Next Generation Science Standards (NGSS)

The NGSS are 3-dimensional:

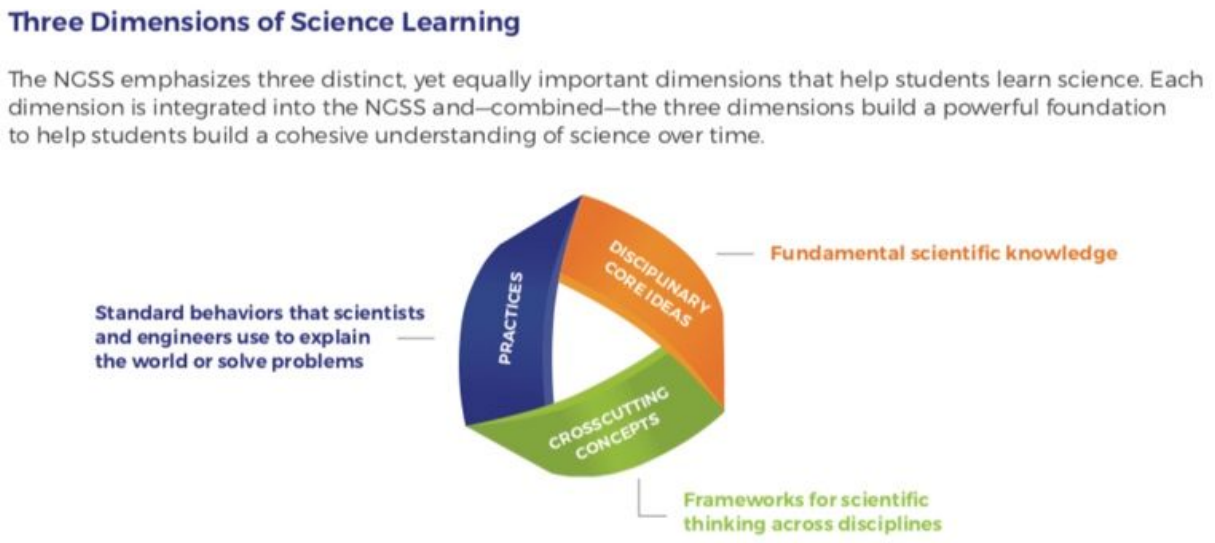
"A Science Framework for K-12 Science Education was drafted by the National Research Council of the National Academy of Sciences & provides the blueprint for developing the Next Generation Science Standards (NGSS). The Framework expresses a vision in science education that requires students to operate at the nexus of three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. The *Framework* specifies that each performance expectation must combine a relevant practice of science or engineering, with a core disciplinary idea and crosscutting concept, appropriate for students of the designated grade level."

Information adapted & retrieved from: NGSS Appendices, Appendix F available at https://www.nextgenscience.org/resources/ngss-appendices and A Framework for K-12 Science Education, available at https://www.nextgenscience.org/framework-k-12-science-education

The NGSS put phenomena first:

"The NGSS focus on helping students use science to make sense of phenomena in the natural and designed world, and use engineering to solve problems. Natural phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict. The goal of building knowledge in science is to develop general ideas, based on evidence, that can explain and predict phenomena."

Information adapted & retrieved from: NGSS Phenomena, available at



https://www.nextgenscience.org/resources/phenomena
Image retrieved from: NGSS Parent Guide available at https://www.nextgenscience.org/parentguides

Disciplinary core ideas (DCI's)

"Disciplinary core ideas are built on the notion of learning as a developmental progression. It is designed to help children continually build on and revise their knowledge and abilities, starting from their curiosity about what they see around them and their initial conceptions about how the world works. The goal is to guide their knowledge toward a more scientifically based and coherent view of the natural sciences and engineering, as well as of the ways in which they are pursued and their results can be used."
The Framework identified a small number of disciplinary core ideas that all students should learn with increasing depth and sophistication, from Kindergarten through grade twelve.
(See example attached at end of packet)

Information adapted & retrieved from: NGSS Appendices, Appendix E available at https://www.nextgenscience.org/resources/ngss-appendices

Crosscutting Concepts (CCC's)

"There are seven crosscutting concepts that bridge disciplinary boundaries, uniting core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas, and develop a coherent and scientifically based view of the world."

1. **Patterns**: Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. **Cause and effect**: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. **Scale, proportion, and quantity**: In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

4. **Systems and system models**: Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. **Energy and matter:**Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

6. **Structure and function**: The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. **Stability and change**: For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Information adapted & retrieved from: NGSS Appendices, Appendix G available at https://www.nextgenscience.org/resources/ngss-appendices

Science & Engineering Practices

The eight science & engineering practices outline what scientists do in the real world. These are ways to get students actively engaged in science and to encourage curiosity about the things they see in their real life.

Practice	Definition
Asking questions (science) & defining problems (engineering)	*Students* ask questions about phenomena they observe, investigations they conduct, or texts they read. For engineering, *students* can define a problem to be solved.
Developing & using models	*Students* can develop diagrams, pictures, analogies, or physical replicas of phenomena they see in the real world.
Planning & carrying out investigations	*Students* engage in investigations that range from those structured by teacher to those that emerge from students' own questions.
Analyzing & interpreting data	*Students* take raw data and organize and interpret that data so that it can be communicated to others.
Using mathematics & computational thinking	*Students* can use math to represent variables and their relationships, make predictions, or build models.
Constructing explanations (science) & designing solutions (engineering)	*Students* demonstrate their own understanding of a phenomena and can make a claim about what they think is happening. For engineering, *students* can communicate solutions to problems that were defined.
Engaging in argument from evidence	*Students* can reason and argue for their explanation based on evidence they have collected or observed.
Obtaining, evaluating, & communicating information	*Students* develop their ability to read, interpret, and produce disciplinary (science or engineering) texts.

Information adapted & retrieved from: NGSS Appendices, Appendix F available at https://www.nextgenscience.org/resources/ngss-appendices

Proto-scientific practices:

“All eight practices are accessible at some level to young children; students’ abilities to use the practices grow over time. However, the NGSS only identifies the capabilities students are expected to acquire by the end of each grade band (K-2, 3-5, 6-8, and 9-12).”

Information retrieved from: NGSS Appendices, Appendix F available at https://www.nextgenscience.org/resources/ngss-appendices

We call those practices that very young children engage in “proto-scientific” because while they may not be the full-fledged practices trained scientists do, they approximate those practices.

Notes:

Helpful resources

Next Generation Science Standards website: https://www.nextgenscience.org

A Framework For K-12 Science Education, available for download at https://www.nextgenscience.org/framework-k-12-science-education

Schwarz, C., Passmore, C., & Reiser, B. J. (2016). *Helping students make sense of the world using next generation science and engineering practices*.