Overview of Next Generation Science Standards

The Next Generation Science Standards (NGSS) are organized around three dimensions: disciplinary core ideas, scientific and engineering practices, and crosscutting concepts. Each standard purposefully includes all dimensions to avoid the pitfall of an emphasis on isolated content over connections among scientific concepts and the application of knowledge to solve problems and think creatively. The expectation is that this integrated approach to the study of science will prepare students for college and careers in science as well as for informed participation in the scientific issues of the day.

Disciplinary Core Ideas

The content portion of the NGSS focuses on fewer concepts that students study in more depth to avoid the "mile wide and inch deep" quality of many science curricula. These concepts include the following:

- Physical Sciences (e.g., Structure and Properties of Matter, Types of Interactions, Definitions of Energy, Energy in Chemical Processes and Everyday Life, Wave Properties, and Electromagnetic Radiation)
- Life Sciences (e.g., Organization for Matter and Energy Flows in Organisms, Interdependent Relationships in Ecosystems, Inheritance of Traits, Natural Selection, and Biodiversity and Humans)
- Earth and Space Sciences (e.g., The Universe and Its Stars, Plate Tectonics and Large-Scale Systems, Weather and Climate, and Human Impacts on Earth Systems)
- Engineering, Technology, and Applications of Science (e.g., Defining and Delimiting an Engineering Problem, Developing Possible Solutions, and Optimizing the Design Solution)

Science and Engineering Practices

NGSS gives clear direction to bring the ideas and practices of engineering into the science classroom. This call for the increased linking of engineering to science is exciting and important—engineering makes science practical. For some students, the problem solving nature of engineering may be more engaging and draw them to STEM.

NGSS Framework suggests that the way to connect engineering to science is by focusing on fewer concepts—those that unify science and engineering. The framework emphasizes eight practices that are common to both science and engineering and calls on science educators to increase authentic experiences with both.

- 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

Crosscutting Concepts

These concepts cross disciplines and topics and afford a way to connect learning to previous and new ideas:
Interdisciplinary Connections

Science, perhaps more than any other core content area, requires connections to other subject areas. The NGSS recognize the importance of literacy and mathematics to the study of science with a connections section that accompanies each student performance description.

The Common Core State Standards for Literacy in History/Social Studies, Science, and Technical Subjects address specific reading and writing requirements for learning science, such as citing “specific textual evidence to support analysis of science and technical texts” and writing “arguments focused on discipline-specific content.” These reading and writing behaviors support literacy across the content areas in ways that meet the specific needs of scientific reading and writing.

Mathematical proficiency is also critical to the understanding of many scientific concepts, and these connections are identified throughout the NGSS. Mathematical models are important for understanding scientific phenomena, and abstract and quantitative reasoning are critical for scientific inquiry. Thinking scientifically also frequently depends on the use of mathematical formulas and statistical reasoning.

The following excerpts from middle school earth and space sciences standards illustrate how the standard incorporates the three dimensions of science standards and the connections with other subject areas.

**MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.**

Science and Engineering Practices
- Develop and use a model to describe phenomena.
- Analyze and interpret data to determine similarities and differences in findings.

Disciplinary Core Ideas
- The solar system consists of the sun and a collection of objects, including planets and their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

Crosscutting Concepts
- Scale, Proportion, and Quantity: Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

ELA/Literacy
- RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- SL.8.5: Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.
Mathematics

- 6.RP.A.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
- 7.EE.B.4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

References