

Overview of NGSS

It has been roughly 15 years since the current state science education standards were developed. Since then, there have been significant advances in science. In addition, opportunities in STEM (science, technology, engineering, and mathematics) majors and careers at every level have changed and grown. The Next Generation Science Standards (NGSS) were developed to address the changing field of science and inspire interest and build skills in STEM that will equip students who might choose to pursue these careers. The NGSS developers acknowledge that standards alone are not the “silver bullet” but strive through NGSS to provide a foundation that allows educators to develop curriculum, instruction, and assessment that allow students to develop science-based skills in specific content areas as well as general skills in critical thinking and inquiry-based problem solving.

NGSS Framework Structure

The NGSS Framework consists of multiple layers. What have traditionally been considered science content standards are addressed in the Performance Expectations (PE). However, the emphasis of these expectations is different than the traditional model. Instead of focusing on what students know, the expectations focus on what a student who demonstrates understanding can do.

Underlying and informing the performance expectations are three dimensions that should be integrated within and across content areas. When all three are integrated, they give students a broader scope for the content being learned, knowledge of how scientific information is acquired, and an understanding of the overarching themes in science that extend across content areas.

Dimension 1: Science and Engineering Practices

This dimension can best be related to an integrated version of the “Investigation and Experimentation” portion of the CA State Science Standards. The term practice is meant to incorporate both skill and knowledge, as a combination of both is needed to engage in investigation. Scientists have a set of major practices that they use to investigate, build models, and develop theories regardless of their specific field. Likewise, engineers have key practices used to design and build systems. Students should have experience with each of these practices rather than learning them second-hand.

Eight key practices are identified.

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

A note about the difference between science and engineering practices: Scientific inquiry involves asking questions that can be answered via investigation while in engineering the emphasis is developing a problem that can be solved through design. These differences are addressed in practices 1 and 6 where both approaches are included.

Dimension 2: Crosscutting Concepts

This dimension is similar to the unifying concepts and processes described in the *National Science Education Standards*, *Benchmarks for Science Literacy*, and *Science College Board Standards for College Success*. Teachers who taught science before NCLB may also be familiar with these concepts as part of what was often referred to simply as “the framework.” This dimension addresses ideas that are applicable and important through all fields of science. The intention is that they are explicitly taught at different grade levels and in various content areas to enable students to better spot connections in science.

Seven crosscutting concepts are identified:

1. Patterns
2. Cause and effect (aka mechanism and explanation)
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter (flows, cycles, and conservation)
6. Structure and function
7. Stability and change

Dimension 3: Disciplinary Core Ideas

This dimension is designed to emphasize continuity of key ideas across grade levels for a specific disciplinary area. A small set of core ideas was selected from each area using four criteria. Each idea should either have widespread significance in science or be central to the specific discipline. Each idea should provide a tool to understand and investigate more complex ideas and problems within the content area. Further, the idea should connect to societal or personal issues that students can access. Finally, the idea should be teachable and learnable across grade levels with more depth and complexity added between each level.

The core ideas are grouped under the domains emphasized in NGSS:

- Physical Sciences
- Life Sciences
- Earth and Space Sciences
- Engineering, technology, and applications of science (identified within the other three domains)

A note about the groupings: Because the lines between different scientific domains are becoming increasingly blurred, some core ideas appear in several disciplines.

NGSS and Common Core

NGSS isn't the same as the Common Core State Standards (CCSS), but they are aligned. The writing teams worked together to ensure that NGSS doesn't outpace the math standards at any grade level. Specific overlaps between math and science standards at different grade levels and in different content areas have been identified. Similarly the writing teams worked together to determine which literacy skills align with the content demands of NGSS. Connections have been made between the NGSS science and engineering practices and the CCSS literacy anchor standards. Both involve students being able to gain knowledge from informational text including diagrams and data, assess information and claims, and make their own arguments based on evidence in writing and orally.

What isn't covered in NGSS?

- How teachers should teach the material- the only emphasis is what students are able to do.
- An exhaustive list of all content- a lot is left to educator and curriculum writer discretion.
- Advanced science learning- NGSS serves as a foundation but can be followed up with additional courses. The content of these courses isn't outlined.
- How address every need within diverse student populations- these are considered and discussed, but some is left to educator discretion.