

Standards, Curriculum, Instruction, and Assessment

Standards - What a student needs to know, understand, and be able to do by the end of each grade. Standards build across grade levels in a progression of increasing understanding and through a range of cognitive demand levels. Standards are adopted at the state level by the State Board of Education.

Curriculum - The resources used for teaching and learning the standards. Curricula are adopted at a local level by districts and schools. Curricula include scope and sequence of K-12 standards and/or learning objectives/targets aligned to the state standards. Comprehensive curricula are necessary to plan the pace of instruction, alignment standards and grade level expectations horizontally and vertically, set district assessment and professional development calendars and guide teachers as they deliver instruction.

Instruction - The methods and processes used by teachers in planning, instruction and assessment. Instructional techniques are employed by individual teachers in response to the needs of the students in their classes to help them progress through the curriculum in order to master the standards.

Assessment - The process of gathering information about student learning to inform education-related decisions. Assessments can reflect a wide variety of learning goals/targets using a range of methods serving many important users and uses at a variety of levels from the classroom to the boardroom. In this sense, assessment is an essential part of informing the teaching and learning process.

Innovations for 2018 Science Standards

- 1. Three-Dimensional Learning:** An instructional approach where students make sense of phenomena of the natural world through “engaging in science and engineering practices and their application of the crosscutting concepts” (Bybee pg. 2). The three dimensions work together by reinforcing inner-related concepts, giving students a way of organizing and applying their knowledge across a broad spectrum
- 2. Explaining Phenomena and Designing Solutions to Problems:** Providing a context for lessons, units, and programs that spark students’ curiosity about the phenomena of the natural world and provides a motivation to learn the core ideas of science. The content becomes meaningful, and students are engaged with learning the content to explain the phenomena or to design solutions to a problem.
- 3. Incorporating Engineering Design:** Incorporating engineering design and nature of science are practiced and experienced by students throughout the Arizona Science Standard.
- 4. Building K-12 Progression:** Science engineering practices, crosscutting concepts, and core ideas build coherent learning progressions both within a grade level and across grade levels so students can continually build on and revise their knowledge and skills throughout their schooling.
- 5. Connecting to ELA/literacy and Mathematics:** Literacy and mathematics are part of science. Integrating these disciplines with science provides broad and deep conceptual understanding in all three subject areas.

Sources:

Bybee, R.W. (2015). *NGSS Innovations*. Retrieved from <https://www.amnh.org/content/download/133084/2214178/file/NGSS%20Innovations.pdf>

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National Research Council (NRC). (2012). *A Framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: The National Academies Press.

Schwarz, C.V., Passmore, C., Reiser, B.J. (2017). *Helping students make sense of the world using next generation science and engineering practices*. Arlington, VA: NSTA Press

What are NGSS Performance Expectations? (2017). Retrieved from <https://www.albert.io/blog/what-are-ngss-performance-expectations/>



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While there is some correlation between the 2004 and 2018 science content standards, the 2018 standards encompass many performance objectives in one core idea. The depth and focus of the 2018 standards do not correlate to the 2004 standards well. Therefore, a crosswalk between 2004 and 2018 standards will not be provided.

Why Move Toward Broad Standards and Away from Performance Objectives?

AzSS standards are expectations of student performance. Neuroscience research has identified factors that facilitate effective learning. A relevant finding is that ideas that are connected are more readily used in new situations than unconnected ideas. In other words, a few big ideas enable understanding of the world and our experiences in it, rather than disjointed facts of content (Big Ideas pg. 5).

Moving Toward Broad Standards

- Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning
- Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned
- Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance
- Students discussing open-ended questions that focus on the strength of the evidence used to generate claims
- Students reading multiple sources, including science-related magazine and journal articles and web-based resources; students developing summaries of information
- Multiple investigations driven by students' questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas
- Student writing of journals, reports, posters, and media presentations that explain and argue
- Provision of supports so that all students can engage in sophisticated science and engineering practices

Moving Away from Performance Objectives

- Rote memorization of facts and terminology
- Learning of ideas disconnected from questions about phenomena
- Teachers providing information to the whole class
- Teachers posing questions with only one right answer
- Students reading textbooks and answering questions at the end of the chapter
- Pre-planned outcome for "cookbook" laboratories or hands-on activities
- Worksheets
- Oversimplification of activities for students who are perceived to be less able to do science and engineering

Source: National Research Council. (2015). Guide to Implementing the Next Generation Science Standards (pp. 8-9). Washington, DC: National Academies Press. <http://www.nap.edu/catalog/18802/guide-to-implementing-the-next-generation-science-standards>.



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Three Dimensions of Science

Sense-making in science occurs with the integrating of three essential dimensions: science and engineering practices, crosscutting concepts, and core ideas.

Science and Engineering Practices	Crosscutting Concepts	Core Ideas
<p>Science and engineering practices describe a robust process for how scientists investigate and build models and theories of the natural world or how engineers design and build systems. As students conduct investigations, they engage in multiple practices as they gather information to solve problems, answer their questions, reason about how the data provide evidence to support their understanding, and then communicate their understanding of phenomena. Student investigations may be observational, experimental, use models or simulations, or use data from other sources. These eight practices identified in <i>A Framework for K-12 Science Education</i> are critical components of scientific literacy, not instructional strategies:</p> <ul style="list-style-type: none"> ● 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 	<p>Crosscutting concepts are a tool for students that cross boundaries between science disciplines and provide an organizational framework to connect knowledge from various disciplines into a coherent and scientifically based view of the world. Their purpose is to provide a lens to help students deepen their understanding of the core ideas as they make sense of phenomena. The seven crosscutting concepts identified in <i>A Framework for K-12 Science Education</i> are:</p> <ul style="list-style-type: none"> ● Patterns ● Cause and effect: Mechanism and explanation ● Scale, proportion, and quantity ● Systems and system models ● Energy and matter: Flow, cycles and conservations ● Structure and function ● Stability and change 	<p>Core ideas for knowing science and using science develop scientific literacy through science content knowledge, understanding the nature of science, applications of science and engineering, and social implications. The thirteen core ideas modified from <i>Working with Big Ideas of Science Education</i> are:</p> <p><u>Physical Science</u></p> <p>P1: All matter in the Universe is made of very small particles. P2: Objects can affect other objects at a distance. P3: Changing the movement of an object requires a net force to be acting on it. P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event.</p> <p><u>Earth and Space Science</u></p> <p>E1: The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and its climate. E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe.</p> <p><u>Life Science</u></p> <p>L1: Organisms are organized on a cellular basis and have a finite life span. L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. L3: Genetic information is passed down from one generation of organisms to another. L4: The unity and diversity of organisms, living and extinct, is the result of evolution.</p> <p><u>Using Science</u></p> <p>U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.</p>



The intention of this document is to help Arizona educators determine if a Next Generation Science Standard (NGSS) resource could be used when planning for instruction with the Arizona Science Standards (AzSS). This document describes how the Arizona Science Standards may or may not align to the Next Generation Science Standards.

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4th Grade Arizona Science Standards (AzSS) Alignment to Next Generation Science Standards (NGSS)

The ADE acknowledges that the acronym “NGSS” is consistently used throughout science resources. To avoid confusion, we want to ensure the community understands that Arizona is not considered an “NGSS” state. To further clarify, AzSS and the NGSS were both designed using the research document, *A Framework for K-12 Science Education*. Both sets of standards include a strong focus on three-dimensional instruction, which includes: Science and Engineering Practices, Crosscutting Concepts, and Core Ideas. The major difference between the AzSS and the NGSS is that Arizona used an additional research document, *Working with Big Ideas of Science Education*, in the development of the Core Ideas of Knowing and Using Science.

Alignment of the AzSS to NGSS Performance Expectations

Note: An “S” or “P” alignment indicates that an NGSS resources could be used. An “NC” indicates that an NGSS resources cannot be used.

- **S = Strong:** Both the Core Idea and Science and Engineering Practice (SEP*) are the same
- **P = Partial:** Core idea is closely related; SEP may or may not match
- **NC** = Not Closely Correlated:** There is no strong or partial correlation in this grade band

**The bolded section of each standard refers to the Science and Engineering Practice that correlates to each standard. However, others should be utilized throughout the learning for this grade level. Naturally, one practice can lead to the use of others.*

***The NGSS performance expectation may be in a different grade level.*

Crosscutting Concepts: Patterns; Cause and Effect; Scale, Proportion and Quantity; **Systems and System Models**; **Energy and Matter**; Structure and Function; **Stability and Change**

**Bolded crosscutting concepts are a focus throughout this grade level.*

Physical Science: Students develop an understanding of how Earth’s resources can be transformed into different forms of energy. Students develop a better understanding of electricity and magnetism.

Arizona Science Standards- 4 th Grade Physical		Next Generation Science Standards- 4 th Grade Physical
4.P4U1.1 Develop and use a model to demonstrate how a system transfers energy from one object to another even when the objects are not touching.	P	3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
4.P4U1.2 Develop and use a model that explains how energy is moved from place to place through electric currents.	P	3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
	P	4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4.P2U1.3 Develop and use a model to demonstrate magnetic forces.	P	3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.



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Arizona Science Standards- 4 th Grade Physical		Next Generation Science Standards- 4 th Grade Physical
4.P4U3.4 Engage in argument from evidence on the use and impact of renewable and nonrenewable resources to generate electricity.	P	4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
Earth and Space: Students develop an understanding of the different Earth systems and how they interact with each other. They understand how geological systems change and shape Earth and the evidence that is used to understand these changes. They also understand how weather, climate, and human interactions can impact the environment.		
Arizona Science Standards- 4 th Grade Earth & Space		Next Generation Science Standards- 4 th Grade Earth & Space
4.E1U1.5 Use models to explain seismic waves and their effect on the Earth.	NC	There is no strong or partial correlation to an NGSS standard in this grade band.
4.E1U1.6 Plan and carry out an investigation to explore and explain the interactions between Earth's major systems and the impact on Earth's surface materials and processes.	P	4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
	P	5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
4.E1U1.7 Develop and/or revise a model using various rock types, fossils location, and landforms to show evidence that Earth's surface has changed over time.	P	4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.
	P	4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
4.E1U1.8 Collect, analyze, and interpret data to explain weather and climate patterns.	S	3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
	P	3-ESS2-2 Obtain and combine information to describe climates in different regions of the world.
4.E1U3.9 Construct and support an evidence-based argument about the availability of water and its impact on life.	P	5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.



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Arizona Science Standards- 4 th Grade Earth & Space		Next Generation Science Standards- 4 th Grade Earth & Space
4.E1U2.10 Define problem(s) and design solution(s) to minimize the effects of natural hazards.	P	3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.
	P	4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Life Science: Students develop an understanding of the diversity of past and present organisms, factors impacting organism diversity, and evidence of change of organisms over time.

Arizona Science Standards- 4 th Grade Life		Next Generation Science Standards- 4 th Grade Life
4.L4U1.11 Analyze and interpret environmental data to demonstrate that species either adapt and survive, or go extinct over time.	P	3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

