



Photo: Fermin Leal

REFORMING SCIENCE INSTRUCTION IN CALIFORNIA A PRIMER

Key Questions & Answers

“Science—and therefore science education—is central to the lives of all Americans, preparing them to be informed citizens in a democracy and knowledgeable consumers.”

– NEXT GENERATION SCIENCE STANDARDS

In 2013, California adopted the Next Generation Science Standards, which are being introduced at a varying pace in school districts around the state. This EdSource primer provides an overview of the new standards.

What are the Next Generation Science Standards (NGSS)?

Standards describe what a student should know and be able to do at each grade level.

California’s Next Generation Science Standards describe a new set of learning goals based on research on how students learn best. Teachers are expected to support more student-centered learning that helps students to think on their own, problem solve, communicate and collaborate. The new standards emphasize critical thinking over rote memorization, more hands-on science projects, and common scientific concepts present in all scientific disciplines such as “cause and effect” and “structure and function.” The standards also require students to investigate, collect and use data, and give evidence-based explanations for what they discover.

The California standards also require science and engineering to be taught in every grade from kindergarten through 12th grade to build understanding and skills systematically year by year.

Acknowledgments

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Why did California decide to adopt them?

Before California adopted the new standards, its science standards had not been updated since 1998 and did not reflect the latest advances in scientific knowledge and technology. Teachers had concerns that the standards were biased toward memorizing science, as opposed to actually doing science. Also, there was a growing consensus among science education experts across the country that K-12 science instruction in the United States trailed behind the rest of the developed world.

Are other states also adopting these standards?

California and 25 other states were involved in developing the new standards. By May 2017, 18 states and the District of Columbia had adopted them.

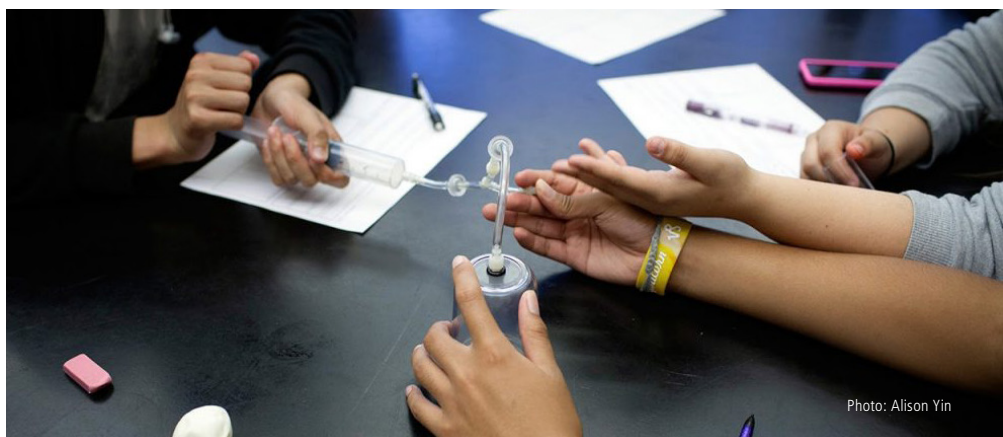
How far along is California in implementing the standards?

At the state level, the State Board of Education approved a new California Science Curriculum Framework in November 2016 based on the Next Generation Science Standards. The framework is essentially an optional blueprint and resource for use by districts and teachers as they create their own schoolwide and classroom science curriculum.

In 2018, the state is expected to convene K-12 science teachers and others to review new science instructional materials to ensure they are aligned to the Next Generation Science Standards. Those new NGSS materials are expected to be available by November 2018. However, this timeline is based on the state allocating funds to convene the teacher panels. If funding is delayed, the timeline will be affected.

Until the new instructional materials are available, the state gives districts the flexibility to review and choose instructional materials on their own and to create their own if needed.

Eight districts and two charter school organizations, as part of the California K-8 Early Implementation Initiative, have been working with the [K-12 Alliance](#) at WestEd. These districts and charter organizations are taking part in professional learning programs for teachers and administrators to help them implement the



standards at their schools. The teachers and administrators are trying out lesson plans, instructional materials and assessments. The lessons learned from these “early implementers” will help smooth the way for the rest of the districts in the state.

The early implementers include Oakland Unified in Northern California; San Diego Unified, Palm Springs Unified, Lakeside Union and Vista Unified in Southern California; Kings Canyon Unified, Galt Union Elementary and Tracy Unified in the Central Valley; and statewide charter organizations Aspire and High Tech High.

Beyond these districts, each of the state’s nearly 1,000 school districts is making decisions about when to implement the science standards, and at what pace, with more districts likely to get involved as textbooks aligned with the standards and more teacher training become available.

Will my child be tested on the new standards?

As a result of state and federal law, all students in grades 5 and 8 and in one high-school grade will be tested on a new California Science Test, or CAST, which the state is currently developing. It will be up to each high school to decide in which grade they administer the test.

In the spring of 2017, California students in these grades took a pilot version of the test. In the spring of 2018, they will take a more complete “field test” to help refine the test before it is used to assess student learning.

The first time the fully operational test will be taken and scores reported will be in the spring of 2019. The earliest the test results will be part of the [California School Dashboard](#) accountability system would likely be in the fall of 2020 after two years of data have been collected.

How will the new test be different from the old California Science Test students took?

Students will take the new test, which includes videos and online simulations, on a computer. The test developers are trying to create questions that require students to think more like scientists and engineers rather than asking them to repeat information they have memorized, the mainstay of the former paper-and-pencil test. The new test will also assess students on concepts that span more than one scientific discipline.

The 5th-grade test will cover material from grades 3 to 5, and the 8th-grade test will cover material from grades 6 to 8. The test is expected to take about two hours and is administered on school campuses.

How is classroom instruction different under the new standards? Will students learn the same concepts? Will they get hands-on learning?

Just like the Common Core has changed English and math instruction, the new science standards allow students to learn through discovery rather than only through information provided by a teacher or text books. Students will learn science by *doing*

science through the science and engineering practices outlined in the standards rather than by mostly memorizing facts. Under the guidance of their teacher, students will develop their own lines of inquiry, conduct their own science experiments, and write up their findings about everyday phenomena.

Students will also learn what are called “disciplinary core ideas” in life science, earth and space sciences, physical science and engineering design. These core ideas are similar to many of the concepts students learned under the previous standards, but teachers will go deeper into fewer subjects. Fourth graders, for example, may be asked to spend more time understanding the properties of waves through building models and experimentation. Content standards reflecting new technologies, such as how digital media transmits information over long distances, are also included in the disciplinary core ideas.

Finally, teachers will stress underlying ideas that cut across different scientific disciplines. These crosscutting concepts can be very broad, especially for students in the early elementary grades. Examples include “cause and effect” and “scale, proportion and quantity.” Middle school students may be asked to explain how scale and proportion matter when describing how rock strata illustrate the earth’s history.

Why does instruction under the new standards integrate different scientific disciplines?

The new standards favor a more integrated approach to science rather than teaching each scientific discipline on its own because that’s how students experience science in the real world.

Parents are likely to see the biggest shift in middle school, where students have typically taken an earth science course in 6th grade, life science in 7th grade and physical science in 8th grade. The state is encouraging districts to instead teach three years of “integrated science,” combining these three disciplines each year.

How do I find out if my school is implementing the new standards?

If students are in elementary school, talk to your child’s teacher or the school principal about how the school plans to implement the new standards. If students are in middle or high school, talk with his or her science teacher. If your child’s middle school is offering any “integrated science” curriculum, then the school is likely implementing the new standards.

What is the relationship between NGSS and the Common Core standards in English language arts and math?

When educators developed the Next Generation Science Standards, they considered how the standards would mesh with the Common Core standards in English. Particularly for children whose first language is not English, science can contribute to developing their speaking and writing abilities in English in an engaging context.

Scientific reasoning reflects a clarity of thinking and expression that is also the goal of the Common Core. When conducting scientific experiments, students need to be able to read about the concepts they are exploring, collaborate and discuss projects with other students, and take notes and write explanations of what they have learned.

The NGSS curriculum framework includes specific ways teachers can integrate Common Core English language arts standards and English Language Development standards for English learners with the new science standards. Similarly, California's English Language Arts/English Language Development Framework provides a blueprint for implementing literacy standards and standards for English learners in science. In the elementary grades, all English language arts standards can be taught through science except for literature.

Similarly, the NGSS and the Common Core math standards complement each other. Both sets of standards encourage students to make sense of problems and persevere in solving them, to reason abstractly, to make persuasive arguments and to critique the reasoning of others.

Are teachers prepared to use the new science standards in their classrooms?

The state requires all districts to address the implementation of all academic content standards, including science, in their Local Control and Accountability Plans (LCAPs). Some districts are providing training for their teachers, but others have not yet set aside funds from their Local Control Funding Formula or applied for grants for this purpose. Check with your school's principal about whether elementary teachers and science teachers in your district have received any training in the new standards.

Will these new standards better prepare students for science-related careers?

California's new science standards ask students to think and behave like scientists and engineers. When students understand how scientists and engineers do their work, and have opportunities to carry out investigations and design solutions, they become more engaged in their learning, increase their comprehension, and have a better understanding of what a scientific career looks like.

In addition, this approach ensures that students, no matter what career they choose, are scientifically literate – that they understand the role of science in everyday life. Students will be asked to develop and use models, analyze and interpret data, and construct explanations and design solutions for real-world problems.

For example, 8th graders might be expected to build and use a model (out of paper, clay or other materials) to describe how gravity governs motions within the Earth's solar system and more distant galaxies. To successfully meet this

expectation, students must learn core ideas about the universe and its stars and understand crosscutting concepts such as scale and proportionality.

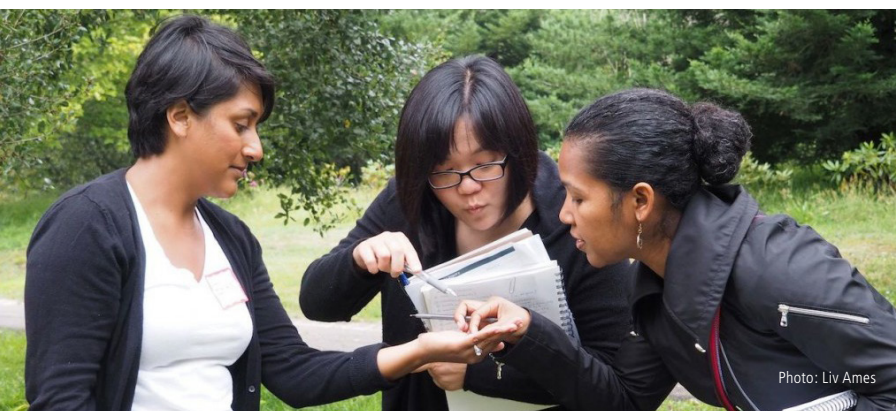
The NGSS also include other new practices common in many of today's workplaces, such as computational thinking and the use of computer modeling and simulation.

How can parents get involved in implementing and sustaining the new science standards at their children's school?

Become more knowledgeable about the standards and what to expect in your children's classrooms by checking out the website of the [California Alliance for NGSS](#). Encourage the principal of your child's school to fully implement the standards. Work with your district and school on the Local Control and Accountability Plan, or LCAP, to encourage districts to fund teacher training and buy the most appropriate textbooks and/or other instructional materials aligned with the new standards. Become an advocate for science!

“To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science.”

– ALBERT EINSTEIN



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