Arizona's 2018 Science Standards Summary & AzSS vs. NGSS Planning Guide – 6th Grade

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

Harlen, W. (2015). *Working with big ideas of science education.* Global Network of Science Academies (IAP) Science Education Programme: Trieste, Italy.

Moulding, B.D., Bybee, R.W., Paulson, N. (2015). *A vision and plan for science teaching and learning.* USA: Essential Teaching and Learning Publications.

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/

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	Moving Away from Performance Objectives
• Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning	• Rote memorization of facts and terminology
• Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned	• Learning of ideas disconnected from questions about phenomena
• Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance	• Teachers providing information to the whole class
• Students discussing open-ended questions that focus on the strength of the evidence used to generate claims	• Teachers posing questions with only one right answer
• Students reading multiple sources, including science-related magazine and journal articles and web-based resources; students developing summaries of information	• Students reading textbooks and answering questions at the end of the chapter
• Multiple investigations driven by students' questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas	• Pre-planned outcome for "cookbook" laboratories or hands-on activities
• Student writing of journals, reports, posters, and media presentations that explain and argue	• Worksheets
• Provision of supports so that all students can engage in sophisticated science and engineering practices	• 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.

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
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 *A Framework for K-12 Science Education* are critical components of scientific literacy, not instructional strategies: • 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** 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 *A Framework for K-12 Science Education* are: • 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	**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 *Working with Big Ideas of Science Education* are: **Physical Science** 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. **Earth and Space Science** 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. **Life Science** 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. **Using Science** 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.

6th 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 forces and energy and how energy can transfer from one object to another or be converted from one form to another. They also develop an understanding of the nature of matter.

Arizona Science Standards- 6th Grade Physical		Next Generation Science Standards- 6th Grade Physical
6.P1U1.1 Analyze and interpret data to show that changes in states of matter are caused by different rates of movement of atoms in solids, liquids, and gases (Kinetic Theory).	P	**MS-PS1-4** Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
6.P1U1.2 Plan and carry out an investigation to demonstrate that variations in temperature and/or pressure affect changes in state of matter.	P	**MS-PS1-4** Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
6.P1U1.3 Develop and use models to represent that matter is made up of smaller particles called atoms.	S	**MS-PS1-1** Develop models to describe the atomic composition of simple molecules and extended structures.

Arizona Science Standards- 6th Physical		Next Generation Science Standards- 6th Physical
6.P2U1.4 Develop and use a model to predict how forces act on objects at a distance.	P	**MS-PS2-5** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
6.P4U2.5 Analyze how humans use technology to store (potential) and/or use (kinetic) energy.	NC	There is no strong or partial correlation to an NGSS standard in this grade band.

Earth and Space: Students develop an understanding of the scale and properties of objects in the solar system and how forces (gravity) and energy cause observable patterns in the Sun-Earth-Moon system.		
Arizona Science Standards- 6th Grade Earth & Space		**Next Generation Science Standards- 6th Grade Earth & Space**
6.E1U1.6 Investigate and construct an explanation demonstrating that radiation from the Sun provides energy and is absorbed to warm the Earth's surface and atmosphere.	P	**MS-ESS2-6** Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
6.E2U1.7 Use ratios and proportions to **analyze and interpret data** related to scale, properties, and relationships among objects in our solar system.	S	**MS-ESS1-3** Analyze and interpret data to determine scale properties of objects in the solar system.
6.E2U1.8 Develop and use models to explain how constellations and other night sky patterns appear to move due to Earth's rotation and revolution.	NC	There is no strong or partial correlation to an NGSS standard in this grade band.
6.E2U1.9 Develop and use models to construct an explanation of how eclipses, moon phases, and tides occur within the Sun-Earth-Moon system.	S	**MS-ESS1-1** Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
6.E2U1.10 Use a model to show how the tilt of Earth's axis causes variations in the length of the day and gives rise to seasons.	S	

Life Science Standards: Students develop an understanding of how energy from the Sun is transferred through ecosystems.		
Arizona Science Standards- 6th Grade Life		**Next Generation Science Standards- 6th Grade Life**
6.L2U3.11 Use evidence to construct an argument regarding the impact of human activities on the environment and how they positively and negatively affect the competition for energy and resources in ecosystems.	P	**MS-LS2-4** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
6.L2U3.12 Engage in argument from evidence to support a claim about the factors that cause species to change and how humans can impact those factors.	P	**MS-LS4-5** Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.
6.L2U1.13 Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors.	P	**MS-LS2-1** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
6.L2U1.14 Construct a model that shows the cycling of matter and flow of energy in ecosystems.	S	**MS-LS2-3** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.