Arizona's 2018 Science Standards Summary & AzSS vs. NGSS Planning Guide – 5th 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

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

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

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.

5th 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 that changes can occur to matter/objects on Earth or in space, but both energy and matter follow the pattern of being conserved during those changes.

Arizona Science Standards- 5th Grade Physical		Next Generation Science Standards- 5th Grade Physical
5.P1U1.1 Analyze and interpret data to explain that matter of any type can be subdivided into particles too small to see and, in a closed system, if properties change or chemical reactions occur, the amount of matter stays the same.	P	**5-PS1-1** Develop a model to describe that matter is made of particles too small to be seen.
	P	**5-PS1-2** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
5.P1U1.2 Plan and carry out investigations to demonstrate that some substances combine to form new substances with different properties and others can be mixed without taking on new properties.	S	**5-PS1-4** Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
5.P2U1.3 Construct an explanation using evidence to demonstrate that objects can affect other objects even when they 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.

Arizona Science Standards- 5th Physical		Next Generation Science Standards- 5th Physical
5.P3U1.4 Obtain, analyze, and communicate evidence of the effects that balanced and unbalanced forces have on the motion of objects.	P	**3-PS2-1** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
5.P3U2.5 Define problems and **design solutions** pertaining to force and motion.	NC	There is no strong or partial correlation to an NGSS standard in this grade band.
5.P4U1.6 Analyze and interpret data to determine how and where energy is transferred when objects move.	P	**4-PS3-3** Ask questions and predict outcomes about the changes in energy that occur when objects collide.
	P	**4-PS3-1** Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Earth and Space: Students develop an understanding of the how gravitational forces in space cause observable patterns due to the position of Earth, Sun, Moon, and stars.		
Arizona Science Standards- 5th Grade Earth & Space		**Next Generation Science Standards- 5th Grade Earth & Space**
5.E2U1.7 Develop, revise, and use models based on evidence to construct explanations about the movement of the Earth and Moon within our solar system.	P	**5-ESS1-2** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
5.E2U1.8 Obtain, analyze, and communicate evidence to support an explanation that the gravitational force of Earth on objects is directed toward the planet's center.	NC	There is no strong or partial correlation to an NGSS standard in this grade band.

Life Science: Students develop an understanding of patterns and how genetic information is passed from generation to generation. They also develop the understanding of how genetic information and environmental features impact the survival of an organism.		
Arizona Science Standards- 5th Grade Life		**Next Generation Science Standards- 5th Grade Life**
5.L3U1.9 Obtain, evaluate, and communicate information about patterns between the offspring of plants, and the offspring of animals (including humans); **construct an explanation** of how genetic information is passed from one generation to the next.	P	**3-LS3-1** Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
5.L3U1.10 Construct an explanation based on evidence that the changes in an environment can affect the development of the traits in a population of organisms.	S	**3-LS3-2** Use evidence to support the explanation that traits can be influenced by the environment.
5.L4U3.11 Obtain, evaluate, and communicate evidence about how natural and human-caused changes to habitats or climate can impact populations.	P	**3-LS4-4** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
5.L4U3.12 Construct an argument based on evidence that inherited characteristics can be affected by behavior and/or environmental conditions.	P	**3-LS4-4** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
	P	**3-LS3-2** Use evidence to support the explanation that traits can be influenced by the environment.