files/2022-07/naaee_selp_2019_status_report.pdf

[72] Office of Elementary and Secondary Education. (n.d.). *Plans that work: Tools for supporting school improvement planning*. Retrieved from https://oese.ed.gov/resources/oese-technical-assistance-centers/state-support-network/resources/plans-work-tools-supporting-school-improvement-planning/