Science

K-8 Curriculum Guides

including

Standards, Three Dimensional Foundations, and Evidence of Learning Specifications

Board Approved February 2020

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Introduction

Scientific thinking enables Arizona students to strengthen skills that people use every day: solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing lifelong learning. A fundamental goal of science education is to help students determine how the world works and make sense of phenomena in the natural world. Phenomena are events or situations that are observed to exist or happen, especially phenomena whose causes or explanations are in question. Science sense-making is a conceptual process in which a learner actively engages with phenomena in the natural world to construct logical and coherent explanations that incorporate their current understanding of science or a model that represents it and are consistent with the available evidence. To develop a scientific understanding of the natural world, students must be able to ask questions, gather information, reason about that information and connect it to scientific principles, theories, or models, and then effectively communicate their understanding and reasoning.

These standards outline what all students need to know, understand, and be able to do by the end of high school and reflect the following shifts for science education:

- Organize standards around thirteen core ideas and develop learning progressions to coherently and logically build scientific literacy from kindergarten through high school.
- Connect core ideas, crosscutting concepts, and science and engineering practices, to make sense of the natural world and understand how science and engineering are practiced and experienced.
- Focus on fewer, broader standards that allow for greater depth, more connections, deeper understanding, and more applications of content.

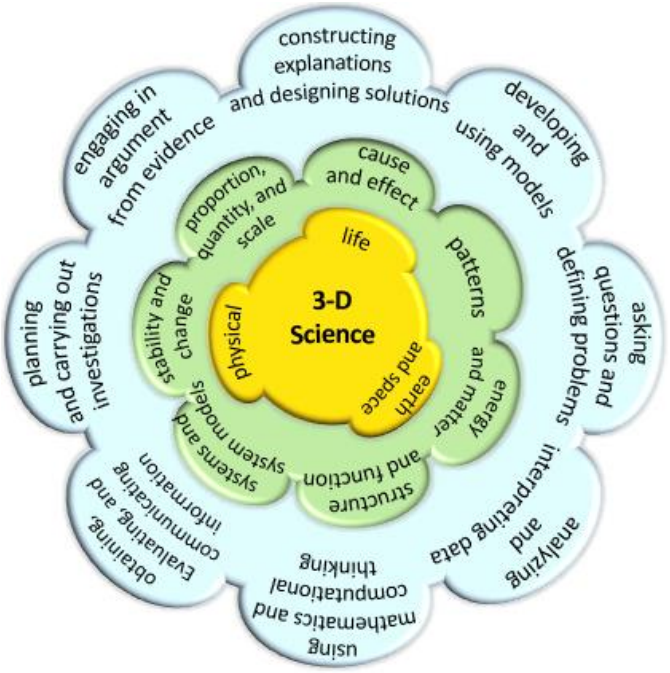


Figure 1: Three Dimensions of Science Instruction

Three Dimensions of Science

Sense-making in science occurs with the integration of three essential dimensions:

- science and engineering practices (shown as the outer ring in Figure 1)
- crosscutting concepts (shown as the middle section of Figure 1)
- core ideas (shown as the center circle in Figure 1)

Science and Engineering Practices

For decades teachers have utilized the scientific method as a methodology to engage in scientific inquiry. How it has been implemented in classrooms describes a set of prescribed steps used to engage in science teaching and to learn in a rather linear process. The new vision calls for students to engage in multifaceted science and engineering practices in more complex, relevant, and authentic ways. The 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. Rather than a linear process from hypothesis to conclusion, these practices reflect science and engineering as they are practiced and experienced. 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:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- engage in argument from evidence
- obtain, evaluate, and communicate information

While the scientific method is still being widely used, and a part of academics, the science and engineering practices are expected to be integrated with the core ideas and crosscutting concepts across all grade levels and disciplines.

Crosscutting Concepts

Crosscutting concepts 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. They bridge boundaries between science and other disciplines and connect core ideas and practices throughout the fields of science and engineering. Their purpose is to provide a lens to help students deepen their understanding of the core ideas as they make sense of phenomena in the natural and designed worlds. The crosscutting concepts identified in *A Framework for K-12 Science Education* are:

- patterns
- cause and effect
- structure and function
- systems and system models
- stability and change

- scale, proportion, and quantity
- energy and matter

The Arizona Science Standards are designed for students to develop their understanding of core ideas through the lens of one or multiple crosscutting concepts. Crosscutting concepts can be combined as students find and use patterns as evidence, determine cause and effect relationships, or define systems to investigate. Students must be provided with structures and opportunities to make explicit connections between their learning and the crosscutting concepts.

The use of crosscutting concepts can be demonstrated within cause and effect relationships. For example, researchers investigate cause and effect mechanisms in the motion of a single object, specific chemical reactions, population changes in an ecosystem, and the development of holes in the polar ozone layers. Patterns are present in all science disciplines, and much of science is about explaining observed patterns. Using data, graphs, charts,

maps, and statistics in combination with the science and engineering practices, students can use their knowledge of cause and effect relationships to formulate investigations, answer questions, and make informed predictions about observed phenomena.

Core Ideas

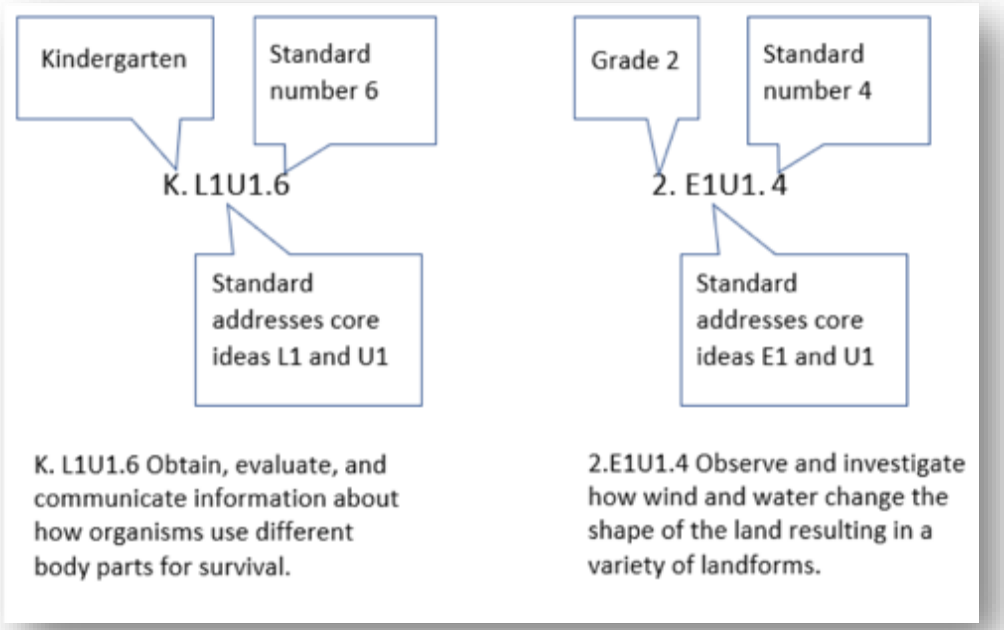
The Arizona Science Standards focus on thirteen core ideas in science and engineering, adapted from *Working with Big Ideas of Science Education*. The ten core ideas for **Knowing Science** center on understanding the causes of phenomena in physical, Earth and space, and life science. The three core ideas for **Using Science** connect scientific principles, theories, and models; engineering and technological applications; and societal implications to the content knowledge to support that understanding. The complexity of each core idea develops as students' progress through each grade band. Each standard is written at the intersection of two core ideas to help students understand both the process of knowing science and using science. These core ideas occur across grade levels and provide the background knowledge for students to develop sense-making around phenomena in the natural world.

Core Ideas for Knowing Science	Core Ideas for Using Science
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.	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

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. *Adapted from *Working with Big Ideas in Science Education*[2]	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.

Coding of the K-8 Science Standards

Each standard represents the intersection of core ideas for knowing science and using science. This intersection stresses that content in physical science, Earth and space science, and life science is not learned independently from ideas about the nature of science, applications of science, or the social implications of using science. The coding of the standard captures this intersection. Students 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, applications, or social implications. They use the crosscutting concepts to support their understanding of patterns, cause and effect relationships, and systems thinking as they make sense of phenomena. The standard number at the end of the code is designed for recording purposes and does not imply instructional sequence or importance. The image below are examples and descriptions of coding of the K-8 Standards and remain similar in high school.



Standards v. Curriculum v. Instruction

Standards:

Standards are what a student needs to know, understand, and be able to do by the end of each grade. They 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 Arizona State Board of Education.

Curriculum:

Curriculum refers to resources used for teaching and learning the standards. Curricula are adopted at the local level.

Instruction:

Instruction refers to the methods, or methodologies, used by teachers to teach their students. 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 to master the standards. Decisions about instructional practice and techniques are made at a local level.

Time Allotment

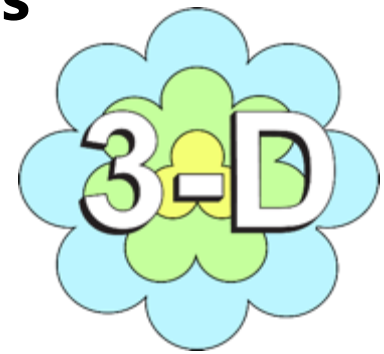
The Arizona Science Standards suggest students have regular standards-based science instruction every year. The amount of time individual students need to learn these standards will vary. The chart below specifies the instructional time necessary for students to master these standards.

The Arizona Science Standards have been designed so that these time suggestions provide adequate time to actively engage in all 3 dimensions of science instruction to master the standards for each grade level. Depending on local factors, schools may allocate more or less time when determining curriculum programming within a specific context. Instruction on the Arizona Science Standards may be a dedicated time in the school schedule or may be integrated with the instruction of other subjects.

These time recommendations do not explicitly address the needs of students who are far below or far above the grade level. No set of grade-specific standards can fully reflect the variety of abilities, needs, learning rates, and achievement levels of students in any given classroom. The Arizona Science Standards do not define the intervention methods to support students who are far below or far above grade level or do not speak English as their first language.

Grade	**K**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**HS**
Suggested Minutes per Week	90	150	150	200	225	225	250	250	250	275
Suggested Average Minutes per Day	18	30	30	40	45	45	50	50	50	55

A Look at the Arizona Science Standards for Mesa Public Schools



The 2018 Arizona Science Standards (AzSS) differ from prior science standards in that they integrate three dimensions (Core Ideas, Science and Engineering Practices, and Crosscutting Concepts) into a single standard document and have intentional connections between standards across all disciplines. The Mesa Public Schools Science Curriculum Guide highlights the Arizona Science Standards as well as each of the three integral dimensions and connections to other grade bands and subjects. This guide includes a table with three main sections.

What is Assessed (The Standard)	**3D Foundations Box**	**Evidence of Learning Specifications Box (EoLS)**
A standard describes what students should be able to do at the end of instruction and incorporates a Science and Engineering Practice and Core Idea. Standards are not instructional strategies or objectives for a lesson. Instead, they are intended to guide the development of assessments and are 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.	The three dimensions foundation boxes contain the learning goals that students should achieve. It is critical that science educators consider the foundations boxes an essential component when reading the AzSS and developing curricula. There are four foundation boxes: Core Ideas, Science and Engineering Practices, Crosscutting Concepts, and Using Science, all of which are derived from *A Framework for Science Education* and *Working with Big Ideas of Science Education*. During instruction, teachers guide students to use multiple practices to help them understand the Core Ideas. Most groupings of standards emphasize only a few practices or Crosscutting Concepts; however, all are emphasized within a grade band. The foundation boxes also contains Using Science (unique to AzSS) that connect scientific principles, theories, and models;	The Evidence of Learning Specification box uses the standards and 3D foundations to develop EoLS, which describe what qualifies as evidence for students' proficiency. High quality assessment practices are critical to the success of the AzSS. The Evidence of Learning Specifications represent learning at the nexus of the 3-dimensions of the AzSS while engaged in AzSS phenomena.

	engineering and technological applications; and societal implications to the content knowledge to support scientific understanding.	

Navigating the Science Curriculum

Core Ideas for the Unit
Core Ideas as described below that will appear in the unit.

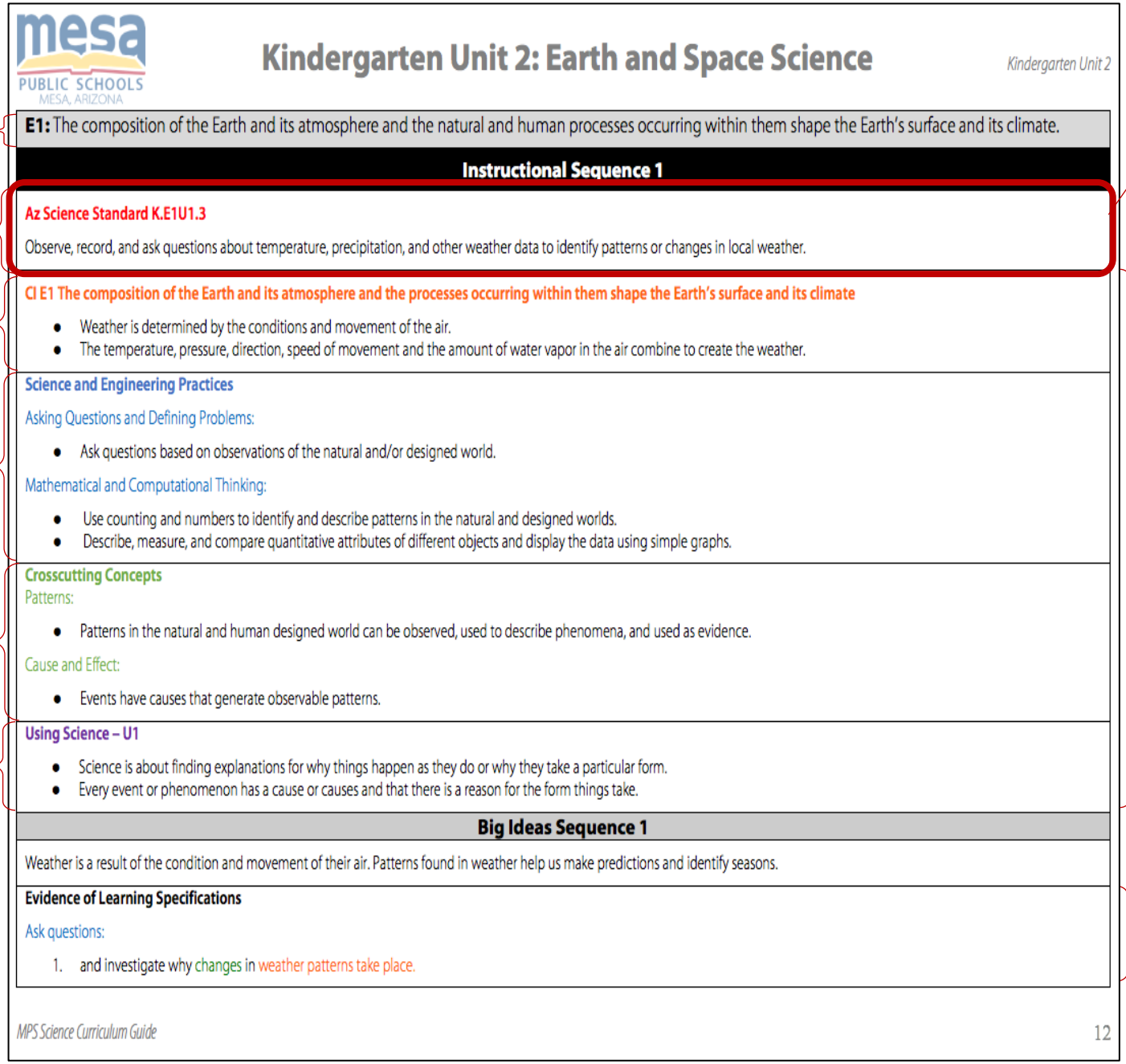
What is Assessed
A collection of one or more standards describing what students should be able to do at the end of instruction

Core Ideas
Concepts in science that that have broad importance within and across disciplines as well as relevance in people's lives

Science & Engineering Practices
Skills and knowledge that scientists and engineers engage in to either understand the world or solve a problem

Crosscutting Concepts
Ideas that are not specific to one discipline but cut across all disciplines

Using Science
Concepts that connect scientific principles, theories, and models; engineering and technological applications; and societal implications to the content knowledge to support scientific understanding.



mesa PUBLIC SCHOOLS MESA, ARIZONA

Kindergarten Unit 2: Earth and Space Science

Kindergarten Unit 2

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.

Instructional Sequence 1

Az Science Standard K.E1U1.3

Observe, record, and ask questions about temperature, precipitation, and other weather data to identify patterns or changes in local weather.

CI E1 The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate

- Weather is determined by the conditions and movement of the air.
- The temperature, pressure, direction, speed of movement and the amount of water vapor in the air combine to create the weather.

Science and Engineering Practices

Asking Questions and Defining Problems:

- Ask questions based on observations of the natural and/or designed world.

Mathematical and Computational Thinking:

- Use counting and numbers to identify and describe patterns in the natural and designed worlds.
- Describe, measure, and compare quantitative attributes of different objects and display the data using simple graphs.

Crosscutting Concepts

Patterns:

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Cause and Effect:

- Events have causes that generate observable patterns.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- Every event or phenomenon has a cause or causes and that there is a reason for the form things take.

Big Ideas Sequence 1

Weather is a result of the condition and movement of their air. Patterns found in weather help us make predictions and identify seasons.

Evidence of Learning Specifications

Ask questions:

1. and investigate why changes in weather patterns take place.

MPS Science Curriculum Guide 12

Standard
A statement that Combines Science and Engineering Practices and Core Ideas to describe how students can show what they have learned

3D Foundations
The Practices, Core Ideas, and Crosscutting Concepts from *A Framework for K-12 Science Education* that were used to form the standards

Evidence of Learning Specifications (EoLS)
Standards and the 3-dimensions are used to develop EoLS, which describe what qualifies as evidence for students' proficiency.

Kindergarten

Scope and Sequence

Kindergarten

By the end of Kindergarten, students learn to use their senses to help them make observations and predictions about the world around them. In this grade level, students will investigate how the senses detect light and sound, observe weather patterns and their influences on plants and animals, and differentiate between systems and structures of living and non-living things. Student investigations focus on collecting and making sense of observational data, as well as simple measurements using the science and engineering practices:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- use evidence
- obtain, evaluate, and communicate information

While individual lessons may include connections to any of the crosscutting concepts, the standards in Kindergarten focus on helping students understand phenomena through the crosscutting concepts of patterns and structure and function.

Unit #	Title	Content
1	The Senses	Students explore how their senses can detect light, sound, and vibration and how technology can be used to extend their senses.
2	Weather	Students develop an understanding of patterns to recognize changes in local weather and seasons.
3	Sun, Moon, and Stars	Students develop an understanding of patterns to recognize changes in daylight.
4	Living Things	Students develop an understanding that the world is comprised of living and non-living things. They investigate the relationship between structure and function in living things; plants and animals use specialized parts to help them meet their needs and survive.

P2: Objects can affect other objects at a distance.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard K.P2U1.1 Investigate how senses can detect light, sound, and vibrations even when they come from far away; use the collected evidence to develop and support an explanation.	**Az Science Standard K.P2U2.2** Design and evaluate a tool that helps people extend their senses.
CI P2 Objects can affect other objects at a distance. • People use their senses to learn about the world around them. • Their eyes detect light, their ears detect sound, and they can feel vibrations by touch. • Objects can have an effect on other objects even when they are not in contact with them. For instance, light affects the objects it reaches, including our eyes. • Objects that are seen either give out or reflect light that human eyes can detect. • Sound comes from things that vibrate and can be detected at a distance from the source because the air or other material around is made to vibrate. • Sounds are heard when the vibrations in the air enter our ears.	**CI P2 Objects can affect other objects at a distance.** • People also use a variety of devices to communicate (send and receive information) over long distances. • Objects that are seen either give out or reflect light that human eyes can detect. • Sounds are heard when the vibrations in the air enter our ears. • Designs can be conveyed through sketches, drawings, or physical models. • There is always more than one possible solution to a problem, so it is useful to compare designs, test them, and discuss their strengths and weaknesses.
Science and Engineering Practices Planning and Carrying Out Investigations: • With guidance, design and conduct investigations in collaboration with peers. • Design and conduct investigations collaboratively. Obtaining, Evaluation, and Communicating Information: • Record observations, thoughts, and ideas. Constructing Explanations and Designing Solutions: • Use information from direct or indirect observations to construct explanations.	**Science and Engineering Practices** Constructing Explanations and Designing Solutions: • Use information from direct or indirect observations to construct explanations. • Use tools and materials provided to design a device or solution to a specific problem. Obtaining, Evaluation, and Communicating Information: • Critique/communicate information, design ideas, or solutions with others in oral and/or written forms using models, drawings, writings, or numbers.
Crosscutting Concepts	**Crosscutting Concepts**

Patterns: • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Cause and Effect: • Events have causes that generate observable patterns. • Simple tests can be designed to gather evidence to support or refute student ideas about causes. Structure and Function: • The shape and stability of structures of natural and designed objects are related to their function(s).	Cause and Effect: • Events have causes that generate observable patterns. • Simple tests can be designed to gather evidence to support or refute student ideas about causes. Structure and Function: • The shape and stability of structures of natural and designed objects are related to their function(s).
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Every event or phenomenon has a cause(s) and there is a reason for the form things take. • Careful observation, including measurement where possible, can suggest what may be happening. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.	**Using Science – U2** • Technologies have been created by people to provide the things they need or can use, such as food, tools, clothes, somewhere to live and ways of communicating. • Materials have been changed so that they can be used for certain purposes.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Five senses can help people understand their world/the world around them; using the five senses helps people learn and communicate.	People can design and engineer products and/or items that can help extend sight and hearing.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out investigations that: 1. explore how humans have specific body parts (structures), like ears, that perform a function and allows them to use their senses to detect sound (vibration). 2. explore how humans have specific body parts (structures), like eyes, that perform a function and allows them to use their senses to detect how some objects give off or reflect light. 3. explore how humans have specific body parts (structures), like fingers, that	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Design a tool (structure that performs the function) through sketches, drawings, or physical models: 1. to extend either sight or hearing. Evaluate and communicate: 1. whether the tool solves the problem (cause) by extending a sense (effect). 2. how different tool designs solve the problem, including evaluating if the design and/or classmate's designs are more efficient than other.

performs a function (touch) and allows them to use their senses to detect how some objects vibrate. Construct an explanation by obtaining and communicating information: 1. through drawing or making models about the observable patterns that sound is produced by vibrations. 2. shows understanding that objects can affect other objects (cause and effect) without being in direct contact with each other.	

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.

Instructional Sequence 1

Az Science Standard K.E1U1.3

Observe, record, and ask questions about temperature, precipitation, and other weather data to identify patterns or changes in local weather.

Az Science Standard K.E1U1.4

Observe, describe, ask questions, and predict seasonal weather patterns; and how those patterns impact plants and animals (including humans).

CI E1 The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate.

- Weather is determined by the conditions and movement of the air.
- The temperature, pressure, direction, speed of movement and the amount of water vapor in the air combine to create the weather.
- Measuring these properties over time enables patterns to be found that can be used to predict the weather a short time ahead.

Science and Engineering Practices

Asking Questions and Defining Problems:

- Ask questions based on observations of the natural and/or designed world.

Mathematical and Computational Thinking:

- Use counting and numbers to identify and describe patterns in the natural and designed worlds.
- Describe, measure, and compare quantitative attributes of different objects and display the data using simple graphs.

Analyzing Data:

- Use and share pictures, drawings, and/or writings of observations.
- Use observations to describe patterns and/or relationships in the natural and designed worlds in order to answer scientific questions and solve problems.
- Make measurements of length to quantify data.

Crosscutting Concepts

Patterns:

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Cause and Effect:

- Events have causes that generate observable patterns.

Stability and Change:

- Things may change slowly or rapidly.

- Some things stay the same while other things change.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- Every event or phenomenon has a cause(s) and there is a reason for the form things take..
- An explanation is not a guess; there has to be some basis for it.
- Careful observation, including measurement where possible, can suggest what may be happening.
- Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.

Big Ideas Sequence 1

Weather is a result of the condition and movement of the air. Patterns found in weather help people make predictions and identify seasons. Seasons affect plants' and animals' survival (i.e., drinking enough water in the summer, hibernation, leaves falling off and growing back, etc.).

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Ask questions and record observations:

1. about why changes in weather patterns take place.

Use mathematical thinking to:

1. observe and record patterns in the weather (i.e., recording data using a bar graph).

Analyze data:

1. to show how patterns in temperature, pressure, direction, speed, and water vapor cause different types of weather (i.e., clouds, wind, rain, snow) and seasons.
2. to describe cause and effect of weather patterns on plants and animals.

Kindergarten Unit 3: Sun, Moon, and Stars

E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe.

Instructional Sequence 1

Az Science Standard K.E2U1.5

Observe and ask questions about patterns of the motion of the Sun, Moon, and stars in the sky.

Note: There is a strong connection between the use of tools like the telescope and the extension of the senses learned in Unit 1 Sequence 2: K.P2U2.2.

CI E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe.

- Patterns of the motion of the Sun, Moon, and stars in the sky can be observed, described, and predicted.
- At night one can see the light coming from many stars with the naked eye, but telescopes make it possible to see many more and to observe them and the Moon and planets in greater detail.

Science and Engineering Practices

Asking Questions and Defining Problems:

- Ask questions based on observations of the natural and/or designed world.
- Define a simple problem that can be solved through the development of a new or improved object or tool.

Obtain, Evaluate, and Communicate Information:

- Read and comprehend grade appropriate texts and media to acquire scientific and/or technical information.
- Record observations, thoughts, and ideas.
- Explain how specific images (e.g., a diagram showing how a machine works) contribute to and clarify a text.

Crosscutting Concepts

Patterns:

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Cause and Effect :

- Events have causes that generate observable patterns.

Stability and Change:

- Some things stay the same while other things change.

Using Science - U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- Every event or phenomenon has a cause(s) and there is a reason for the form things take.

- An explanation is not a guess; there has to be some basis for it.
- Careful observation, including measurement where possible, can suggest what may be happening.
- Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.

Big Ideas Sequence 1

The Sun rises and sets the same every day as the Earth moves around the Sun. As the Earth moves, shadows change throughout the day depending on the location of the Sun. Stars can be seen in the sky and can be used for navigation or finding your way. The Moon changes shape in regular patterns.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Ask questions and record observations about:

1. how the Earth moves around the Sun and why the Sun, Moon, and stars can't be seen at all times of the day.
2. the change of appearance of the night sky, including Moon phases.

Obtain and communicate information about:

1. patterns and effects (shadows, sunrise, sunset) of the Earth's motion around the Sun.
2. the effects of using a telescope (or a scientific tool that extends the senses) vs. the naked eye when observing the Moon and stars.

Kindergarten Unit 4: Living Things

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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard K.L2U1.8 Observe, ask questions, and explain the difference between the characteristics of living and non-living things.	**Az Science Standard K.L1U1.7** Observe, ask questions, and explain how specialized structures found on a variety of plants and animals (including humans) help them sense and respond to their environment. **Az Science Standard K.L1U1.6** Obtain, evaluate, and communicate information about how organisms use different body parts for survival.
CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. ● There is a wide variety of living things (organisms), including plants and animals. ● Living things are distinguished from non-living things by their ability to move, reproduce, and react to certain stimuli.	**CI L1: Organisms are organized on a cellular basis and have a finite life span.** ● All organisms have external parts. ● Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. ● Animals have body parts that capture and convey different kinds of information needed for growth and survival—for example, eyes for light, ears for sounds, and skin for temperature or touch. Animals respond to these senses with behaviors that help them survive (e.g., find food, run from a predator) ● Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive, grow, and produce more plants.
Science and Engineering Practices Asking Questions and Defining Problems: ● Ask questions based on observations of the natural and/or designed world. Constructing Explanations: ● Use information from direct or indirect observations to construct explanations. ● Distinguish between opinions and evidence in one's own explanations. Obtaining, Evaluating, and Communicating Information:	**Science and Engineering Practices** Asking Questions and Defining Problems: ● Ask questions based on observations of the natural and/or designed world. Develop and Use Models: ● Distinguish between a model and the actual object, process, and/or events the model represents. ● Compare models to identify common features and differences. ● Develop and/or use models (e.g., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent amounts,

• Record observations, thoughts, and ideas. • Read and comprehend grade-appropriate texts and media to acquire scientific and/or technical information.	relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds. Obtaining, Evaluating, and Communicating Information: • Explain how specific images (e.g., a diagram showing plant and/or animal structures) contribute to and clarify a text. • Record observations, thoughts, and ideas.
Crosscutting Concepts Patterns: • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.	**Crosscutting Concepts** Structure and Function: • The shape and stability of structures of natural and designed objects are related to their function(s).
Using Science - U1 • An explanation is not a guess; there has to be some basis for it. • Careful observation, including measurement where possible, can suggest what may be happening. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening. • Every event or phenomenon has a cause(s) and there is a reason for the form things take.	**Using Science – U1** • Science is about finding explanations for why things happen as they do or why they take a particular form. • Every event or phenomenon has a cause(s) and there is a reason for the form things take. • An explanation is not a guess; there has to be some basis for it. • Careful observation, including measurement where possible, can suggest what may be happening. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Knowledge about the difference between living and non-living things can help people understand the world.	Living things use their parts (structures) in different ways to help them sense, respond to, and survive the world around them.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Ask questions: 1. about the characteristics (grow, reproduce, need nutrients for energy, air, water) of living things based on observable patterns. Obtain information and construct explanations:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Ask questions from observations: 1. about how animals and humans use body parts and senses in different ways. 2. about how plants use their parts (roots, stems, leaves, flowers, fruits) to survive.

1. about patterns among living and non-living things such as their ability to move, reproduce, and react to certain stimuli.	Develop a model: 1. that demonstrates how animals and humans use body parts (structures) for survival (function), having students distinguish between a model and the actual object, process, and/or events the model represents. 2. that demonstrates how plants use their parts (structures) for survival (function), having students distinguish between a model and the actual object, process, and/or events the model represents. Evaluate: 1. the usefulness of the model in explaining how different parts (external structures) of organisms contribute to survival. 2. the function of organisms using different parts (external structures) in different ways to survive, such as using ears to hear a predator or using sight/touch to determine if food is safe to eat.

First Grade

Scope and Sequence

First Grade

By the end of first grade, students make observations to understand the connections between Earth materials and the ability for Earth to sustain a variety of organisms. Students learn how objects can impact other objects from a distance or by contact with each other, how organisms interact with Earth materials for survival, and how life systems have cycles. Student investigations focus on collecting and making sense of observational data and simple measurements using the science and engineering practices:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- use evidence
- obtain, evaluate, and communicate information

While individual lessons may include connections to any of the crosscutting concepts, the standards in first grade focus on helping students understand phenomena through cause and effect and stability and change.

Unit #	Title	Content
1	Light and Sound	Students explore the relationships between sound and vibrating materials, as well as relationships between light and materials, including the ability of sound and light to travel from place to place. Some materials allow light to pass through while others do not.
2	Forces	Students develop an understanding of the effects of forces and how energy can be transferred from one energy store to another.
3	Natural Resources	Students develop an understanding that Earth materials are essential for organisms' survival.
4	Animals and Plants	Students develop an understanding that Earth has supported, and continues to support, a large variety of organisms. These organisms can be distinguished by their physical characteristics, life cycles, and resources needed for survival. Organisms live where Earth resources such as food, air, and water are available.

First Grade Unit 1: Light and Sound

P2: Objects can affect other objects at a distance.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 1.P2U1.1 Plan and carry out investigations demonstrating the effect of placing objects made with different materials in the path of a beam of light and predict how objects with similar properties will affect the beam of light. *Note: Stress that light can be multiple sources, i.e., Sun, flashlight, lightbulb, candle.*	**Az Science Standard 1.P2U1.2** Use models to provide evidence that vibrating matter creates sound and sound can make matter vibrate. *Note: Experience and define vibration. Experience and define matter.*
CI P2: Objects can affect other objects at a distance. • Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them (i.e., on the other side from the light source), where the light cannot reach. • Mirrors and prisms can be used to redirect a light beam. • Light and sound are wavelike phenomena.	**CI P2: Objects can affect other objects at a distance.** • Light and sound are wavelike phenomena. • Sound can make matter vibrate, and vibrating matter can make sound.
Science and Engineering Practices Asking Questions and Defining Problems: • Ask questions based on observations of the natural and/or designed world. Planning and Carrying Out Investigations: • With guidance, design and conduct investigations in collaboration with peers. • Design and conduct investigations collaboratively. • Evaluate different ways of observing and/or measuring an attribute of interest. • Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons. • Identify questions and make predictions based on prior experiences. Developing and Using Models: • Develop and/or use models (e.g., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent amounts,	**Science and Engineering Practices** Asking Questions and Defining Problems: • Ask questions based on observations of the natural and/or designed world. Planning and Carrying Out Investigations: • With guidance, design and conduct investigations in collaboration with peers. • Design and conduct investigations collaboratively. • Evaluate different ways of observing and/or measuring an attribute of interest. • Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons. • Identify questions and make predictions based on prior experiences. Developing and Using Models: • Develop and/or use models (e.g., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent amounts,

relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds.	relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds.
Crosscutting Concepts Patterns: ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Cause and Effect: ● Events have causes that generate observable patterns.	**Crosscutting Concepts** Cause and Effect: ● Events have causes that generate observable patterns. Energy and Matter: ● Energy can be transferred in various ways and between objects. Stability and Change: ● Things may change slowly or rapidly. Patterns: ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Using Science – U1 ● Science is about finding explanations for why things happen as they do or why they take a particular form. ● Careful observation, including measurement where possible, can suggest what may be happening. ● Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.	**Using Science – U1** ● Science is about finding explanations for why things happen as they do or why they take a particular form. ● Careful observation, including measurement where possible, can suggest what may be happening. ● Every event or phenomenon has a cause(s) and there is a reason for the form things take. An explanation is not a guess; there has to be some basis for it. ● Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Light can come from multiple sources and light is needed to see objects. Some objects allow more light to pass through them than others, and other objects like mirrors or prisms reflect light or change the direction of light.	Sound can make matter vibrate, and can be visible like holding a piece of paper near a speaker. Vibrating matter can make sound, such as a guitar string being plucked.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Ask questions and define problems that:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Ask questions and define problems that:

1. explore how light travels from place to place in wave patterns. Plan and carry out investigations that: 1. show the cause and effect (i.e., passing through, blocked, create shadows) of a beam of light hitting different materials. 2. show how a beam of light is redirected by mirrors and prisms. 3. make predictions about the passage of light through different materials. Develop and use models from the investigations that: 1. demonstrate how light passes through some materials and not others or creates shadows. 2. explain how prisms and mirrors can redirect a beam of light.	1. explore how changes in vibrations created affect sound (loudness, pitch). 2. explore how sound is created by vibrations in wavelike patterns. Plan and carry out investigations that: 1. Provide evidence that the cause and effect vibrations have on objects and the ability to make sound. Develop and use models from the investigations that: 1. demonstrate how sound causes vibrations in matter and how vibrations in matter cause sound.

First Grade Unit 2: Forces

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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 1.P3U1.3 Plan and carry out investigations which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape. *Note: Students will need to understand the term "force".*	**Az Science Standard 1.P4U2.4** Design and evaluate ways to increase or reduce heat from friction between two objects.
CI P3: Changing the movement of an object requires a net force to be acting on it. ● Forces can push, pull, or twist objects, making them change their motion or shape. ● Forces act in particular directions. ● Equal forces acting in opposite directions in the same line cancel each other and are described as being in balance. ● The movement of objects is changed if the forces acting on them are not in balance.	**CI 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.** ● When two objects rub against each other, this interaction is called friction. ● Friction between two surfaces can warm both of them (i.e., rubbing hands together). ● There are ways to reduce the friction between two objects. ● Designs can be conveyed through sketches, drawings, or physical models.
Science and Engineering Practices Planning and Carrying Out Investigations: ● With guidance, design and conduct investigations in collaboration with peers. ● Design and conduct investigations collaboratively. ● Evaluate different ways of observing and/or measuring an attribute of interest. ● Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons. ● Identify questions and make predictions based on prior experiences. Developing and Using Models: ● Develop and/or use models (e.g., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds.	**Science and Engineering Practices** Planning and Carrying Out Investigations: ● With guidance, design and conduct investigations in collaboration with peers. ● Design and conduct investigations collaboratively. ● Evaluate different ways of observing and/or measuring an attribute of interest. ● Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons. ● Identify questions and make predictions based on prior experiences. Constructing Explanations and Designing Solutions: ● Use tools and materials provided to design a device or solution to a specific problem. Obtain, Evaluate, and Communicate:

• Compare models to identify common features and differences.	• Critique and/or communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers.
Crosscutting Concepts Cause and Effect: • Events have causes that generate observable patterns. Stability and Change: • Some things stay the same while other things change.	**Crosscutting Concepts** Systems and System Models: • Systems in the natural and designed world have parts that work together. Cause and Effect: • Simple tests can be designed to gather evidence to support or refute student ideas about causes. Energy and Matter: • Energy can be transferred in various ways and between objects.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Careful observation, including measurement where possible, can suggest what may be happening. • Every event or phenomenon has a cause or causes and that there is a reason for the form things take. An explanation is not a guess; there has to be some basis for it.	**Using Science – U2** • Technologies have been created by people to provide the things they need or can use, such as food, tools, clothes, somewhere to live and ways of communicating. • Materials have been changed so that they can be used for certain purposes.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Force can change the movement or stop the movement of an object.	When two objects rub together it is called friction. Friction can produce heat.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out investigations that demonstrate: 1. objects are affected by force (push or pull); objects being pushed or pulled cause change of motion (i.e., the force either increase/decrease speed, change direction or stop movement of the object). 2. the effect of equal forces acting in opposite directions in the same line cancel each other and are described as being in balance. Develop and use models that:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out investigations that: 1. show friction is caused by two objects that rub against one another. Construct an explanation and design a solution that: 1. shows the effects of the heat energy produced by friction. 2. shows that the reduction of friction causes a reduction in heat. Evaluate:

1. represent the cause and effect relationships of forces on an object.	1. the design (system) for how well friction and heat is either reduced or increased.

First Grade Unit 3: Natural Resources

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.

Instructional Sequence 1

Az Science Standard 1.E1U1.5

Obtain, evaluate, and communicate information about the properties of Earth materials and investigate how people use natural resources.

CI 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.

- Wind and water can change the shape of the land.
- The resulting landforms, together with the materials on the land, provide homes for living things.
- People use natural resources for everything they do: for example, they use soil and water to grow food, wood to burn to provide heat or to build shelters, and materials such as iron or copper (minerals) extracted from Earth to make tools.

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information:

- Obtain information by using various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons).
- Record observations, thoughts, and ideas.

Planning and Carrying Out Investigations:

- With guidance, design and conduct investigations in collaboration with peers.
- Evaluate different ways of observing and/or measuring an attribute of interest.
- Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons.
- Identify questions and make predictions based on prior experiences.

Crosscutting Concepts

Cause and Effect:

- Identifying events and the patterns that can result.

Stability and Change:

- Different materials of the Earth change over time.

Systems and System Models:

- Systems in the natural and designed world have parts that work together.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- Careful observation, including measurement where possible, can suggest what may be happening.

- Every event or phenomenon has a cause(s) and there is a reason for the form things take. An explanation is not a guess; there has to be some basis for it.

Big Ideas Sequence 1

Wind and water can change the shape of the land. The resulting landforms, together with the materials on the land, provide homes and resources for living things.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Obtain, evaluate, and communicate Information related to:

1. how changes caused by wind, water, and climate can change the shape of the land and creates landforms.
2. how Earth systems provide more than basic survival needs including minerals extracted from the Earth.

Plan and carry out investigations that:

1. show the cause and effect of wind and water on the shape of land.
2. explore Earth systems (water, air, and resources from the land) used by people in daily life.

First Grade Unit 4: Animals and Plants

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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 1.L1U1.6 Observe, describe, and predict life cycles of animals and plants. *Note: Identify the parts of the life cycle. Model and explain how to make a prediction.*	**Az Science Standard 1.L2U2.7** Develop and use models about how living things use resources to grow and survive; design and evaluate habitats for organisms using Earth materials. **Az Science Standard 1.L2U1.8** Construct an explanation describing how organisms obtain resources from the environment including materials that are used again by other organisms.
CI L1: Organisms are organized on a cellular basis and have a finite life span. • Plants and animals have predictable characteristics at different stages of development. • Plants and animals grow and change. • Adult plants and animals can have young.	**CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** • Animals depend on their surroundings to get what they need, including food, water, shelter, and a favorable temperature. Animals depend on plants or other animals for food. • Designs can be conveyed through sketches, drawings, or physical models. • Because there is always more than one possible solution to a problem, it is useful to compare designs, test them, and discuss their strengths and weaknesses. • They use their senses to find food and water, and they use their body parts to gather, catch, eat, and chew the food. Plants depend on air, water, minerals (in the soil), and light to grow. • Animals can move around, but plants cannot, and they often depend on animals for pollination or to move their seeds around. • Animals need food that they can break down, which comes either directly by eating plants (herbivores) or by eating animals (carnivores) which have eaten plants or other animals.
Science and Engineering Practices Obtaining, Evaluating, and Communicating Information:	**Science and Engineering Practices** Constructing Explanations and Designing Solutions:

• Read and comprehend grade appropriate texts and media to acquire scientific and/or technical information. • Critique and/or communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers. Asking Questions and Defining Problems: • Ask questions based on observations of the natural and/or designed world. Developing and Using Models: • Compare models to identify common features and differences.	• Use tools and materials provided to design a device or solution to a specific problem. • Use information from direct or indirect observations to construct explanations. • Generate and compare multiple solutions to a problem. Developing and Using Models: • Distinguish between a model and the actual object, process, and/or events the model represents. • Compare models to identify common features and differences.
Crosscutting Concepts Stability and Change: • Some things stay the same while other things change. • Things may change slowly or rapidly. Patterns: • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.	**Crosscutting Concepts** Energy and Matter: • Energy can be transferred in various ways and between objects. Patterns: • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Using Science - U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Careful observation, including measurement where possible, can suggest what may be happening. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.	**Using Science - U2** • Technologies have been created by people to provide the things they need or can use, such as food, tools, clothes, somewhere to live and ways of communicating. • Materials have been changed so that they can be used for certain purposes. **Using Science - U1** • Every event or phenomenon has a cause(s) and there is a reason for the form things take. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Every living thing has a life cycle. Living things have predictable characteristics at different stages of development.	Plants and animals need resources to grow and survive. Habitats are made up of all the living and non-living things organisms need to grow and survive. Animals depend on their surroundings to get what they need, including food, water, shelter, and a favorable temperature.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain and communicate information that predicts: 1. consistent observable patterns of birth, life, and death of living things that make up their life cycle. Ask questions: 1. how living things grow and change throughout their life cycle and stages of development. Develop and use models to: 1. describe the life cycle of a living thing. 2. compare the life cycles of two different living things.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models that: 1. show patterns of how living things use resources to grow and survive (within their designed habitat). 2. show plants and animals are dependent on other plants and animals for food (energy). 3. evaluate your design and classmate's designs to compare models to identify common features and differences (patterns). Construct and explain how: 1. herbivores and carnivores use their senses, body parts and movement to find, eat and obtain food (for energy). 2. many materials used for energy come from organisms and are used again by other organisms.

Instructional Sequence 3 Unit 4: Animals and Plants	Instructional Sequence 4 Unit 4: Animals and Plants
Az Science Standard 1.L3U1.9 Obtain, evaluate, and communicate information to support an evidence-based explanation that plants and animals produce offspring of the same kind, but offspring are generally not identical to each other or their parents.	**Az Science Standard 1.L4U1.10** Develop a model to describe how animals and plants are classified into groups and subgroups according to their similarities.
CI L3: Genetic information is passed down from one generation of organisms to another. ● Organisms have characteristics that can be similar or different. ● Plants and animals, including humans, resemble their parents in many features because information is passed from one generation to the next. ● Living things produce offspring of the same kind, but offspring are not identical with each other or with their parents. ● Young animals are very much, but not exactly, like their parents and also resemble other animals of the same kind. ● Plants also are very much, but not exactly, like their parents and resemble other plants of the same kind.	**CI: L4 The diversity of organisms, living and extinct, is the result of evolution.** ● Animals and plants are classified into groups and subgroups according to their similarities.
Science and Engineering Practices Obtaining, Evaluating, and Communicating Information: ● Record observations, thoughts, and ideas. ● Read and comprehend grade appropriate texts and media to acquire scientific and/or technical information. ● Critique and/or communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers. Constructing Explanations and Designing Solutions: ● Use information from direct or indirect observations to construct explanations. ● Distinguish between opinions and evidence in one's own explanations.	**Science and Engineering Practices** Developing and Using Models: ● Develop and/or use models (e.g., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds. ● Compare models to identify common features and differences.
Crosscutting Concepts Structure and Function:	**Crosscutting Concepts** Patterns:

• The shape and stability of structures of natural and designed objects are related to their function(s). Stability and Change: • Some things stay the same while other things change. • Things may change slowly or rapidly. Patterns: • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.	• Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Every event or phenomenon has a cause(s) and there is a reason for the form things take. • An explanation is not a guess; there has to be some basis for it. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.	**Using Science - U1** • Science is about finding explanations for why things happen as they do or why they take a particular form. • Every event or phenomenon has a cause(s) and there is a reason for the form things take. An explanation is not a guess; there has to be some basis for it. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.
Big Ideas Sequence 3	**Big Ideas Sequence 4**
Plants and animals produce offspring of the same kind, but offspring are generally not identical to each other or their parent.	Some animals and plants have more similarities than others. Animals and plants that are similar can be grouped and studied based on these similarities.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain, evaluate, and communicate information that shows: 1. observable patterns (similar body parts; structures) in animals, plants, and their offspring. 2. plants also are very much, but not exactly, like their parents and resemble other plants of the same kind (structures). 3. Some traits are passed down to generations, some change while others stay the same. Construct an explanation about:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models (i.e., diagrams, drawings, physical replicas): 1. to observe patterns in living things used to classify groups and subgroups of plants and animals. 2. to describe how groups and subgroups (plants and animals) are similar (patterns) (i.e.; amphibians, birds, reptiles, fish, mammals).

1. young animals share similar characteristics (similar body parts; i.e.; hair color, eye color) with their parents; however, they are generally not identical to each other (siblings) or their parents.	

Instructional Sequence 5
Unit 4: Animals and Plants

Az Science Standard 1.L4U3.11

Ask questions and explain how factors can cause species to go extinct.

CI L4: The diversity of organisms, living and extinct, is the result of evolution.

- There are many different kinds of plants and animals in the world today and many kinds that once lived but are now extinct. These are evident from their fossils.
- Some kinds of plants and animals that once lived on Earth (e.g., dinosaurs) are no longer found anywhere, although others now living (e.g., lizards) resemble them in some ways.

Science and Engineering Practices

Asking Questions and Defining Problems:

- Ask questions based on observations of the natural and/or designed world.

Analyzing and Interpreting Data:

- Use and share pictures, drawings, and/or writings of observations.
- Use observations to describe patterns and/or relationships in the natural and designed worlds in order to answer scientific questions and solve problems.

Crosscutting Concepts

Cause and Effect:

- Events have causes that generate observable patterns.

Stability and Change:

- Some things stay the same while other things change.
- Things may change slowly or rapidly.

Using Science – U3

- Understanding the natural world can often be applied to change or make things to help solve human problems.

Big Ideas Sequence 5

On Earth, there are many different kinds of plants and animals. Some plants and animals that once lived are now extinct, as evidenced by their fossils.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Ask questions and define problems:

1. to explain how factors (environmental or human impact) can cause species to go extinct.

Analyze and interpret data (use and share pictures, drawings, observations):

1. that explain many kinds of plants and animals that were once alive are now extinct, by observing the changes in the fossil record.

Second Grade

Scope and Sequence

Second Grade

By the end of second grade, students understand the basic concept that energy can change the phase of matter and is necessary for life. Students begin to understand energy and matter, the formation of Earth's surface features, water cycles and energy flow, changes in the environment, patterns in the sky, and the conditions necessary for life on Earth. Student investigations focus on collecting and making sense of observational data and simple measurements using the science and engineering practices:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- use evidence
- obtain, evaluate, and communicate information

While individual lessons may include connections to any of the crosscutting concepts, the standards in second grade focus on helping students understand phenomena through systems and system models and energy and matter.

Unit #	Title	Content
1	Matter	Students develop an understanding of observable properties of matter and how changes in energy (heating or cooling) can affect matter or materials.
2	Wind and Water	Students develop an understanding of the water cycle, weather patterns, and the role of water and wind in shaping the Earth's surface. (*Note: connections can be made back to Physical Science Unit 1)*
3	The Environment	Students learn that humans and other organisms make positive and negative changes to the environment.
4	The Earth, Sun, and Moon	Students develop an understanding of changing patterns in the sky, including the position of the Sun, the Moon and its apparent change in shape.
5	Organisms and Energy	Students develop an understanding that life on Earth depends on energy from the Sun or energy from other organisms to survive.

Second Grade Unit 1: Matter

P1: All matter in the universe is made of very small particles.
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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 2.P1U1.1 Plan and carry out an investigation to determine that matter has mass, takes up space, and is recognized by its observable properties; use the collected evidence to develop and support an explanation.	**Az Science Standard 2.P1U1.2** Plan and carry out investigations to gather evidence to support an explanation on how heating or cooling can cause a phase change in matter. **Az Science Standard 2.P4U1.3** Obtain, evaluate and communicate information about ways heat energy can cause change in objects or materials.
CI P1: All matter in the Universe is made of very small particles. ● All the "stuff" encountered in everyday life is called matter because it has mass, and therefore weight on Earth, and takes up space. ● Different materials are recognizable by their properties, some of which are used to classify them as being in the solid, liquid or gas state. ● Different kinds of matter exist (i.e., wood, metal, water).	**CI P1: All matter in the Universe is made of very small particles.** ● Different materials are recognizable by their properties, some of which are used to classify them as being in the solid, liquid or gas state. ● Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature. **CI P4: The total amount of energy in the Universe is always the same but can transferred from one energy store to another during an event.** ● There are various ways of causing an event or bringing about change in objects or materials. Heating can cause change, as in cooking, melting solids or changing water to vapor.
Science and Engineering Practices Planning and Carrying Out Investigations: ● With guidance, design and conduct investigations in collaboration with peers. ● Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons. Constructing Explanations and Designing Solutions: ● Use information from direct or indirect observations to construct explanations. ● Distinguish between opinions and evidence in one's own explanations.	**Science and Engineering Practices** Planning and Carrying Out Investigations: ● With guidance, design and conduct investigations in collaboration with peers. ● Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons. ● Identify questions and make predictions based on prior experiences. Engaging in Argument from Evidence: ● Identify arguments that are supported by evidence.

	• Listen actively to others' explanations and arguments and ask questions for clarification. Obtaining, Evaluating, and Communicating Information: • Read and comprehend grade appropriate texts and media to acquire scientific and/or technical information. • Obtain information by using various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons). • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.
Crosscutting Concepts Energy and Matter: • Objects may break into smaller pieces, be put together into larger pieces, or change shapes.	**Crosscutting Concepts** Energy and Matter: • Objects may break into smaller pieces, be put together into larger pieces, or change shapes. Cause and Effect: • Events have causes that generate observable patterns. • Simple tests can be designed to gather evidence to support or refute student ideas about causes. Stability and Change: • Some things stay the same while other things change. • Things may change slowly or rapidly.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.	**Using Science – U1** • Science is about finding explanations for why things happen as they do or why they take a particular form. • Every event or phenomenon has a cause(s) and there is a reason for the form things take. • An explanation is not a guess; there has to be some basis for it. • Careful observation, including measurement where possible, can suggest what may be happening. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**

Matter has mass, takes up space, and is recognized by its observable properties.	Heating requires a transfer of energy. Cooling requires heat to leave an object. Heating and cooling can cause a phase change (solid, liquid, gas) in matter.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out an investigation that: 1. gathers evidence to determine and explain that all things are made up of matter, and that different types of matter exist. 2. explain recognizable properties of matter (solid, liquid, and gas).	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Plan an investigation to gather evidence: 1. that temperature can affect changes (hot or cold) in matter. Argue with evidence: 1. To support how heating and cooling matter can change its state (solid, liquid, and gas). Obtain, evaluate, and communicate information: 1. about how heat energy can cause changes (i.e., melting solids) in characteristics of objects (different kinds of matter, i.e., wood, metal or water). *Note: Heat energy is energy that is transferred. Heat can only flow from hotter objects to cooler objects.*

Second Grade Unit 2: Wind and Water

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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 2.E1U1.4 Observe and investigate how wind and water change the shape of the land resulting in a variety of landforms.	**Az Science Standard 2.E1U1.5** Develop and use models to represent that water can exist in different states and is found in oceans, glaciers, lakes, rivers, ponds, and the atmosphere.
CI 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. ● Wind and water can change the shape of the land. It carries soil and rocks from one place to another and determines the variety of life forms that can live in a particular location. ● Resulting landforms together with the materials on land determine the variety of life forms that can live in a particular location.	**CI 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.** ● Water is found in the ocean, rivers, lakes, and ponds. ● Water exists as solid ice and in liquid form.
Science and Engineering Practices Planning and Carrying Out Investigations: ● With guidance, design and conduct investigations in collaboration with peers. ● Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons.	**Science and Engineering Practices** Developing and Using Models: ● Distinguish between a model and the actual object, process, and/or events the model represents. ● Develop and/or use models (e.g., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds.
Crosscutting Concepts Patterns: ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Stability and Change: ● Some things stay the same while other things change. ● Things may change slowly or rapidly.	**Crosscutting Concepts** Energy and Matter: ● Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. Systems and System Models: ● Objects and organisms can be described in terms of their parts. ● Systems in the natural and designed world have parts that work together.

Using Science – U1 ● Every event or phenomenon has a cause(s) and there is a reason for the form things take. ● Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening. ● Science is about finding explanations for why things happen as they do or why they take a particular form.	**Using Science – U1** ● Science is about finding explanations for why things happen as they do or why they take a particular form. ● Every event or phenomenon has a cause(s) and there is a reason for the form things take. ● Careful observation, including measurement where possible, can suggest what may be happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Wind and water change the shape of the Earth and create a variety of landforms.	Water exists on the Earth in the form of liquid, gas, and solid. It is found in oceans, glaciers, lakes, rivers, ponds, and the atmosphere.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out an investigation to observe: 1. patterns within landforms (i.e., canyons, cliffs, mountains, caves, plain). 2. how wind and water make changes to the land by weathering and erosion.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models: 1. to represent (i.e., physical models or drawings) that water can be found in many places in different states (i.e., glaciers [ice], oceans, lakes, rivers, ponds [liquids]) on Earth. 2. to show that energy and matter can cycle through the Earth's systems (i.e., from land to water to air).

Instructional Sequence 3
Unit 2: Wind and Water

Az Science Standard 2.E1U2.6

Analyze patterns in weather conditions of various regions of the world and design, test, and refine solutions to protect people from severe weather conditions.

CI 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.

- Weather is the combination of sunlight, wind, snow, or rain, and temperature in a particular region at a particular time.
- People measure these conditions to describe and record the weather and to notice patterns over time.
- Designs can be conveyed through sketches, drawings, or physical models.
- Because there is always more than one possible solution to a problem, it is useful to compare designs, test them, and discuss their strengths and weaknesses.

Science and Engineering Practices

Analyzing and Interpreting Data:

- Use and share pictures, drawings, and/or writings of observations.
- Use observations to describe patterns and/or relationships in the natural and designed worlds in order to answer scientific questions and solve problems.
- Analyze data from tests of an object or tool to determine if it works as intended.

Constructing Explanations and Designing Solutions:

- Use tools and materials provided to design a device or solution to a specific problem.
- Generate and compare multiple solutions to a problem.

Crosscutting Concepts

Patterns:

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Systems and System Models:

- Systems in the natural and designed world have parts that work together.

Using Science – U2

- Technologies have been created by people to provide the things they need or can use, such as food, tools, clothes, somewhere to live and ways of communicating.

Big Ideas Sequence 3

Weather is sunlight, wind, snow, rain, and/or temperature in a particular area at a particular time. It is determined by patterns. People can create solutions to weather problems in order to protect themselves from severe weather.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Analyze and interpret data:

1. about a weather system's patterns and conditions in various regions around the world.

Design a solution:

1. using provided tools and materials, that protects people from severe weather conditions.
2. how different designs solve the problem of protecting people from severe weather conditions, including evaluating if the design and/or classmate's designs are more efficient than other.

Second Grade Unit 3: The Environment

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.

Instructional Sequence 1

Az Science Standard 2.E1U3.7

Construct an argument (explanation) from evidence regarding positive and negative changes in water and land systems that impact people and the environment.

CI 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.

- Plants and animals (including humans) depend on the land, water, and air to live and grow.
- They in turn can change their environment (i.e., the shape of land, the flow of water).
- People use natural resources for everything they do: for example, they use soil and water to grow food, wood to burn to provide heat or to build shelters, and materials such as iron or copper extracted from Earth to make cooking pans.
- Things that people do to live comfortably can affect the world around them, but they can make choices that reduce their impacts on the land, water, air, and other living things—for example, by reducing trash through reuse and recycling.

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information:

- Read and comprehend grade appropriate texts and media to acquire scientific and/or technical information.
- Obtain information by using various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons).

Asking Questions and Defining Problems:

- Ask questions based on observations of the natural and/or designed world.
- Define how to improve a process (ways to recycle or reduce waste).

Engaging in Argument from Evidence:

- Identify arguments that are supported by evidence.
- Listen actively to others' explanations and arguments and ask questions for clarification.

Crosscutting Concepts

Systems and System Models:

- Systems in the natural and designed world have parts that work together.

Stability and Change:

- Things may change slowly or rapidly.

Cause and Effect:

- Events have causes that generate observable patterns.
- Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Using Science – U3

- Understanding the natural world can often be applied to change or make things to help solve human problems.
- There are generally both positive and negative consequences of the applications of science.

Big Ideas Sequence 1

Humans and animals have an impact on water and land systems. These impacts cause changes in water and land systems, which cyclically impact people and the environment (i.e., deforestation can cause flooding).

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Obtain, evaluate, and communicate:

1. what resources and processes are required for people to live comfortably (i.e., housing, cars, clothing, and student's brainstormed examples).
2. information from grade level texts that explains how humans and animals impact the environment.
3. how people alter land and water systems and the resulting impacts (i.e., deforestation, water pollution) to humans and animals.

Ask questions and define problems:

1. about current methods of reducing waste and recycling.

Engage in argument from evidence:

1. to explain how changes in water and land systems (how humans and animals use the land) affect people and their environment.
2. explaining the affect that people have on the environment.

Second Grade Unit 4: The Earth, Sun, and Moon

E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe.

Instructional Sequence 1

Az Science Standard 2.E2U1.8

Observe and explain the Sun's position at different times during a twenty-four-hour period and changes in the apparent shape of the Moon from one night to another.

CI E2 Our solar system is a very small part of one of billions of galaxies in the Universe.

- There are patterns in the position of the Sun seen at different times of the day and in the shape of the Moon from one night to another.

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information:

- Record observations, thoughts, and ideas.
- Critique and/or communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers.

Analyzing and Interpreting Data:

- Use and share pictures, drawings, and/or writings of observations.
- Use observations to describe patterns and/or relationships in the natural and designed worlds in order to answer scientific questions and solve problems.

Developing and Using Models:

- Compare models to identify common features and differences (peer created).

Crosscutting Concepts

Patterns:

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Stability and Change:

- Some things stay the same while other things change.
- Things may change slowly or rapidly.

Systems and System Models:

- Systems in the natural and designed world have parts that work together.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- Every event or phenomenon has a cause(s) and there is a reason for the form things take.

- Careful observation, including measurement where possible, can suggest what may be happening.
- Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening.

Big Ideas Sequence 1

At different times of the day, either the Sun or the Moon can be seen. The Moon has several phases throughout the month, and they can be seen with the human eye.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Obtain, evaluate, and communicate observations related to:

1. patterns of the Sun's position throughout a 24-hour period.
2. the changes of the Moon's shape over a month.

Develop and use a model:

1. that explains the role of the Sun and the Earth in the Moon's visible phase changes.

Analyze and interpret data:

1. to explain the Sun and Moon's position in the solar system in relation to the Earth.

Second Grade Unit 5: Organisms and Energy

L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 2.L2U1.9 Obtain, analyze, and communicate evidence that organisms need a source of energy, air, water, and certain temperature conditions to survive.	**Az Science Standard 2.L2U1.10** Develop a model representing how life on Earth depends on energy from the Sun and energy from other organisms.
CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. ● All living things need food as their source of energy as well as air, water, and certain temperature conditions. ● Plants containing chlorophyll can use sunlight to make the food they need and can store food that they do not immediately use.	**CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** ● Animals need food that they can break down, which comes either directly by eating plants (herbivores) or by eating animals (carnivores) which have eaten plants or other animals. ● Animals are ultimately dependent on plants for their survival. ● The relationships among organisms can be represented as food chains and food webs.
Science and Engineering Practices Obtaining, Evaluating, and Communicating Information: ● Obtain information by using various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons). ● Record observations, thoughts, and ideas. ● Explain how specific images (e.g., a diagram showing how a machine works) contribute to and clarify a text.	**Science and Engineering Practices** Developing and Using Models: ● Develop and/or use models (e.g., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds.
Crosscutting Concepts Stability and Change: ● Some things stay the same while other things change. ● Things may change slowly or rapidly. Energy and Matter: ● Energy can be transferred in various way and between objects (from Sun to plants to animals).	**Crosscutting Concepts** Systems and System Models: ● Systems in the natural and designed world have parts that work together. (i.e., food web). Energy and Matter: ● Energy can be transferred in various ways and between objects (from Sun to plants to animals).

Using Science – U1	Using Science – U1
• Science is about finding explanations for why things happen as they do or why they take a particular form. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening. • Every event or phenomenon has a cause(s) and there is a reason for the form things take. • An explanation is not a guess; there has to be some basis for it. • Careful observation, including measurement where possible, can suggest what may be happening.	• Science is about finding explanations for why things happen as they do or why they take a particular form. • Everyone can ask questions about things in the natural world and can do something to find answers that help explain what is happening. • Every event or phenomenon has a cause(s) and there is a reason for the form things take. • An explanation is not a guess; there has to be some basis for it. • Careful observation, including measurement where possible, can suggest what may be happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
All living things need energy, as well as certain temperature conditions, to survive. Energy can come from multiple sources (i.e., air, water, food, and sunlight).	To obtain energy, plants use sunlight to make the food they need. Animals cannot make their own energy and need to eat plants or other animals to obtain energy.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain, evaluate and communicate information that provides evidence of: 1. how organisms use energy sources (including air, temperature, and water) to survive. 2. how plants use sunlight and other energy sources, changing it into the food they need and storing it as energy for future use.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models that show how: 1. all life on Earth depends on the Sun's energy. 2. the Sun's energy feeds plants and plant energy feeds animals. 3. organisms depend on/compete with each other resulting in a food chain/food web (system). 4. organisms survive by consuming either plants (herbivores), animals (carnivores), or both (omnivores).

Third Grade

Scope and Sequence

Third Grade

By the end of third grade, students will gain an understanding of how the Sun provides energy for life on Earth. Students apply their understanding of light and sound waves and how they travel, are detected, and transfer energy. Students learn that organisms have different structures and functions which increase their chances of survival. Student investigations focus on collecting and making sense of observational data and simple measurements using the science and engineering practices:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- use evidence
- obtain, evaluate, and communicate information

While individual lessons may include connections to any of the crosscutting concepts, the standards in third grade focus on helping students understand phenomena through systems and system models and structure and function.

Unit #	Title	Content
1	Light and Sound	Students develop an understanding of the sources, properties, and characteristics of energy (sound and light) along with the relationship between energy transfer and the human body (ear and eye).
2	Sun Energy	Students develop an understanding of how the Sun provides light and energy for Earth systems (geosphere, hydrosphere, atmosphere, biosphere).
3	Survival Structures	Students develop an understanding that plants and animals (including humans) have specialized internal and external structures and can respond to stimuli to increase survival.

Third Grade Unit 1: Light and Sound

P2: Objects can affect other objects at a distance.
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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 3.P2U1.2 Plan and carry out an investigation to explore how sound waves affect objects at varying distances. *Note: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.*	**Az Science Standard 3.P2U1.1** Ask questions and investigate the relationship between light, objects, and the human eye.
CI P2: Objects can affect other objects at a distance. ● Sounds are heard when the vibrations in the air enter our ears. ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). ● Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other.	**CI P2: Objects can affect other objects at a distance.** ● Sources give out light, which travels from them in various directions and is detected when it reaches and enters our eyes. ● Light is seen because it affects the objects it reaches, including our eyes. ● Objects that are seen either give out or reflect light that human eyes can detect. ● The color humans see depends on the color of the available light sources as well as the properties of the surface. ● Because lenses bend light beams, they can be used, singly or in combination, to provide magnified images of objects too small or too far away to be seen with the naked eye.
Science and Engineering Practices Planning and Carrying Out Investigations: ● Design and conduct investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. ● Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon or test a design solution. Using Mathematics and Computational Thinking: ● Decide when to use qualitative vs. quantitative data. ● Organize simple data sets to reveal patterns that suggest relationships. Obtaining, Evaluating, and Communicating Information:	**Science and Engineering Practices** Asking Questions and Defining Problems: ● Ask questions based on careful observations of phenomena and information. ● Ask questions that relate one variable to another variable. ● Formulate questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Obtaining, Evaluating, and Communicating Information: ● Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.

• Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.	• Use models to share findings or solutions in oral and/or written presentations, and/or extended discussions. Planning and Carrying Out Investigations: • Evaluate different ways of observing and/or measuring an attribute of interest. • Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons. • Identify questions and make predictions based on prior experiences.
Crosscutting Concepts Patterns: • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation. Cause and Effect: • Cause and effect relationships are routinely identified, tested, and used to explain change.	**Crosscutting Concepts** Structure and Function: • Different materials have different structures, which can sometimes be observed. • Structures have shapes and parts that serve functions. Patterns: • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • There are various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening.	**Using Science – U1** • Science is about finding explanations for why things happen as they do or why they take a particular form. • There are various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Sounds are heard when vibrations in the air enter our ears. Sound waves of the same type can differ in amplitude and wavelength as well as add or cancel one another at varying distances.	Objects that are seen either give off or reflect light that human eyes can detect. An object can be seen when light is reflected from its surface and enters the eyes.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out an investigation: 1. that depicts the pattern of sound waves on objects of varying distances.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Ask questions and carry out an investigation:

2. that explains how sound waves can add or cancel one another as they cross. Use mathematical and computational thinking to: 1. organize qualitative data to reveal patterns in how speed of vibrations affect sound. Obtain, evaluate, and communicate information: 1. that explains how wavelength and amplitude cause different sounds (i.e., loudness and pitch).	1. about how an object can be seen only if light follows a path between a light source, the object, and the eye. 2. about how light travels in patterns (i.e. straight line). 3. to demonstrate how different lenses bend light to make objects look bigger or smaller. Obtain, evaluate, and communicate information: 1. to show how light color is dependent upon a light source and properties of a surface. 2. about the structure and function of the human eye.

Instructional Sequence 3
Unit 1: Light and Sound

Az Science Standard 3.P4U1.3

Develop and use models to describe how light and sound waves transfer energy.

Note: At this grade level, no attempt is made to give a precise or complete definition of energy.

CI 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.

- The faster a given object is moving, the more energy it possesses.
- Energy can be moved from place to place by moving objects or through sound or light. *(Note: At this grade level, no attempt is made to give a precise or complete definition of energy.)*
- Energy is present whenever there are moving objects, sound, light, or heat.
- When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- Light also transfers energy from place to place. For example, energy radiated from the Sun is transferred to Earth by light.
- When this light is absorbed, it warms Earth's land, air, and water and facilitates plant growth.

Science and Engineering Practices

Developing and Using Models:

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
- Develop a diagram or simple physical prototype to convey a proposed object, tool or process.

Analyzing and Interpreting Data:

- Use data to evaluate claims about cause and effect.
- Interpret data to make sense of and explain phenomena, using logical reasoning, mathematics, and/or computation.

Crosscutting Concepts

Energy and Matter:

- Matter is made of particles.
- Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.
- Energy can be transferred in various ways and between objects.

Stability and Change:

- Change is measured in terms of differences over time and may occur at different rates.
- Some things stay the same while other things change.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- There are various ways of finding out what makes things work or why they happen.
- In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.

Big Ideas Sequence 3

Energy is present whenever there are moving objects, sound, light or heat.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Use a model (i.e., solar powered object):

1. or object to observe changes in movement, sound, light, or heat, signifying energy.
2. to describe how light (i.e., solar power) waves transfer energy into motion.
3. to demonstrate that the faster the moving object, the more energy required (i.e., cloudy days = less solar energy).

Analyze and interpret data:

1. to explore how colliding objects transfer energy (make sound) and will also change the motion of the objects.

Third Grade Unit 2: Sun Energy

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.

Instructional Sequence 1

Az Science Standard: 3.E1U1.4

Construct an explanation describing how the Sun is the primary source of energy impacting Earth systems.

CI 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.

- All Earth processes are the result of energy flowing and matter cycling within and among the Earth's systems.
- This energy originates from the Sun and from Earth's interior.
- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans).
- These systems interact in multiple ways to affect Earth's surface materials and processes.

Science and Engineering Practices

Constructing Explanations and Designing Solutions:

- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation.
- Identify the evidence that supports particular points in an explanation.
- Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.

Asking Questions and Defining Problems:

- Ask questions based on careful observations of phenomena and information.
- Ask questions that relate one variable to another variable.
- Formulate questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

Crosscutting Concepts

System and System Models:

- A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.
- A system can be described in terms of its components and their interactions.

Energy and Matter:

- Matter is made of particles.
- Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substance does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.
- Energy can be transferred in various ways and between objects.

Cause and Effect:

- Cause and effect relationships are routinely identified, tested, and used to explain change.

Using Science – U1

- It is important to see that other things stay the same so that the result can only be the effect of changing one thing.
- In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.

Big Ideas Sequence 1

Earth's major systems (geosphere, hydrosphere, atmosphere, and biosphere) have energy flowing and matter cycling within and among them which affects the surface materials and processes (i.e., warming of the surface, evaporation, atmospheric circulation, weather).

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Ask questions and define problems:

1. to identify how matter and energy cycle through Earth's four major systems and cause Earth's processes.
2. to explore what might happen to Earth's systems, plants and animals if the Sun was not present to provide energy.

Construct explanations:

1. to describe how Earth processes within the geosphere, hydrosphere, atmosphere, and biosphere are caused by the need for Sun energy.

Third Grade Unit 3: Survival Structures

L1: Organisms are organized on a cellular basis and have a finite lifespan.
L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 3.L1U1.5 Develop and use models to explain that plants and animals (including humans) have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction. **Az Science Standard 3.L2U1.6** Plan and carry out investigations to demonstrate ways plants and animals react to stimuli. *Note: This Learning Sequence will focus on plants. Focus is on understanding the macroscale systems and their function, not microscopic processes.*	**Az Science Standard 3.L1U1.5** Develop and use models to explain that plants and animals (including humans) have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction. **Az Science Standard 3.L2U1.6** Plan and carry out investigations to demonstrate ways plants and animals react to stimuli. *Note: This Learning Sequence will focus on animals. Focus is on understanding the macroscale systems and their function, not microscopic processes.*
CI L1: Organisms are organized on a cellular basis and have a finite life span. **CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** ● Plants have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Plants also have different parts (roots, stems, leaves, flowers, and fruits) that help them survive, grow, and produce more plants.	**CI L1: Organisms are organized on a cellular basis and have a finite life span.** **CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** ● Animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Different sense receptors are specialized for particular kinds of information, which may then be processed and integrated by an animal's brain, with some information stored as memories. ● Animals are able to use their perceptions and memories to guide their actions. ● Some responses to information are instinctive—that is, animals' brains are organized so that they do not have to think about how to respond to certain stimuli.
Science and Engineering Practices Developing and Using Models: ● Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system.	**Science and Engineering Practices** Developing and Using Models: ● Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

• Use a simple model to test cause and effect relationships concerning the functioning of a proposed object, tool or process. Planning and Carrying Out Investigations: • Design and conduct investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and tools for collecting data. • Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon or test a design solution.	• Use a simple model to test cause and effect relationships concerning the functioning of a proposed object, tool or process. Planning and Carrying Out Investigations: • Design and conduct investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and tools for collecting data. • Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon or test a design solution. Obtaining, Evaluating, and Communicating Information: • Compare and/or combine across complex texts and/or other reliable media to acquire appropriate scientific and/or technical information. • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts.
Crosscutting Concepts Structure and Function: • Different materials have different substructures, which can sometimes be observed. • Substructures have shapes and parts that serve functions.	**Crosscutting Concepts** Structure and Function: • Different materials have different substructures, which can sometimes be observed. • Substructures have shapes and parts that serve functions.
Using Science – U1 • There are various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening. • It is important to see that other things stay the same so that the result can only be the effect of changing one thing. • In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.	**Using Science – U1** • There are various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening. • It is important to see that other things stay the same so that the result can only be the effect of changing one thing. • In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Plants have internal and external structures that aid in growth, survival, and reproduction. Plants react to stimuli in different ways.	Animals have external structures that aid in growth, survival, behavior, and reproduction. Animals react to varying stimuli in different ways including using perceptions, memories or instincts (i.e., connection to desert animals found in Arizona).

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models: 1. to explain how plants' internal and external structures affect growth, survival, and reproduction, including roots, stems, leaves, flowers, and fruits. Plan and carry out investigations: 1. to demonstrate how plants use sense receptors to react to stimuli (i.e., growing towards the Sun).	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models: 1. to explain how animals' internal and external structures affect survival, growth, behavior, and reproduction (i.e., camouflage, echolocation, hibernation). Plan and carry out investigations: 1. to demonstrate how animals use sense receptors and instincts to process stimuli and store information as memories. Obtain, evaluate, and communicate information: 1. to record how animals have reacted to environmental stimuli during well-known experimentation (mouse finding cheese in a maze, Pavlov's dogs salivating at the ring of a bell, etc.)

Instructional Sequence 3 Unit 3: Survival Structures	Instructional Sequence 4 Unit 3: Survival Structures
Az Science Standard 3.L1U1.5 Develop and use models to explain that plants and animals (including humans) have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction. *Note: This Learning Sequence will focus on humans. Focus is on understanding the macroscale systems and their function, not microscopic processes.*	**Az Science Standard 3.L2U1.7** Develop and use system models to describe the flow of energy from the Sun to and among living organisms. **Az Science Standard 3.L2U1.8** Construct an argument from evidence that organisms are interdependent.
CI L1: Organisms are organized on a cellular basis and have a finite life span. ● Animals (humans) have both internal and external structures that serve various functions in growth, survival, and behavior.	**CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** ● The food of almost any kind of animal can be traced back to plants. ● Organisms are related in food webs in which some animals eat plants. ● Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." ● A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. ● Organisms obtain gases, water, and minerals from the environment and release waste matter (gas, liquid, or solid) back into the environment. (Simple photosynthesis)
Science and Engineering Practices Developing and Using Models: ● Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system. ● Use a simple model to test cause and effect relationships concerning the functioning of a proposed object, tool or process. Obtaining, Evaluating, and Communicating Information: ● Compare and/or combine across complex texts and/or other reliable media to acquire appropriate scientific and/or technical information. ● Combine information in written text with that contained in corresponding tables, diagrams, and/or charts.	**Science and Engineering Practices** Developing and Using Models: ● Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system. ● Develop a diagram or simple physical prototype to convey a proposed object, tool or process. Engage in Argument from Evidence: ● Construct and/or support scientific arguments with evidence, data, and/or a model. ● Compare and refine arguments based on the strengths and weaknesses of the evidence presented.

Crosscutting Concepts Structure and Function: ● Different materials have different substructures, which can sometimes be observed. ● Substructures have shapes and parts that serve functions. Cause and Effect: ● Cause and effect relationships are routinely identified, tested, and used to explain change. ● Events that occur together with regularity might or might not be a cause and effect relationship.	**Crosscutting Concepts** Stability and Change: ● Some things stay the same while other things change. ● Things may change slowly or rapidly. Systems and System Models: ● Objects and organisms can be described in terms of their parts. ● Systems in the natural and designed world have parts that work together Energy and Matter: ● Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. ● Energy can be transferred in various ways and between objects.
Using Science – U1 ● Careful observation, including accurate measurement where possible, can suggest what may be happening. ● In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.	**Using Science – U1** ● Careful observation, including accurate measurement where possible, can suggest what may be happening. ● Whether or not an effective explanation can be obtained depends on what data are collected and this is usually guided by having some theory or hypothesis about what might be happening. ● In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.
Big Ideas Sequence 3	**Big Ideas Sequence 4**
Humans have external and internal structures that aid in growth, survival, and behavior.	All food chains have consumers that rely on a producer that gets their energy from the Sun. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use system models (food webs): 1. to show how organisms require a flow of energy from the Sun to and among other living organisms.

1. to explain how animals (including humans) have internal and external structures affect survival, growth, and behavior (i.e., brain, heart, lungs, stomach, intestines, the five senses, external body parts). Obtain, evaluate, and communicate information: 1. from student created models that shows how humans use their internal and external structures for survival, growth, and behavior.	2. to describe how consumers rely on producers for energy/food. 3. to predict how a plant or animal would respond if certain consumers were removed from a food chain system. Construct an argument from evidence: 1. that supports the idea that organisms depend on or compete with each other. 2. to explain why multiple species are necessary to create a stable web of life. 3. to understand how plant and animal decomposition releases gas, water, and minerals back into the environment. 4. that shows the Sun is the source of energy for a web of life.

Fourth Grade

Scope and Sequence

Fourth Grade

By the end of fourth grade, students expand on the idea that energy from the Sun interacts with Earth systems and explore other forms of energy used in everyday life. Students apply their understanding of the various Earth systems (geosphere, hydrosphere, atmosphere, biosphere) and how they interact with both each other and heat from the Sun. Students understand how geological systems change and shape the planet and provide resources. Students also develop an understanding of how Earth processes and human interactions positively and negatively change environments, impacting the ability for organisms to survive. Student investigations focus on collecting and making sense of observational data and simple measurements using the science and engineering practices:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- use evidence
- obtain, evaluate, and communicate information

While individual lessons may include connections to any of the crosscutting concepts, the standards in fourth grade focus on helping students understand phenomena through systems and system models, energy and matter, and stability and change.

Unit #	Title	Content
1	Magnets and Electricity	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.
2	Earth Systems	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.
3	Adaptations	Students develop an understanding of the diversity of past and present organisms, factors impacting organism diversity, and evidence of change in organisms over time.

Fourth Grade Unit 1: Magnets and Electricity

P4: The total amount of energy in the universe is always the same but can transfer from one energy store to another during an event.
P2: Objects can affect other objects at a distance.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 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. **Az Science Standard 4.P2U1.3** Develop and use a model to demonstrate magnetic forces.	**Az Science Standard 4.P4U1.2** Develop and use a model that explains how energy is moved from place to place through electric currents.
CI P4: The total amount of energy in the universe is always the same but can transfer from one energy store to another during an event. ● The faster a given object is moving, the more energy it possesses. ● Energy can be moved place to place by moving objects, or through sound, light, or electric currents. *Note: At this grade level, no attempt is made to give a precise or complete definition of energy.* **CI P2: Objects can affect other objects at a distance.** ● Objects in contact exert forces on each other (elastic pushes and pulls). ● Magnetic forces between a pair of objects do not require that the objects be in contact—for example, magnets push or pull at a distance. ● The sizes of the forces in each situation depends on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	**CI P4: The total amount of energy in the universe is always the same but can transfer from one energy store to another during an event.** ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. ● The currents may have been produced to begin with by transforming the energy of motion into electrical energy (e.g., moving water drives a spinning turbine which generates electric currents).
Science and Engineering Practices Developing and Using Models: ● Develop and revise models collaboratively to measure and explain frequent and regular events. ● Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system. ● Identify limitations of models. ● Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.	**Science and Engineering Practices** Developing and Using Models: ● Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system. ● Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.

Crosscutting Concepts Energy and Matter: • Energy can be transferred in various ways and between objects. Systems and System Models: • A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. • A system can be described in terms of its components and their interactions.	**Crosscutting Concepts** Energy and Matter: • Energy can be transferred in various ways and between objects. Systems and System Models: • A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. • A system can be described in terms of its components and their interactions.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • There can figure out various ways of finding out what makes things work or why they happen. • In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.	**Using Science – U1** • Careful observation, including accurate measurement where possible, can suggest what may be happening. • Students can figure out various ways of finding out what makes things work or why they happen.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Energy cannot be created or destroyed. Energy is present within light, sound, and moving objects. Energy can be transferred in various ways. Many processes and phenomena are described in terms of energy exchanges. Objects have an effect on other objects even when they are not in contact with them. This can be seen with magnetic pull.	Energy can be transferred from place to place by electric currents to become energy people use in the form of motion, sound, heat, or light. People generate and transport this energy with wind turbines, dams, solar panels, and electrical cables.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use a model of a system: 1. to show that the faster an objects moves, the more energy it possesses. 2. to show the transfer of energy from object to object when they are not touching (i.e., radiation). 3. to test that magnets can exert forces on other magnets, causing energy to be transferred. 4. to explain how size, distance, strength, and orientation of magnets impact the interactions of those two magnets.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use a model: 1. to show how energy such as motion, sound, heat, or light are produced by electric currents. 2. to explain that electric currents are produced by the transfer of energy from one object to another (i.e., a battery to a light) within a system.

Instructional Sequence 3
Unit 1: Magnets and Electricity

Az Science Standard 4.P4U3.4

Engage in an argument from evidence on the use and impact of renewable and nonrenewable resources to generate electricity.

CI P4: The total amount of energy in the universe is always the same but can transfer from one energy store to another during an event.

- Electric power generation is based on fossil fuels (i.e., coal, oil, and natural gas), nuclear fission, or renewable resources (e.g., solar, wind, tidal, geothermal, and hydro power).
- Transportation today chiefly depends on fossil fuels, but the use of electric and alternative fuel (e.g., hydrogen, biofuel) vehicles is increasing.
- All forms of electricity generation and transportation fuels have associated economic, social, and environmental costs and benefits, both short and long term.
- Technological advances and regulatory decisions can change the balance of those costs and benefits.
- All materials, energy, and fuels that people use are derived from natural sources, and their use affects the environment in multiple ways.
- Some resources are renewable over time, and others are not.

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information:

- Compare and/or combine across complex texts and/or other reliable media to acquire appropriate scientific and/or technical information.
- Determine the main idea of a scientific text and explain how it is supported by key details; summarize the text.
- Combine information in written text with that contained in corresponding tables, diagrams, and/or charts.
- Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.
- Use models to share findings or solutions in oral and/or written presentations, and/or extended discussions.
- Obtain and combine information from books and/or other reliable media about potential solutions to a specific design problem.

Engaging in Argument from Evidence:

- Construct and/or support scientific arguments with evidence, data, and/or a model.
- Compare and refine arguments based on the strengths and weaknesses of the evidence presented.
- Respectfully provide and receive criticism on scientific arguments from peers by citing relevant evidence and posing specific questions.
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Crosscutting Concepts

Energy and Matter:

- Energy can be transferred in various ways and between objects.

Stability and Change:

- Change is measured in terms of differences over time and may occur at different rates.
- Some systems appear stable, but over long periods of time will eventually change.

Using Science – U3

- Understanding the natural world can often be applied to change or make things to help solve human problems.
- Technological solutions have improved lives and the health of many people in countries across the world.
- Use of technological materials from the natural world may be in short supply or detrimental to the environment.

Big Ideas Sequence 3

Fuels like wood are non-renewable energy sources. Fossil fuels, such as oil, gas, and coal, are also non-renewable. Some energy resources are renewable, such as those produced by wind, water, sunlight, and tides. Ethical and moral judgements are important when considering where people draw their energy from, based on such considerations as resource equity, human safety, and impacts on people and the environment.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Obtain, evaluate, and communicate information that explains:

1. the differences between energy resources, such as how some are renewable over time (stability and change), i.e., solar, wind, tidal, geothermal and hydro power, and others are not (i.e., fossil fuels and nuclear fission).
2. the impact of using renewable and nonrenewable energy resources by presenting evidence from scientific texts and corresponding diagrams, tables, and/or charts., data, and/or a model.

Engage in argument from evidence:

1. that cites relevant evidence and poses specific questions about the impact of using renewable and nonrenewable energy resources, allowing for critiques and rebuttals.
2. that considers how technological advances and outcomes of regulatory decisions impact the balance of renewable and nonrenewable energy.
3. that presents a final claim about the merit of a solution (i.e., alternative fuels for vehicles and homes) that addresses the economic, social, and environmental costs and benefits of renewable and nonrenewable energy resources.

Fourth Grade Unit 2: Earth Systems

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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 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.	**Az Science Standard 4.E1U1.7** Develop and/or revise a model using various rock types, fossil location, and landforms to show evidence that Earth's surface has changed over time. *Note: At this level, fossils will be examined in different rock layers/types to understand changes in Earth's landscape over time. Rock types are not covered in detail.* **Az Science Standard 4.E1U1.5** Use models to explain seismic waves and their effect on the Earth. *Note: At this level, students are to understand that earthquakes are evidence of change and can shape Earth. Wave properties are not covered in detail. "Seismic" is not defined.*
CI E1: The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate. ● Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). ● These systems interact in multiple ways to affect Earth's surface materials and processes. ● The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate.	**CI E1: The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate.** ● Rainfall helps shape the land and affects the types of living things found in a region. ● Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. ● Human activities affect Earth's systems and their interactions at its surface. ● Earth has changed over time. ● Understanding how landforms develop, are weathered (broken down into smaller pieces), and erode (get transported elsewhere) can help infer the history of the current landscape. ● Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes. ● The presence and location of certain fossil types indicate the order in which rock layers were formed. ● The downhill movement of water as it flows to the ocean shapes the appearance of the land.
Science and Engineering Practices Planning and Carrying Out Investigations:	**Science and Engineering Practices** Obtaining, Evaluating, and Communicating Information:

• Design and conduct investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and tools for collecting data. • Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon or test a design solution. Constructing Explanations and Designing Solutions: • Identify the evidence that supports particular points in an explanation.	• Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. • Use models to share findings or solutions in oral and/or written presentations, and/or extended discussions. Developing and Using Models: • Develop and revise models collaboratively to measure and explain frequent and regular events. • Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system. • Develop a diagram or simple physical prototype to convey a proposed object, tool or process. • Use a simple model to test cause and effect relationships concerning the functioning of a proposed object, tool or process.
Crosscutting Concepts Systems and System Models: • A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. Cause and Effect: • Events that occur together with regularity might or might not be a cause and effect relationship. • Simple tests can be designed to gather evidence to support or refute student ideas about causes.	**Crosscutting Concepts** Stability and Change: • Change is measured in terms of differences over time and may occur at different rates. • Some systems appear stable, but over long periods of time will eventually change. Patterns: • Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products. • Patterns can be used as evidence to support an explanation.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Students discover various ways of finding out what makes things work or why they happen.	**Using Science – U1** • Science is about finding explanations for why things happen as they do or why they take a particular form. • Students discover various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**

Earth's major systems (geosphere, hydrosphere, atmosphere, and biosphere) affect Earth's surface (i.e., mountains, valleys, canyons, glaciers) and processes (i.e., weathering, erosion, plate tectonics).	The Earth has changed over time. Those changes can be caused by weather, Earth forces, and human activity. Those changes can be examined in the layers of the Earth and fossils within them.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out investigations: 1. to explore the Earth's major systems (geosphere, hydrosphere, atmosphere, and biosphere). 2. to explain how the Earth's major systems interact with and are dependent on each other (cause and effect). a. to describe how the ocean supports a variety of systems, influences climate, and shapes landforms.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain, evaluate, and communicate information: 1. by gathering evidence to support an explanation that the pattern of rock layers and types (i.e., sedimentary, igneous, and metamorphic) found in an area can indicate different time periods (ordering of rock layers) in Earth's history. a. rock layers taken from the same location show marine fossils in some layers and land fossils in other layers. Develop and use models: 1. to explain how landforms develop (change) over time by earthquakes (tectonic plate movements), erosion, and weathering. 2. to explain how living organisms (including humans) cause changes to the Earth's surface. 3. to describe or support explanations that fossil types can be used to show the timeline of rock layer formation.

Instructional Sequence 3 Unit 2: Earth Systems	Instructional Sequence 4 Unit 2: Earth Systems
Az Science Standard 4.E1U1.8 Collect, analyze, and interpret data to explain weather and climate patterns. **Az Science Standard 4.E1U2.10** Define problem(s) and design solution(s) to minimize the effects of natural hazards. *Note: Examples of design solutions to weather related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.* **Az Science Standard 4.E1U1.5** Use models to explain seismic waves and their effect on the Earth. *Note: At this level, students are to understand that earthquakes are natural hazards. Wave properties are not covered in detail. "Seismic" is not defined.*	**Az Science Standard 4.E1U3.9** Construct and support an evidence-based argument about the availability of water and its impact on life.
CI E1: The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate. ● Weather is the minute-by-minute to day-by-day variation of the atmosphere's condition on a local scale. ● Climate describes the ranges of an area's typical weather conditions and the extent to which those conditions vary over years to centuries. ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). ● Earthquakes cause seismic waves, which are waves of motion in Earth's crust. ● People cannot eliminate natural hazards but can take steps to reduce their impacts. ● Possible solutions to a problem are limited by available materials and resources (constraints). ● The success of a designed solution is determined by considering the desired features of a solution (criteria).	**CI E1: The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate.** ● Water is found almost everywhere on Earth: as vapor; as fog or clouds in the atmosphere; as rain or snow falling from clouds; as ice, snow, and running water on land and in the ocean; and as groundwater beneath the surface. ● Nearly all of Earth's available water is in the ocean. ● Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
Science and Engineering Practices Asking Questions and Defining Problems: ● Use prior knowledge to describe problems that can be solved.	**Science and Engineering Practices** Asking Questions and Defining Problems: ● Use prior knowledge to describe problems that can be solved. ● Ask questions based on careful observations of phenomena and information.

- Define a simple design problem that can be solved through the development of an object, tool or process and includes several criteria for success and constraints on materials, time, or cost.

Developing and Using Models:

- Develop and revise models collaboratively to measure and explain frequent and regular events.
- Develop a diagram or simple physical prototype to convey a proposed object, tool or process.

Analyzing and Interpreting Data:

- Display data in tables and graphs, using digital tools when feasible, to reveal patterns that indicate relationships.
- Interpret data to make sense of and explain phenomena, using logical reasoning, mathematics, and/or computation.
- Analyze data to refine a problem statement or the design of a proposed object, tool or process.

Constructing Explanations and Designing Solution:

- Construct explanations of observed quantitative relationships (e.g., the distribution of plants in the backyard).
- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation
- Identify the evidence that supports particular points in an explanation.
- Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.
- Apply scientific knowledge to solve design problems.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the problem.

Engaging in Argument from Evidence:

- Construct and/or support scientific arguments with evidence, data, and/or a model.
- Compare and refine arguments based on the strengths and weaknesses of the evidence presented.
- Respectfully provide and receive critiques on scientific arguments with peers by citing relevant evidence and posing specific questions.
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Crosscutting Concepts

Cause and Effect:

- Events that occur together with regularity might or might not be a cause and effect relationship.

Patterns:

- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.

Crosscutting Concepts

Stability and Change:

- Change is measured in terms of differences over time and may occur at different rates.
- Some systems appear stable, but over long periods of time will eventually change.

Cause and Effect:

• Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation. Systems and System Models: • A system can be described in terms of its components and their interactions. • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.	• Events that occur together with regularity might or might not be a cause and effect relationship.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Students discover various ways of finding out what makes things work or why they happen. • In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources. **Using Science – U2** • Technologies are developed using engineering, which involves identifying problems and using ideas of science and other ideas to design and develop the best possible solution. • There are always different ways of approaching problems, so various possibilities need to be tried out. • In order to decide which is the best solution it is necessary to be clear about what the result is intended to be and how success is to be judged.	**Using Science – U3** • Understanding the natural world can often be applied to change or make things to help solve human problems. • Technological solutions have improved the lives and health of many people in countries across the world. • Technology use materials from the natural world which may be in short supply or may be detrimental to the environment.
Big Ideas Sequence 3	**Big Ideas Sequence 4**
Weather is determined by the conditions and movement of the air. The temperature, pressure, direction, speed of movement and the amount of water vapor in the air combine to create the weather. The measurement of these properties over time enables patterns to be recognized. These patterns in the weather are referred to as climates, and are different in different parts of the world. Along with extreme weather, other natural disasters such as earthquakes have an effect on the Earth. People can design solutions to reduce the effects of natural hazards.	Two thirds of the Earth's surface is covered in liquid water, which is essential to life. The availability of water varies depends on natural processes and environmental factors. These changes can impact life.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning.

Analyze and interpret data: 1. by recording data in tables and graphs to evaluate patterns in average temperature, precipitation, and wind direction that indicate relationships in the Earth's weather (i.e., Arizona). 2. to explain patterns of typical seasonal weather used to predict extreme seasonal weather (i.e., drought in winter contributes to summer wildfires). 3. from a system model that demonstrates an earthquake's effect on Earth. Use models: 1. to define problems caused by weather related hazards (i.e., earthquakes). Design solutions: 1. to weather-related hazards (i.e., heavy rains that cause flooding, lightning that causes fires). 2. and receive/provide critiques on how the proposed solution mitigates the effects of weather-related hazards. 3. to evaluate positive and negative effect on people and the environment.	Ask questions and define problems: 1. to identify where different forms of water are found. 2. that relate to the availability of water and its effect on life locally and/or around the world. 3. by recording data in tables and graphs to evaluate the Earth's available water compared to the amount of freshwater. Engage in argument from evidence: 1. to develop a claim on how the availability of water affects life over time.

L4: The diversity of organisms, living and extinct, are the result of evolution.

Instructional Sequence 1

Az Science Standard 4.L4U1.11

Analyze and interpret environmental data to demonstrate that species either adapt and survive or go extinct over time.

Note: Provide a basic definition of "species" for student context.

CI L4: The diversity of organisms, living and extinct, are the result of evolution.

- When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.
- Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments.
- Fossils can be compared with one another and to living organisms according to their similarities and differences.
- Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful.

Science and Engineering Practices

Analyzing and Interpreting Data:

- Display data in tables and graphs, using digital tools when feasible, to reveal patterns that indicate relationships.
- Use data to evaluate claims about cause and effect.
- Interpret data to make sense of and explain phenomena, using logical reasoning, mathematics, and/or computation.

Crosscutting Concepts

Stability and Change:

- Change is measured in terms of differences over time and may occur at different rates.
- Some systems appear stable, but over long periods of time will eventually change.

Patterns:

- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.
- Patterns of change can be used to make predictions.
- Patterns can be used as evidence to support an explanation.

Cause & Effect:

- Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
- Cause and effect relationships are routinely identified, tested, and used to explain change.

- Events that occur together with regularity might or might not be a cause and effect relationship.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- It is important to see that other things stay the same so that the result can only be the effect of changing one thing.
- In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.
- Whether or not an effective explanation can be obtained depends on what data are collected and this is usually guided by having some theory or hypothesis about what might be happening.

Big Ideas Sequence 1

Living things are found in certain environments because they have features that enable them to survive. These adaptations have come about because of the small differences that occur every generation. Over time these changes can accumulate to the point where the survivors must adapt, move, or become extinct.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Analyze and interpret data:

1. to explain how environmental changes (i.e., temperature, availability of and competition for food and habitat) cause organisms to either survive and reproduce, move to a new place, or die.
    a. The change in an organism's habitat are sometimes beneficial and sometimes harmful to that organism.
2. to identify similarities and differences between fossils and modern organisms.
3. to reveal patterns in fossil evidence about the existence, diversity, extinction, and change in lifeforms throughout the history of Earth.
    a. Patterns include slow changes over time and mass extinctions.

Fifth Grade

Scope and Sequence

Fifth Grade

By the end of fifth grade, students apply their understanding of scale at macro (time and space) and micro (particles of matter) levels to understand patterns and scale across life, Earth and space, and physical sciences. Students will develop an understanding of forces, conservation of matter, and the passing down of genetic information from parent to offspring. Student investigations focus on collecting and making sense of observational data and measurements using the science and engineering practices:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- use evidence
- obtain, evaluate, and communicate information

While individual lessons may include connections to any of the crosscutting concepts, the standards in fifth grade focus on helping students understand phenomena through patterns and scale, proportion and quantity.

Unit #	Title	Content
1	Matter	Students develop an understanding that matter can be subdivided into particles and can be combined and rearranged into new substances, but both energy and matter follow the pattern of conservation during those changes.
2	Force and Motion	Students develop an understanding that unbalanced forces cause objects to move, and that those forces have both a strength and direction.
3	Gravity in 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. Students develop an understanding that changes can occur to objects in space, but both energy and matter follow the pattern of conservation during those changes.
4	Survival Traits	Students develop an understanding of patterns and how genetic information is passed from generation to generation. They also develop an understanding of how genetic information and environmental features impact the survival of an organism.

Fifth Grade Unit 1: Matter

P1: All matter in the Universe is made of very small particles.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 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.	**Az Science Standard 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.
CI P1: All matter in the Universe is made of very small particles. ● When two or more different substances are mixed, a new substance with different properties may be formed; such occurrences depend on the substances and the temperature. ● No matter what reaction or change in properties occurs, the total weight of the substances does not change. *(Note: Mass and weight are not distinguished at this grade level.)* ● Other substances simply mix without changing permanently and can often be separated again.	**CI P1: All matter in the Universe is made of very small particles** ● Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. For example, a model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects (e.g., leaves in wind, dust suspended in air); and the appearance of visible scale water droplets in condensation, fog, and, by extension, also in clouds or the contrails of a jet.
Science and Engineering Practices Planning and Carrying Out Investigations: ● Design and conduct investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. ● Evaluate appropriate methods and tools for collecting data. ● Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon.	**Science and Engineering Practices** Analyze and Interpret Data: ● Interpret data to make sense of and explain phenomena, using logical reasoning, mathematics, and/or computation.
Crosscutting Concepts Scale, Proportion, and Quantity: ● Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. ● Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. Energy and Matter: ● Matter is made of particles. ● Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the	**Crosscutting Concepts** Scale, Proportion, and Quantity: ● Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. Energy and Matter: ● Matter is made of particles.

substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. ● Energy can be transferred in various ways and between objects. Patterns: ● Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products. ● Patterns of change can be used to make predictions. ● Patterns can be used as evidence to support an explanation.	
Using Science – U1 ● Science is about finding explanations for why things happen as they do or why they take a particular form. ● Careful observation, including accurate measurement where possible, can suggest what may be happening. ● Whether or not an effective explanation can be obtained depends on what data is collected and this is usually guided by having some theory or hypothesis about what might be happening.	**Using Science – U1** ● Science is about finding explanations for why things happen as they do or why they take a particular form. ● Careful observation, including accurate measurement where possible, can suggest what may be happening. ● Whether or not an effective explanation can be obtained depends on what data is collected and this is usually guided by having some theory or hypothesis about what might be happening. ● In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Some substances can be combined to create a new substance with different properties. Other substances can be combined without taking on new properties. The amount of matter does not change when the substance changes form.	Matter of any type can be subdivided into particles too small to see.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out investigations: 1. to show evidence that when two or more substances are combined, they may or may not create a new substance with different properties (i.e., state of matter, color, texture, odor). a. Such occurrences of new substances depend on the substances involved and the temperature. These are observable patterns. b. Evidence can be qualitative (i.e., color, state of matter, texture, odor) or quantitative (i.e., mass).	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Analyze and interpret data: 1. explaining that matter is made of particles too small to be seen, but when grouped in large quantities, they are visible with the human eye (i.e., many molecules of water make up one drop).

2. using appropriate tools and data collection methods to show that the amount of matter does not change during a combination of substances (conservation of matter). (I.e., sugar dissolved into a solution does not lose its weight.)	

Instructional Sequence 3
Unit 1: Matter

Az Science Standard 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.

CI P1: All matter in the Universe is made of very small particles.

- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.
- At room temperature, some substances are in the solid state, some in the liquid state and some in the gas state.
- The state of many substances can be changed by heating or cooling them.
- The amount of matter does not change when a solid melts or a liquid evaporates.

Science and Engineering Practices

Analyze and Interpret Data:

- Compare data collected by different groups in order to discuss similarities and differences in their findings.
- Interpret data to make sense of and explain phenomena, using logical reasoning, mathematics, and/or computation.

Obtaining, Evaluating and Communicating Information:

- Combine information in written text with that contained in corresponding tables, diagrams, and/or charts.

Developing and Using Models:

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Crosscutting Concepts

Systems and System Models:

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Energy and Matter:

- Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.

Stability and Change:

- Change is measured in terms of differences over time and may occur at different rates.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- Careful observation, including accurate measurement where possible, can suggest what may be happening.
- Whether or not an effective explanation can be obtained depends on what data is collected and this is usually guided by having some theory or hypothesis about what might be happening.
- In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.

Big Ideas Sequence 3

The amount of matter stays the same when reactions occur in a closed system or when a substance undergoes a phase change.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Analyze and interpret data:

1. to explain that when matter is subdivided, the amount of matter (weight) still stays the same. This is called conservation of matter.

Obtain, evaluate, and communicate information:

1. proving that in a closed system if properties change or chemical reactions occur the amount of matter stays the same.

Develop and use models:

1. to support that matter is made of particles and that at room temperature, some matter is solid, some is liquid, and some is gas.

Fifth Grade Unit 2: Force and Motion

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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 5.P3U1.4 Obtain, analyze, and communicate evidence of the effects that balanced and unbalanced forces have on the motion of objects.	**Az Science Standard 5.P3U2.5** Define problems and design solutions pertaining to force and motion.
CI P3: Changing the movement of an object requires a net force to be acting on it. • Each force acts on one particular object and has both a strength and a direction. • An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. • Forces that do not sum to zero can cause changes in the object's speed or direction of motion. *(Note: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)* • The patterns of an object's motion in various situations can be observed and measured; when past motion exhibits a regular pattern, future motion can be predicted from it. • Objects in contact exert forces on each other (friction, elastic pushes and pulls). • Electric, magnetic, and gravitational forces between a pair of objects do not require that the objects be in contact - for example, magnets push and pull at a distance.	**CI P3: Changing the movement of an object requires a net force to be acting on it.** • How quickly an object's motion is changed depends on the force acting and the object's mass. • The greater the mass of an object, the longer it takes to speed it up or slow it down, a property of mass described as inertia.
Science and Engineering Practices Obtaining, Evaluating and Communicating information: • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts. • Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. • Use models to share findings or solutions in oral and/or written presentations, and/or extended discussions. Planning and Carrying Out Investigations:	**Science and Engineering Practices** Define Problems: • Ask questions based on careful observations of phenomena and information. • Ask questions to clarify the constraints of solutions to a problem. • Use prior knowledge to describe problems that can be solved. • Formulate questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Define a simple design problem that can be solved through the development of an object, tool or process and includes several criteria for success and constraints on materials, time, or cost.

• Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon or test a design solution. Using Mathematics and Computational Thinking: • Describe, measure, estimate, and graph quantities such as weight and time to address scientific and engineering questions and problems.	Constructing Explanations and Designing Solutions: • Construct explanations of observed quantitative relationships. • Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the problem.
Crosscutting Concepts Cause and Effect: • Cause and effect relationships are routinely identified, tested, and used to explain change. Stability and Change: • Change is measured in terms of differences over time and may occur at different rates. Patterns: • Patterns of change can be used to make predictions.	**Crosscutting Concepts** Cause and Effect: • Cause and effect relationships are routinely identified, tested, and used to explain change. Energy and Matter: • Energy can be transferred in various ways and between objects.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Students discover various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening. • It is important to see that other things stay the same so that the result can only be the effect of changing one thing.	**Using Science – U2** • Technologies are developed using engineering, which involves identifying problems and using ideas of science and other ideas to design and develop the best possible solution. • There are always different ways of approaching problems, so various possibilities need to be tried out. • In order to decide which is the best solution it is necessary to be clear about what the result is intended to be and how success is to be judged.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
An object at rest has multiple forces acting on it, but all those forces add to zero, resulting in no movement. When an unbalanced (non-zero) force is added to the object, it can cause a change in the object's motion and/or direction.	Inertia (a property of mass) states that the greater the mass of an object the longer it takes to speed it up or slow it down.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Plan and carry out an investigation:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Define a problem:

1. to describe the change in motion of an object at rest, after:
    a. application of balanced forces (forces that sum to zero) to the object.
    b. application of different strengths and directions of unbalanced forces (forces that do not sum to zero) to the object (i.e., strong force on the right, weak force on the left).

Use mathematics and computational thinking:

1. to explain that an object at rest has multiple forces acting on it with a net force of zero, and when forces that do not have a net force of zero, they will affect the speed or direction of an object.
2. to predict an object's motion based on observable patterns.

Obtain, evaluate, and communicate information:

1. using evidence from the investigations that explains:
    a. When all forces acting on an object are balanced, the object is at rest and when the forces acting on an object are unbalanced, the object is in motion in a direction.
    b. How quickly an object's motion is changed depends on the acting force and the object's mass, so that the greater the mass of an object, the longer it takes to speed the object up or slow it down.
2. about how electric, magnetic, and gravitational forces between a pair of objects do not require that the objects be in contact.

1. that can be solved by applying a scientific understanding of how forces act in the movement of a heavy object (i.e., causing motion, slowing it down, making it go faster).

Design a solution:

1. to the problem that the greater the mass of an object, the more energy it takes to speed up or slow down.

Instructional Sequence 3
Unit 2: Force and Motion

Az Science Standard 5.P4U1.6

Analyze and interpret data to determine how and where energy is transferred when objects move.

CI: 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.

- The faster a given object is moving, the more energy it possesses.
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
- Energy is present whenever there are moving objects, sound, light, or heat.
- Light also transfers energy from place to place.
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light.
- The currents may have been produced to begin with by transforming the energy of motion into electrical energy (e.g., moving water driving a spinning turbine which generates electric currents).

Science and Engineering Practices

Planning and Carrying Out an Investigation:

- Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon or test a design solution.

Analyzing and Interpreting Data:

- Interpret data to make sense of and explain phenomena, using logical reasoning, mathematics, and/or computation.
- Analyze data to refine a problem statement or the design of a proposed object, tool or process.
- Display data in tables and graphs, using digital tools when feasible, to reveal patterns that indicate relationships.
- Use data to evaluate claims about cause and effect.

Crosscutting Concepts

Cause and Effect:

- Cause and effect relationships are routinely identified, tested, and used to explain change.

Energy and Matter:

- Energy can be transferred in various ways and between objects.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- Students discover various ways of finding out what makes things work or why they happen.
- Careful observation, including accurate measurement where possible, can suggest what may be happening.

- In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.

Big Ideas Sequence 3

Energy can be moved or transferred from place to place by moving objects. It can also be transferred through sound, light, or electric currents, which can then be used locally to produce motion, sound, heat, or light. Through technology, moving objects can also be used to store energy via wind and dam turbines. (I.e., motion doesn't cause a light bulb to light up, but energy from a moving turbine must be transferred to another place via electric current to light up the bulb.)

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Plan and carry out an investigation to collect data that will serve as a basis of evidence for:

1. the presence of sound, light, or heat before and after an interaction (i.e., shining a light on an object can increase the temperature of an object; a sound can move an object).

Analyze and interpret data to explain that:

1. energy can be used to produce motion, sound, heat, or light.
2. energy can be transferred from place to place (i.e., moving objects, sound, light, heat, electric currents)
    a. electric currents flowing through wires links one form of energy output (i.e. a moving object) to another form of energy output (i.e. another moving object; turning on a lightbulb).
3. Sound, light, and heat have a cause and effect interaction.

Fifth Grade Unit 3: Gravity in Space

E2: The Earth and our solar system are a very small part of one of many Galaxies within the Universe.
P2: Objects can affect other objects at a distance.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 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.	**Az Science Standard 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.
CI E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe. ● Gravity is the universal attraction between all objects, however large or small, although it is only apparent when one of the objects is very large. ● On the Earth it results in everything being pulled down towards the center of the Earth. This downward attraction is called the weight of an object. ● The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	**CI E2:The Earth and our solar system are a very small part of one of many galaxies within the Universe.** ● The Earth moves round the Sun taking about a year for one orbit. ● The Moon orbits the Earth taking about four weeks to complete an orbit. ● The Sun, at the center of the solar system, is the only object in the solar system that is a source of visible light. ● The Moon reflects light from the Sun and as it moves round the Earth only those parts illuminated by the Sun are seen. ● The Earth rotates about an axis lying north to south and this motion makes it appear that the Sun, Moon and stars are moving round the Earth. ● The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns.
Science and Engineering Practices Obtaining, Evaluating, and Communicating Information: ● Determine the main idea of a scientific text and explain how it is supported by key details; summarize the text. ● Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. Analyzing and Interpreting Data: ● Display data in tables and graphs, using digital tools when feasible, to reveal patterns that indicate relationships. ● Use data to evaluate claims about cause and effect. ● Interpret data to make sense of and explain phenomena, using logical reasoning, mathematics, and/or computation.	**Science and Engineering Practices** Developing and Using Models: ● Develop and revise models collaboratively to measure and explain frequent and regular events. ● Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system. ● Identify limitations of models. Constructing Explanations and Designing Solutions: ● Construct explanations of observed quantitative relationships (e.g., the distribution of plants in the back yard). ● Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or design a solution to a problem.

Using Mathematical and Computational Thinking: • Organize simple data sets to reveal patterns that suggest relationships.	• Identify the evidence that supports particular points in an explanation.
Crosscutting Concepts Scale, Proportion and Quantity: • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. Cause and Effect: • Cause and effect relationships are routinely identified, tested, and used to explain change. • Events that occur together with regularity might or might not be a cause and effect relationship. Patterns: • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation.	**Crosscutting Concepts** Patterns: • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation. Systems and System Models: • A system can be described in terms of its components and their interactions. Stability and Change: • Change is measured in terms of differences over time and may occur at different rates. • Some systems appear stable, but over long periods of time will eventually change.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Careful observation, including accurate measurement where possible, can suggest what may be happening.	**Using Science – U1** • Science is about finding explanations for why things happen as they do or why they take a particular form. • Students discover various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening. • Whether or not an effective explanation can be obtained depends on what data is collected and this is usually guided by having some theory or hypothesis about what might be happening.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Gravity is the universal attraction between all objects and pulls them toward the planet's center. The larger the mass of an object, the greater its gravitational pull.	Earth moves around the Sun and rotates about an axis while the Moon revolves around the Earth.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain, evaluate, and communicate information:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use a model:

1. supporting an explanation of the cause and effect relationship between the gravitational force of Earth and the pull of objects toward its center. Analyze and Interpret data: 1. to show that gravity is the universal attraction between objects and increases with mass (proportion) and decreases with distance (scale). 2. to recognize that gravity acts on objects near the Earth. Use mathematical and computational thinking: 1. to organize data to reveal patterns in gravitational forces (i.e. falling objects in a vacuum).	1. to show the Earth (including the tilt of its axis of rotation) within a system (i.e., Sun, Moon, Earth). 2. to demonstrate that light from the Sun bounces off the Moon and is viewed on Earth as the bright part of the Moon a. the illuminated part of the Moon changes over the course of a month as the system rotates (i.e., Moon phases). Construct an explanation: 1. about the patterns of: Earth rotates on its tilted axis approximately one Earth day; the Moon rotates on its axis approximately once a month; the Earth-Moon system involves movement around the Sun, about once an Earth year.

Instructional Sequence 3
Unit 3: Gravity in Space

Az Science Standard 5.P2U1.3

Construct an explanation using evidence to demonstrate that objects can affect other objects even when they are not touching.

CI P2: Objects can affect other objects at a distance.

- Gravity is the universal attraction between all objects, however large or small, although it is only apparent when one of the objects is very large.
- This gravitational attraction keeps the planets in orbit around the Sun, the Moon round the Earth and their moons round other planets.
- On the Earth it results in everything being pulled down towards the center of the Earth. This downward attraction is called the weight of an object.
- Electric, magnetic, and gravitational forces between a pair of objects do not require that the objects be in contact-for example, magnets push pull at a distance.

Science and Engineering Practices

Constructing Explanations and Designing Solutions:

- Construct explanations of observed quantitative relationships (e.g., the distribution of plants in the back yard).
- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or design a solution to a problem.
- Identify the evidence that supports particular points in an explanation.

Developing and Using Models:

- Develop and revise models collaboratively to measure and explain frequent and regular events.
- Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Crosscutting Concepts

Scale, Proportion and Quantity:

- Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods.

Cause and Effect:

- Cause and effect relationships are routinely identified, tested, and used to explain change.
- Events that occur together with regularity might or might not be a cause and effect relationship.

Using Science – U1

- Science is about finding explanations for why things happen as they do or why they take a particular form.
- Students discover various ways of finding out what makes things work or why they happen.
- Careful observation, including accurate measurement where possible, can suggest what may be happening.
- In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.

Big Ideas Sequence 3

Gravity is the universal attraction between all objects. The gravitational force of Earth acting on an object near Earth's surface pulls that object towards the planet's center. This gravitational attraction keeps the planets in orbit around the Sun, the Moon around the Earth, and moons around other planets.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Construct explanations using evidence:

1. to support a claim that the gravitational force exerted by earth on objects causes objects dropped to appear to fall straight down. ("Down" is a local description of a direction that points towards the center of the spherical earth.)
2. that gravity is an attractive force found in objects in the solar system that, based on scale and proportion, increases with mass and decreases with distance.

Develop and use models:

1. to describe that the gravitational force of the Sun keeps the Earth, Moon, and other objects in orbit (i.e., illustrate smaller objects (moons) orbit around larger objects (planets)).

Fifth Grade Unit 4: Survival Traits

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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 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.	**Az Science Standard 5.L4U3.11** Obtain, evaluate, and communicate evidence about how natural and human-caused changes to habitats or climate can impact populations.
CI L3: Genetic information is passed down from one generation of organisms to another. ● Many characteristics of organisms are inherited from their parents. ● Offspring acquire a mix of traits from their biological parents. ● Different organisms vary in how they look and function because they have different inherited information. ● In each kind of organism there is variation in the traits themselves, and different kinds of organisms may have different versions of the trait. ● Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. ● Many characteristics involve both inheritance and environment.	**CI L4: The Unity and diversity of organisms, living and extinct, is the result of evolution.** ● Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. ● For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Scientists have identified and classified many plants and animals. ● Populations of organisms live in a variety of habitats and change in those habitats affects the organisms living there. ● Humans, like all other organisms, obtain living and non-living resources from their environments.
Science and Engineering Practices Obtaining, Evaluating and Communicating Information: ● Combine information in written text with that contained in corresponding tables, diagrams, and/or charts. ● Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. Constructing Explanations and Designing Solutions: ● Construct explanations of observed quantitative relationships (e.g., the distribution of plants in the back yard).	**Science and Engineering Practices** Obtaining, Evaluating and Communicating Information: ● Combine information in written text with that contained in corresponding tables, diagrams, and/or charts. ● Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts ● Use models to share findings or solutions in oral and/or written presentations, and/or extended discussions. Constructing Explanations and Designing Solutions: ● Construct explanations of observed quantitative relationships (e.g., the distribution of plants in the back yard).

Crosscutting Concepts Patterns: • Patterns of change can be used to make predictions • Patterns can be used as evidence to support an explanation. Cause and Effect: • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.	**Crosscutting Concepts** Patterns: • Patterns of change can be used to make predictions • Patterns can be used as evidence to support an explanation. Stability and Change: • Change is measured in terms of differences over time and may occur at different rates. • Some systems appear stable, but over long periods of time will eventually change Cause and Effect: • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Students discover various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening. • Whether or not an effective explanation can be obtained depends on what data is collected and this is usually guided by having some theory or hypothesis about what might be happening.	**Using Science – U3** • Understanding the natural world can often be applied to change or make things to help solve human problems. • Technology use materials from the natural world which may be in short supply or may be detrimental to the environment. • There are generally both positive and negative consequences of the applications of science. Some negative impacts can be anticipated but others emerge from experience.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Many characteristics of organisms involve both inheritance and environment.	Humans can have both positive and negative impacts on the environment. Both humans and other species compete for the same natural resources.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain, evaluate and communicate information:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain, evaluate and communicate information:

1. about patterns of variation of traits (i.e., height, hair color, eye color in animals; height, flower color in plants) between offspring of plants and animals. 2. to make predictions based on patterns of traits in plants and in animals. Construct an explanation from evidence: 1. demonstrating how factors can affect genetic information from being passed from one generation to another. 2. that offspring acquire a mix of traits from both parents (i.e., siblings resemble each other but are not identical). 3. illustrating environmental factors vary for organisms of the same type (amount/type of food, opportunities for learning, clean water) that may influence an organism's traits.	1. about how human activity (i.e., industry, agriculture, need for energy) affects Earth's resources (living and non-living) and environments. 2. on the positive and negative effects on the environment as a result of human activity. 3. identifying patterns in the populations of ecosystems that affect the stability of the organisms living there. Construct an explanation: 1. for how changes in habitats are sometimes beneficial or harmful and can be measured by differences over time. 2. using scientific understanding, to protect, or defend the use of a natural resource and the environment in which the resource is found.

Instructional Sequence 3 Unit 4: Survival Traits	Instructional Sequence 4 Unit 4: Survival Traits
Az Science Standard 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.	**Az Science Standard 5.L4U3.12** Construct an argument based on evidence that inherited characteristics can be affected by behavior and/or environmental conditions.
CI L3: Genetic information is passed down from one generation of organisms to another. ● The environment affects the traits that an organism develops—differences in where they grow or in the food they consume may cause organisms that are related to end up looking or behaving differently. ● When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.	**CI L4: The Unity and diversity of organisms, living and extinct, is the result of evolution.** ● Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. ● Many characteristics of organisms are inherited from their parents. ● Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. ● Many characteristics involve both inheritance and environment.
Science and Engineering Practices Constructing Explanations and Designing Solutions: ● Construct explanations of observed quantitative relationships (e.g., the distribution of plants in the back yard). ● Identify the evidence that supports particular points in an explanation. ● Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. Obtaining, Evaluating, and Communicating Information: ● Combine information in written text with that contained in corresponding tables, diagrams, and/or charts.	**Science and Engineering Practices** Asking Questions and Defining Problems: ● Ask questions based on careful observations of phenomena and information. ● Ask questions to clarify ideas or request evidence. ● Ask questions that relate one variable to another variable. Engage in Argument from Evidence: ● Construct and/or support scientific arguments with evidence, data, and/or a model. ● Compare and refine arguments based on the strengths and weaknesses of the evidence presented.
Crosscutting Concepts Patterns: ● Patterns of change can be used to make predictions ● Patterns can be used as evidence to support an explanation. Cause and Effect: ● Cause and effect relationships are routinely identified, tested, and used to explain change.	**Crosscutting Concepts** Patterns: ● Patterns of change can be used to make predictions ● Patterns can be used as evidence to support an explanation. Stability and Change: ● Change is measured in terms of differences over time and may occur at different rates.

• Events that occur together with regularity might or might not be a cause and effect relationship. Stability and Change: • Change is measured in terms of differences over time and may occur at different rates. • Some systems appear stable, but over long periods of time will eventually change	• Some systems appear stable, but over long periods of time will eventually change Cause and Effect: • Cause and effect relationships are routinely identified, tested, and used to explain change. • Events that occur together with regularity might or might not be a cause and effect relationship.
Using Science – U1 • Science is about finding explanations for why things happen as they do or why they take a particular form. • Students discover various ways of finding out what makes things work or why they happen. • Careful observation, including accurate measurement where possible, can suggest what may be happening. • Whether or not an effective explanation can be obtained depends on what data is collected and this is usually guided by having some theory or hypothesis about what might be happening.	**Using Science – U3** • Understanding the natural world can often be applied to change or make things to help solve human problems. • Technological solutions have improved the lives and health of many people in countries across the world. • Technology uses materials from the natural world which may be in short supply or may be detrimental to the environment.
Big Ideas Sequence 3	**Big Ideas Sequence 4**
Plants and animals must adapt to the changes within their environment. Populations over time will develop traits that help them survive in their habitat.	The habitat has an impact on organisms that live there. They pass down behaviors to their offspring to help them thrive and reproduce.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Construct an explanation: 1. showing how changes in the environment (i.e., amount of food, amount of water, amount of exercise and animal gets, chemicals present in an environment) affect organisms with consistent patterns in the way traits (i.e., height or weight of plants and animals, color or quantity of flowers) change. 2. of how environmental changes cause an organism to adapt, move to a new location, or die (i.e., changes in honeybee population). Obtain, evaluate, and communicate information: 1. connecting environmental changes to changes in inherited traits of organisms.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Ask questions and define problems that: 1. cause advantages or disadvantages in chances of survival and finding mates. Construct an argument that: 1. shows an organism's environment can change over time (ex: loss of forest, natural disasters, human impact), and affected the behavior and/or traits of that population. 2. explains that characteristics and behaviors (i.e., keeping offspring safe from predators, feeding offspring, becoming silent to avoid predators, finding mates) can be patterns that are inherited from parents or acquired from interactions with the environment.

2. showing patterns of cause and effect relationships between an environmental factor (i.e., drought) and its effect on a given trait (i.e., plant height) in an organism.	

Sixth Grade

Scope and Sequence

Sixth Grade

By the end of sixth grade, students apply their understanding of how matter and energy relate to atoms, the solar system, and ecosystems. Students will develop an understanding of the nature of matter and the role of energy transformation. Students will also deepen their understanding of scales, patterns, and properties of matter, the solar system, and ecosystems. Student investigations focus on collecting and making sense of observational data and measurements using the science and engineering practices:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- use evidence
- obtain, evaluate, and communicate information

While individual lessons may include connections to any of the crosscutting concepts, the standards in sixth grade focus on helping students understand phenomena through patterns; scale, proportion, and quantity; systems and system models; and energy and matter.

Unit #	Title	Content
1	Energy and Matter	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.
2	Movement in the Solar System	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.
3	Solar Radiation	Students develop an understanding that the atmosphere is transparent to allow energy from the Sun to pass, keeping the Earth warm.
4	Ecosystems	Students develop an understanding of how energy from the Sun is transferred through ecosystems.

Sixth Grade Unit 1: Energy and Matter

P1: All matter in the universe is made of very small particles.

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.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 6.P1U1.3 Develop and use models to represent that matter is made up of smaller particles called atoms.	**Az Science Standard 6.P1U1.2** Plan and carry out an investigation to demonstrate that variations in temperature and/or pressure affect changes in state of matter. **Az Science Standard 6.P1U1.1** Analyze and interpret data to show that changes in the states of matter are caused by different rates of movement of atoms in solids liquids, and gases (Kinetic Theory).
CI P1: All Matter in the Universe is made of very small particles. ● If a substance could be divided into smaller and smaller pieces it would be found to be made of very, very small particles, smaller than can be seen even with a microscope. These particles are not in a substance; they are the substance. ● All materials, anywhere in the universe, living and non-living, are made of a very large number of basic 'building blocks' called atoms, of which there are about 100 different kinds.	**CI P1: All Matter in the Universe is made of very small particles.** ● The differences between substances in the solid, liquid or gas state can be explained in terms of the speed and range of the movement of particles and the separation and strength of the attraction between neighboring particles. ● The properties of different materials can be explained in terms of the behavior of atoms and groups of atoms of which they are made. ● All the particles of a particular substance are the same and different from those of other substances. ● The particles are not static but move in random directions. ● The speed at which they move is experienced as the temperature of the material.
Science and Engineering Practices Develop and Use Models: ● Use and/or develop models to predict, describe, support explanations, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. ● Develop models to describe unobservable mechanisms. ● Modify models—based on their limitations—to increase detail or clarity, or to explore what will happen if a component is changed.	**Science and Engineering Practices** Obtaining, Evaluating, and Communicating Information: ● Communicate scientific information and/or technical information (e.g. about a proposed object, tool, process, system) in different formats (e.g., verbally, graphically, textually, and mathematically). Planning and Carrying Out Investigations: ● Conduct an investigation and evaluate and revise the experimental design to ensure that the data generated can meet the goals of the experiment. ● Design an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how much data are needed to support their claim.

	• Evaluate the accuracy of various methods for collecting data. • Collect data and generate evidence to answer scientific questions or test design solutions under a range of conditions. Analyzing and Interpreting Data: • Consider limitations of data analysis (e.g., measurement error), and seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data in order to determine similarities and differences in findings. • Distinguish between causal and correlational relationships. • Use graphical displays (e.g., maps) of large data sets to identify temporal and special relationships.
Crosscutting Concepts Patterns: • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. • Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. • Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data. Energy and Matter: • Matter is conserved because atoms are conserved in physical and chemical processes. • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). • The transfer of energy can be tracked as energy flows through a designed or natural system. Scale, Proportion, and Quantity: • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods.	**Crosscutting Concepts** Energy and Matter: • Matter is conserved because atoms are conserved in physical and chemical processes. • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). • The transfer of energy can be tracked as energy flows through a designed or natural system. Systems and System Models: • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. • Models are limited in that they only represent certain aspects of the system under study. Stability and Change: • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale. • Small changes in one part of a system might cause large changes in another part.

	• Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
Using Science – U1 • To help explain observations, scientists create models to represent what they think may be happening. Sometimes these are physical models, such as a ball and stick model of how atoms are thought to be arranged in a substance. • Other models are theoretical, more abstract, such as in representing light as a wave motion, or representing relationships as mathematical formulae. • Some models are firmly established in theories which have been shown to work without contradiction in all contexts so far encountered. • Others (models) are more tentative and are likely to be changed in future. • There may be more than one possible model and the evidence of which works best is not conclusive; and in other cases scientists do not yet have a satisfactory explanatory model.	**Using Science – U1** • Careful and systematic observations and accurate descriptions of what is observed are fundamental to scientific investigation. • What people expect to happen can influence what they observe, so it is good practice for observations to be made by several people independently and for results to be reported clearly enough to be checked by others. • To help explain observations, scientists create models to represent what they think may be happening. • In science, explanations are sought through some kind of systematic inquiry that involves collecting data by observing or measuring features of the objects being studied or using data from other sources.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
All matter is made of atoms. Scientists develop models because atoms are too small to see, even with a microscope. There are different types of atoms which are determined by the number of their protons.	Matter can be found in different states. Temperature and pressure of particles in the matter causes changes in states of matter.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models that: 1. represent that substances (matter) can be divided into smaller particles called atoms, and atoms combine in patterns to make up all substances. 2. When substances are divided into smaller particles, they remain the same substances. 3. support the understanding that all things are made up of atoms. a. Some things are made up entirely of one type of atom (i.e., silver), and in enough quantity, can be seen by the human eye. b. Some things are made up of two or more types of atoms (i.e., sodium chloride or salt).	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain, evaluate, and communicate information: 1. about the motion of molecules in a system (i.e., the faster the molecules move, the more energy they have). 2. about how temperature and/or pressure affect changes in states of matter (solid, liquid, gas) and the particle motion (i.e., gas particles are separated and far apart with no regular arrangement, liquid particles are close together with no regular arrangement, solid particles are tightly packed in a regular pattern). Plan and carry out an investigation: 1. evaluate data to show the relationship between changes of temperature (i.e., increase or decrease temperature to change a matter's state).

	2. that shows that, in a gaseous state, higher energy molecules collide with greater force, therefore increasing the pressure of a system and vice versa (i.e., a sealed soda can submerged in ice water will collapse). Analyze and interpret data: 1. evaluate data within the investigation to show the relationship between changes of temperature (Kinetic Theory) affecting states of matter.

Instructional Sequence 3
Unit 1: Energy and Matter

Az Science Standard 6.P4U2.5

Analyze how people use technology to store (potential) and/or use (kinetic) energy.

CI 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.

- The chemicals in the cells of a battery store energy which is released when the battery is connected so that an electric current flows, transferring energy to other components in the circuit and on to the environment.
- Motion energy is properly called kinetic energy.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information:

- Read critically using scientific knowledge and reasoning to evaluate data, hypotheses, conclusions that appear in scientific and technical texts in light of competing information or accounts; provide an accurate summary of the text distinct from prior knowledge or opinions.
- Critically evaluate whether or not technical information on a device, tool or process is relevant to its suitability to solve a specific design problem.

Analyzing and Interpreting Data:

- Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Crosscutting Concepts

Energy and Matter:

- Matter is conserved because atoms are conserved in physical and chemical processes.
- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
- The transfer of energy can be tracked as energy flows through a designed or natural system.

Systems and System Models:

- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

Using Science -U2

- Designing a solution to a problem generally involves making a drawing or model.
- Physical, mathematical, or computer models enable the effect of changes in materials or design to be tested and the solution improved.
- There are usually many factors to be considered in optimizing a solution, such as cost, availability of materials and impact on users and on the environment, which may constrain choices.

Big Ideas Sequence 3

People utilize technology to store (potential) and use (kinetic) energy.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Obtain, evaluate, and communicate information:

1. Energy is contained in a closed system and energy can be transferred from one energy store to another during an event.
2. on how people store energy (i.e., pumped hydroelectric, compressed air, flywheels, batteries, thermal energy storage).
3. about why people utilize certain systems of energy storage over others.

Analyze and interpret data to show:

1. how people have used technology, such as batteries connected to a circuit, to store potential energy and transfer it into kinetic energy.

Sixth Grade Unit 2:
Movement in the Solar System

E2: Our solar system is a very small part of one of billions of galaxies in the Universe.
P2: Objects can affect other objects at a distance.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 6.P2U1.4 Develop and use a model to predict how forces act on objects at a distance. **Az Science Standard 6.E2U1.7** Use ratios and proportions to analyze and interpret data related to scale, properties, and relationships among objects in our solar system.	**Az Science Standard 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.
CI P2: Objects can affect other objects at a distance. • Gravity is the universal attraction between all objects, however large or small, although it is only apparent when one of the objects is very large. • This gravitational attraction keeps the planets in orbit around the Sun, the Moon round the Earth and their moons round other planets. • The pull of the Earth on the Moon keeps it orbiting the Earth while the pull of the Moon on the Earth gives rise to tides. **CI E2: Our solar system is a very small part of one of billions of galaxies in the Universe.** • The Earth is one of eight (so far known) planets in our solar system which, along with many other smaller bodies, orbit the Sun, in roughly circular paths, at different distances from the Sun and taking different times to complete an orbit. • The distances between these bodies are huge – Neptune is 4.5 billion km from the Sun, 30 times further than Earth. • As seen from Earth, planets move in relation to the positions of the stars which appear fixed relative to each other.	**CI E2: Our solar system is a very small part of one of billions of galaxies in the Universe.** • The Earth's axis is tilted relative to the plane of its orbit around the Sun so that the length of day varies with position on the Earth's surface and time of the year, giving rise to the seasons. • Earth's spin axis is fixed in direction over the short term but tilted relative to its orbit around the Sun. • The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.
Science and Engineering Practices Obtaining, Evaluating, and Communicating Information: • Gather, read, and communicate information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used.	**Science and Engineering Practices** Develop and Use Models: • Use and/or develop models to predict, describe, support explanations, and/or collect data to test ideas about phenomena in natural or designed

Developing and Using Models: ● Use and/or develop models to predict, describe, support explanations, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. ● Develop models to describe unobservable mechanisms. ● Develop a model that allows for manipulation and testing of a proposed system. ● Evaluate limitations of a model. Analyzing and Interpreting Data: ● Construct, analyze, and interpret graphical displays of data to identify linear and nonlinear relationships. ● Analyze and interpret data in order to determine similarities and differences in findings. ● Distinguish between causal and correlational relationships. ● Use graphical displays (e.g., maps) of large data sets to identify temporal and spatial relationships.	systems, including those representing inputs and outputs, and those at unobservable scales. ● Develop models to describe unobservable mechanisms. ● Modify models—based on their limitations—to increase detail or clarity, or to explore what will happen if a component is changed.
Crosscutting Concepts System and System Models: ● Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. ● Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. ● Models are limited in that they only represent certain aspects of the system under study. 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. ● Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. ● Phenomena that can be observed at one scale may not be observable at another scale.	**Crosscutting Concepts** Patterns: ● Patterns can be used to identify cause and effect relationships. ● Graphs, charts, and images can be used to identify patterns in data. Stability and Change: ● Small changes in one part of a system might cause large changes in another part. ● Cause and effect relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. Cause and Effect: ● Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Cause and Effect: • Cause and effect relationships may be used to predict phenomena in natural or designed systems. Patterns: • Patterns can be used to identify cause and effect relationships. • Graphs, charts, models, and images can be used to identify patterns in data.	
Using Science – U1 • To help explain observations, scientists create models to represent what they think may be happening. • Sometimes these are physical models, such as an orrery – a model of the solar system where various objects are used to represent the Sun, Moon, Earth and other planets – or a ball and stick model of how atoms are thought to be arranged in a substance. • Computer-based models enable phenomena to be simulated and variables easily changed to investigate their effect. • Some models are firmly established in theories which have been shown to work without contradiction in all contexts so far encountered. • There may be more than one possible model and the evidence of which works best is not conclusive; and in other cases scientists do not yet have a satisfactory explanatory model.	**Using Science – U1** • Careful and systematic observations and accurate descriptions of what is observed are fundamental to scientific investigation. • To help explain observations, scientists create models to represent what they think may be happening. • Sometimes these are physical models, such as an orrery – a model of the solar system where various objects are used to represent the Sun, Moon, Earth and other planets – or a ball and stick model of how atoms are thought to be arranged in a substance. • Some models are firmly established in theories which have been shown to work without contradiction in all contexts so far encountered.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Gravity is a universal attraction between objects, especially between those with a larger mass such as planets and moons. Ratios and proportions can be used to determine the scale and distance of objects within the solar system.	The Earth rotates about an imaginary line that passes through the North and South Poles of the planet (axis of rotation). The most intense solar energy occurs over the summer months and the least direct and intense energy occurs over the winter months because the Earth's axis is tilted.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Obtain, evaluate, and communicate Information: 1. on how gravity is an attractive force between solar system and galaxy objects that increases with mass and decreases with distance. 2. about how objects in the solar system (i.e., Sun, planets, moons, asteroids) compare in distance, and size using proportions and ratios. Develop and use a model:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use a model to: 1. demonstrate the tilt of Earth's axis as it orbits around the Sun creates a consistent pattern of length of day. 2. demonstrate the tilt of Earth's axis as it orbits around the Sun causes a change in the intensity of sunlight on the Earth's surface, creating the pattern of seasons.

1. To predict how the size of an object affects its gravitational attraction within a system (i.e., larger planets cause smaller objects like moons to orbit around them). 2. to explain how the gravitational force of the Sun causes the planets to orbit around it, holding the solar system together. 3. gravitational forces from the center of the milky way cause stellar (star) systems to orbit around the center of the galaxy. 4. to utilize scale in order to understand the relationship between distance, properties, and proportions of objects within the solar system. *Note: expand original model as needed.* Analyze and interpret data: 1. about the identifying characteristics of different categories of objects in the solar system (i.e., planets, asteroids, meteors). 2. to find evidence that two objects may be similar when viewed at one scale (i.e., surface features) but may be different when viewed at another scale (i.e., diameter, number of features). 3. to draw conclusions about the patterns of scale properties at more than one scale, such as those that are too large to observe.	a. Summer occurs in the northern hemisphere at times in Earths obit when the northern axis of Earth is tilted towards the Sun. b. Summer occur in the southern hemisphere at times in Earth's orbit when the southern axis of Earth is tilted towards the Sun.

Instructional Sequence 3 Unit 2: Movement in the Solar System	Instructional Sequence 4 Unit 2: Movement in the Solar System
Az Science Standard 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.	**Az Science Standard 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.
CI E2: Our solar system is a very small part of one of billions of galaxies in the Universe. ● The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. ● This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.	**CI E2: Our solar system is a very small part of one of billions of galaxies in the Universe.** ● The Earth rotates about an axis lying north to south and this motion makes it appear that the Sun, Moon and stars are moving round the Earth. ● This rotation causes day and night as parts of the Earth's surface turn to face towards or away from the Sun. It takes a year for the Earth to pass around the Sun.
Science and Engineering Practices Develop and Use Models: ● Use and/or develop models to predict, describe, support explanations, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. ● Develop models to describe unobservable mechanisms. ● Modify models—based on their limitations—to increase detail or clarity, or to explore what will happen if a component is changed. ● Develop a model that allows for manipulation and testing of a proposed object, tool, process or system. ● Evaluate limitations of a model.	**Science and Engineering Practices** Develop and Use Models: ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. ● Use and/or develop models to predict, describe, support explanations, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. ● Develop models to describe unobservable mechanisms. ● Modify models—based on their limitations—to increase detail or clarity, or to explore what will happen if a component is changed. ● Develop a model that allows for manipulation and testing of a proposed object, tool, process or system. ● Evaluate limitations of a model.
Crosscutting Concepts Systems and System Models: ● Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. ● Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.	**Crosscutting Concepts** Patterns: ● Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. ● Patterns can be used to identify cause and effect relationships. ● Graphs, charts, and images can be used to identify patterns in data.

• Models are limited in that they only represent certain aspects of the system under study. Cause and Effect: • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. Stability and Change: • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale. • Stability might be disturbed either by sudden events or gradual changes that accumulate over time.	Cause and Effect: • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Using Science – U1 • To help explain observations, scientists create models to represent what they think may be happening. • Sometimes these are physical models, such as an orrery – a model of the solar system where various objects are used to represent the Sun, Moon, Earth and other planets – or a ball and stick model of how atoms are thought to be arranged in a substance. • Computer-based models enable phenomena to be simulated and variables easily changed to investigate their effect. • Some models are firmly established in theories which have been shown to work without contradiction in all contexts so far encountered.	**Using Science – U1** • Careful and systematic observations and accurate descriptions of what is observed are fundamental to scientific investigation. • To help explain observations, scientists create models to represent what they think may be happening. • Sometimes these are physical models, such as an orrery – a model of the solar system where various objects are used to represent the Sun, Moon, Earth and other planets – or a ball and stick model of how atoms are thought to be arranged in a substance. • Some models are firmly established in theories which have been shown to work without contradiction in all contexts so far encountered.
Big Ideas Sequence 3	**Big Ideas Sequence 4**
The gravitational pull and resulting rotation within the Sun-Earth-Moon system creates patterns of eclipses, Moon phases, and tides.	Constellations and other night sky patterns appear to move due to Earth's rotation and revolution. The Earth's rotation on its axis creates day and night. The Earth takes one year to make a full revolution around the Sun.
Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use system models to:	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use a model:

1. show how light from the Sun is prevented from reaching the Earth during a solar eclipse due to the Moon's location between the Sun and the Earth. 2. show how sunlight is prevented from reaching the Moon during a lunar eclipse because Earth is located between the Sun and the Moon. 3. explain how light from the Sun bounces off the Moon and is viewed on Earth as the "bright part" of the Moon. a. The illuminated part of the Moon changes over the course of a month as the location of the Moon relative to the Earth and the Sun changes (Moon phases). 4. explain how the gravitational pull of the Moon causes the oceans to shift towards Moon (low tide) and how a shift in the opposite direction creates a high tide. a. Since the Earth is rotating while this is happening, two tides occur each day.	1. to explain why certain groups of stars disappear from the visible night sky depending on the time of year and the viewer's location on Earth. 2. to explain how the tilt of the Earth's axis, rotation, and revolution cause consistent night sky patterns including constellations.

E1: The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface.

Instructional Sequence 1

Az Science Standard 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.

CI E1: The composition of the Earth and its atmosphere, and the processes occurring within them shape the Earth's surface.

- The layer of air at the Earth's surface is transparent to most of the radiation coming from the Sun, which passes through.
- The radiation that is absorbed at its surface is the Earth's external source of energy.
- The radiation from the Sun absorbed by the Earth warms the surface which then emits radiation of longer wavelength (infrared) that does not pass through the atmosphere but is absorbed by it, keeping the Earth warm. This is called the greenhouse effect because it is similar to the way the inside of a greenhouse is heated by the Sun.

Science and Engineering Practices

Planning and Carrying Out Investigation:

- Conduct an investigation and evaluate and revise the experimental design to ensure that the data generated can meet the goals of the experiment.
- Design an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how much data are needed to support their claim.
- Collect data and generate evidence to answer scientific questions or test design solutions under a range of conditions.

Constructing Explanations and Designing Solutions:

- Construct explanations for either qualitative or quantitative relationships between variables.
- Apply scientific knowledge and evidence to explain real-world phenomena, examples, or events.
- Construct explanations from models or representations.

Crosscutting Concepts

Energy and Matter:

- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
- Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion).
- The transfer of energy can be tracked as energy flows through a designed or natural system.

System and System Models:

- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.

Cause and Effect:

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Using Science – U1

- Careful and systematic observations and accurate descriptions of what is observed are fundamental to scientific investigation.
- What people expect to happen can influence what they observe, so it is good practice for observations to be made by several people independently and for results to be reported clearly enough to be checked by others.
- To help explain observations, scientists create models to represent what they think may be happening.

Big Ideas Sequence 1

Radiation from the Sun provides energy (waves) to warm the Earth. When this energy enters the atmosphere, it hits the ground and the wavelengths slow down, which prevents the energy from leaving the atmosphere. This trapped energy warms the planet and creates the greenhouse effect by regulating the Earth's average surface temperature and keeping the Earth habitable.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning.

Plan an investigation:

1. that supports how heat energy applied to a closed system causes a greenhouse effect.
2. that explores the composition of the atmosphere.

Construct an explanation:

1. describing what happens when light energy from the Sun reaches Earth's atmosphere and some of it is reflected back to space while some of it is absorbed and reradiated by greenhouse gases that regulate temperatures on Earth.
2. describing the wavelength of the Sun's energy.

Sixth Grade Unit 4: Ecosystems

L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

Instructional Sequence 1	Instructional Sequence 2
Az Science Standard 6.L2U1.13 Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors. **Az Science Standard 6.L2U3.12** Engage in argument from evidence to support a claim about the factors that cause species to change and how people can impact those factors. **Az Science Standard 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.	**Az Science Standard 6.L2U1.14** Construct a model that shows the cycling of matter and flow of energy in ecosystems.
CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. • Interdependent organisms living together in particular environmental conditions form an ecosystem. In a stable ecosystem there are producers of food (plants), consumers (animals) and decomposers, (bacteria and fungi which feed on waste products and dead organisms). The decomposers produce materials that help plants grow, so the molecules in the organisms are constantly re-used. • In any given ecosystem, there is competition among species for the energy resources and the materials they need to live. • Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors. • Growth of organisms and population increases are limited by access to resources. Organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. • Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms.	**CI L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.** • Energy resources pass through the ecosystem. When food is used by organisms for life processes some energy is dissipated as heat but is replaced in the ecosystem by radiation from the Sun being used to produce plant food. • The persistence of an ecosystem depends on the continued availability in the environment of these energy resources and materials. • A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life.

• Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. • A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. • Newly introduced species can damage the balance of an ecosystem. • Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of many other species. • Changes to Earth's environment can have different impacts (negative and positive) for different living things.	
Science and Engineering Practices Developing and Using Models: • Use and/or develop models to predict, describe, support explanations, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. • Modify models—based on their limitations—to increase detail or clarity, or to explore what will happen if a component is changed. Engage in Argument from Evidence: • Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation for a phenomenon or a solution to a problem. • Respectfully provide and receive critiques on scientific arguments by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Compare two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system, based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.	**Science and Engineering Practices** Developing and Using Models: • Use and/or develop models to predict, describe, support explanations, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. • Develop models to describe unobservable mechanisms. • Modify models—based on their limitations—to increase detail or clarity, or to explore what will happen if a component is changed. • Develop a model that allows for manipulation and testing of a proposed object, tool, process or system.
Crosscutting Concepts Patterns: • Patterns can be used to identify cause and effect relationships • Graphs, charts, and images can be used to identify patterns in data.	**Crosscutting Concepts** Energy and Matter: • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

Cause and Effect ● Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. ● Cause and effect relationships may be used to predict phenomena in natural or designed systems.	● The transfer of energy can be tracked as energy flows through a designed or natural system. Systems and System Models ● Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. ● Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. ● Models are limited in that they only represent certain aspects of the system under study.
Using Science – U1 ● Different kinds of natural phenomena are explained in different ways. In some cases a possible explanation (hypothesis) indicates the variable factor thought to cause a phenomenon. To test a hypothesis it is used to predict what will happen when the variable identified as a possible cause is changed and then see if what happens fits the prediction. If the outcome agrees with the prediction, and no other changes are found to produce the same result, then the factor is accepted as being the cause that explains the observation. ● Scientists develop and use physical models, such as an orrery – a model of the solar system where various objects are used to represent the Sun, Moon, Earth and other planets – or a ball and stick model of how atoms are thought to be arranged in a substance. **Using Science – U3** ● There are generally both positive and negative consequences of the applications of science. Some negative impacts can be anticipated but others emerge from experience.	**Using Science – U1** ● Careful and systematic observations and accurate descriptions of what is observed are fundamental to scientific investigation.
Big Ideas Sequence 1	**Big Ideas Sequence 2**
Food webs show the patterns of interactions in ecosystems. Organisms in an ecosystem interact with each other in different ways, including predation, competition, and symbiosis. People impact ecosystems in both direct and indirect ways.	Ecosystem models can be used to describe the transfer of energy and cycling of matter.

Evidence of Learning Specifications: how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models that predict: 1. consistent patterns of interactions between living and non-living parts of ecosystems. 2. consistent patterns of types of interactions including competitive, predatory, and mutually beneficial interactions. Engage in argument from evidence that: 1. supports a claim with empirical evidence and scientific reasoning about the factors (including human interactions) that cause populations to change over time. 2. supports or refute how increases in human population cause negative and/or positive impacts on the Earth.	**Evidence of Learning Specifications:** how students show proficiency in standards through engaging with phenomena and 3D learning. Develop and use models that explain: 1. how matter is conserved as it flows through the ecosystem and that energy starts with the Sun (food web). 2. how as energy moves up a food web (i.e., producer to primary consumer to secondary consumer to tertiary consumer), some is transferred to the level above, but most energy is lost as heat to the environment.

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