



# ARKANSAS

## K-12 SCIENCE STANDARDS

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EDUCATION FOR A NEW GENERATION

# Kindergarten

# 2015

Realigned Fall 2024 to the Arkansas Mathematics Standards  
and Arkansas English Language Arts Standards

# How to Read Arkansas K-12 Science Standards

Topic →      **GRADE TWO**

An asterisk indicates an engineering connection to a practice or disciplinary core idea.

**Interdependent Relationships in Ecosystems**

Students who demonstrate understanding can:

2-LS2-1 **Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [Assessment Boundary: Assessment is limited to testing one variable.] \*

2-LS2-2 **Develop a simple model that mimics the function of plants that use photosynthesis to produce food.** [Assessment Boundary: Assessment includes models of seeds or pollinating plants.]

2-LS4-1 **Make observations of plants and animals to compare growth and behavior of different habitats.** [Clarification Statement: Emphasis is on the diversity of living things in a variety of habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan and conduct an investigation collaboratively to produce data as the basis for evidence to answer a question. (2-LS2-1)</li> <li>Make observations (firsthand or from media) to collect data that can be used to make comparisons. (2-LS4-1)</li> </ul> <hr/> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Scientists look for patterns and order when making observations about the world. (2-LS4-1)</li> </ul>	<p><b>LS2.A: Interdependent Relationships in Ecosystems</b></p> <ul style="list-style-type: none"> <li>Plants depend on water and light to grow. (2-LS2-1)</li> <li>Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)</li> </ul> <p><b>LS4.D: Biodiversity and Humans</b></p> <ul style="list-style-type: none"> <li>There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (2-LS2-2)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Events have causes that generate observable patterns. (2-LS2-1)</li> </ul> <p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)</li> </ul>

Connections to other DCIs in second grade: N/A  
Connections to other DCIs across grade levels: **K.LS1.C** (2-LS2-1); **K-ESS3.A** (2-LS2-1); **K-2.ETS1.A** (2-LS2-2); **3.LS4.C** (2-LS4-1); **3.LS4.D** (2-LS4-1); **5.LS1.C** (2-LS2-1); **5.LS2.A** (2-LS2-2, 2-LS4-1)

Connections to the Arkansas English Language Arts and Mathematics Standards are often found by scrolling to the next page

## Arkansas K-12 Science Standards Overview

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

As part of teaching the Arkansas K-12 Science Standards, it will be important to instruct and guide students in adopting appropriate safety precautions for their student-directed science investigations. Reducing risk and preventing accidents in science classrooms begin with planning. The following four steps are recommended in carrying out a hazard and risk assessment for any planned lab investigation:

- 1) Identify all hazards. Hazards may be physical, chemical, health, or environmental.
- 2) Evaluate the type of risk associated with each hazard.
- 3) Write the procedure and all necessary safety precautions in such a way as to eliminate or reduce the risk associated with each hazard.
- 4) Prepare for any emergency that might arise in spite of all of the required safety precautions.

According to Arkansas Code Annotated § 6-10-113 (2012) for eye protection, every student and teacher in public schools participating in any chemical or combined chemical-physical laboratories involving caustic or explosive chemicals or hot liquids or solids is required to wear industrial-quality eye protective devices (eye goggles) at all times while participating in science investigations.

The Arkansas K-12 Science Standards outline the knowledge and science and engineering practices that all students should learn by the end of high school. The standards are three-dimensional because each student performance expectation engages students at the nexus of the following three dimensions:

- Dimension 1 describes scientific and engineering practices.
- Dimension 2 describes crosscutting concepts, overarching science concepts that apply across science disciplines.
- Dimension 3 describes core ideas in the science disciplines.

### Science and Engineering Practices

The eight practices describe what scientists use to investigate and build models and theories of the world around them or that engineers use as they build and design systems. The practices are essential for all students to learn and are as follows:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

### Crosscutting Concepts

The seven crosscutting concepts bridge disciplinary boundaries and unit core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas, and develop a coherent, and scientifically based view of the world. The seven crosscutting concepts are as follows:

1. *Patterns*- Observed patterns of forms and events guide organization and classification, and prompt questions about relationships and the factors that influence them.
2. *Cause and effect- Mechanism and explanation*. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms

by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

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

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

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

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

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

## Disciplinary Core Ideas

The disciplinary core ideas describe the content that occurs at each grade or course. The Arkansas K-12 Science Standards focus on a limited number of core ideas in science and engineering both within and across the disciplines and are built on the notion of learning as a developmental progression. The Disciplinary Core Ideas are grouped into the following domains:

- Physical Science (PS)
- Life Science (LS)
- Earth and Space Science (ESS)
- Engineering, Technology and Applications of Science (ETS)

## Connections to the Arkansas English Language Arts Standards

Evidence-based reasoning is the foundation of good scientific practice. The Arkansas K-12 Science Standards incorporate reasoning skills used in language arts to help students improve mastery and understanding in all three disciplines. The Arkansas K-8 Science Committee made every effort to align grade-by-grade with the English language arts (ELA) standards so concepts support what students are learning in their entire curriculum. Connections to specific ELA standards are listed for each student performance expectation, giving teachers a blueprint for building comprehensive cross-disciplinary lessons.

The intersections between Arkansas K-12 Science Standards and Arkansas ELA Standards teach students to analyze data, model concepts, and strategically use tools through productive talk and shared activity. Reading in science requires an appreciation of the norms and conventions of the discipline of science, including understanding the nature of evidence used, an attention to precision and detail, and the capacity to make and assess intricate arguments, synthesize complex information, and follow detailed procedures and accounts of events and concepts. These practice-based standards help teachers foster a classroom culture where students think and reason together, connecting around the subject matter and core ideas.

## Connections to the Arkansas Mathematics Standards

Science is a quantitative discipline, so it is important for educators to ensure that students' science learning coheres well with their understanding of mathematics. To achieve this alignment, the Arkansas K-12 Science Committee made every effort to ensure that the mathematics standards do not outpace or misalign to the grade-by-grade science standards. Connections to specific math standards are listed for each student performance expectation, giving teachers a blueprint for building comprehensive cross-disciplinary lessons.

Table below lists key topics relevant to science and the grades at which topics are first expected in the Arkansas Mathematics Standards.

<b>Number and Operations</b>	<b>Grade First Expected</b>
Multiplication and division of whole numbers	3
Concept of a fraction alb	3
Beginning fraction arithmetic	4
<b>Measurement</b>	<b>Grade First Expected</b>
Standard length units (inch, centimeter, etc.)	2
Area	3
Convert from a larger unit to a smaller in the same system	4

**Grades K-4 Science Core Ideas and Topics**

<b>Kindergarten</b>	PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES
	K. Forces and Interactions: Pushes and Pulls	K. Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment		K. Weather and Climate
<b>Grade 1</b>	PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES
	1. Waves: Light and Sound	1. Structure, Function, and Information Processing		1. Space Systems: Patterns and Cycles
<b>Grade 2</b>	PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES
	2. Structure and Properties of Matter	2. Interdependent Relationships in Ecosystems		2. Earth's Systems: Processes that Shape the Earth
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE K-2. Engineering Design				

<b>Grade 3</b>	PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES
	3. Forces and Interactions	3. Interdependent Relationships in Ecosystems	3. Inheritance and Variation of Traits	3. Weather and Climate
<b>Grade 4</b>	PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES
	4. Waves	4. Structure, Function, and Information Processing		4. Energy 4. Earth's Systems: Processes that Shape the Earth
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE 3-4. Engineering Design				

## Science K-4

The Arkansas K-12 Science Standards for Grades K-4 is a curriculum framework of grade level student performance expectations based on the core ideas of the physical sciences (PS), life sciences (LS), earth and space sciences (ESS), and engineering (ETS) from *A Framework for K-12 Science Education* (NRC 2012). The performance expectations build logically from Grades K-4 to Grades 5-8. The performance expectations clarify what students need to know and be able to do at the end of each grade. Student performance expectations consist of three dimensions: science and engineering practices, disciplinary core ideas, and crosscutting concepts. Engineering performance expectations are meant to be integrated into science instruction to support the learning of science phenomena at all levels from Kindergarten to Grade 12.

As part of teaching the Arkansas K-12 Science Standards, it will be important to instruct and guide students in adopting appropriate safety precautions for their student-directed science investigations. Reducing risk and preventing accidents in science classrooms begin with planning. There are four recommended steps in carrying out a hazard and risk assessment for any planned lab investigation.

- 1) Identify all hazards. Hazards may be physical, chemical, health, or environmental.
- 2) Evaluate the type of risk associated with each hazard.
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### Notes:

1. Student Performance Expectations (PEs) may be taught in any sequence or grouping within a grade level.
2. An asterisk (\*) indicates an engineering connection to a practice, core idea, or crosscutting concept.
3. The Clarification Statements are examples and additional guidance for the instructor. **AR** indicates Arkansas-specific Clarification Statements.
4. The Assessment Boundaries delineate content that may be taught but not assessed in large-scale assessments. **AR** indicates Arkansas-specific Assessment Boundaries.
5. The examples given (e.g.,) are suggestions for the instructor.
6. Throughout this document, connections are provided to the nature of science as defined by *A Framework for K-12 Science Education* (NRC 2012).
7. Throughout this document, connections are provided to Engineering, Technology, and Applications of Science as defined by *A Framework for K-12 Science Education* (NRC 2012).
8. Each set of PEs lists connections to other disciplinary core ideas (DCIs) within the Arkansas K-12 Science Standards and to the Arkansas Mathematics Standards and the Arkansas English Language Arts Standards.

**Kindergarten Learning Progression by Topic**

Kindergarten				
PHYSICAL SCIENCES		EARTH and SPACE SCIENCES		LIFE SCIENCES
Forces and Interactions: Pushes and Pulls		Weather and Climate		Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment
K-PS2-1	K-PS3-1	K-ESS2-1	K-ESS2-2	K-LS1-1
K-PS2-2	K-PS3-2	K-ESS3-2	K-ESS3-1	
			K-ESS3-3	
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design K-ETS1-1, K-ETS1-2, K-ETS1-3				

**Kindergarten Learning Progression by Disciplinary Core Idea**

Kindergarten				
PHYSICAL SCIENCES		EARTH and SPACE SCIENCES		LIFE SCIENCES
Matter and Stability: Forces and Interactions	Energy	Earth's Systems	Earth and Human Activity	From Molecules to Organisms: Structures and Processes
K-PS2-1	K-PS3-1	K-ESS2-1	K-ESS3-1	K-LS1-1
K-PS2-2	K-PS3-2	K-ESS2-2	K-ESS3-2	
			K-ESS3-3	
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design K-ETS1-1, K-ETS1-2, K-ETS1-3				

## **Kindergarten Standards Overview**

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- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

### **Science and Engineering Practices**

Students are expected to demonstrate grade-appropriate proficiency in

- asking questions,
- developing and using models,
- planning and carrying out investigations,
- analyzing and interpreting data,
- designing solutions,
- engaging in argument from evidence, and
- obtaining, evaluating, and communicating information.

Students are expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

### **Crosscutting Concepts**

Students are expected to demonstrate grade-appropriate understanding of

- patterns,
- cause and effect,
- systems and system models,
- interdependence of science, engineering, and technology, and
- influence of engineering, technology, and science on society and the natural world as organizing concepts for the disciplinary core ideas.

### **Disciplinary Core Ideas**

Students are expected to continually build on and revise their knowledge of

- PS2 - Motion and Stability: Forces and Interactions,
- PS3 - Energy,
- LS1 - Molecules to Organisms: Structures and Processes,
- ESS2 - Earth's Systems,
- ESS3 - Earth and Human Activity, and
- ETS1 - Engineering Design in a K-2 developmental learning progression.

The (PS) performance expectations in Kindergarten help students formulate answers to the question, "What happens if you push or pull an object with varying amounts of force?" Students apply an understanding of the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze a design solution.

### **Life Sciences (LS)**

The (LS) performance expectations in Kindergarten help students explore the question, "Where do animals live and why do they live there?" Students are also expected to develop understanding of what plants and animals (including humans) need to survive and the relationship between their needs and where they live.

### **Earth and Space Sciences (ESS)**

The (ESS) performance expectations in Kindergarten help students investigate the question, "What is the weather like today and how it is different from yesterday?" Students are expected to develop understanding of patterns and variations in local weather and the purpose of weather forecasting to prepare for, and respond to, severe weather.

### **Engineering, Technology, and Applications of Science (ETS)**

Engineering design performance expectations in the primary grades help students recognize that creative energy can be a means to solve problems and achieve goals through a systematic process. Children are born with a creative urge to design and build things and it is the task of the teacher to channel this natural tendency. Connections with the other science disciplines help students develop these capabilities in various contexts. The engineering design process involves three stages:

- **Defining engineering problems** begins in Kindergarten as students learn that a situation people want to change can be thought of as a problem that can be solved. By the time they leave second grade students should be able to ask questions and make observations to gather information about the problem so they can envision an object or a tool that would solve it.
- **Designing possible solutions to engineering problems** progresses from the problem definition stage. One of the most challenging aspects of this stage is to keep students from immediately implementing the first solution they think of and to think it through before acting. Students should sketch their ideas or make a physical model to help shape their ideas to meet the requirements of the problem.
- **Comparing different solutions** involves testing each one to see how well it solves a problem or achieves a goal. Consumer product testing is a good model of this capability. Although students in this grade range should not be held accountable for designing controlled experiments, they should be able to think of ways to compare two products to determine which is better for a given purpose.

Students in Kindergarten are beginning to develop the ability to achieve all three performance expectations (K-ETS1-1, K-ETS1-2, K-ETS1-3) related to a single problem in order to understand the interrelated processes of engineering design. Students can use tools and materials to solve simple problems, use visual or physical representations to convey solutions, and compare different solutions to a problem, test them, and determine which is best. These component ideas do not always follow in order. At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that is not working.

## KINDERGARTEN

<b>Forces and Interactions: Pushes and Pulls</b>		
<p>Students who demonstrate understanding can:</p> <p><b>K-PS2-1</b> <b>Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.</b> [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]</p> <p><b>K-PS2-2</b> <b>Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*</b> [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]</p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<p style="text-align: center; background-color: #000080; color: white; padding: 2px;"><b>Science and Engineering Practices</b></p> <p><b>Planning and Carrying Out Investigations</b>                      Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>■ With guidance, plan and conduct an investigation in collaboration with peers. (K-PS2-1)</li> </ul> <p><b>Analyzing and Interpreting Data</b>                      Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> <li>■ Analyze data from tests of an object or tool to determine if it works as intended. (K-PS2-2)</li> </ul> <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Scientific Investigations Use a Variety of Methods</b></p> <ul style="list-style-type: none"> <li>■ Scientists use different ways to study the world. (K-PS2-1)</li> </ul>	<p style="text-align: center; background-color: #ff8c00; color: white; padding: 2px;"><b>Disciplinary Core Ideas</b></p> <p><b>PS2.A: Forces and Motion</b></p> <ul style="list-style-type: none"> <li>■ Pushes and pulls can have different strengths and directions. (K-PS2-1, K-PS2-2)</li> <li>■ Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1, K-PS2-2)</li> </ul> <p><b>PS2.B: Types of Interactions</b></p> <ul style="list-style-type: none"> <li>■ When objects touch or collide, they push on one another and can change motion. (K-PS2-1)</li> </ul> <p><b>PS3.C: Relationship Between Energy and Forces</b></p> <ul style="list-style-type: none"> <li>■ A bigger push or pull makes things speed up or slow down more quickly. (K-PS2-1)</li> </ul> <p><b>ETS1.A: Defining Engineering Problems</b></p> <ul style="list-style-type: none"> <li>■ A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (K-PS2-2)</li> </ul>	<p style="text-align: center; background-color: #008000; color: white; padding: 2px;"><b>Crosscutting Concepts</b></p> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>■ Simple tests can be designed to gather evidence to support or refute student ideas about causes. (K-PS2-1, K-PS2-2)</li> </ul>
<p><i>Connections to other DCIs in Kindergarten:</i> <b>K-2.ETS1.A</b> (K-PS2-2); <b>K-2.ETS1.B</b> (K-PS2-2)</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>K-2.ETS1.B</b> (K-PS2-2); <b>3.PS2.A</b> (K-PS2-1, K-PS2-2); <b>3.PS2.B</b> (K-PS2-1); <b>4.PS3.A</b> (K-PS2-1); <b>3-5.ETS1.A</b> (K-PS2-2)</p>		

*Connections to the Arkansas English Language Arts Standards –*

**K.RC.1.RF** Ask questions about key details in a text. (K-PS2-2)

**K.RC.2.RF** Answer questions about key details in a text. (K-PS2-2)

**K.W.7.P** Participate in teacher-led research projects and produce simple findings. (K-PS2-1)

**K.CC.2.0L** Ask and answer questions orally about what a speaker says to gather additional information and clarify understanding. (K-PS2-2)

*Connections to the Arkansas Mathematics Standards –*

**AR.M.2** Applying reasoning about quantities and relationships. (K-PS2-1)

**K.GM.6** Make direct comparisons of the length, capacity, weight, and temperature of objects, recognizing which object is shorter/longer, lighter/heavier, warmer/cooler, or holds more. (K-PS2-1)

## KINDERGARTEN

### Weather and Climate

Students who demonstrate understanding can:

- K-PS3-1** **Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]
- K-PS3-2** **Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.\*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]
- K-ESS2-1** **Use and share observations of local weather conditions to describe patterns over time.** [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, or warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon or the number of sunny days versus cloudy days in different months.] [Assessment Boundary: Assessment of quantitative observations is limited to whole numbers and relative measures such as warmer/cooler.]
- K-ESS3-2** **Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.\*** [Clarification Statement: Emphasis is on local forms of severe weather.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

#### Science and Engineering Practices

##### Asking Questions and Defining Problems

Asking questions and defining problems in grades K-2 builds on prior experiences and progresses to simple descriptive questions that can be tested.

- Ask questions based on observations to find more information about the designed world. (K-ESS3-2)

##### Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations (firsthand or from media) to collect data that can be used to make comparisons. (K-PS3-1)

##### Analyzing and Interpreting Data

Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-ESS2-1)

##### Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

#### Disciplinary Core Ideas

##### PS3.B: Conservation of Energy and Energy Transfer

- Sunlight warms Earth's surface. (K-PS3-1, K-PS3-2)

##### ESS2.D: Weather and 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. (K-ESS2-1)

##### ESS3.B: Natural Hazards

- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2)

##### ETS1.A: Defining and Delimiting an Engineering Problem

- Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-ESS3-2)

#### Crosscutting Concepts

##### Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (K-ESS2-1)

##### Cause and Effect

- Events have causes that generate observable patterns. (K-PS3-1, K-PS3-2, K-ESS3-2)

##### Connections to Engineering, Technology, and Applications of Science

##### Interdependence of Science, Engineering, and Technology

- People encounter questions about the natural world every day. (K-ESS3-2)

##### Influence of Engineering, Technology, and Science on Society and the Natural World

- People depend on various technologies in their lives; human life would be very different without technology. (K-ESS3-2)

- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. (K-PS3-2)

### Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information.

- Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. (K-ESS3-2)

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### Connections to Nature of Science

#### Scientific Investigations Use a Variety of Methods

- Scientists use different ways to study the world. (K-PS3-1)

#### Science Knowledge is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world. (K-ESS2-1)

*Connections to other DCIs in Kindergarten:* **K-2.ET51.A** (K-PS3-2, K-ESS3-2); **K-2.ET51.B** (K-PS3-2)

*Connections to other DCIs across grade levels:* **1.P54.B** (K-PS3-1, K-PS3-2); **2.E551.C** (K-ESS3-2); **2.E552.A** (K-ESS2-1); **K-2.ET51.B** (K-PS3-2); **3.E552.D** (K-PS3-1, K-ESS2-1); **3.E553.B** (K-ESS3-2); **4.E552.A** (K-ESS2-1); **4.E553.B** (K-ESS3-2); **4.E552.E** (K-ESS2-2); **3-5.ET51.A** (K-PS3-2)

*Connections to the Arkansas English Language Arts Standards –*

**K.RC.1.RF** Ask questions about key details in a text. (K-ESS3-2)

**K.RC.2.RF** Answer questions about key details in a text. (K-ESS3-2)

**K.W.7.P** Participate in teacher-led research projects and produce simple findings. (K-PS3-1, K-PS3-2, K-ESS2-1)

**K.CC.2.OL** Ask and answer questions orally about what a speaker says to gather additional information and clarify understanding. (K-ESS3-2)

*Connections to the Arkansas Mathematics Standards –*

**AR.M.2** Applying reasoning about quantities and relationships. (K-ESS2-1)

**AR.M.4** Select and use relationships and tools. (K-ESS2-1, K-ESS3-2)

**K.GM.6** Make direct comparisons of the length, capacity, weight, and temperature of objects, recognizing which object is shorter/longer, lighter/heavier, warmer/cooler, or holds more. (K-ESS3-1, K-ESS3-2)

**K.NPV.1** Count to 100 by ones and tens; count forward by ones from any given number up to 100. (K-ESS2-1)

**K.NPV.2** Count a set of objects up to 20 using one-to-one correspondence, demonstrating that the last number stated indicates the number of objects in the set regardless of the arrangement. (K-ESS3-2)

## KINDERGARTEN

### Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment

Students who demonstrate understanding can:

- K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive.**  
[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and that all living things need water.]
- K-ESS2-2 Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.** [Clarification Statement: Examples of plants and animals changing their environment could include squirrels digging in the ground to hide food and tree roots breaking concrete.]
- K-ESS3-1 Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.** [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]
- K-ESS3-3 Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.\*** [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in K-2 builds on prior experiences and progresses to include using and developing models (e.g., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>▪ Use a model to represent relationships in the natural world. (K-ESS3-1)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> <li>▪ Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-LS1-1)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in K-2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>▪ Construct an argument with evidence to support a claim. (K-ESS2-2)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> <li>▪ Communicate solutions with others in oral and/or written forms using models</li> </ul>	<p><b>LS1.C: Organization for Matter and Energy Flow in Organisms</b></p> <ul style="list-style-type: none"> <li>▪ All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)</li> </ul> <p><b>ESS2.E: Biogeology</b></p> <ul style="list-style-type: none"> <li>▪ Plants and animals can change their environment. (K-ESS2-2)</li> </ul> <p><b>ESS3.A: Natural Resources</b></p> <ul style="list-style-type: none"> <li>▪ Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1)</li> </ul> <p><b>ESS3.C: Human Impacts on Earth Systems</b></p> <ul style="list-style-type: none"> <li>▪ 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. (K-ESS2-2, K-ESS3-3)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>▪ Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-ESS3-3)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>▪ Patterns in the natural and human designed world can be observed and used as evidence. (K-LS1-1)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>▪ Events have causes that generate observable patterns. (K-ESS3-3)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>▪ Systems in the natural and designed world have parts that work together. (K-ESS2-2, K-ESS3-1)</li> </ul>

<p>and/or drawings that provide detail about scientific ideas. (K-ESS3-3)</p>		
<p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>▪ Scientists look for patterns and order when making observations about the world. (K-LS1-1)</li> </ul>		
<p><i>Connections to other DCIs in Kindergarten:</i> <b>K-2.ETS1.A</b> (K-ESS3-3)</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>1.LS1.A</b> (K-LS1-1, K-ESS3-1); <b>2.LS2.A</b> (K-LS1-1); <b>K-2.ETS1.B</b> (K-ESS3-3); <b>3.LS2.C</b> (K-LS1-1); <b>3.LS4.B</b> (K-LS1-1); <b>4.ESS2.E</b> (K-ESS2-2); <b>4.ESS3.A</b> (K-ESS3-3); <b>5.LS1.C</b> (K-LS1-1); <b>5.LS2.A</b> (K-LS1-1) (K-ESS3-1); <b>5.ESS2.A</b> (K-ESS2-2, K-ESS3-1); <b>5.ESS3.C</b> (K-ESS3-3)</p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p> <p><b>K.RC.1.RF</b> Ask questions about key details in a text. (K-ESS2-2)</p> <p><b>K.RC.2.RF</b> Answer questions about key details in a text. (K-ESS2-2)</p> <p><b>K.W.4.P</b> Produce writing, using precise language and grade-appropriate conventions. (K-ESS2-2)</p> <p><b>K.W.1.S</b> Write an opinion piece about a topic or text, including a reason. (K-ESS2-2)</p> <p><b>K.W.2.S</b> Write an informative piece with facts. (K-ESS2-2, K-ESS3-3)</p> <p><b>K.W.7.P</b> Participate in teacher-led research projects and produce simple findings. (K-LS1-1)</p> <p><b>K.CC.4.P</b> Use visual displays to provide additional detail. (K-ESS3-1)</p>		
<p><i>Connections to the Arkansas Mathematics Standards –</i></p> <p><b>AR.M.2</b> Applying reasoning about quantities and relationships. (K-ESS3-1)</p> <p><b>AR.M.4</b> Select and use relationships and tools. (K-ESS3-1)</p> <p><b>K.GM.6</b> Make direct comparisons of the length, capacity, weight, and temperature of objects, recognizing which object is shorter/longer, lighter/heavier, warmer/cooler, or holds more. (K-LS1-1)</p> <p><b>K.NPV.2</b> Count a set of objects up to 20 using one-to-one correspondence, demonstrating that the last number stated indicates the number of objects in the set regardless of the arrangement. (K-ESS3-1)</p>		

**KINDERGARTEN**

<b>Engineering, Technology, and Applications of Science</b>		
<p>Students who demonstrate understanding can:</p> <p><b>K-ETS1-1</b> Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.</p> <p><b>K-ETS1-2</b> Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.</p> <p><b>K-ETS1-3</b> Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.</p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in K-2 builds on prior experiences and progresses to simple descriptive questions.</p> <ul style="list-style-type: none"> <li>Ask questions based on observations to find more information about the natural and/or designed world. (K-ETS1-1)</li> <li>Define a simple problem that can be solved through the development of a new or improved object or tool. (K-ETS1-1)</li> </ul> <p><b>Developing and Using Models</b> Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a simple model based on evidence to represent a proposed object or tool. (K-ETS1-2)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> <li>Analyze data from tests of an object or tool to determine if it works as intended. (K-ETS1-3)</li> </ul>	<p><b>ETS1.A: Defining and Delimiting Engineering Problems</b></p> <ul style="list-style-type: none"> <li>A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-ETS1-1)</li> <li>Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-ETS1-1)</li> <li>Before beginning to design a solution, it is important to clearly understand the problem. (K-ETS1-1)</li> </ul> <p><b>ETS1.8: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-ETS1-2)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-ETS1-3)</li> </ul>	<p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (K-ETS1-2)</li> </ul>
<p><i>Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include: Kindergarten: (K-PS2-2, K-ESS3-2)</i>  <i>Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include: Kindergarten: (K-ESS3-3);</i>  <b>First Grade: (1-PS4-4); Second Grade: (2-LS2-2)</b>  <i>Connections to K-2-ETS1.C: Optimizing the Design Solution include: Second Grade: (2-ESS2-1)</i></p>		
<p><i>Connections to other DCIs across grade levels: 3-5.ETS1.A (K-ETS1-1, K-ETS1-2, K-ETS1-3); 3-5.ETS1.8 (K-ETS1-2, K-ETS1-3); 3-5.ETS1.C (K-ETS1-1, K-ETS1-2, K-ETS1-3)</i></p>		



# ARKANSAS

## K-12 SCIENCE STANDARDS

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EDUCATION FOR A NEW GENERATION

# Grade 1

# 2015

Realigned Fall 2024 to the Arkansas Mathematics Standards  
and Arkansas English Language Arts Standards

# How to Read Arkansas K-12 Science Standards

Topic → **GRADE TWO**

An asterisk indicates an engineering connection to a practice or disciplinary core idea.

<b>Interdependent Relationships in Ecosystems</b> Students who demonstrate understanding can:		
2-LS2-1 <b>Plan and conduct an investigation to determine if plants need sunlight and water to grow.</b> [Assessment Boundary: Assessment is limited to testing one variable.]	<b>Student Performance Expectations (PEs)</b>	*
2-LS2-2 <b>Develop a simple model that mimics the function of plants or animals that depend on seeds or pollinating plants.</b>	[Clarification: Assessment Statement: Emphasis is on the diversity of living things in a variety of habitats.]	[Clarification: Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<b>Science and Engineering Practices</b>  <b>Developing and Using Models</b> Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. <ul style="list-style-type: none"> <li>▪ Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)</li> </ul> <b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. <ul style="list-style-type: none"> <li>▪ Plan and conduct an investigation collaboratively to produce data as the basis for evidence to answer a question. (2-LS2-1)</li> <li>▪ Make observations (firsthand or from media) to collect data that can be used to make comparisons. (2-LS4-1)</li> </ul> <hr style="border-top: 1px dashed black;"/> <b>Connections to Nature of Science</b>  <b>Scientific Knowledge is Based on Empirical Evidence</b> <ul style="list-style-type: none"> <li>▪ Scientists look for patterns and order when making observations about the world. (2-LS4-1)</li> </ul>	<b>Disciplinary Core Ideas</b>  <b>LS2.A: Interdependent Relationships in Ecosystems</b> <ul style="list-style-type: none"> <li>▪ Plants depend on water and light to grow. (2-LS2-1)</li> <li>▪ Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)</li> </ul> <b>LS4.D: Biodiversity and Humans</b> <ul style="list-style-type: none"> <li>▪ There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)</li> </ul> <b>ETS1.B: Developing Possible Solutions</b> <ul style="list-style-type: none"> <li>▪ Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (2-LS2-2)</li> </ul>	<b>Crosscutting Concepts</b>  <b>Cause and Effect</b> <ul style="list-style-type: none"> <li>▪ Events have causes that generate observable patterns. (2-LS2-1)</li> </ul> <b>Structure and Function</b> <ul style="list-style-type: none"> <li>▪ The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)</li> </ul>
Designates which PE uses this practice	Designates which PE incorporates this disciplinary core idea (DCI)	Designates which PE incorporates this crosscutting concept (CC)
Connections to the Nature of Science	DCI codes from <i>A Framework for K-12 Science Education</i> in boldface type.	
Connections to other DCIs in second grade: N/A Connections to other DCIs across grade levels: <b>K.LS1.C</b> (2-LS2-1); <b>K.ESS3.A</b> (2-LS2-1); <b>K-2.ETS1.A</b> (2-LS2-2); <b>3.LS4.C</b> (2-LS4-1); <b>3.LS4.D</b> (2-LS4-1); <b>5.LS1.C</b> (2-LS2-1); <b>5.LS2.A</b> (2-LS2-2, 2-LS4-1)		

Connections to the Arkansas English Language Arts and Mathematics Standards are often found by scrolling to the next page

## Arkansas K-12 Science Standards Overview

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

As part of teaching the Arkansas K-12 Science Standards, it will be important to instruct and guide students in adopting appropriate safety precautions for their student-directed science investigations. Reducing risk and preventing accidents in science classrooms begin with planning. The following four steps are recommended in carrying out a hazard and risk assessment for any planned lab investigation:

- 1) Identify all hazards. Hazards may be physical, chemical, health, or environmental.
- 2) Evaluate the type of risk associated with each hazard.
- 3) Write the procedure and all necessary safety precautions in such a way as to eliminate or reduce the risk associated with each hazard.
- 4) Prepare for any emergency that might arise in spite of all of the required safety precautions.

According to Arkansas Code Annotated § 6-10-113 (2012) for eye protection, every student and teacher in public schools participating in any chemical or combined chemical-physical laboratories involving caustic or explosive chemicals or hot liquids or solids is required to wear industrial-quality eye protective devices (eye goggles) at all times while participating in science investigations.

The Arkansas K-12 Science Standards outline the knowledge and science and engineering practices that all students should learn by the end of high school. The standards are three-dimensional because each student performance expectation engages students at the nexus of the following three dimensions:

- Dimension 1 describes scientific and engineering practices.
- Dimension 2 describes crosscutting concepts, overarching science concepts that apply across science disciplines.
- Dimension 3 describes core ideas in the science disciplines.

### Science and Engineering Practices

The eight practices describe what scientists use to investigate and build models and theories of the world around them or that engineers use as they build and design systems. The practices are essential for all students to learn and are as follows:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

### Crosscutting Concepts

The seven crosscutting concepts bridge disciplinary boundaries and unit core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas, and develop a coherent, and scientifically based view of the world. The seven crosscutting concepts are as follows:

1. *Patterns*- Observed patterns of forms and events guide organization and classification, and prompt questions about relationships and the factors that influence them.
2. *Cause and effect- Mechanism and explanation*. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms

by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

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

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

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

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

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

## Disciplinary Core Ideas

The disciplinary core ideas describe the content that occurs at each grade or course. The Arkansas K-12 Science Standards focus on a limited number of core ideas in science and engineering both within and across the disciplines and are built on the notion of learning as a developmental progression. The Disciplinary Core Ideas are grouped into the following domains:

- Physical Science (PS)
- Life Science (LS)
- Earth and Space Science (ESS)
- Engineering, Technology and Applications of Science (ETS)

## Connections to the Arkansas English Language Arts Standards

Evidence-based reasoning is the foundation of good scientific practice. The Arkansas K-12 Science Standards incorporate reasoning skills used in language arts to help students improve mastery and understanding in all three disciplines. The Arkansas K-8 Science Committee made every effort to align grade-by-grade with the English language arts (ELA) standards so concepts support what students are learning in their entire curriculum. Connections to specific ELA standards are listed for each student performance expectation, giving teachers a blueprint for building comprehensive cross-disciplinary lessons.

The intersections between Arkansas K-12 Science Standards and Arkansas ELA Standards teach students to analyze data, model concepts, and strategically use tools through productive talk and shared activity. Reading in science requires an appreciation of the norms and conventions of the discipline of science, including understanding the nature of evidence used, an attention to precision and detail, and the capacity to make and assess intricate arguments, synthesize complex information, and follow detailed procedures and accounts of events and concepts. These practice-based standards help teachers foster a classroom culture where students think and reason together, connecting around the subject matter and core ideas.

## Connections to the Arkansas Mathematics Standards

Science is a quantitative discipline, so it is important for educators to ensure that students' science learning coheres well with their understanding of mathematics. To achieve this alignment, the Arkansas K-12 Science Committee made every effort to ensure that the mathematics standards do not outpace or misalign to the grade-by-grade science standards. Connections to specific math standards are listed for each student performance expectation, giving teachers a blueprint for building comprehensive cross-disciplinary lessons.

Table below lists key topics relevant to science and the grades at which topics are first expected in the Arkansas Mathematics Standards.

**Grade 1 Learning Progression by Topic**

Grade 1		
PHYSICAL SCIENCES	LIFE SCIENCES	EARTH and SPACE SCIENCES
Waves: Light and Sound	Structure, Function, and Information Processing	Space Systems: Patterns and Cycles
1-PS4-1	1-LS1-1	1-ESS1-1
1-PS4-2	1-LS1-2	1-ESS1-2
1-PS4-3	1-LS3-1	
1-PS4-4		
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 1-ETS1-1, 1-ETS1-2, 1-ETS1-3		

**Grade 1 Learning Progression by Disciplinary Core Idea**

Grade 1			
PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES
Waves and Their Applications in Technologies for Information Transfer	From Molecules to Organisms: Structure and Processes	Heredity: Inheritance and Variation of Traits	Earth's Place in the Universe
1-PS4-1	1-LS1-1	1-LS3-1	1-ESS1-1
1-PS4-2	1-LS1-2		1-ESS1-2
1-PS4-3			
1-PS4-4			
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 1-ETS1-1, 1-ETS1-2, 1-ETS1-3			

## **First Grade Standards Overview**

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

### **Science and Engineering Practices**

Students are expected to demonstrate grade-appropriate proficiency in

- planning and carrying out investigations,
- analyzing and interpreting data,
- constructing explanations and designing solutions, and
- obtaining, evaluating, and communicating information.

Students are expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

### **Crosscutting Concepts**

Students are expected to demonstrate grade-appropriate understanding of

- patterns,
- cause and effect,
- structure and function, and
- influence of engineering, technology, and science on society and the natural world as organizing concepts for the disciplinary core ideas.

### **Disciplinary Core Ideas**

Students are expected to continually build on and revise their knowledge of

- PS4 - Waves and their Applications in Technologies for Information Transfer,
- LS1 - Molecules to Organisms: Structures and Processes,
- LS3 - Heredity: Inheritance and Variation of Traits
- ESS1 - Earth's Place in the Universe, and
- ETS1 - Engineering Design in a K-2 developmental learning progression.

### **Physical Sciences (PS)**

The (PS) performance expectations in first grade help students formulate answers to the questions, "What happens when materials vibrate?" and "What happens when there is no light?" Students develop understanding of the relationship between sound and vibrating materials as well as between the availability of light and ability to see objects. The idea that light travels from place to place can be understood by students at this level through determining the effect of placing objects made with different materials in the path of a beam of light.

### **Life Sciences (LS)**

The (LS) performance expectations in first grade help students explore the questions, "What are some ways plants and animals meet their needs so that they can survive and grow?" and "How are parents and their children similar and different?" Students develop understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs as well as how behaviors of parents and offspring help the offspring survive. The understanding is developed that young plants and animals are alike, but not exactly the same as, their parents.

### **Earth and Space Sciences (ESS)**

The (ESS) performance expectations in first grade help students investigate the question, "What objects are in the sky and how do they seem to move?" Students observe, describe, and predict some patterns of the movement of objects in the sky.

### **Engineering, Technology, and Applications of Science (ETS)**

Engineering design performance expectations in the primary grades help students recognize that creative energy can be a means to solve problems and achieve goals through a systematic process. Children are born with a creative urge to design and build things and it is the task of the teacher to channel this natural tendency. Connections with the other science disciplines help students develop these capabilities in various contexts. The engineering design process involves three stages:

- **Defining engineering problems** begins in Kindergarten as students learn that a situation people want to change can be thought of as a problem that can be solved. By the time they leave second grade students should be able to ask questions and make observations to gather information about the problem so they can envision an object or a tool that would solve it.
- **Designing possible solutions to engineering problems** progresses from the problem definition stage. One of the most challenging aspects of this stage is to keep students from immediately implementing the first solution they think of and to think it through before acting. Students should sketch their ideas or make a physical model to help shape their ideas to meet the requirements of the problem.
- **Comparing different solutions** involves testing each one to see how well it solves a problem or achieves a goal. Consumer product testing is a good model of this capability. Although students in this grade range should not be held accountable for designing controlled experiments, they should be able to think of ways to compare two products to determine which is better for a given purpose.

Students in the first grade are still developing the ability to achieve all three performance expectations (1-ETS1-1, 1-ETS1-2, 1-ETS1-3) related to a single problem in order to understand the interrelated processes of engineering design. Students can use tools and materials to solve simple problems, use visual or physical representations to convey solutions, and compare different solutions to a problem, test them, and determine which is best. These component ideas do not always follow in order. At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that is not working.

## GRADE ONE

### Waves: Light and Sound

Students who demonstrate understanding can:

- 1-PS4-1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** [Clarification Statement: Examples of vibrating materials that make sound could include striking a tuning fork and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]
- 1-PS4-2 Make observations to construct an evidence-based account that objects can be seen only when illuminated.** [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]
- 1-PS4-3 Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.** [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), or reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]
- 1-PS4-4 Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.\*** [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones", and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Planning and Carrying Out Investigations</b>                      Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>▪ Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (1-PS4-1, 1-PS4-3)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b>                      Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> <li>▪ Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena (1-PS4-2)</li> <li>▪ Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)</li> </ul>	<p><b>PS4.A: Wave Properties</b></p> <ul style="list-style-type: none"> <li>▪ Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)</li> </ul> <p><b>PS4.B: Electromagnetic Radiation</b></p> <ul style="list-style-type: none"> <li>▪ Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)</li> <li>▪ 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, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3)</li> </ul> <p><b>PS4.C: Information Technologies and Instrumentation</b></p> <ul style="list-style-type: none"> <li>▪ People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>▪ Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1, 1-PS4-2, 1-PS4-3)</li> </ul> <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Engineering, Technology, and Science, on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>▪ People depend on various technologies in their lives; human life would be very different without technology. (1-PS4-4)</li> </ul>

<p style="text-align: center;">-----</p> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Scientific Investigations Use a Variety of Methods</b></p> <ul style="list-style-type: none"> <li>▪ Science investigations begin with a question. (1-PS4-1)</li> <li>▪ Scientists use different ways to study the world. (1-PS4-1)</li> </ul>		
<p><i>Connections to other DCIs in first grade: NIA</i></p>		
<p><i>Connections to other DCIs across grade levels: <b>K-2.ETS1.A</b> (1-PS4-4); <b>2.PS1.A</b> (1-PS4-3); <b>K-2.ETS1.B</b> (1-PS4-4); <b>4.PS4.B</b> (1-PS4-4); <b>4.PS4.C</b> (1-PS4-4); <b>3-5.ETS1.A</b> (1-PS4-4)</i></p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p> <p><b>1.W.2.S</b> Write an informative or explanatory piece about a topic, using facts from a source. (1-PS4-2)</p> <p><b>1.W.9.P</b> Participate in teacher-led research projects and gather information from experiences and/or provided sources to produce a response. (1-PS4-1, 1-PS4-2, 1-PS4-3, 1-PS4-4)</p> <p><b>1.W.2.S</b> Write an informative or explanatory piece about a topic, using facts from a source. (1-PS4-1, 1-PS4-2, 1-PS4-3)</p> <p><b>1.CC.1.0L</b> Participate in collaborative conversations, following class created discussion guidelines. (1-PS4-1, 1-PS4-2, 1-PS4-3)</p>		
<p><i>Connections to the Arkansas Mathematics Standards –</i></p> <p><b>AR.M.5</b> Identify relationships using structure and patterns. (1-PS4-4)</p> <p><b>1.GM.3</b> Express the length of an object as a whole number of units by laying multiple copies of a shorter object end to-end, understanding that the length of one object is equal to the number of same-size units that span the object with no gaps or overlaps. (1-PS4-4)</p> <p><b>1.GM.4</b> Order three objects by their length, indirectly comparing the lengths of two objects by using a third object. (1-PS4-4)</p>		

**GRADE ONE**

<b>Structure, Function, and Information Processing</b>	
Students who demonstrate understanding can:	
<b>1-LS1-1</b>	<b>Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*</b> [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and detecting intruders by mimicking eyes or ears.]
<b>1-LS1-2</b>	<b>Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.</b> [Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) or the responses of the parents (such as feeding, comforting, and protecting the offspring).]
<b>1-LS3-1</b>	<b>Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.</b> [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [Assessment Boundary: Assessment does not include inheritance, animals that undergo metamorphosis or hybrids.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> <li>Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-LS3-1)</li> <li>Use materials to design a device that solves a specific problem or a solution to a specific problem. (1-LS1-1)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> <li>Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. (1-LS1-2)</li> </ul>	<p><b>LS1.A: Structure and Function</b></p> <ul style="list-style-type: none"> <li>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. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)</li> </ul> <p><b>LS1.B: Growth and Development of Organisms</b></p> <ul style="list-style-type: none"> <li>Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2)</li> </ul> <p><b>LS1.D: Information Processing</b></p> <ul style="list-style-type: none"> <li>Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1)</li> </ul> <p><b>LS3.A: Inheritance of Traits</b></p> <ul style="list-style-type: none"> <li>Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents. (1-LS3-1)</li> </ul> <p><b>LS3.B: Variation of Traits</b></p> <ul style="list-style-type: none"> <li>Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (1-LS3-1)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-LS1-2, 1-LS3-1)</li> </ul> <p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (1-LS1-1)</li> </ul> <hr/> <p align="center"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>Every human-made product is designed by applying some knowledge of the natural world and is built by built using materials derived from the natural world. (1-LS1-1)</li> </ul>

<p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>▪ Scientists look for patterns and order when making observations about the world. (1-LS1-2)</li> </ul>		
<p><i>Connections to other DCIs in first grade:</i> N/A</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>K-2.ETS1.A</b> (1-LS1-1); <b>3.LS2.D</b> (1-LS1-2) <b>3.LS3.A</b> (1-LS3-1); <b>3.LS3.B</b> (1-LS3-1); <b>4.LS1.A</b> (1-LS1-1); <b>4.LS1.D</b> (1-LS1-1); <b>3-5.ETS1.A</b> (1-LS1-1)</p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p> <p><b>1.RC.1.RF</b> Ask questions about key details in a text. (1-LS1-2, 1-LS3-1)</p> <p><b>1.RC.2.RF</b> Answer questions about key details in a text. (1-LS1-2, 1-LS3-1)</p> <p><b>1.RC.13.RI</b> Identify reasons an author provides to support the main points in a text. (1-LS1-2)</p> <p><b>1.RC.14.RI</b> Compare and contrast two texts on the same topic. (1-LS1-2)</p> <p><b>1.RC.15.RI</b> Identify text elements (e.g., title, captions, photographs, diagrams, descriptions) in an informational text. (1-LS1-2)</p> <p><b>1.RC.16.RI</b> Use text features (e.g., title, author, illustrator, table of contents, bold font, italics) to locate key facts and information. (1-LS1-2)</p> <p><b>1.RC.17.RI</b> Explain how visual images (e.g., charts, graphs, illustrations) support a text by clarifying or providing key details. (1-LS1-2)</p> <p><b>1.RC.18.RI</b> Identify the author's purpose of a text. (1-LS1-2)</p> <p><b>1.W.9.P</b> Participate in teacher-led research projects and gather information from experiences and/or provided sources to produce a response. (1-LS1-1, 1-LS3-1)</p> <p><b>1.W.2.S</b> Write an informative or explanatory piece about a topic, using facts from a source. (1-LS3-1)</p> <p><i>Connections to the Arkansas Mathematics Standards –</i></p> <p><b>AR.M.2</b> Applying reasoning about quantities and relationships. (1-LS3-1)</p> <p><b>AR.M.5</b> Identify relationships using structure and patterns. (1-LS3-1)</p> <p><b>1.CAR.4</b> Use concrete models or drawings to add within 100, including a two-digit number and a one-digit number as well as a two-digit number and a multiple of ten; relate strategy used to a written expression or equation, explaining reasoning. (1-LS1-2)</p> <p><b>1.GM.4</b> Order three objects by their length, indirectly comparing the lengths of two objects by using a third object. (1-LS3-1)</p> <p><b>1.NPV.5</b> Use concrete models or drawings to subtract multiples of 10 from multiples of 10 (within the range of 10-90), relate the strategy to a written expression or equation, and explain the reasoning used to solve. (1-LS1-2)</p> <p><b>1.NPV.6</b> Use mental strategies to find 10 more or 10 less than a given two-digit number. (1-LS1-2)</p> <p><b>1.NPV.7</b> Compare two two-digit numbers using symbols (&lt;, &gt;, =) based on the value of tens and ones in the given numbers. (1-LS1-2)</p>		

**GRADE ONE**

<b>Space Systems: Patterns and Cycles</b>		
Students who demonstrate understanding can:		
<b>1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted.</b> [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars, other than our sun, are visible at night but not during the day.] [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.]		
<b>1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.</b> [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. <ul style="list-style-type: none"> <li>Make observations (firsthand or from media) to collect data that can be used to make comparisons. (1-ESS1-2)</li> </ul> <b>Analyzing and Interpreting Data</b> Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. <ul style="list-style-type: none"> <li>Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (1-ESS1-1)</li> </ul>	<b>ESS1.A: The Universe and its Stars</b> <ul style="list-style-type: none"> <li>Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1)</li> </ul> <b>ESS1.B: Earth and the Solar System</b> <ul style="list-style-type: none"> <li>Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)</li> </ul>	<b>Patterns</b> <ul style="list-style-type: none"> <li>Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-ESS1-1, 1-ESS1-2)</li> </ul> <hr/> <p align="center"><b>Connections to Nature of Science</b></p> <b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> <ul style="list-style-type: none"> <li>Science assumes natural events happen today as they happened in the past. (1-ESS1-1)</li> <li>Many events are repeated. (1-ESS1-1)</li> </ul>
<i>Connections to other DCIs in first grade:</i> NIA		
<i>Connections to other DCIs across grade levels:</i> <b>3.PS2.A</b> (1-ESS1-1); <b>5.PS2.B</b> (1-ESS1-1, 1-ESS1-2) <b>5-ESS1.B</b> (1-ESS1-1, 1-ESS1-2)		
<i>Connections to the Arkansas English Language Arts Standards –</i>		
<b>1.W.9.P</b> Participate in teacher-led research projects and gather information from experiences and/or provided sources to produce a response. (1-ESS1-1, 1-ESS1-2)		
<b>1.W.2.S</b> Write an informative or explanatory piece about a topic, using facts from a source. (1-ESS1-1, 1-ESS1-2)		
<i>Connections to the Arkansas Mathematics Standards –</i>		
<b>AR.M.2</b> Applying reasoning about quantities and relationships. (1-ESS1-2)		
<b>AR.M.4</b> Select and use relationships and tools. (1-ESS1-2)		
<b>AR.M.5</b> Identify relationships using structure and patterns.. (1-ESS1-2)		
<b>1.CAR.6</b> Solve real-world problems involving addition and subtraction within 20; Problem types include: adding to, taking from, putting together, taking apart, and comparing with unknowns present throughout the addition and subtraction problem. (1-ESS1-2)		
<b>1.DA.1</b> Organize, represent, and interpret data with up to three categories (e.g., tally tables, picture graphs, bar graphs). (1-ESS1-2)		
<b>1.DA.2</b> Ask and answer questions about the total number represented such as how many in each category and how many more or less in one category compared to another. (1-ESS1-2)		

**GRADE ONE**

<b>Engineering, Technology, and Applications of Science</b>		
Students who demonstrate understanding can:		
<b>1-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.</b>		
<b>1-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.</b>		
<b>1-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.</b>		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in K-2 builds on prior experiences and progresses to simple descriptive questions.</p> <ul style="list-style-type: none"> <li>Ask questions based on observations to find more information about the natural and/or designed world. (1-ETS1-1)</li> <li>Define a simple problem that can be solved through the development of a new or improved object or tool. (1-ETS1-1)</li> </ul> <p><b>Developing and Using Models</b> Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a simple model based on evidence to represent a proposed object or tool. (1-ETS1-2)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> <li>Analyze data from tests of an object or tool to determine if it works as intended. (1-ETS1-3)</li> </ul>	<p><b>ETS1.A: Defining and Delimiting Engineering Problems</b></p> <ul style="list-style-type: none"> <li>A situation that people want to change or create can be approached as a problem to be solved through engineering. (1-ETS1-1)</li> <li>Asking questions, making observations, and gathering information are helpful in thinking about problems. (1-ETS1-1)</li> <li>Before beginning to design a solution, it is important to clearly understand the problem. (1-ETS1-1)</li> </ul> <p><b>ETS1.8: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (1-ETS1-2)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (1-ETS1-3)</li> </ul>	<p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (1-ETS1-2)</li> </ul>
<i>Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include: Kindergarten: (K-PS2-2, K-ESS3-2)</i> <i>Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include: Kindergarten: (K-ESS3-3);</i> <b>First Grade: (1-PS4-4); Second Grade: (2-LS2-2)</b> <i>Connections to K-2-ETS1.C: Optimizing the Design Solution include: Second Grade: (2-ESS2-1)</i>		
<i>Connections to other DCIs across grade levels: 3-5.ETS1.A (1-ETS1-1, 1-ETS1-2, 1-ETS1-3); 3-5.ETS1.8 (1-ETS1-2, 1-ETS1-3); 3-5.ETS1.C (1-ETS1-1, 1-ETS1-2, 1-ETS1-3)</i>		

*Connections to the Arkansas English Language Arts Standards –*

**1.RC.1.RF** Ask questions about key details in a text. (1-ETS1-1)

**1.RC.2.RF** Answer questions about key details in a text. (1-ETS1-1)

**1.W.2.5** Write an informative or explanatory piece about a topic, using facts from a source. (1-ETS1-1,1-ETS1-3)

**1.CC.4.P** Use visual displays to clarify ideas, thoughts, and feelings. (1-ETS1-2)

*Connections to the Arkansas Mathematics Standards –*

**AR.M.2** Applying reasoning about quantities and relationships. (1-ETS1-1, 1-ETS1-3)

**AR.M.4** Select and use relationships and tools. (1-ETS1-1, 1-ETS1-3)

**AR.M.5** Identify relationships using structure and patterns. (1-ETS1-1, 1-ETS1-3)



# ARKANSAS

## K-12 SCIENCE STANDARDS

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EDUCATION FOR A NEW GENERATION

# Grade 2

# 2015

Realigned Fall 2024 to the Arkansas Mathematics Standards  
and Arkansas English Language Arts Standards

**Grade 2 Learning Progression by Topic**

Grade 2		
PHYSICAL SCIENCES	LIFE SCIENCES	EARTH and SPACE SCIENCES
Structure and the Properties of Matter	Interdependent Relationships in Ecosystems	Earth's Systems: Processes that Shape the Earth
2-PS1-1	2-LS2-1	2-ESS1-1
2-PS1-2	2-LS2-2	2-ESS2-1
2-PS1-3	2-LS4-1	2-ESS2-2
2-PS1-4		2-ESS2-3
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 2-ETS1-1, 2-ETS1-2, 2-ETS1-3		

**Grade 2 Learning Progression by Disciplinary Core Idea**

Grade 2				
PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES	
Matter and Its Interactions	Ecosystems: Interactions, Energy, and Dynamics	Biological Evolution: Unity and Diversity	Earth's Place in the Universe	Earth's Systems
2-PS1-1	2-LS2-1	2-LS4-1	2-ESS1-1	2-ESS2-1
2-PS1-2	2-LS2-2			2-ESS2-2
2-PS1-3				2-ESS2-3
2-PS1-4				
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 2-ETS1-1, 2-ETS1-2, 2-ETS1-3				

## **Second Grade Standards Overview**

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

### **Science and Engineering Practices**

Students are expected to demonstrate grade-appropriate proficiency in

- developing and using models,
- planning and carrying out investigations,
- analyzing and interpreting data,
- constructing explanations and designing solutions, and
- engaging in argument from evidence, and obtaining, evaluating, and communicating information.

Students are expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

### **Crosscutting Concepts**

Students are expected to demonstrate grade-appropriate understanding of

- patterns,
- cause and effect,
- energy and matter,
- structure and function,
- stability and change, and
- influence of engineering, technology, and science on society and the natural world as organizing concepts for the disciplinary core ideas.

### **Disciplinary Core Ideas**

Students are expected to continually build on and revise their knowledge of

- PS1 - Matter and Its Interactions,
- LS2 - Ecosystems: Interactions, Energy, and Dynamics,
- LS4 - Biological Evolution: Unity and Diversity,
- ESS1 - Earth's Place in the Universe,
- ESS2 - Earth's Systems, and
- ETS1 - Engineering Design in a K-2 developmental learning progression.

The (PS) performance expectations in second grade help students formulate answers to the questions, "How do the properties of materials determine their use?" and "How are materials similar and different from one another?" Students develop an understanding of observable properties of materials at this level through analysis and classification of different materials.

### **Life Science (LS)**

The (LS) performance expectations in second grade help students explore the questions, "What do plants need to grow?" and "How many types of organisms live in a place?" Students are expected to develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination. Students compare the diversity of life in different habitats.

### **Earth and Space Science (ESS)**

The (ESS) performance expectations in second grade help students investigate the questions, "How does the surface of the Earth change over time?", and "What are the different land forms and bodies of water?" Students apply their understanding of the idea that wind and water can change the shape of the land and compare design solutions to slow or prevent such changes. Students use information and make models to identify and represent landforms and bodies of water found on Earth.

### **Engineering, Technology, and Applications of Science (ETS)**

Engineering design performance expectations in the primary grades help students recognize that creative energy can be a means to solve problems and achieve goals through a systematic process. Children are born with a creative urge to design and build things and it is the task of the teacher to channel this natural tendency. Connections with the other science disciplines help students develop these capabilities in various contexts. The engineering design process involves three stages:

- **Defining engineering problems** begins in Kindergarten as students learn that a situation people want to change can be thought of as a problem that can be solved. By the time they leave second grade students should be able to ask questions and make observations to gather information about the problem so they can envision an object or a tool that would solve it.
- **Designing possible solutions to engineering problems** progresses from the problem definition stage. One of the most challenging aspects of this stage is to keep students from immediately implementing the first solution they think of and to think it through before acting. Students should sketch their ideas or make a physical model to help shape their ideas to meet the requirements of the problem.
- **Comparing different solutions** involves testing each one to see how well it solves a problem or achieves a goal. Consumer product testing is a good model of this capability. Although students in this grade range should not be held accountable for designing controlled experiments, they should be able to think of ways to compare two products to determine which is better for a given purpose.

By the time students leave the second grade they should be able to achieve all three performance expectations (2-ETS1-1, 2-ETS1-2, 2-ETS1-3) related to a single problem in order to understand the interrelated processes of engineering design. Students can use tools and materials to solve simple problems, use visual or physical representations to convey solutions, and compare different solutions to a problem, test them, and determine which is best. These component ideas do not always follow in order. At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that is not working.

## GRADE TWO

<b>Structure and Properties of Matter</b>	
Students who demonstrate understanding can:	
<b>2-PS1-1</b>	<b>Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.</b> [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]
<b>2-PS1-2</b>	<b>Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*</b> [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]
<b>2-PS1-3</b>	<b>Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.</b> [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]
<b>2-PS1-4</b>	<b>Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.</b> [Clarification Statement: Examples of reversible changes could include materials such as water or butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :	

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Planning and Carrying Out Investigations</b>            Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-PS1-1)</li> </ul> <p><b>Analyzing and Interpreting Data</b>            Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> <li>Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b>            Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> <li>Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3)</li> </ul> <p><b>Engaging in Argument from Evidence</b>            Engaging in argument from evidence in K-2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).</p>	<p><b>PS1.A: Structure and Properties of Matter</b></p> <ul style="list-style-type: none"> <li>Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1)</li> <li>Different properties are suited to different purposes. (2-PS1-2, 2-PS1-3)</li> <li>A great variety of objects can be built up from a small set of pieces. (2-PS1-3)</li> </ul> <p><b>PS1.B: Chemical Reactions</b></p> <ul style="list-style-type: none"> <li>Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns in the natural and human designed world can be observed. (2-PS1-1)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Events have causes that generate observable patterns. (2-PS1-4)</li> <li>Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2)</li> </ul> <p><b>Energy and Matter</b></p> <ul style="list-style-type: none"> <li>Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (2-PS1-3)</li> </ul> <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">-</p> <p style="text-align: center;"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (2-PS1-2)</li> </ul>

<ul style="list-style-type: none"> <li>▪ Construct an argument with evidence to support a claim. (2-PS1-4)</li> </ul> <p style="text-align: center;">-----</p> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena</b></p> <ul style="list-style-type: none"> <li>▪ Scientists search for cause and effect relationships to explain natural events. (2-PS1-4)</li> </ul>		
<p><i>Connections to other DCIs in second grade:</i> N/A</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>4.ESS2.A</b> (2-PS1-3); <b>5.PS1.A</b> (2-PS1-1, 2-PS1-2, 2-PS1-3); <b>5.PS1.B</b> (2-PS1-4); <b>5.LS2.A</b> (2-PS1-3)</p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p> <p><b>2.RC.1.RF</b> Ask questions about key details in a text. (2-PS1-4)</p> <p><b>2.RC.2.RF</b> Answer questions about key details in a text. (2-PS1-4)</p> <p><b>2.RC.13.RI</b> Explain how an author uses reasons/evidence to support main points in a text. (2-PS1-2, 2-PS1-4)</p> <p><b>2.W.1.S</b> Write an opinion piece about a topic or text with details to support the opinion. (2-PS1-4)</p> <p><b>2.W.9.P</b> Participate in shared research projects to gather information from experiences and/or provided sources to produce writing. (2-PS1-1, 2-PS1-2, 2-PS1-3)</p> <p><b>2.W.2.S</b> Write an informative or explanatory piece about a topic, using facts from a source. (2-PS1-1, 2-PS1-2, 2-PS1-3)</p> <p><i>Connections to the Arkansas Mathematics Standards –</i></p> <p><b>AR.M.2</b> Applying reasoning about quantities and relationships. (2-PS1-2)</p> <p><b>AR.M.4</b> Select and use relationships and tools. (2-PS1-1, 2-PS1-2)</p> <p><b>AR.M.5</b> Identify relationships using structure and patterns. (2-PS1-2)</p> <p><b>2.DA.1</b> Use bar graphs, picture graphs, and line plots to organize and represent data, interpreting data with up to four categories. (2-PS1-1, 2-PS1-2)</p> <p><b>2.DA.2</b> Ask and answer simple put together, take apart, and compare problems, using information presented in the bar graphs, picture graphs, and line plots. (2-PS1-1, 2-PS1-2)</p>		

**GRADE TWO**

**Interdependent Relationships in Ecosystems**

Students who demonstrate understanding can:

- 2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [Assessment Boundary: Assessment is limited to testing one variable at a time.]
- 2-LS2-2 Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.\***
- 2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats.** [Clarification Statement: Emphasis is on the diversity of living things in a variety of habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>■ Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>■ Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1)</li> <li>■ Make observations (firsthand or from media) to collect data that can be used to make comparisons. (2-LS4-1)</li> </ul> <hr style="border-top: 1px dashed black;"/> <p align="center"><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>■ Scientists look for patterns and order when making observations about the world. (2-LS4-1)</li> </ul>	<p><b>LS2.A: Interdependent Relationships in Ecosystems</b></p> <ul style="list-style-type: none"> <li>■ Plants depend on water and light to grow. (2-LS2-1)</li> <li>■ Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)</li> </ul> <p><b>LS4.D: Biodiversity and Humans</b></p> <ul style="list-style-type: none"> <li>■ There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>■ Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (2-LS2-2)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>■ Events have causes that generate observable patterns. (2-LS2-1)</li> </ul> <p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>■ The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)</li> </ul>

*Connections to other DCIs in second grade:* N/A

*Connections to other DCIs across grade levels:* **K.LS1.C** (2-LS2-1); **K-ESS3.A** (2-LS2-1); **K-2.ETS1.A** (2-LS2-2); **3.LS4.C** (2-LS4-1); **3.LS4.D** (2-LS4-1); **5.LS1.C** (2-LS2-1); **5.LS2.A** (2-LS2-2, 2-LS4-1)

*Connections to the Arkansas English Language Arts Standards –*

- 2.W.9.P** Participate in shared research projects to gather information from experiences and/or provided sources to produce writing. (2-LS2-1, 2-LS4-1)
- 2.W.2.S** Write an informative or explanatory piece about a topic, using facts from a source. (2-LS2-1, 2-LS4-1)
- 2.CC.3.P** Use relevant, descriptive details to orally share a story or experience that includes appropriate facts. (2-LS2-2)
- 2.CC.4.P** Use visual displays to clarify ideas, thoughts, and feelings. (2-LS2-2)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships. (2-LS2-1, 2-LS4-1)
- AR.M.4** Select and use relationships and tools. (2-LS2-1, 2-LS2-2, 2-LS4-1)
- AR.M.5** Identify relationships using structure and patterns. (2-LS2-1)
- 2.DA.1** Use bar graphs, picture graphs, and line plots to organize and represent data, interpreting data with up to four categories. (2-LS2-2, 2-LS4-1)
- 2.DA.2** Ask and answer simple put together, take apart, and compare problems, using information presented in the bar graphs, picture graphs, and line plots. (2-LS2-2, 2-LS4-1)

**GRADE TWO**

<b>Earth's Systems: Processes that Shape the Earth</b>		
Students who demonstrate understanding can:		
<b>2-ESS1-1</b>	<b>Use information from several sources to provide evidence that Earth events can occur quickly or slowly.</b> [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]	
<b>2-ESS2-1</b>	<b>Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*</b> [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]	
<b>2-ESS2-2</b>	<b>Develop a model to represent the shapes and kinds of land and bodies of water in an area.</b> [Assessment Boundary: Assessment does not include quantitative scaling in models.]	
<b>2-ESS2-3</b>	<b>Obtain information to identify where water is found on Earth and that it can be solid or liquid.</b>	
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Developing and Using Models</b> Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a model to represent patterns in the natural world. (2-ESS2-2)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> <li>Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)</li> <li>Compare multiple solutions to a problem. (2-ESS2-1)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> <li>Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)</li> </ul>	<p><b>ESS1.C: The History of Planet Earth</b></p> <ul style="list-style-type: none"> <li>Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)</li> </ul> <p><b>ESS2.A: Earth Materials and Systems</b></p> <ul style="list-style-type: none"> <li>Wind and water can change the shape of the land. (2-ESS2-1)</li> </ul> <p><b>ESS2.B: Plate Tectonics and Large-Scale System Interactions</b></p> <ul style="list-style-type: none"> <li>Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)</li> </ul> <p><b>ESS2.C: The Roles of Water in Earth's Surface Processes</b></p> <ul style="list-style-type: none"> <li>Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (2-ESS2-1)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns in the natural world can be observed. (2-ESS2-2, 2-ESS2-3)</li> </ul> <p><b>Stability and Change</b></p> <ul style="list-style-type: none"> <li>Things may change slowly or rapidly. (2-ESS1-1, 2-ESS2-1)</li> </ul> <p align="center">-----</p> <p align="center">-</p> <p align="center"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p align="center">-----</p> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>Developing and using technology has impacts on the natural world. (2-ESS2-1)</li> </ul> <p align="center">-----</p> <p align="center">-</p> <p align="center"><b>Connections to Nature of Science</b></p> <p><b>Science Addresses Questions About the Natural and Material World</b></p> <ul style="list-style-type: none"> <li>Scientists study the natural and material world. (2-ESS2-1)</li> </ul>
<i>Connections to other DCIs in second grade:</i> <b>2.PS1.A</b> (2-ESS2-3)		
<i>Connections to other DCIs across grade levels:</i> <b>K-2.ETS1.A</b> (2-ESS2-1); <b>3.LS2.C</b> (2-ESS1-1); <b>4.ESS1.C</b> (2-ESS1-1); <b>4.ESS2.A</b> (2-ESS1-1, 2-ESS2-1); <b>4.ESS2.B</b> (2-ESS2-2); <b>3-5.ETS1.A</b> (2-ESS2-1); <b>3-5.ETS1.B</b> (2-ESS2-1); <b>3-5.ETS1.C</b> (2-ESS2-1); <b>5.ESS2.A</b> (2-ESS2-1); <b>5.ESS2.C</b> (2-ESS2-2, 2-ESS2-3)		

*Connections to the Arkansas English Language Arts Standards –*

- 2.RC.1.RF** Ask questions about key details in a text. (2-ESS1-1)
- 2.RC.2.RF** Answer questions about key details in a text. (2-ESS1-1)
- 2.RC.14.RI** Compare and contrast two texts on the same topic.(2-ESS2-1)
- 2.W.9.P** Participate in shared research projects to gather information from experiences and/or provided sources to produce writing. (2-ESS1-1)
- 2.W.2.S** Write an informative or explanatory piece about a topic, using facts from a source. (2-ESS1-1, 2-ESS2-3)
- 2.CC.2.OL** Ask and answer questions about what a speaker says to gather additional information and clarify understanding. (2-ESS1-1)
- 2.CC.3.P** Use relevant, descriptive details to orally share a story or experience that includes appropriate facts. (2-ESS2-2)
- 2.CC.4.P** Use visual displays to clarify ideas, thoughts, and feelings. (2-ESS2-2)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships. (2-ESS2-1, 2-ESS2-1, 2-ESS2-2)
- AR.M.4** Select and use relationships and tools. (2-ESS1-1, 2-ESS2-1, 2-ESS2-2)
- AR.M.5** Identify relationships using structure and patterns. (2-ESS2-1)
- 2.GM.6** Solve real-world problems involving lengths of the same units, using addition and subtraction within 100. (2-ESS2-1)
- 2.NPV.1** Count within 1,000 forwards and backwards by ones, tens, and hundreds from any given number. (2-ESS1-1)
- 2.NPV.2** Identify the value of hundreds, tens, and ones place in a three-digit number. (2-ESS1-1)
- 2.NPV.3** Read, write, and represent whole numbers up to 1,000 using concrete models or drawings, number names, and a variety of expanded forms. (2-ESS2-2)
- 2.NPV.5** Compare two three-digit numbers using symbols (<, =, >) based on the value of hundreds, tens, and ones in the given numbers. (2-ESS1-1)

**GRADE TWO**

<b>Engineering, Technology, and Applications of Science</b>		
Students who demonstrate understanding can:		
<b>2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.</b>		
<b>2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.</b>		
<b>2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.</b>		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in K-2 builds on prior experiences and progresses to simple descriptive questions.</p> <ul style="list-style-type: none"> <li>Ask questions based on observations to find more information about the natural and/or designed world. (2-ETS1-1)</li> <li>Define a simple problem that can be solved through the development of a new or improved object or tool. (2-ETS1-1)</li> </ul> <p><b>Developing and Using Models</b> Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a simple model based on evidence to represent a proposed object or tool. (2-ETS1-2)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> <li>Analyze data from tests of an object or tool to determine if it works as intended. (2-ETS1-3)</li> </ul>	<p><b>ETS1.A: Defining and Delimiting Engineering Problems</b></p> <ul style="list-style-type: none"> <li>A situation that people want to change or create can be approached as a problem to be solved through engineering. (2-ETS1-1)</li> <li>Asking questions, making observations, and gathering information are helpful in thinking about problems. (2-ETS1-1)</li> <li>Before beginning to design a solution, it is important to clearly understand the problem. (2-ETS1-1)</li> </ul> <p><b>ETS1.8: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (2-ETS1-2)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (2-ETS1-3)</li> </ul>	<p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (2-ETS1-2)</li> </ul>
<p><i>Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include: Kindergarten: (K-PS2-2, K-ESS3-2)</i>  <i>Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include: Kindergarten: (K-ESS3-3);</i>  <b>First Grade: (1-PS4-4); Second Grade: (2-LS2-2)</b>  <i>Connections to K-2-ETS1.C: Optimizing the Design Solution include: Second Grade: (2-ESS2-1)</i></p>		
<p><i>Connections to other DCIs across grade levels: 3-5.ETS1.A (2-ETS1-1, 2-ETS1-2, 2-ETS1-3); 3-5.ETS1.8 (2-ETS1-2, 2-ETS1-3); 3-5.ETS1.C (2-ETS1-1, 2-ETS1-2, 2-ETS1-3)</i></p>		

*Connections to the Arkansas English Language Arts Standards –*

- 2.RC.1.RF** Ask questions about key details in a text. (2-ETS1-1)
- 2.RC.2.RF** Answer questions about key details in a text. (2-ETS1-1)
- 2.W.2.S** Write an informative or explanatory piece about a topic, using facts from a source. (2-ETS1-1 , 2-ETS1-3)
- 2.CC.3.P** Use relevant, descriptive details to orally share a story or experience that includes appropriate facts. (2-ETS1-2)
- 2.CC.4.P** Use visual displays to clarify ideas, thoughts, and feelings. (2-ETS1-2)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships. (2-ETS1-1, 2-ETS1-3)
- AR.M.4** Select and use relationships and tools. (2-ETS1-1, 2-ETS1-3)
- AR.M.5** Identify relationships using structure and patterns. (2-ETS1-1, 2-ETS1-3)
- 2.DA.1** Use bar graphs, picture graphs, and line plots to organize and represent data, interpreting data with up to four categories. (2-ETS1-1, 2-ETS1-3)
- 2.DA.2** Ask and answer simple put together, take apart, and compare problems, using information presented in the bar graphs, picture graphs, and line plots. (2-ETS1-1, 2-ETS1-3)

## Contributors

The following educators contributed to the development of this document:

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Leslie Brodie - Fort Smith School District	Laura Mewborn - Pulaski County Special School District
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Cindy Cardwell - Bentonville School District	Reggie Nalls - Dollarway School District
Pam Carpenter - Bald Knob School District	Yolanda Prim - Dollarway School District
Debbie Daily - University of Central Arkansas	Kathy Prophet - Springdale School District
Rosa Dumond - Arkadelphia School District	Virginia Rhame - Northwest Arkansas Education Cooperative
Tami Eggensperger - Cabot School District	Brian Schuller - DeQueen Mena Education Cooperative
Alana Eifert - Malvern School District	Carolyn Smith - El Dorado School District
Linda Flynn - Farmington School District	Mary Smith - Nettleton School District
Jenny Gammill - Fayetteville School District	Melinda Smith - Jonesboro School District
A. Wade Geery - Norfolk School District	Pam Vaughan - Camden School District
Kyla Gentry - Searcy School District	Deborah Walker - Magnolia School District
Josh Jenkins - Springdale School District	Greg Wertenberger - Henderson University STEM Center
Marilyn Johnson - Little Rock School District	Rebecca Wilbern - Fayetteville School District
Christina Johnson - North Little Rock School District	Andrew Williams - University of Arkansas at Monticello
Debbie Jones - Sheridan School District	Gene Williams - Little Rock School District
Tifanie King - West Memphis School District	Shawna Williams - Farmington School District
Sandra Leiterman - Little Rock School District	Cathy Wissehr - University of Arkansas at Fayetteville
Steven Long - Rogers School District	



# ARKANSAS

## K-12 SCIENCE STANDARDS

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EDUCATION FOR A NEW GENERATION

### Grade 3

# 2015

Realigned Fall 2024 to the Arkansas Mathematics Standards  
and Arkansas English Language Arts Standards

**Grade 3 Learning Progression by Topic**

Grade 3			
PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES
Forces and Interactions	Interdependent Relationships in Ecosystems	Inheritance and Variation of Traits	Weather and Climate
3-PS2-1 <sup>AR</sup>	3-LS2-1 <sup>AR</sup>	3-LS1-1	3-ESS2-1
3-PS2-2	3-LS4-1	3-LS3-1	3-ESS2-2
3-PS2-3	3-LS4-3 <sup>AR</sup>	3-LS3-2	3-ESS3-1
3-PS2-4	3-LS4-4	3-LS4-2 <sup>AR</sup>	
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 3-ETS1-1, 3-ETS1-2, 3-ETS1-3			

Arkansas Clarification Statement (<sup>AR</sup>)

**Grade 3 Learning Progression by Disciplinary Core Idea**

Grade 3						
PHYSICAL SCIENCES	LIFE SCIENCES				EARTH and SPACE SCIENCES	
Motion and Stability: Forces and Interactions	From Molecules to Organisms: Structures and Processes	Ecosystems: Interactions, Energy, and Dynamics	Heredity: Inheritance and Variation of Traits	Biological Evolution: Unity and Diversity	Earth's Systems	Earth and Human Activity
3-PS2-1 <sup>AR</sup>	3-LS1-1	3-LS2-1 <sup>AR</sup>	3-LS3-1	3-LS4-1	3-ESS2-1	3-ESS3-1
3-PS2-2			3-LS3-2	3-LS4-2 <sup>AR</sup>	3-ESS2-2	
3-PS2-3				3-LS4-3 <sup>AR</sup>		
3-PS2-4				3-LS4-4		
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 3-ETS1-1, 3-ETS1-2, 3-ETS1-3						

Arkansas Clarification Statement (<sup>AR</sup>)

## **Third Grade Standards Overview**

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

### **Science and Engineering Practices**

Students are expected to demonstrate grade-appropriate proficiency in

- asking questions and defining problems,
- developing and using models,
- planning and carrying out investigations,
- analyzing and interpreting data,
- constructing explanations and designing solutions,
- engaging in argument from evidence, and
- obtaining, evaluating, and communicating information.

Students are expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

### **Crosscutting Concepts**

Students are expected to demonstrate grade-appropriate understanding of

- patterns,
- cause and effect,
- scale, proportion, and quantity,
- systems and system models,
- interdependence of science, engineering, and technology, and
- influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for the disciplinary core ideas.

### **Disciplinary Core Ideas**

Students are expected to continually build on and revise their knowledge of

- PS2- Motion and Stability: Forces and Interactions,
- LS1- Molecules to Organisms: Structures and Processes,
- LS2- Ecosystem: Interactions, Energy, and Dynamics,
- LS3- Heredity: Inheritance and Variation of Traits,
- LS4- Biological Evolution: Unity and Diversity,
- ESS2- Earth's Systems,
- ESS3- Earth and Human Activity, and
- ETS1- Engineering Design in a 3-5 developmental learning progression.

The PS performance expectations in third grade help students formulate answers to the questions, "How do equal and unequal forces on an object affect the object?" and "How can magnets be used?" Students determine the effects of balanced and unbalanced forces on the motion of an object and the cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Students are then able to apply their understanding of magnetic interactions to define a simple design problem that can be solved with magnets.

### **Life Sciences (LS)**

The LS performance expectations in third grade help students explore the questions, "How do organisms vary in their traits?", "How are plants, animals, and environments of the past similar or different from current plants, animals, and environments?", and "What happens to organisms when their environment changes?" Third graders are expected to develop an understanding of the idea that when the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Students develop an understanding of the similarities and differences of organisms' life cycles. Students at this level acquire an understanding that organisms have different inherited traits, and that the environment can also affect the traits that an organism develops. In addition, students construct an explanation using evidence for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. Students are expected to develop an understanding of types of organisms that lived long ago and also about the nature of their environments.

### **Earth and Space Sciences (ESS)**

The ESS performance expectations in third grade help students investigate the questions, "What is typical weather in different parts of the world and during different times of the year?" and "How can the impact of weather-related hazards be reduced?" Students organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students make a claim about the merit of a design solution that reduces the impacts of such hazards.

### **Engineering, Technology, and Applications of Science (ETS)**

Engineering design performance expectations in the earliest grades introduce students to "problems" as situations that people want to change. With increased maturity students in third through fifth grade are able to develop these capabilities in various scientific contexts. The engineering design process involves three stages:

- **Defining and delimiting engineering problems** involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits. In this grade range the additional step of specifying criteria and constraints.
- **Designing solutions to engineering problems** begins with generating a number of different possible solutions, and then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem. In this grade range students generate several alternative solutions and compare them systematically to see which best meet the criteria and constraints of the problem.
- **Optimizing the engineering design** involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important. In this grade range students build and test models or prototypes using controlled experiments in which only one variable is changed from trial to trial while all other variables are kept the same.

In the third grade students are beginning to develop the ability to achieve all three performance expectations (3-ETS1-1, 3-ETS1-2, 3-ETS1-3) related to a single problem in order to understand the interrelated processes of engineering design. Students can use tools and materials to solve simple problems, use visual or physical representations to convey solutions, and compare different solutions to a problem, test them, and determine which is best. These component ideas do not always follow in order. At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that is not working.

## GRADE THREE

Forces and Interactions	
Students who demonstrate understanding can:	
<b>3-PS2-1</b>	<b>Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.</b> [AR Clarification Statement: Examples could include an unbalanced force on one side of a box can make it start moving or balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]
<b>3-PS2-2</b>	<b>Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.</b> [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]
<b>3-PS2-3</b>	<b>Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.</b> [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon or the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force or how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]
<b>3-PS2-4</b>	<b>Define a simple design problem that can be solved by applying scientific ideas about magnets.*</b> [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :	

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in grades 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> <li>Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3)</li> <li>Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1)</li> <li>Make observations and/or measurements to produce data to serve as the basis for</li> </ul>	<p><b>PS2.A: Forces and Motion</b></p> <ul style="list-style-type: none"> <li>Each force acts on one particular object and has both 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. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)</li> <li>The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns of change can be used to make predictions. (3-PS2-2)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Cause and effect relationships are routinely identified. (3-PS2-1)</li> <li>Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3)</li> </ul>

<p>evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2)</p> <hr/> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Science Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Science findings are based on recognizing patterns. (3-PS2-2)</li> </ul> <p><b>Scientific Investigations Use a Variety of Methods</b></p> <ul style="list-style-type: none"> <li>Science investigations use a variety of methods, tools, and techniques. (3-PS2-1)</li> </ul>	<p><b>PS2.B: Types of Interactions</b></p> <ul style="list-style-type: none"> <li>Objects in contact exert forces on each other. (3-PS2-1)</li> <li>Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3, 3-PS2-4)</li> </ul>	<hr/> <p style="text-align: center;"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Interdependence of Science, Engineering, and Technology</b></p> <ul style="list-style-type: none"> <li>Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3-PS2-4)</li> </ul>
<p><i>Connections to other DCIs in third grade: N/A</i></p>		
<p><i>Connections to other DCIs across grade levels: K.PS2.A (3-PS2-1); K.PS2.B (3-PS2-1); K.PS3.C (3-PS2-1); K-2.ETS1.A (3-PS2-4); 1.ESS1.A (3-PS2-2); 4.PS4.A (3-PS2-2); 3-5.ETS1.A (3-PS2-4); 5.PS2.B (3-PS2-1); 7.ESS2.C (3-PS2-1); 8.PS2.A (3-PS2-1, 3-PS2-2); 8.PS2.B (3-PS2-3, 3-PS2-4); 8.ESS1.B (3-PS2-1, 3-PS2-2)</i></p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p> <p><b>3.RC.1.RF</b> Ask questions about key details in a text. (3-PS2-1, 3-PS2-3)</p> <p><b>3.RC.2.RF</b> Answer questions about key details in a text. (3-PS2-1, 3-PS2-3)</p> <p><b>3.RC.15.RI</b> Describe how each successive part or paragraph builds on earlier sections. (3-PS2-3)</p> <p><b>3.W.9.P</b> Conduct short research by gathering information from relevant experiences and/or print and digital sources to produce a response. (3-PS2-1, 3-PS2-2)</p> <p><b>3.W.10.P</b> Take notes from sources and sort evidence into categories. (3-PS2-1, 3-PS2-2)</p> <p><b>3.CC.2.OL</b> Ask and answer questions about what a speaker says to gather additional information and clarify understanding. (3-PS2-3)</p> <p><i>Connections to the Arkansas Mathematics Standards –</i></p> <p><b>AR.M.2</b> Applying reasoning about quantities and relationships. (3-PS2-1)</p> <p><b>AR.M.5</b> Identify relationships using structure and patterns. (3-PS2-1)</p> <p><b>3.GM.8</b> Measure and estimate liquid volumes and masses of objects using standard units. (3-PS2-1)</p> <p><b>3.GM.9</b> Solve one-step real-world problems involving liquid volumes and masses of objects in the same units, using all four operations. (3-PS2-1)</p>		

## GRADE THREE

### Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:

- 3-LS2-1 Construct an argument that some animals form groups that help members survive.** [AR Clarification Statement: Examples could include ant colonies, herds of bison, or hives of bees.]
- 3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.** [Clarification Statement: Examples of data could include type, size, and distributions of fossilized organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [Assessment Boundary: Assessment does not include identification of specific fossils or living plants and animals. Assessment is limited to major fossil types and relative ages.]
- 3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.** [AR Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other for survival.]
- 3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.\*** [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

#### Science and Engineering Practices

##### Analyzing and Interpreting Data

Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1)

##### Engaging in Argument from Evidence

Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed worlds.

- Construct an argument with evidence, data, and/or a model. (3-LS2-1)
- Construct an argument with evidence. (3-LS4-3)
- 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. (3-LS4-4)

#### Disciplinary Core Ideas

##### LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- 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. (3-LS4-4)

##### LS2.D: Social Interactions and Group Behavior

- Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. (3-LS2-1)

##### LS4.A: Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (3-LS4-1)
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)

##### LS4.C: Adaptation

- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)

#### Crosscutting Concepts

##### Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS2-1, 3-LS4-3)

##### Scale, Proportion, and Quantity

- Observable phenomena exist from very short to very long time periods. (3-LS4-1)

##### Systems and System Models

- A system can be described in terms of its components and their interactions. (3-LS4-4)

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##### Connections to Engineering, Technology, and Applications of Science

##### Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (3-LS4-4)

	<p><b>LS4.D: Biodiversity and Humans</b></p> <ul style="list-style-type: none"> <li>Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)</li> </ul>	<p style="text-align: center;">-----</p> <p style="text-align: center;">-</p> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b></p> <ul style="list-style-type: none"> <li>Science assumes consistent patterns in natural systems. (3-LS4-1)</li> </ul>
<p><i>Connections to other DCIs in third grade: 3.ESS2.D (3-LS4-3); 3.ESS3.B (3-LS4-4)</i></p>		
<p><i>Connections to other DCIs across grade levels: K.ESS3.A (3-LS4-3, 3-LS4-4); K-2.ETS1.A (3-LS4-4); 1.LS1.B (3-LS2-1); 2.LS2.A (3-LS4-3, 3-LS4-4); 2.LS4.D (3-LS4-3, 3-LS4-4); 4.ESS1.C (3-LS4-1); 4.ESS3.B (3-LS4-4); 3-5.ETS1.A (3-LS4-4); 6.ESS3.C (3-LS4-4); 7.LS2.A (3-LS2-1, 3-LS4-1, 3-LS4-3, 3-LS4-4); 7.LS2.C (3-LS4-4); 7.ESS2.B (3-LS4-1); 8.LS4.A (3-LS4-1); 8.LS4.B (3-LS4-3); 8.LS4.C (3-LS4-3, 3-LS4-4); 8.ESS1.C (3-LS4-1, 3-LS4-3, 3-LS4-4)</i></p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p>		
<p><b>3.RC.1.RF</b> Ask questions about key details in a text. (3-LS2-1, 3-LS4-1, 3-LS4-3, 3-LS4-4)</p> <p><b>3.RC.2.RF</b> Answer questions about key details in a text. (3-LS2-1, 3-LS4-1, 3-LS4-3, 3-LS4-4)</p> <p><b>3.RC.3.RF</b> Summarize multi-paragraph texts, providing key details to demonstrate understanding of the central message or topic. (3-LS4-1, 3-LS4-3, 3-LS4-4)</p> <p><b>3.W.1.S</b> Write an opinion to convince the reader to take an action or adopt a position with logical reasons supported by evidence from various sources. (3-LS2-1, 3-LS4-1, 3-LS4-3, 3-LS4-4)</p> <p><b>3.W.2.S</b> Write informative or explanatory pieces about a topic, using sources. (3-LS4-1, 3-LS4-3, 3-LS4-4)</p> <p><b>3.W.10.P</b> Take notes from sources and sort evidence into categories. (3-LS4-1)</p> <p><b>3.CC.3.P</b> Use relevant, descriptive details to orally report on a topic or text, tell a story, or recount an experience, speaking clearly at an understandable pace. (3-LS4-3, 3-LS4-4)</p>		
<p><i>Connections to the Arkansas Mathematics Standards –</i></p>		
<p><b>AR.M.2</b> Applying reasoning about quantities and relationships. (3-LS4-1, 3-LS4-3, 3-LS4-4)</p> <p><b>AR.M.4</b> Select and use relationships and tools. (3-LS2-1, 3-LS4-1, 3-LS4-3, 3-LS4-4)</p> <p><b>AR.M.5</b> Identify relationships using structure and patterns. (3-LS4-1)</p> <p><b>3.CAR.1</b> Use computational fluency to add and subtract three-digit whole numbers, using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction. (3-LS2-1)</p> <p><b>3.CAR.4</b> Use strategies to multiply one-digit numbers by multiples of 10 ranging from 10-90; strategies are based on place value and properties of operations (e.g., <math>9 \cdot 80</math>, <math>5 \cdot 60</math>). (3-LS2-1)</p> <p><b>3.DA.1</b> Represent a data set with multiple categories, using a scaled picture graph, scaled bar graph, and a line plot. (3-LS4-3)</p> <p><b>3.DA.2</b> Solve one and two-step problems, using categorical data represented with a scaled picture graph, scaled bar graph, and a line plot. (3-LS4-3)</p> <p><b>3.GM.5</b> Describe area as the number of unit squares that cover a plane figure without gaps and overlaps. (3-LS4-1)</p> <p><b>3.NPV.1</b> Round four-digit whole numbers to the nearest 10 or 100, using place value understanding. (3-LS2-1)</p> <p><b>3.NPV.2</b> Identify the value of thousands, hundreds, tens, and ones place in a four-digit number. (3-LS2-1)</p> <p><b>3.NPV.3</b> Read and write whole numbers up to 10,000, using base ten numerals, word form, and a variety of expanded forms. (3-LS2-1)</p> <p><b>3.NPV.4</b> Compare two four-digit numbers using symbols (<math>&lt;</math>, <math>=</math>, <math>&gt;</math>) based on the value of thousands, hundreds, tens, and ones in the given numbers. (3-LS2-1)</p>		

## GRADE THREE

### Inheritance and Variation of Traits: Life Cycles and Traits

Students who demonstrate understanding can:

- 3-LS1-1** **Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]
- 3-LS3-1** **Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]
- 3-LS3-2** **Use evidence to support the explanation that traits can be influenced by the environment.** [Clarification Statement: Examples of the environment affecting a trait could include insufficient water stunting normally tall plants ; and, a pet dog becoming overweight that is given too much food and too little exercise.]
- 3-LS4-2** **Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.** [AR Clarification Statement: Examples of cause and effect relationships could be plants of the same species with larger thorns may be less likely to be eaten; and, animals of the same species with more effective camouflage or coloration may be more likely to survive and produce offspring.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> <li>▪ Develop models to describe phenomena. (3-LS1-1)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> <li>▪ Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS3-1)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>▪ Use evidence (e.g., observations, patterns) to support an explanation. (3-LS3-2)</li> </ul>	<p><b>LS1.B: Growth and Development of Organisms</b></p> <ul style="list-style-type: none"> <li>▪ Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)</li> </ul> <p><b>LS3.A: Inheritance of Traits</b></p> <ul style="list-style-type: none"> <li>▪ Many characteristics of organisms are inherited from their parents. (3-LS3-1)</li> <li>▪ Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2)</li> </ul> <p><b>LS3.B: Variation of Traits</b></p> <ul style="list-style-type: none"> <li>▪ Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1)</li> <li>▪ The environment also affects the traits that an organism develops. (3-LS3-2)</li> </ul> <p><b>LS4.B: Natural Selection</b></p> <ul style="list-style-type: none"> <li>▪ Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>▪ Similarities and differences in patterns can be used to sort and classify natural phenomena. (3-LS3-1)</li> <li>▪ Patterns of change can be used to make predictions. (3-LS1-1)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>▪ Cause and effect relationships are routinely identified and used to explain change. (3-LS3-2, 3-LS4-2)</li> </ul>

<ul style="list-style-type: none"> <li>Use evidence (e.g., observations, patterns) to construct an explanation. (3-LS4-2)</li> </ul> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Science findings are based on recognizing patterns. (3-LS1-1)</li> </ul>		
<p><i>Connections to other DCIs in third grade:</i> <b>3.LS4.C</b> (3-LS4-2)</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>1.LS3.A</b> (3-LS3-1, 3-LS4-2); <b>1.LS3.B</b> (3-LS3-1); <b>6.LS1.B</b> (3-LS1-1, 3-LS3-2); <b>6.LS3.B</b> (3-LS3-1, 3-LS4-2); <b>7.LS2.A</b> (3-LS4-2); <b>8.LS3.A</b> (3-LS3-1); <b>8.LS4.B</b> (3-LS4-2)</p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p>		
<p><b>3.RC.1.RF</b> Ask questions about key details in a text. (3-LS3-1, 3-LS3-2, 3-LS4-2)</p> <p><b>3.RC.2.RF</b> Answer questions about key details in a text. (3-LS3-1, 3-LS3-2, 3-LS4-2)</p> <p><b>3.RC.3.RF</b> Summarize multi-paragraph texts, providing key details to demonstrate understanding of the central message or topic. (3-LS3-1, 3-LS3-2, 3-LS4-2)</p> <p><b>3.RC.17.RI</b> Explain how information gained from illustrations (e.g., maps, photographs) and the words in a text, contribute to understanding a text. (3-LS1-1)</p> <p><b>3.W.2.S</b> Write informative or explanatory pieces about a topic, using sources. (3-LS3-1, 3-LS3-2, 3-LS4-2)</p> <p><b>3.CC.3.P</b> Use relevant, descriptive details to orally report on a topic or text, tell a story, or recount an experience, speaking clearly at an understandable pace. (3-LS3-1, 3-LS3-2, 3-LS4-2)</p> <p><b>3.CC.4.P</b> Use visual displays and/or audio appropriately to emphasize or enhance certain facts or details when presenting. (3-LS1-1)</p>		
<p><i>Connections to the Arkansas Mathematics Standards –</i></p>		
<p><b>AR.M.2</b> Applying reasoning about quantities and relationships. (3-LS3-1, 3-LS3-2, 3-LS4-2)</p> <p><b>AR.M.4</b> Select and use relationships and tools. (3-LS1-1, 3-LS3-1, 3-LS3-2, 3-LS4-2)</p> <p><b>3.CAR.1</b> Use computational fluency to add and subtract three-digit whole numbers, using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction. (3-LS1-1)</p> <p><b>3.CAR.4</b> Use strategies to multiply one-digit numbers by multiples of 10 ranging from 10-90; strategies are based on place value and properties of operations (e.g., <math>9 \cdot 80</math>, <math>5 \cdot 60</math>). (3-LS1-1)</p> <p><b>3.DA.1</b> Represent a data set with multiple categories, using a scaled picture graph, scaled bar graph, and a line plot. (3-LS4-2)</p> <p><b>3.DA.2</b> Solve one and two-step problems, using categorical data represented with a scaled picture graph, scaled bar graph, and a line plot. (3-LS4-2)</p> <p><b>3.GM.5</b> Describe area as the number of unit squares that cover a plane figure without gaps and overlaps. (3-LS3-1, 3-LS3-2)</p> <p><b>3.NPV.1</b> Round four-digit whole numbers to the nearest 10 or 100, using place value understanding. (3-LS1-1)</p> <p><b>3.NPV.2</b> Identify the value of thousands, hundreds, tens, and ones place in a four-digit number. (3-LS1-1)</p> <p><b>3.NPV.3</b> Read and write whole numbers up to 10,000, using base ten numerals, word form, and a variety of expanded forms. (3-LS1-1)</p> <p><b>3.NPV.4</b> Compare two four-digit numbers using symbols (<math>&lt;</math>, <math>=</math>, <math>&gt;</math>) based on the value of thousands, hundreds, tens, and ones in the given numbers. (3-LS1-1)</p> <p><b>3.NPV.5</b> Compare two fractions with the same numerator or denominator by reasoning about their size based on the same whole; use symbols (<math>&lt;</math>, <math>=</math>, <math>&gt;</math>) and justify the conclusion using visual fraction models, concrete objects, or words. (3-LS1-1)</p> <p><b>3.NPV.8</b> Identify and represent a unit fraction as a number on the number line. Fractions include: denominators 2, 3, 4, 6, and 8. (3-LS1-1)</p> <p><b>3.NPV.9</b> Identify and represent a non-unit fraction as a number on the number line, including fractions greater than one. Fractions include: denominators 2, 3, 4, 6, and 8. (3-LS1-1)</p> <p><b>3.NPV.10</b> Decompose and compose a non-unit fraction <math>a/b</math> as the quantity formed by the sum of unit fractions. Fractions include: denominators 2, 3, 4, 6, and 8. (3-LS1-1)</p>		

**GRADE THREE**

**Weather and Climate**

Students who demonstrate understanding can:

- 3-ESS2-1** **Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.]
- 3-ESS2-2** **Obtain and combine information to describe climates in different regions of the world.**
- 3-ESS3-1** **Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.\*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Analyzing and Interpreting Data</b> Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> <li>■ Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. (3-ESS2-1)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>■ 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. (3-ESS3-1)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in 3-5 builds on K-2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> <li>■ Obtain and combine information from books and other reliable media to explain phenomena. (3-ESS2-2)</li> </ul>	<p><b>ESS2.D: Weather and Climate</b></p> <ul style="list-style-type: none"> <li>■ Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1)</li> <li>■ Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)</li> </ul> <p><b>ESS3.B: Natural Hazards</b></p> <ul style="list-style-type: none"> <li>■ A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>■ Patterns of change can be used to make predictions. (3-ESS2-1, 3-ESS2-2)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>■ Cause and effect relationships are routinely identified, tested, and used to explain change. (3-ESS3-1)</li> </ul> <hr/> <p align="center"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>■ Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). (3-ESS3-1)</li> </ul> <hr/> <p align="center">-</p> <p align="center"><b>Connections to Nature of Science</b></p> <p><b>Science is a Human Endeavor</b></p> <ul style="list-style-type: none"> <li>■ Science affects everyday life. (3-ESS3-1)</li> </ul>

Connections to other DCIs in third grade: N/A

Connections to other DCIs across grade levels: **K.ESS2.D** (3-ESS2-1); **K.ESS3.B** (3-ESS3-1); **K-2.ETS1.A** (3-ESS3-1); **4.ESS2.A** (3-ESS2-1); **4.ESS3.B** (3-ESS3-1); **3-5.ETS1.A** (3-ESS3-1); **5.ESS2.A** (3-ESS2-1); **6.ESS2.D** (3-ESS2-1, 3-ESS2-2); **7.ESS2.C** (3-ESS2-1, 3-ESS2-2); **7.ESS3.B** (3-ESS3-1)

*Connections to the Arkansas English Language Arts Standards –*

- 3.RC.1.RF** Ask questions about key details in a text. (3-ESS2-2)
- 3.RC.2.RF** Answer questions about key details in a text. (3-ESS2-2)
- 3.RC.14.RI** Compare and contrast two texts on the same topic, identifying key details from each text. (3-ESS2-2)
- 3.W.1.S** Write an opinion to convince the reader to take an action or adopt a position with logical reasons supported by evidence from various sources. (3-ESS3-1)
- 3.W.9.P** Conduct short research by gathering information from relevant experiences and/or print and digital sources to produce a response. (3-ESS3-1)
- 3.W.10.P** Take notes from sources and sort evidence into categories. (3-ESS2-2)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships. (3-ESS2-1, 3-ESS2-2, 3-ESS3-1)
- AR.M.4** Select and use relationships and tools. (3-ESS2-1, 3-ESS2-2, 3-ESS3-1)
- AR.M.5** Identify relationships using structure and patterns. (3-ESS2-1)
- 3.DA.1** Represent a data set with multiple categories, using a scaled picture graph, scaled bar graph, and a line plot. (3-ESS2-1)
- 3.DA.2** Solve one and two-step problems, using categorical data represented with a scaled picture graph, scaled bar graph, and a line plot. (3-ESS2-1)
- 3.GM.8** Measure and estimate liquid volumes and masses of objects using standard units. (3-ESS2-1)
- 3.GM.9** Solve one-step real-world problems involving liquid volumes and masses of objects in the same units, using all four operations. (3-ESS2-1)

## GRADE THREE

<b>Engineering, Technology, and Applications of Science</b>		
<p>Students who demonstrate understanding can:</p> <p><b>3-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</b></p> <p><b>3-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</b></p> <p><b>3-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</b></p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Asking Questions and Defining Problems</b></p> <p>Asking questions and defining problems in 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> <li>Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-ETS1-1)</li> </ul> <p><b>Planning and Carrying Out Investigations</b></p> <p>Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-ETS1-3)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b></p> <p>Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-ETS1-2)</li> </ul>	<p><b>ETS1.A: Defining and Delimiting Engineering Problems</b></p> <ul style="list-style-type: none"> <li>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). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-ETS1-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-ETS1-2)</li> <li>At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-ETS1-2)</li> <li>Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-ETS1-3)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-ETS1-3)</li> </ul>	<p><b>Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>People's needs and wants change over time, as do their demands for new and improved technologies. (3-ETS1-1)</li> <li>Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-ETS1-2)</li> </ul>

*Connections to 3-5-ETS1.A: Defining and Delimiting Engineering Problems include: Fourth Grade: (4-PS3-4)*

*Connections to 3-5-ETS1.B: Designing Solutions to Engineering Problems include: Fourth Grade: (4-ESS3-2)*

*Connections to 3-5-ETS1.C: Optimizing the Design Solution include: Fourth Grade: (4-PS4-3)*

*Connections to other DCIs across grade levels: K-2.ET51.A (3-ETS1-1, 3-ETS1-2, 3-ETS1-3); K-2.ET51.B (3-ETS1-2); K-2.ET51.C (3-ETS1-2, 3-ETS1-3); 6-8.ET51.A (3-ETS1-1); 6-8.ET51.B (3-ETS1-1, 3-ETS1-2, 3-ETS1-3); 6-8.ET51.C (3-ETS1-2, 3-ETS1-3)*

*Connections to the Arkansas English Language Arts Standards –*

**3.RC.1.RF** Ask questions about key details in a text. (3-ETS1-2)

**3.RC.2.RF** Answer questions about key details in a text. (3-ETS1-2)

**3.RC.17.RI** Explain how information gained from illustrations (e.g., maps, photographs) and the words in a text, contribute to understanding a text. (3-ETS1-2)

**3.RC.14.RI** Compare and contrast two texts on the same topic, identifying key details from each text. (3-ETS1-2)

**3.W.9.P** Conduct short research by gathering information from relevant experiences and/or print and digital sources to produce a response. (3-ETS1-1, 3-ETS1-3)

**3.W.10.P** Take notes from sources and sort evidence into categories. (3-ETS1-1, 3-ETS1-3)

*Connections to the Arkansas Mathematics Standards –*

**AR.M.2** Applying reasoning about quantities and relationships. (3-ETS1-1, 3-ETS1-2, 3-ETS1-3)

**AR.M.4** Select and use relationships and tools. (3-ETS1-1, 3-ETS1-2, 3-ETS1-3)

**AR.M.5** Identify relationships using structure and patterns. (3-ETS1-1, 3-ETS1-2, 3-ETS1-3)

**3.CAR.2** Use basic fact fluency to multiply and divide whole numbers with mastery by the end of third grade. Knowing all products with factors up to and including 12 and the corresponding division facts from the products with factors up to and including 12. Using strategies such as the relationship between multiplication and division (e.g., Knowing that  $8 \cdot 5 = 40$ , one knows  $40 \div 5 = 8$ ) or properties of operations. (3-ETS1-1, 3-ETS1-2)

**3.CAR.3** Apply properties of operations as strategies to multiply and divide. Properties include: Distributive, Commutative, and Associative Properties of Multiplication. (3-ETS1-1, 3-ETS1-2)

**3.CAR.5** Identify arithmetic patterns including, but not limited to, patterns in an addition or multiplication table, explaining use of properties of operations appropriate to the pattern. (3-ETS1-1, 3-ETS1-2)

**3.CAR.6** Solve real-world problems using multiplication and division within 100 involving equal groups, arrays, partitive and measurement division. (3-ETS1-1, 3-ETS1-2)

**3.CAR.7** Solve two-step real-world situations using addition, subtraction, multiplication, and division, representing these problems using equations with a symbol standing for an unknown quantity. (3-ETS1-1, 3-ETS1-2)

**3.CAR.8** Determine the unknown whole number in a multiplication or division equation relating three whole numbers.

**3.CAR.9** Understand division as an unknown-factor problem. (3-ETS1-1, 3-ETS1-2)

**3.DA.2** Solve one and two-step problems, using categorical data represented with a scaled picture graph, scaled bar graph, and a line plot. (3-ETS1-1, 3-ETS1-2)

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# ARKANSAS

## K-12 SCIENCE STANDARDS

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EDUCATION FOR A NEW GENERATION

# Grade 4

# 2015

Realigned Fall 2024 to the Arkansas Mathematics Standards  
and Arkansas English Language Arts Standards

**Grade 4 Learning Progression by Topic**

Grade 4			
LIFE SCIENCES	PHYSICAL SCIENCES		EARTH and SPACE SCIENCES
Structure, Function, and Information Processing	Waves	Energy	Earth's Systems: Processes that Shape the Earth
4-LS1-1 <sup>AR</sup>	4-PS4-1	4-PS3-1	4-ESS 1-1
4-LS1-2 <sup>AR</sup>	4-PS4-3	4-PS3-2	4-ESS 2-1
4-PS4-2		4-PS3-3	4-ESS 2-2
		4-PS3-4	4-ESS 3-2
		4-ESS3-1	
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 4-ETS1-1, 4-ETS1-2, 4-ETS1-3			

Arkansas Clarification Statement (<sup>AR</sup>)

**Grade 4 Learning Progression by Disciplinary Core Idea**

Grade 4					
LIFE SCIENCES	PHYSICAL SCIENCES		EARTH and SPACE SCIENCES		
From Molecules to Organisms: Structures and Processes	Energy	Waves and Their Applications in Technologies for Information Transfer	Earth's Place in the Universe	Earth's Systems	Earth and Human Activity
4-LS1-1 <sup>AR</sup>	4-PS3-1	4-PS4-1	4-ESS1-1	4-ESS2-1	4-ESS3-1
4-LS1-2 <sup>AR</sup>	4-PS3-2	4-PS4-3		4-ESS2-2	4-ESS3-2
	4-PS3-3				
	4-PS3-4				
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 4-ETS1-1, 4-ETS1-2, 4-ETS1-3					

Arkansas Clarification Statement (<sup>AR</sup>)

## **Fourth Grade Standards Overview**

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

### **Science and Engineering Practices**

Students are expected to demonstrate grade-appropriate proficiency in

- asking questions,
- developing and using models,
- planning and carrying out investigations,
- analyzing and interpreting data,
- constructing explanations and designing solutions,
- engaging in argument from evidence, and
- obtaining, evaluating, and communicating information.

Students are expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

### **Crosscutting Concepts**

Students are expected to demonstrate grade-appropriate understanding of

- patterns,
- cause and effect,
- energy and matter,
- systems and system models,
- interdependence of science, engineering, and technology, and
- influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for the disciplinary core ideas.

### **Disciplinary Core Ideas**

Students are expected to continually build on and revise their knowledge of

- PS3- Energy,
- PS4- Waves and Their Applications in Technologies for Information Transfer,
- LS1- From Molecules to Organisms: Structures and Processes,
- ESS1- Earth's Place in the Universe,
- ESS2- Earth's Systems,
- ESS3- Earth and Human Activity, and
- ETS1- Engineering Design in a 3-5 developmental learning progression.

### **Physical Sciences (PS)**

The (PS) performance expectations in fourth grade help students formulate answers to the questions, "What are waves and what are some things they can do?", "What is energy and how is it related to motion?", "How is energy transferred?", and "How can energy be used to solve a problem?" Students use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. By using a model, fourth grade students describe that an object can be seen when light reflected from its surface enters the eye. Students use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. Students apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.

### **Life Sciences (LS)**

The (LS) performance expectations in fourth grade help students explore the question, "How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals?" Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

### **Earth and Space Sciences (ESS)**

The (ESS) performance expectations in fourth grade help students investigate the questions, "How can water, ice, wind and vegetation change the land?" and "What patterns of Earth's features can be determined with the use of maps?" Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps.

### **Engineering, Technology, and Applications of Science (ETS)**

Engineering design performance expectations in the earliest grades introduce students to problems as situations that people want to change. With increased maturity students in third through fifth grade are able to develop these capabilities in various scientific contexts. The engineering design process involves three stages:

- **Defining and delimiting engineering problems** involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits. In this grade range the additional step of specifying criteria and constraints.
- **Designing solutions to engineering problems** begins with generating a number of different possible solutions, and then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem. In this grade range students generate several alternative solutions and compare them systematically to see which best meet the criteria and constraints of the problem.
- **Optimizing the engineering design** involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important. In this grade range students build and test models or prototypes using controlled experiments in which only one variable is changed from trial to trial while all other variables are kept the same.

In the fourth grade students are still developing the ability to achieve all three performance expectations (4-ETS1-1, 4-ETS1-2, 4-ETS1-3) related to a single problem in order to understand the interrelated processes of engineering design. Students can use tools and materials to solve simple problems, use visual or physical representations to convey solutions, and compare different solutions to a problem, test them, and determine which is best. These component ideas do not always follow in order. At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that is not working.

## GRADE FOUR

### Structure, Function, and Information Processing

Students who demonstrate understanding can:

- 4-PS4-2** Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected or seen, the cellular mechanisms of vision, or how the retina works.]
- 4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [AR Clarification Statement: Examples of structures for survival could include thorns and teeth. Examples of structures for growth could include stems and the skeleton. Examples of structures for behavior could include roots and the brain. Examples of reproduction could include pistils, stamens, and eggs.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]
- 4-LS1-2** Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. [Clarification Statement: Emphasis is on systems of information transfer. Use of models could include diagrams, computer simulations, and physical models.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> <li>■ Develop a model to describe phenomena. (4-PS4-2)</li> <li>■ Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>■ Construct an argument with evidence, data, and/or a model. (4-LS1-1)</li> </ul>	<p><b>PS4.B: Electromagnetic Radiation</b></p> <ul style="list-style-type: none"> <li>■ An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)</li> </ul> <p><b>LS1.A: Structure and Function</b></p> <ul style="list-style-type: none"> <li>■ Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)</li> </ul> <p><b>LS1.D: Information Processing</b></p> <ul style="list-style-type: none"> <li>■ Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>■ Cause and effect relationships are routinely identified. (4-PS4-2)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>■ A system can be described in terms of its components and their interactions. (4-LS1-1, 4-LS1-2)</li> </ul>

*Connections to other DCIs in fourth grade:* N/A

*Connections to other DCIs across grade levels:* **1.PS4.B** (4-PS4-2); **1.LS1.A** (4-LS1-1); **1.LS1.D** (4-LS1-2); **3.LS3.B** (4-LS1-1); **6.LS1.A** (4-LS1-1, 4-LS1-2); **6.LS1.D** (4-PS4-2, 4-LS1-2); **8.PS4.B** (4-PS4-2)

*Connections to the Arkansas English Language Arts Standards –*

- 4.W.1.S** Write an opinion (argument) to convince the reader to take action or adopt a position, including logical reasons supported by evidence from relevant sources. (4-LS1-1)
- 4.CC.4.P** Use visual displays and/or audio appropriately to emphasize or enhance certain facts or details when presenting. (4-PS4-2, 4-LS1-2)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.4** Select and use relationships and tools. (4-PS4-2)
- 4.GM.4** Identify and draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines, identifying these in quadrilaterals and triangles. (4-PS4-2)
- 4.GM.6** Identify and/or draw lines of symmetry for a two-dimensional figure. (4-LS1-1)

## GRADE FOUR

### Waves: Waves and Information

Students who demonstrate understanding can:

**4-PS4-1 Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]

**4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information.\*** [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1s and 0s representing black and white to send information about a picture, or using Morse code to send text.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> <li>Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)</li> </ul> <hr/> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Science findings are based on recognizing patterns. (4-PS4-1)</li> </ul>	<p><b>PS4.A: Wave Properties</b></p> <ul style="list-style-type: none"> <li>Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (4-PS4-1)</li> <li>Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)</li> </ul> <p><b>PS4.C: Information Technologies and Instrumentation</b></p> <ul style="list-style-type: none"> <li>Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information-convert it from digitized form to voice-and vice versa. (4-PS4-3)</li> </ul> <p><b>ETS1.C: Optimizing The Design Solution</b></p> <ul style="list-style-type: none"> <li>Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (4-PS4-3)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)</li> <li>Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)</li> </ul> <hr/> <p style="text-align: center;"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Interdependence of Science, Engineering, and Technology</b></p> <ul style="list-style-type: none"> <li>Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)</li> </ul>

*Connections to other DCIs in fourth grade:* **4.PS3.A** (4-PS4-1); **4.PS3.B** (4-PS4-1); **4.ETS1.A** (4-PS4-3)

*Connections to other DCIs across grade levels:* **K-2.ETS1.A** (4-PS4-3); **1.PS4.C** (4-PS4-3); **K-2.ETS1.B** (4-PS4-3); **K-2.ETS1.C** (4-PS4-3); **3.PS2.A** (4-PS4-3); **6-8.ETS1.B** (4-PS4-3); **8.PS4.A** (4-PS4-1); **8.PS4.C** (4-PS4-3)

*Connections to the Arkansas English Language Arts Standards –*

**4.RC.2.RF** Answer explicit and inferential questions, using details from a text. (4-PS4-3)

**4.RC.15.RI** Integrate information from two texts on the same topic when writing or speaking about the topic. (4-PS4-3)

**4.CC.4.P** Use visual displays and/or audio appropriately to emphasize or enhance certain facts or details when presenting. (4-PS4-1)

*Connections to the Arkansas Mathematics Standards –*

**AR.M.4** Select and use relationships and tools. (4-PS4-1)

**4.GM.4** Identify and draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines, identifying these in quadrilaterals and triangles. (4-PS4-1)

## GRADE FOUR

Energy	
Students who demonstrate understanding can:	
<b>4-PS3-1</b>	<b>Use evidence to construct an explanation relating the speed of an object to the energy of that object.</b> [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]
<b>4-PS3-2</b>	<b>Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</b> [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
<b>4-PS3-3</b>	<b>Ask questions and predict outcomes about the changes in energy that occur when objects collide.</b> [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
<b>4-PS3-4</b>	<b>Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*</b> [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion, light, or sound energy; or, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, and time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]
<b>4-ESS3-1</b>	<b>Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.</b> [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, or sunlight; non-renewable energy resources are fossil fuels or fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from the burning of fossil fuels.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in grades 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> <li>Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)</li> </ul>	<p><b>PS3.A: Definitions of Energy</b></p> <ul style="list-style-type: none"> <li>The faster a given object is moving, the more energy it possesses. (4-PS3-1)</li> <li>Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2, 4-PS3-3)</li> </ul> <p><b>PS3.B: Conservation of Energy and Energy Transfer</b></p> <ul style="list-style-type: none"> <li>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. (4-PS3-2, 4-PS3-3)</li> <li>Light also transfers energy from place to place. (4-PS3-2)</li> <li>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. (4-PS3-2, 4-PS3-4)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)</li> </ul> <p><b>Energy and Matter</b></p> <ul style="list-style-type: none"> <li>Energy can be transferred in various ways and between objects. (4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4)</li> </ul> <p style="text-align: center;">-----</p> <p style="text-align: center;"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Interdependence of Science, Engineering, and Technology</b></p> <ul style="list-style-type: none"> <li>Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)</li> </ul> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)</li> <li>Engineers improve existing technologies or develop new ones. (4-PS3-4)</li> </ul>

<p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)</li> <li>Apply scientific ideas to solve design problems. (4-PS3-4)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in 3-5 builds on K-2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> <li>Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)</li> </ul>	<p><b>PS3.C: Relationship Between Energy and Forces</b></p> <ul style="list-style-type: none"> <li>When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)</li> </ul> <p><b>PS3.D: Energy in Chemical Processes and Everyday Life</b></p> <ul style="list-style-type: none"> <li>The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)</li> </ul> <p><b>ESS3.A: Natural Resources</b></p> <ul style="list-style-type: none"> <li>Energy and fuels that humans 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. (4-ESS3-1)</li> </ul> <p><b>ETS1.A: Defining Engineering Problems</b></p> <ul style="list-style-type: none"> <li>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). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (4-PS3-4)</li> </ul>	<p>----- <b>Connections to Nature of Science</b></p> <p><b>Science is a Human Endeavor</b></p> <ul style="list-style-type: none"> <li>Most scientists and engineers work in teams. (4-PS3-4)</li> <li>Science affects everyday life. (4-PS3-4)</li> </ul>
<p><i>Connections to other DCIs in fourth grade:</i> NIA</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>K.PS2.B</b> (4-PS3-3); <b>K-2.ETS1.A</b> (4-PS3-4); <b>K-2.ETS1.B</b> (4-PS3-4); <b>3.PS2.A</b> (4-PS3-3); <b>5.PS3.D</b> (4-PS3-4); <b>5.LS1.C</b> (4-PS3-4); <b>5.ESS3.C</b> (4-ESS3-1); <b>8.PS2.A</b> (4-PS3-3); <b>8.PS2.B</b> (4-PS3-2); <b>8.PS3.A</b> (4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4); <b>8.PS3.B</b> (4-PS3-2, 4-PS3-3, 4-PS3-4); <b>6.PS3.C</b> (4-PS3-3); <b>6.PS3.D</b> (4-ESS3-1); <b>6.ESS3.C</b> (4-ESS3-1); <b>6.ESS3.D</b> (4-ESS3-1); <b>6-8.ETS1.B</b> (4-PS3-4); <b>6-8.ETS1.C</b> (4-PS3-4); <b>7.ESS2.A</b> (4-ESS3-1); <b>7.ESS3.A</b> (4-ESS3-1); <b>8.PS4.B</b> (4-PS3-2)</p>		

*Connections to the Arkansas English Language Arts Standards –*

- 4.RC.2.RF** Answer explicit and inferential questions, using details from a text. (4-PS3-1)
- 4.RC.15.RI** Integrate information from two texts on the same topic when writing or speaking about the topic. (4-PS3-1)
- 4.W.2.S** Write informative or explanatory pieces about a topic, using sources. (4-PS3-1)
- 4.W.9.P** Conduct short research by gathering and paraphrasing information from relevant experiences and/or from sources to produce a written response. (4-PS3-2, 4-PS3-3, 4-PS3-4, 4-ESS3-1)
- 4.W.10.P** Take notes, sort evidence into categories, and include a list of sources. (4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4, 4-ESS3-1)
- 4.W.2.S** Write informative or explanatory pieces about a topic, using sources. (4-PS3-1, 4-ESS3-1)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships. (4-ESS3-1)
- AR.M.4** Select and use relationships and tools. (4-ESS3-1)
- 4.DA.2** Use a line plot to display a data set of measurements in fractions of a unit, solving problems involving addition and subtraction of fractions with like denominators using data presented in line plots. (4-ESS3-1)
- 4.CAR.8** Solve multi-step, real-world problems posed with whole numbers and having whole-number answers, using addition, subtraction, multiplication, and division; include problems in which remainders must be interpreted and represent these problems using equations with symbols standing for the unknown quantity. (4-PS3-4)

## GRADE FOUR

### Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

- 4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]
- 4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, or volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]
- 4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]
- 4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.\*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building or improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

#### Science and Engineering Practices

##### Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)

##### Analyzing and Interpreting Data

Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)

#### Disciplinary Core Ideas

##### ESS1.C: The History of Planet Earth

- 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. (4-ESS1-1)

##### ESS2.A: Earth Materials and Systems

- Rainfall helps to 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. (4-ESS2-1)

##### ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

##### ESS2.E: Biogeology

- Living things affect the physical characteristics of their regions. (4-ESS2-1)

#### Crosscutting Concepts

##### Patterns

- Patterns can be used as evidence to support an explanation. (4-ESS1-1, 4-ESS2-2)

##### Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1, 4-ESS3-2)

##### Connections to Engineering, Technology, and Applications of Science

##### Influence of Engineering, Technology, and Science on Society and the Natural World

- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

<p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>Identify the evidence that supports particular points in an explanation. (4-ESS1-1)</li> <li>Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)</li> </ul>	<p><b>ESS3.B: Natural Hazards</b></p> <ul style="list-style-type: none"> <li>A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2)</li> </ul> <p><b>ETS1.B: Designing Solutions to Engineering Problems</b></p> <ul style="list-style-type: none"> <li>Testing a solution involves investigating how well it performs under a range of likely conditions.</li> </ul>	<p style="text-align: center;">----- - <b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b></p> <ul style="list-style-type: none"> <li>Science assumes consistent patterns in natural systems. (4-ESS1-1)</li> </ul>
<p><i>Connections to other DCIs in fourth grade:</i> <b>4.ETS1.C</b> (4-ESS3-2)</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>K-2.ETS1.A</b> (4-ESS3-2); <b>2.ESS1.C</b> (4-ESS1-1, 4-ESS2-1); <b>2.ESS2.A</b> (4-ESS2-1); <b>2.ESS2.B</b> (4-ESS2-2); <b>2.ESS2.C</b> (4-ESS2-2); <b>K-2.ETS1.B</b> (4-ESS3-2); <b>K-2.ETS1.C</b> (4-ESS3-2); <b>3.LS4.A</b> (4-ESS1-1); <b>5.ESS2.A</b> (4-ESS2-1); <b>5.ESS2.C</b> (4-ESS2-2); <b>6.ETS1.B</b> (4-ESS3-2); <b>7.ESS2.A</b> (4-ESS1-1, 4-ESS2-2, 4-ESS3-2); <b>7.ESS2.B</b> (4-ESS1-1, 4-ESS2-2); <b>7.ESS3.B</b> (4-ESS3-2); <b>8.LS4.A</b> (4-ESS1-1); <b>8.ESS1.C</b> (4-ESS1-1, 4-ESS2-2)</p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p>		
<p><b>4.RC.2.RF</b> Answer explicit and inferential questions, using details from a text. (4-ESS3-2)</p> <p><b>4.RC.17.RI</b> Explain how information presented visually, orally, or quantitatively (e.g., charts and graphs) contributes to a text. (4-ESS2-2)</p> <p><b>4.RC.15.RI</b> Integrate information from two texts on the same topic when writing or speaking about the topic. (4-ESS3-2)</p> <p><b>4.W.9.P</b> Conduct short research by gathering and paraphrasing information from relevant experiences and/or from sources to produce a written response. (4-ESS1-1, 4-ESS2-1)</p> <p><b>4.W.10.P</b> Take notes, sort evidence into categories, and include a list of sources. (4-ESS1-1, 4-ESS2-1)</p> <p><b>4.W.2.S</b> Write informative or explanatory pieces about a topic, using sources. (4-ESS1-1)</p>		
<p><i>Connections to the Arkansas Mathematics Standards –</i></p>		
<p><b>AR.M.2</b> Applying reasoning about quantities and relationships. (4-ESS1-1, 4-ESS2-1, 4-ESS3-2)</p> <p><b>AR.M.4</b> Select and use relationships and tools. (4-ESS1-1, 4-ESS2-1, 4-ESS3-2)</p> <p><b>AR.M.5</b> Identify relationships using structure and patterns. (4-ESS2-1)</p> <p><b>4.DA.2</b> Use a line plot to display a data set of measurements in fractions of a unit, solving problems involving addition and subtraction of fractions with like denominators using data presented in line plots. (4-ESS3-2)</p> <p><b>4.GM.8</b> Convert measurements of length, weight/mass, and liquid volume within the same system of measurement, metric and customary, expressing measurements of a larger unit in terms of a smaller unit. (4-ESS1-1, 4-ESS2-1)</p> <p><b>4.GM.9</b> Solve real-world problems involving time intervals that may cross the hour. (4-ESS2-1, 4-ESS2-2)</p> <p><b>4.GM.10</b> Solve real-world problems involving addition and subtraction of money, including the ability to make change. (4-ESS2-1, 4-ESS2-2)</p> <p><b>4.GM.11</b> Solve real-world problems involving distances, liquid volume, and masses of objects, including problems that require expressing measurements given in a larger unit in terms of a smaller unit. (4-ESS2-1, 4-ESS2-2)</p>		

## GRADE FOUR

Engineering, Technology, and Applications of Science		
<p>Students who demonstrate understanding can:</p> <p><b>4-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</b></p> <p><b>4-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</b></p> <p><b>4-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</b></p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> <li>Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (4-ETS1-1)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (4-ETS1-3)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (4-ETS1-2)</li> </ul>	<p><b>ETS1.A: Defining and Delimiting Engineering Problems</b></p> <ul style="list-style-type: none"> <li>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). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (4-ETS1-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (4-ETS1-2)</li> <li>At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (4-ETS1-2)</li> <li>Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (4-ETS1-3)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (4-ETS1-3)</li> </ul>	<p><b>Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>People's needs and wants change over time, as do their demands for new and improved technologies. (4-ETS1-1)</li> <li>Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (4-ETS1-2)</li> </ul>

*Connections to 3-5-ETS1.A: Defining and Delimiting Engineering Problems include: Fourth Grade: (4-PS3-4)*

*Connections to 3-5-ETS1.B: Designing Solutions to Engineering Problems include: Fourth Grade: (4-ESS3-2)*

*Connections to 3-5-ETS1.C: Optimizing the Design Solution include: Fourth Grade: (4-PS4-3)*

*Connections to other DCIs across grade levels: K-2.ET51.A (4-ETS1-1, 4-ETS1-2, 4-ETS1-3); K-2.ET51.B (4-ETS1-2);*

*K-2.ET51.C (4-ETS1-2, 4-ETS1-3); 6-8.ET51.A (4-ETS1-1); 6-8.ET51.B (4-ETS1-1, 4-ETS1-2, 4-ETS1-3);*

*6-8.ET51.C (4-ETS1-2, 4-ETS1-3)*

*Connections to the Arkansas English Language Arts Standards –*

**4.RC.2.RF** Answer explicit and inferential questions, using details from a text. (3-ETS1-2)

**4.RC.17.RI** Explain how information presented visually, orally, or quantitatively (e.g., charts and graphs) contributes to a text. (4-ETS1-2)

**4.RC.15.RI** Integrate information from two texts on the same topic when writing or speaking about the topic. (4-ETS1-2)

**4.W.9.P** Conduct short research by gathering and paraphrasing information from relevant experiences and/or from sources to produce a written response. (4-ETS1-1, 4-ETS1-3)

**4.W.10.P** Take notes, sort evidence into categories, and include a list of sources. (4-ETS1-1, 4-ETS1-3)

**4.W.2.S** Write informative or explanatory pieces about a topic, using sources. (4-ETS1-1, 4-ETS1-3)

*Connections to the Arkansas Mathematics Standards –*

**AR.M.2** Applying reasoning about quantities and relationships. (4-ETS1-1, 4-ETS1-2, 4-ETS1-3)

**AR.M.4** Select and use relationships and tools. (4-ETS1-1, 4-ETS1-2, 4-ETS1-3)

**AR.M.5** Identify relationships using structure and patterns. (4-ETS1-1, 4-ETS1-2, 4-ETS1-3)

**4.CAR.1** Find the factor pairs for a given number in the range of 1-100, identifying whether a number is prime or composite; determine whether a given whole number in the range of 1-100 is a multiple of a given one-digit number. (4-ETS1-1, 4-ETS1-2)

**4.CAR.7** Solve real-world problems involving multiplicative comparison, using drawings and/or equations with a symbol for the unknown number, and distinguish between multiplicative comparison and additive comparison. (4-ETS1-1, 4-ETS1-2)

**4.CAR.8** Solve multi-step, real-world problems posed with whole numbers and having whole-number answers, using addition, subtraction, multiplication, and division; include problems in which remainders must be interpreted and represent these problems using equations with symbols standing for the unknown quantity. (4-ETS1-1, 4-ETS1-2)

**4.CAR.11** Generate a number or shape pattern that follows a given rule, identifying apparent features of the pattern that are not explicit in the rule itself. (4-ETS1-1, 4-ETS1-2)

**4.DA.2** Use a line plot to display a data set of measurements in fractions of a unit, solving problems involving addition and subtraction of fractions with like denominators using data presented in line plots. (4-ETS1-1, 4-ETS1-2)

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# ARKANSAS

## K-12 SCIENCE STANDARDS

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EDUCATION FOR A NEW GENERATION

### Grade 5

# 2015

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# How to Read Arkansas K-12 Science Standards

Topic

GRADE TWO

An asterisk indicates an engineering connection to a practice or disciplinary core idea.

**Interdependent Relationships in Ecosystems**

Students who demonstrate understanding can:

**2-LS2-1** Plan and conduct an investigation to determine if plants need sunlight and water to grow. [Assessment Boundary: Assessment is limited to testing one variable.] \*

**2-LS2-2** Develop a simple model that mimics the function of plants, animals, or ecosystems in different habitats. [Clarification Statement: Emphasis is on the diversity of living things in a variety of habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

**2-LS4-1** Make observations of plants and animals to compare growth and behavior over time.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan and conduct an investigation collaboratively to produce data as the basis for evidence to answer a question. (2-LS2-1)</li> <li>Make observations (firsthand or from media) to collect data that can be used to make comparisons. (2-LS4-1)</li> </ul> <hr/> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Scientists look for patterns and order when making observations about the world. (2-LS4-1)</li> </ul>	<p><b>LS2.A: Interdependent Relationships in Ecosystems</b></p> <ul style="list-style-type: none"> <li>Plants depend on water and light to grow. (2-LS2-1)</li> <li>Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)</li> </ul> <p><b>LS4.D: Biodiversity and Humans</b></p> <ul style="list-style-type: none"> <li>There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (2-LS2-2)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Events have causes that generate observable patterns. (2-LS2-1)</li> </ul> <p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)</li> </ul>

*Connections to other DCIs in second grade: N/A*

*Connections to other DCIs across grade levels: K.LS1.C (2-LS2-1); K.ESS3.A (2-LS2-1); K-2.ETS1.A (2-LS2-2); 3.LS4.C (2-LS4-1); 3.LS4.D (2-LS4-1); 5.LS1.C (2-LS2-1); 5.LS2.A (2-LS2-2, 2-LS4-1)*

Connections to the Arkansas English Language Arts and Mathematics Standards are often found by scrolling to the next page

## Arkansas K-12 Science Standards Overview

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

As part of teaching the Arkansas K-12 Science Standards, it will be important to instruct and guide students in adopting appropriate safety precautions for their student-directed science investigations. Reducing risk and preventing accidents in science classrooms begin with planning. The following four steps are recommended in carrying out a hazard and risk assessment for any planned lab investigation:

- 1) Identify all hazards. Hazards may be physical, chemical, health, or environmental.
- 2) Evaluate the type of risk associated with each hazard.
- 3) Write the procedure and all necessary safety precautions in such a way as to eliminate or reduce the risk associated with each hazard.
- 4) Prepare for any emergency that might arise in spite of all of the required safety precautions.

According to Arkansas Code Annotated § 6-10-113 (2012) for eye protection, every student and teacher in public schools participating in any chemical or combined chemical-physical laboratories involving caustic or explosive chemicals or hot liquids or solids is required to wear industrial-quality eye protective devices (eye goggles) at all times while participating in science investigations.

The Arkansas K-12 Science Standards outline the knowledge and science and engineering practices that all students should learn by the end of high school. The standards are three-dimensional because each student performance expectation engages students at the nexus of the following three dimensions:

- Dimension 1 describes scientific and engineering practices.
- Dimension 2 describes crosscutting concepts, overarching science concepts that apply across science disciplines.
- Dimension 3 describes core ideas in the science disciplines.

### Science and Engineering Practices

The eight practices describe what scientists use to investigate and build models and theories of the world around them or that engineers use as they build and design systems. The practices are essential for all students to learn and are as follows:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

### Crosscutting Concepts

The seven crosscutting concepts bridge disciplinary boundaries and unit core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas, and develop a coherent, and scientifically based view of the world. The seven crosscutting concepts are as follows:

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

2. *Cause and effect- Mechanism and explanation.* Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
3. *Scale, proportion, and quantity-* In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
4. *Systems and system models-* Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
5. *Energy and matter: Flows, cycles, and conservation-* Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
6. *Structure and function-* The way in which an object or living thing is shaped and its substructure determines many of its properties and functions.
7. *Stability and change-* For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

### Disciplinary Core Ideas

The disciplinary core ideas describe the content that occurs at each grade or course. The Arkansas K-12 Science Standards focus on a limited number of core ideas in science and engineering both within and across the disciplines and are built on the notion of learning as a developmental progression. The Disciplinary Core Ideas are grouped into the following domains:

- Physical Science (PS)
- Life Science (LS)
- Earth and Space Science (ESS)
- Engineering, Technology and Applications of Science (ETS)

### Connections to the Arkansas English Language Arts Standards

Evidence-based reasoning is the foundation of good scientific practice. The Arkansas K-12 Science Standards incorporate reasoning skills used in language arts to help students improve mastery and understanding in all three disciplines. The Arkansas K-8 Science Committee made every effort to align grade-by-grade with the English language arts (ELA) standards so concepts support what students are learning in their entire curriculum. Connections to specific ELA standards are listed for each student performance expectation, giving teachers a blueprint for building comprehensive cross-disciplinary lessons.

The intersections between Arkansas K-12 Science Standards and Arkansas ELA Standards teach students to analyze data, model concepts, and strategically use tools through productive talk and shared activity. Reading in science requires an appreciation of the norms and conventions of the discipline of science, including understanding the nature of evidence used, an attention to precision and detail, and the capacity to make and assess intricate arguments, synthesize complex information, and follow detailed procedures and accounts of events and concepts. These practice-based standards help teachers foster a classroom culture where students think and reason together, connecting around the subject matter and core ideas.

### Connections to the Arkansas Disciplinary Literacy Standards

Reading is critical to building knowledge in science. College and career ready reading in science requires an appreciation of the norms and conventions of each discipline, such as the kinds of evidence used in science; an understanding of domain-specific words and phrases; an attention to precise details; and the capacity to evaluate intricate arguments, synthesize complex information, and follow detailed descriptions of events and concepts. When reading scientific and technical texts, students need to be able to gain knowledge from challenging texts that often make extensive use of elaborate diagrams and data to convey information and illustrate concepts. Students must be able to read complex informational texts in science with independence and confidence because the vast majority of reading in college and workforce training programs will be sophisticated nonfiction.

For students, writing is a key means of asserting and defending claims, showing what they know about science, and conveying what they have experienced, imagined, thought, and felt. To be college and career ready writers, students must take task, purpose, and audience into careful consideration, choosing words, information, structures, and formats deliberately. They need to be able to use technology strategically when creating, refining, and collaborating on writing. They have to become adept at gathering information, evaluating sources, and citing material accurately, reporting finds from their research and analysis of sources in a clear and cogent manner. They must have the flexibility, concentration, and fluency to produce high-quality first-draft text under a tight deadline and the capacity to revisit and make improvements to a piece of writing over multiple drafts when circumstances encourage or require it.

### Connections to the Arkansas Mathematics Standards

Science is a quantitative discipline, so it is important for educators to ensure that students' science learning coheres well with their understanding of mathematics. To achieve this alignment, the Arkansas K-12 Science Committee made every effort to ensure that the mathematics standards do not outpace or misalign to the grade-by-grade science standards. Connections to specific math standards are listed for each student performance expectation, giving teachers a blueprint for building comprehensive cross-disciplinary lessons.

Table below lists key topics relevant to science and the grades at which topics are first expected in the Arkansas Mathematics Standards.

<b>Number and Operations</b>	<b>Grade First Expected</b>
The coordinate plane	5
Ratios, rates (e.g. speed), proportional relationships	6
Simple percent problems	6
Rational number system/signed numbers-concepts	6
Rational number system/signed numbers-arithmetic	7
<b>Measurement</b>	<b>Grade First Expected</b>
Convert units within a given measurement system	5
Volume	5
Convert units across measurement systems (e.g. inches to cm)	6
<b>Statistics and Probability</b>	<b>Grade First Expected</b>
Statistical distributions (including center, variation, clumping, outliers, mean, median, mode, range, quartiles), and statistical association or trends (including two-way tables, bivariate measurement data, scatter plots, trend line, line of best fit, correlation)	6-8
Probability, including chance, likely outcomes, probability models	7

## Grades 5-8 Science Core Ideas and Topics Overview

Grades 5-8 Science Core Ideas and Topics Overview								
<b>Grade 5</b>	PHYSICAL SCIENCES		LIFE SCIENCES			EARTH and SPACE SCIENCES		
	5. Structure and Properties of Matter		5. Matter and Energy in Organisms and Ecosystems			5. Earth's Systems	5. Space Systems	
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE 5. Engineering Design								
Grades 5-8 Science Core Ideas and Topics Overview								
<b>Grade 6</b>	PHYSICAL SCIENCES		LIFE SCIENCES		EARTH and SPACE SCIENCES			
	6. Energy		6. Structure, Function, and Information Processing	6. Growth, Development, and Reproduction of Organisms	6. Earth's Systems	6. Human Impacts	6. Weather and Climate	
Grades 5-8 Science Core Ideas and Topics Overview								
<b>Grade 7</b>	PHYSICAL SCIENCES		LIFE SCIENCES		EARTH and SPACES SCIENCES			
	7. Structure and Properties of Matter	7. Chemical Reactions	7. Interdependent Relationships in Ecosystems	7. Matter and Energy in Organisms and Ecosystems	7. Earth's Systems	7. History of Earth	7. Human Impacts	
Grades 5-8 Science Core Ideas and Topics Overview								
<b>Grade 8</b>	PHYSICAL SCIENCES		LIFE SCIENCES		EARTH and SPACES SCIENCES			
	8. Waves and Electromagnetic Radiation	8. Forces and Interactions	8. Growth, Development, and Reproduction of Organisms	8. Natural Selection and Adaptations	8. Energy	8. Space Systems	8. History of Earth	
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE 6-8. Engineering Design								

## Science Grades 5-8 Overview

The Arkansas K-12 Science Standards for Grades 5-8 is a curriculum framework of grade level student performance expectations based on the core ideas of the physical sciences (PS), life sciences (LS), earth and space sciences (ESS), and engineering (ETS) from *A Framework for K-12 Science Education* (NRC 2012). The performance expectations build logically from Grades K-4 to Grades 5-8. The performance expectations clarify what students need to know and be able to do at the end of each grade. Student performance expectations consist of three dimensions: science and engineering practices, disciplinary core ideas, and crosscutting concepts. Engineering performance expectations are meant to be integrated into science instruction to support the learning of science phenomena at all levels from Kindergarten to Grade 12.

As part of teaching the Arkansas K-12 Science Standards, it will be important to instruct and guide students in adopting appropriate safety precautions for their student-directed science investigations. Reducing risk and preventing accidents in science classrooms begin with planning. There are four recommended steps in carrying out a hazard and risk assessment for any planned lab investigation.

- 1) Identify all hazards. Hazards may be physical, chemical, health, or environmental.
- 2) Evaluate the type of risk associated with each hazard.
- 3) Write the procedure and all necessary safety precautions in such a way as to eliminate or reduce the risk associated with each hazard.
- 4) Prepare for any emergency that might arise in spite of all of the required safety precautions.

According to Arkansas Code Annotated § 6-10-113 (2012) for eye protection, every student and teacher in public schools participating in any chemical or combined chemical-physical laboratories involving caustic or explosive chemicals or hot liquids or solids is required to wear industrial-quality eye protective devices (eye goggles) at all times while participating in science investigations.

### Notes:

1. Student Performance Expectations (PEs) may be taught in any sequence or grouping within a grade level.
2. An asterisk (\*) indicates an engineering connection to a practice, core idea, or crosscutting concept.
3. The Clarification Statements are examples and additional guidance for the instructor. **AR** indicates Arkansas-specific Clarification Statements.
4. The Assessment Boundaries delineate content that may be taught but not assessed in large-scale assessments. **AR** indicates Arkansas-specific Assessment Boundaries.
5. The examples given (e.g.,) are suggestions for the instructor.
6. Throughout this document, connections are provided to the nature of science as defined by *A Framework for K-12 Science Education* (NRC 2012).
7. Throughout this document, connections are provided to Engineering, Technology, and Applications of Science as defined by *A Framework for K-12 Science Education* (NRC 2012).
8. Each set of PEs lists connections to other disciplinary core ideas (DCIs) within the Arkansas K-12 Science Standards and to the Arkansas Mathematics Standards, Arkansas English Language Arts Standards, and Arkansas Disciplinary Literacy Standards.

**Grade 5 Learning Progression by Topic**

Grade 5				
EARTH and SPACE SCIENCES		PHYSICAL SCIENCES		LIFE SCIENCES
Earth's Systems	Space Systems	Structure and Properties of Matter	Matter and Energy in Organisms and Ecosystems	
5-ESS2-1	5-PS2-1	5-PS1-1	5-PS3-1	
5-ESS2-2	5-ESS1-1	5-PS 1-2 <sup>AR</sup>	5-LS1-1	
5-ESS3-1	5-ESS1-2	5-PS1-3	5-LS2-1	
		5-PS1-4 <sup>AR</sup>		
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 5-ETS1-1, 5-ETS1-2, 5-ETS1-3				

Arkansas Clarification Statement/Assessment Boundary (<sup>AR</sup>)

**Grade 5 Learning Progression by Disciplinary Core Idea**

Grade 5							
EARTH and SPACE SCIENCES			PHYSICAL SCIENCES			LIFE SCIENCES	
Earth's Place in the Universe	Earth's Systems	Earth and Human Activity	Matter and its Interactions	Motion and Stability: Forces and Interactions	Energy	From Molecules to Organisms: Structures and Processes	Ecosystems: Interactions, Energy, and Dynamics
5-ESS1-1	5-ESS2-1	5-ESS3-1	5-PS1-1	5-PS2-1	5-PS3-1	5-LS1-1	5-LS2-1
	5-ESS2-2		5-PS1-2 <sup>AR</sup>				
			5-PS1-3				
			5-PS1-4 <sup>AR</sup>				
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 5-ETS1-1, 5-ETS1-2, 5-ETS1-3							

Arkansas Clarification Statement/Assessment Boundary (<sup>AR</sup>)

## **Grade Five Standards Overview**

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

### **Science and Engineering Practices**

Students are expected to demonstrate grade-appropriate proficiency in

- developing and using models,
- planning and carrying out investigations,
- analyzing and interpreting data,
- using mathematics and computational thinking,
- engaging in argument from evidence, and
- obtaining, evaluating, and communicating information.

Students are expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

### **Crosscutting Concepts**

Students are expected to demonstrate grade-appropriate understanding of

- patterns,
- cause and effect,
- scale, proportion, and quantity,
- energy and matter,
- systems and systems models, and
- the influence of engineering, technology, and science on society and the natural world as organizing concepts for the disciplinary core ideas.

### **Disciplinary Core Ideas**

Students are expected to continually build on and revise their knowledge of

- PS1 - Matter and Its Interactions,
- PS2 - Motion and Stability: Forces and Interactions,
- PS3 - Energy,
- LS1 - Molecules to Organisms: Structures and Processes,
- LS2 - Ecosystems: Interactions, Energy, and Dynamics,
- ESS1 - Earth's Place in the Universe,
- ESS2 - Earth's Systems,
- ESS3 - Earth and Human Activity, and
- ETS1- Engineering Design in a 3-5 developmental learning progression.

### **Physical Sciences (PS)**

The (PS) performance expectations in fifth grade help students formulate answers to the questions, “Can new substances be created by combining other substances?” and “When matter changes, does its weight change?” Fifth grade students are expected to be able to describe that matter is made of particles too small to be seen through the development of a model. Students determine whether the mixing of two or more substances results in new substances. Students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved.

### **Life Sciences (LS)**

The (LS) performance expectations in fifth grade help students explore the questions, “Where does the energy in food come from?” and “What is it used for?” Students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals’ food was once energy from the sun.

### **Earth and Space Sciences (ESS)**

The (ESS) performance expectations in fifth grade help students investigate the questions, “How much water can be found in different places on Earth?”, “How does matter cycle through ecosystems?”, and “How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?” Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. Through the development of a model, fifth grade students describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. Students describe and graph data to provide evidence about the distribution of water on Earth.

### **Engineering, Technology, and Applications of Science (ETS)**

Engineering design performance expectations in the earliest grades introduce students to problems as situations that people want to change. With increased maturity students in third through fifth grade are able to develop these capabilities in various scientific contexts. The engineering design process involves three stages:

- **Defining and delimiting engineering problems** involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits. In this grade range the additional step of specifying criteria and constraints.
- **Designing solutions to engineering problems** begins with generating a number of different possible solutions, and then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem. In this grade range students generate several alternative solutions and compare them systematically to see which best meet the criteria and constraints of the problem.
- **Optimizing the engineering design** involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important. In this grade range students build and test models or prototypes using controlled experiments in which only one variable is changed from trial to trial while all other variables are kept the same.

By the end of fifth grade students should be able to achieve all three performance expectations (5-ETS1-1, 5-ETS1-2, 5-ETS1-3) related to a single problem in order to understand the interrelated processes of engineering design. Students can use tools and materials to solve simple problems, use visual or physical representations to convey solutions, and compare different solutions to a problem, test them, and determine which is best. These component ideas do not always follow in order. At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that is not working.

## GRADE FIVE

Earth's Systems		
<p>Students who demonstrate understanding can:</p> <p><b>5-ESS2-1</b> <b>Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.</b> [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; or the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]</p> <p><b>5-ESS2-2</b> <b>Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.</b> [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]</p> <p><b>5-ESS3-1</b> <b>Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.</b></p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<p style="text-align: center;"><b>Science and Engineering Practices</b></p> <p><b>Developing and Using Models</b> Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> <li>Develop a model using an example to describe a scientific principle. (5-ESS2-1)</li> </ul> <p><b>Using Mathematics and Computational Thinking</b> Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.</p> <ul style="list-style-type: none"> <li>Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> <li>Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)</li> </ul>	<p style="text-align: center;"><b>Disciplinary Core Ideas</b></p> <p><b>ESS2.A: Earth Materials and Systems</b></p> <ul style="list-style-type: none"> <li>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. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)</li> </ul> <p><b>ESS2.C: The Roles of Water in Earth's Surface Processes</b></p> <ul style="list-style-type: none"> <li>Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)</li> </ul> <p><b>ESS3.C: Human Impacts on Earth Systems</b></p> <ul style="list-style-type: none"> <li>Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)</li> </ul>	<p style="text-align: center;"><b>Crosscutting Concepts</b></p> <p><b>Scale, Proportion, and Quantity</b></p> <ul style="list-style-type: none"> <li>Standard units are used to measure and describe physical quantities such as weight, and volume. (5-ESS2-2)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions. (5-ESS2-1, 5-ESS3-1)</li> </ul> <p style="text-align: center;">-----</p> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Science Addresses Questions About the Natural and Material World</b></p> <ul style="list-style-type: none"> <li>Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)</li> </ul>
<p><i>Connections to other Disciplinary Core Ideas (DCIs) in fifth grade: N/A</i></p>		
<p><i>Connections to other DCIs across grade levels: 2.ESS2.A (5-ESS2-1); 2.ESS2.C (5-ESS2-2); 3.ESS2.D (5-ESS2-1); 4.ESS2.A (5-ESS2-1); 7.ESS2.A (5-ESS2-1); 7.ESS2.C (5-ESS2-1, 5-ESS2-2); 6.ESS2.D (5-ESS2-1); 7.ESS3.A (5-ESS2-2, 5-ESS3-1); 6.ESS3.C (5-ESS3-1); 6.ESS3.D (5-ESS3-1)</i></p>		

*Connections to the Arkansas English Language Arts Standards –*

- 5.RC.2.RF** Answer explicit and inferential questions, using details from a text. (5-ESS3-1)
- 5.RC.15.RI** Integrate information from several texts on the same topic when writing or speaking about the topic. (5-ESS2-1, 5-ESS2-2, 5-ESS3-1)
- 5.W.10.P** Take notes, sort evidence into categories, and include a list of sources. (5-ESS2-2, 5-ESS3-1)
- 5.W.2.S** Write informative or explanatory pieces, using multiple sources to examine a topic. (5-ESS31)
- 5.CC.4.P** Use visual displays and/or audio appropriately to emphasize or enhance certain facts or details when presenting. (5-ESS2-1, 5-ESS2-2)

*Connections to the Arkansas Mathematics Standards–*

- AR.M.2** Applying reasoning about quantities and relationships. (5-ESS2-1, 5-ESS2-2, 5-ESS3-1)
- AR.M.4** Select and use relationships and tools (5-ESS2-1, 5-ESS2-2, 5-ESS3-1)
- 5.GM.8** Represent real-world and mathematical problems by graphing points in the first quadrant on a coordinate plane, interpreting coordinate values of points in the context of the situation. (5-ESS2-1)

## GRADE FIVE

### Space Systems

Students who demonstrate understanding can:

- 5-PS2-1** Support an argument that the gravitational force exerted by Earth on objects is directed down. [Clarification Statement: “Down” is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]
- 5-ESS1-1** Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. [Assessment Boundary: Assessment is limited to relative distances rather than sizes of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, or stage).]
- 5-ESS1-2** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and select stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Analyzing and Interpreting Data</b> Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> <li>Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>Support an argument with evidence, data, or a model. (5-PS2-1, 5-ESS1-1)</li> </ul>	<p><b>PS2.B: Types of Interactions</b></p> <ul style="list-style-type: none"> <li>The gravitational force of Earth acting on an object near Earth’s surface pulls that object toward the planet’s center. (5-PS2-1)</li> </ul> <p><b>ESS1.A: The Universe and its Stars</b></p> <ul style="list-style-type: none"> <li>The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)</li> </ul> <p><b>ESS1.B: Earth and the Solar System</b></p> <ul style="list-style-type: none"> <li>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. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. (5-ESS1-2)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1)</li> </ul> <p><b>Scale, Proportion, and Quantity</b></p> <ul style="list-style-type: none"> <li>Natural objects exist from the very small to the immensely large. (5-ESS1-1)</li> </ul>
<p><i>Connections to other DCIs in fifth grade:</i> N/A</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>1.ESS1.A</b> (5-ESS1-2); <b>1.ESS1.B</b> (5-ESS1-2); <b>3.PS2.A</b> (5-PS2-1, 5-ESS1-2); <b>3.PS2.B</b> (5-PS2-1); <b>8.PS2.B</b> (5-PS2-1); <b>8.ESS1.A</b> (5-ESS1-1, 5-ESS1-2); <b>8.ESS1.B</b> (5-PS2-1, 5-ESS1-1, 5-ESS1-2); <b>7.ESS2.C</b> (5-PS2-1)</p>		

*Connections to the Arkansas English Language Arts Standards –*

- 5.RC.2.RF** Answer explicit and inferential questions, using details from a text. (5-PS2-1, 5-ESS1-1)
- 5.RC.15.RI** Integrate information from several texts on the same topic when writing or speaking about the topic. (5-PS2-1, 5-ESS1-1)
- 5.RC.14.RI** Identify which reasons and evidence an author uses to support which points. (5-ESS1-1)
- 5.W.1.S** Write an argument to persuade the reader to take an action or adopt a position, stating a claim and supporting the claim with relevant evidence from sources. (5-PS2-1, 5-ESS1-1)
- 5.CC.4.P** Use visual displays and/or audio appropriately to emphasize or enhance certain facts or details when presenting. (5-ESS1-2)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships. (5-ESS1-1, 5-ESS1-2)
- AR.M.4** Select and use relationships and tools. (5-ESS1-1, 5-ESS1-2)
- 5.GM.8** Represent real-world and mathematical problems by graphing points in the first quadrant on a coordinate plane, interpreting coordinate values of points in the context of the situation. (5-ESS1-2)
- 5.NPV.2** Explain patterns in the number of zeros and/or the decimal point when multiplying a number by a power of 10, using whole-number exponents to denote powers of 10. (5-ESS1-2)

## GRADE FIVE

### Structure and Properties of Matter

Students who demonstrate understanding can:

- 5-PS1-1** **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]
- 5-PS1-2** **Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.** [AR Clarification Statement: Examples could include chemical reactions that form new substances or physical changes including phase changes, dissolving, and mixing.] [AR Assessment Boundary: Assessment does not include distinguishing mass from weight or reactions that involve gases.]
- 5-PS1-3** **Make observations and measurements to identify materials based on their properties.** [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass from weight.]
- 5-PS1-4** **Conduct an investigation to determine whether the mixing of two or more substances results in new substances.** [AR Clarification Statement: Examples of qualitative evidence could include temperature change, color change, odor change, and the formation of a gas to determine if a new substance has formed.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

#### Science and Engineering Practices

##### Developing and Using Models

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena. (5-PS1-1)

##### Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4)
- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)

#### Disciplinary Core Ideas

##### PS1.A: Structure and Properties of Matter

- 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. 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 and the effects of air on larger particles or objects. (5-PS1-1)
- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)
- Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)

##### PS1.B: Chemical Reactions

- When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)
- No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)

#### Crosscutting Concepts

##### Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4)

##### Scale, Proportion, and Quantity

- Natural objects exist from the very small to the immensely large. (5-PS1-1)
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2, 5-PS1-3)

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##### Connections to Nature of Science

##### Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems. (5-PS1-2)

**Using Mathematics and Computational Thinking**

Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

*Connections to other DCIs in fifth grade:* N/A

*Connections to other DCIs across grade levels:* **2.PS1.A** (5-PS1-1, 5-PS1-2, 5-PS1-3); **2.PS1.B** (5-PS1-2, 5-PS1-4); **7.PS1.A** (5-PS1-1, 5-PS1-2, 5-PS1-3, 5-PS1-4); **7.PS1.B** (5-PS1-2, 5-PS1-4)

*Connections to the Arkansas English Language Arts Standards –*

- 5.RC.15.RI** Integrate information from several texts on the same topic when writing or speaking about the topic. (5-PS1-1)
- 5.W.9.P** Conduct short research, using quotations and summaries from relevant sources or experiences to produce a written product. (5-PS1.2, 5-PS1-3, 5-PS1-4)
- 5.W.10.P** Take notes, sort evidence into categories, and include a list of sources. (5-PS1.2, 5-PS1-3, 5-PS1-4)
- 5.W.2.S** Write informative or explanatory pieces, using multiple sources to examine a topic. (5-PS1.2, 5-PS1-3, 5-PS1-4)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships (5-PS1-1, 5-PS1-2, 5-PS1-3)
- AR.M.4** Select and use relationships and tools. (5-PS1-1, 5-PS1-2, 5-PS1-3)
- AR.M.5** Identify relationships using structure and patterns. (5-PS1-2, 5-PS1-3)
- 5.CAR.8** Apply previous understanding of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1)
- 5.CAR.11** Solve real-world problems involving the division of unit fractions by whole numbers and whole numbers by unit fractions, using visual fraction models and equations. (5-PS1-1)
- 5.GM.3** Measure volumes by counting unit cubes using cubic cm (cm<sup>3</sup>), cubic in (in<sup>3</sup>), cubic ft (ft<sup>3</sup>), and improvised units (u<sup>3</sup>). (5-PS1-1)
- 5.GM.6** Convert among different-sized standard measurement units within the same system, including both the metric and customary systems, and solve multi-step, real-world problems using conversions. (5-PS1-2)
- 5.NPV.1** Recognize that in a multi-digit number, a digit in a given place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left. (5-PS1-1)

Matter and Energy in Organisms and Ecosystems	
Students who demonstrate understanding can:	
<b>5-PS3-1</b>	<b>Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.</b> [Clarification Statement: Examples of models could include diagrams and flow charts.]
<b>5-LS1-1</b>	<b>Support an argument that plants get the materials they need for growth chiefly from air and water.</b> [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]
<b>5-LS2-1</b>	<b>Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.</b> [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :	

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> <li>Use models to describe phenomena. (5-PS3-1)</li> <li>Develop a model to describe phenomena. (5-LS2-1)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>Support an argument with evidence, data, or a model. (5-LS1-1)</li> </ul> <p>-----</p> <p><b>Connections to Nature of Science</b></p> <p><b>Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena</b></p> <ul style="list-style-type: none"> <li>Science explanations describe the mechanisms for natural events. (5-LS2-1)</li> </ul>	<p><b>PS3.D: Energy in Chemical Processes and Everyday Life</b></p> <ul style="list-style-type: none"> <li>The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1)</li> </ul> <p><b>LS1.C: Organization for Matter and Energy Flow in Organisms</b></p> <ul style="list-style-type: none"> <li>Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)</li> <li>Plants acquire their material for growth chiefly from air and water. (5-LS1-1)</li> </ul> <p><b>LS2.A: Interdependent Relationships in Ecosystems</b></p> <ul style="list-style-type: none"> <li>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 for food and other animals eat the animals that 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.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. 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. (5-LS2-1)</li> </ul>	<p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions. (5-LS2-1)</li> </ul> <p><b>Energy and Matter</b></p> <ul style="list-style-type: none"> <li>Matter is transported into, out of, and within systems. (5-LS1-1)</li> <li>Energy can be transferred in various ways and between objects. (5-PS3-1)</li> </ul>

**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**

- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)

*Connections to other DCIs in fifth grade:* **5.PS1.A** (5-LS1-1, 5-LS2-1); **5.ESS2.A** (5-LS2-1)

*Connections to other DCIs across grade levels:* **K.LS1.C** (5-PS3-1, 5-LS1-1); **2.PS1.A** (5-LS2-1); **2.LS2.A** (5-PS3-1, 5-LS1-1); **2.LS4.D** (5-LS2-1); **4.PS3.A** (5-PS3-1); **4.PS3.B** (5-PS3-1); **4.PS3.D** (5-PS3-1); **4.ESS2.E** (5-LS2-1); **6.PS3.D** (5-PS3-1, 5-LS2-1); **8.PS4.B** (5-PS3-1); **6.LS1.C** (5-PS3-1, 5-LS1-1, 5-LS2-1); **7.LS2.A** (5-LS2-1); **7.LS2.B** (5-PS3-1, 5-LS2-1)

*Connections to the Arkansas English Language Arts Standards –*

**5.RC.2.RF** Answer explicit and inferential questions, using details from a text. (5-LS1-1)

**5.RC.15.RI** Integrate information from several texts on the same topic when writing or speaking about the topic. (5-PS3-1, 5-LS2-1, 5-LS1-1)

**5.W.1.S** Write an argument to persuade the reader to take an action or adopt a position, stating a claim and supporting the claim with relevant evidence from sources. (5-LS1-1)

**5.CC.4.P** Use visual displays and/or audio appropriately to emphasize or enhance certain facts or details when presenting. (5-PS3-1, 5-LS2-1)

*Connections to the Arkansas Mathematics Standards –*

**AR.M.2** Applying reasoning and quantities and relationships. (5-LS1-1, 5-LS2-1)

**AR.M.4** Select and use relationships and tools. (5-LS1-1, 5-LS2-1)

**AR.M.5** Identify relationships using structure and patterns. (5-LS1-1)

**5.GM.6** Convert among different-sized standard measurement units within the same system, including both the metric customary systems, and solve multi step, real-world problems using conversions. (5-LS1-2)

## GRADE FIVE

Engineering, Technology, and Applications of Science		
<p>Students who demonstrate understanding can:</p> <p><b>5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</b></p> <p><b>5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</b></p> <p><b>5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</b></p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Asking Questions and Defining Problems</b></p> <p>Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> <li>Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (5-ETS1-1)</li> </ul> <p><b>Planning and Carrying Out Investigations</b></p> <p>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-ETS1-3)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b></p> <p>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (5-ETS1-2)</li> </ul>	<p><b>ETS1.A: Defining and Delimiting Engineering Problems</b></p> <ul style="list-style-type: none"> <li>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). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (5-ETS1-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (5-ETS1-2)</li> <li>At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (5-ETS1-2)</li> <li>Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (5-ETS1-3)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (5-ETS1-3)</li> </ul>	<p><b>Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>People’s needs and wants change over time, as do their demands for new and improved technologies. (5-ETS1-1)</li> <li>Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (5-ETS1-2)</li> </ul>

*Connections to 3-5.ETS1.A: Defining and Delimiting Engineering Problems include: **Fourth Grade:** (4-PS3-4)*

*Connections to 3-5.ETS1.B: Designing Solutions to Engineering Problems include: **Fourth Grade:** (4-ESS3-2)*

*Connections to K-2.ETS1.C: Optimizing the Design Solution include: **Fourth Grade:** (4-PS4-3)*

*Connections to other DCIs across grade levels: **K-2.ETS1.A** (5-ETS1-1, 5-ETS1-2, 5-ETS1-3); **K-2.ETS1.B** (5-ETS1-2); **K-2.ETS1.C** (5-ETS1-2, 5-ETS1-3); **6-8.ETS1.A** (5-ETS1-1); **6-8.ETS1.B** (5-ETS1-1, 5-ETS1-2, 5-ETS1-3); **6-8.ETS1.C** (5-ETS1-2, 5-ETS1-3)*

*Connections to the Arkansas English Language Arts Standards –*

**5.RC.2.RF** Answer explicit and inferential questions, using details from a text. (5-ETS1-2)

**5.RC.15.RI** Integrate information from several texts on the same topic when writing or speaking about the topic. (5-ETS1-2)

**5.W.9.P** Conduct short research, using quotations and summaries from relevant sources or experiences to produce a written product. (5-ETS1-1, 5-ETS1-3)

**5.W.10.P** Take notes, sort evidence into categories, and include a list of sources. (5-ETS1-1, 5-ETS1-3)

**5.W.2.S** Write informative or explanatory pieces, using multiple sources to examine a topic. (5-ETS1-1, 5-ETS1-3)

*Connections to the Arkansas Mathematics Standards--*

**AR.M.2** Applying reasoning about quantities and relationships. (5-ETS1-1, 5-ETS1-2, 5-ETS1-3)

**AR.M.4** Select and use relationships and tools. (5-ETS1-1, 5-ETS1-2, 5-ETS1-3)

**AR.M.5** Identify relationships using structure and patterns. (5-ETS1-1, 5-ETS1-2, 5-ETS1-3)

**5.CAR.1-8** Computation and Algebraic Reasoning: Operations & Properties (5-ETS1-1, 5-ETS1-2)

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# ARKANSAS

## K-12 SCIENCE STANDARDS

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EDUCATION FOR A NEW GENERATION

# Grade 6

# 2015

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# How to Read Arkansas K-12 Science Standards

Topic

GRADE TWO

An asterisk indicates an engineering connection to a practice or disciplinary core idea.

**Interdependent Relationships in Ecosystems**

Students who demonstrate understanding can:

**2-LS2-1** Plan and conduct an investigation to determine if plants need sunlight and water to grow. [Assessment Boundary: Assessment is limited to testing one variable.] \*

**2-LS2-2** Develop a simple model that mimics the function of plants, seeds or pollinating plants.

**2-LS4-1** Make observations of plants and animals to compare growth rates and changes over time. [Clarification Statement: Emphasis is on the diversity of living things in a variety of habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan and conduct an investigation collaboratively to produce data as the basis for evidence to answer a question. (2-LS2-1)</li> <li>Make observations (firsthand or from media) to collect data that can be used to make comparisons. (2-LS4-1)</li> </ul> <hr/> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Scientists look for patterns and order when making observations about the world. (2-LS4-1)</li> </ul>	<p><b>LS2.A: Interdependent Relationships in Ecosystems</b></p> <ul style="list-style-type: none"> <li>Plants depend on water and light to grow. (2-LS2-1)</li> <li>Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)</li> </ul> <p><b>LS4.D: Biodiversity and Humans</b></p> <ul style="list-style-type: none"> <li>There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (2-LS2-2)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Events have causes that generate observable patterns. (2-LS2-1)</li> </ul> <p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)</li> </ul>

*Connections to other DCIs in second grade: N/A*

*Connections to other DCIs across grade levels: K.LS1.C (2-LS2-1); K.ESS3.A (2-LS2-1); K-2.ETS1.A (2-LS2-2); 3.LS4.C (2-LS4-1); 3.LS4.D (2-LS4-1); 5.LS1.C (2-LS2-1); 5.LS2.A (2-LS2-2, 2-LS4-1)*

Connections to the Arkansas English Language Arts and Mathematics Standards are often found by scrolling to the next page

## Arkansas K-12 Science Standards Overview

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

As part of teaching the Arkansas K-12 Science Standards, it will be important to instruct and guide students in adopting appropriate safety precautions for their student-directed science investigations. Reducing risk and preventing accidents in science classrooms begin with planning. The following four steps are recommended in carrying out a hazard and risk assessment for any planned lab investigation:

- 1) Identify all hazards. Hazards may be physical, chemical, health, or environmental.
- 2) Evaluate the type of risk associated with each hazard.
- 3) Write the procedure and all necessary safety precautions in such a way as to eliminate or reduce the risk associated with each hazard.
- 4) Prepare for any emergency that might arise in spite of all of the required safety precautions.

According to Arkansas Code Annotated § 6-10-113 (2012) for eye protection, every student and teacher in public schools participating in any chemical or combined chemical-physical laboratories involving caustic or explosive chemicals or hot liquids or solids is required to wear industrial-quality eye protective devices (eye goggles) at all times while participating in science investigations.

The Arkansas K-12 Science Standards outline the knowledge and science and engineering practices that all students should learn by the end of high school. The standards are three-dimensional because each student performance expectation engages students at the nexus of the following three dimensions:

- Dimension 1 describes scientific and engineering practices.
- Dimension 2 describes crosscutting concepts, overarching science concepts that apply across science disciplines.
- Dimension 3 describes core ideas in the science disciplines.

### Science and Engineering Practices

The eight practices describe what scientists use to investigate and build models and theories of the world around them or that engineers use as they build and design systems. The practices are essential for all students to learn and are as follows:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

### Crosscutting Concepts

The seven crosscutting concepts bridge disciplinary boundaries and unit core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas, and develop a coherent, and scientifically based view of the world. The seven crosscutting concepts are as follows:

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

2. *Cause and effect- Mechanism and explanation.* Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
3. *Scale, proportion, and quantity-* In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
4. *Systems and system models-* Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
5. *Energy and matter: Flows, cycles, and conservation-* Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
6. *Structure and function-* The way in which an object or living thing is shaped and its substructure determines many of its properties and functions.
7. *Stability and change-* For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

### Disciplinary Core Ideas

The disciplinary core ideas describe the content that occurs at each grade or course. The Arkansas K-12 Science Standards focus on a limited number of core ideas in science and engineering both within and across the disciplines and are built on the notion of learning as a developmental progression. The Disciplinary Core Ideas are grouped into the following domains:

- Physical Science (PS)
- Life Science (LS)
- Earth and Space Science (ESS)
- Engineering, Technology and Applications of Science (ETS)

### Connections to the Arkansas English Language Arts Standards

Evidence-based reasoning is the foundation of good scientific practice. The Arkansas K-12 Science Standards incorporate reasoning skills used in language arts to help students improve mastery and understanding in all three disciplines. The Arkansas K-8 Science Committee made every effort to align grade-by-grade with the English language arts (ELA) standards so concepts support what students are learning in their entire curriculum. Connections to specific ELA standards are listed for each student performance expectation, giving teachers a blueprint for building comprehensive cross-disciplinary lessons.

The intersections between Arkansas K-12 Science Standards and Arkansas ELA Standards teach students to analyze data, model concepts, and strategically use tools through productive talk and shared activity. Reading in science requires an appreciation of the norms and conventions of the discipline of science, including understanding the nature of evidence used, an attention to precision and detail, and the capacity to make and assess intricate arguments, synthesize complex information, and follow detailed procedures and accounts of events and concepts. These practice-based standards help teachers foster a classroom culture where students think and reason together, connecting around the subject matter and core ideas.

### Connections to the Arkansas Disciplinary Literacy Standards

Reading is critical to building knowledge in science. College and career ready reading in science requires an appreciation of the norms and conventions of each discipline, such as the kinds of evidence used in science; an understanding of domain-specific words and phrases; an attention to precise details; and the capacity to evaluate intricate arguments, synthesize complex information, and follow detailed descriptions of events and concepts. When reading scientific and technical texts, students need to be able to gain knowledge from challenging texts that often make extensive use of elaborate diagrams and data to convey information and illustrate concepts. Students must be able to read complex informational texts in science with independence and confidence because the vast majority of reading in college and workforce training programs will be sophisticated nonfiction.

For students, writing is a key means of asserting and defending claims, showing what they know about science, and conveying what they have experienced, imagined, thought, and felt. To be college and career ready writers, students must take task, purpose, and audience into careful consideration, choosing words, information, structures, and formats deliberately. They need to be able to use technology strategically when creating, refining, and collaborating on writing. They have to become adept at gathering information, evaluating sources, and citing material accurately, reporting finds from their research and analysis of sources in a clear and cogent manner. They must have the flexibility, concentration, and fluency to produce high-quality first-draft text under a tight deadline and the capacity to revisit and make improvements to a piece of writing over multiple drafts when circumstances encourage or require it.

### Connections to the Arkansas Mathematics Standards

Science is a quantitative discipline, so it is important for educators to ensure that students' science learning coheres well with their understanding of mathematics. To achieve this alignment, the Arkansas K-12 Science Committee made every effort to ensure that the mathematics standards do not outpace or misalign to the grade-by-grade science standards. Connections to specific math standards are listed for each student performance expectation, giving teachers a blueprint for building comprehensive cross-disciplinary lessons.

Table below lists key topics relevant to science and the grades at which topics are first expected in the Arkansas Mathematics Standards.

<b>Number and Operations</b>	<b>Grade First Expected</b>
The coordinate plane	5
Ratios, rates (e.g. speed), proportional relationships	6
Simple percent problems	6
Rational number system/signed numbers-concepts	6
Rational number system/signed numbers-arithmetic	7
<b>Measurement</b>	<b>Grade First Expected</b>
Convert units within a given measurement system	5
Volume	5
Convert units across measurement systems (e.g. inches to cm)	6
<b>Statistics and Probability</b>	<b>Grade First Expected</b>
Statistical distributions (including center, variation, clumping, outliers, mean, median, mode, range, quartiles), and statistical association or trends (including two-way tables, bivariate measurement data, scatter plots, trend line, line of best fit, correlation)	6-8
Probability, including chance, likely outcomes, probability models	7

**Grades 5-8 Science Core Ideas and Topics Overview**

<b>Grade 5</b>							
<b>Grade 5</b>	PHYSICAL SCIENCES		LIFE SCIENCES			EARTH and SPACE SCIENCES	
	5. Structure and Properties of Matter		5. Matter and Energy in Organisms and Ecosystems			5. Earth's Systems	5. Space Systems
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE 5. Engineering Design							
<b>Grade 6</b>							
<b>Grade 6</b>	PHYSICAL SCIENCES		LIFE SCIENCES		EARTH and SPACE SCIENCES		
	6. Energy		6. Structure, Function, and Information Processing	6. Growth, Development, and Reproduction of Organisms	6. Earth's Systems	6. Human Impacts	6. Weather and Climate
<b>Grade 7</b>							
<b>Grade 7</b>	PHYSICAL SCIENCES		LIFE SCIENCES		EARTH and SPACES SCIENCES		
	7. Structure and Properties of Matter	7. Chemical Reactions	7. Interdependent Relationships in Ecosystems	7. Matter and Energy in Organisms and Ecosystems	7. Earth's Systems	7. History of Earth	7. Human Impacts
<b>Grade 8</b>							
<b>Grade 8</b>	PHYSICAL SCIENCES		LIFE SCIENCES		EARTH and SPACES SCIENCES		
	8. Waves and Electromagnetic Radiation	8. Forces and Interactions	8. Growth, Development, and Reproduction of Organisms	8. Natural Selection and Adaptations	8. Energy	8. Space Systems	8. History of Earth
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE 6-8. Engineering Design							

## Science Grades 5-8 Overview

The Arkansas K-12 Science Standards for Grades 5-8 is a curriculum framework of grade level student performance expectations based on the core ideas of the physical sciences (PS), life sciences (LS), earth and space sciences (ESS), and engineering (ETS) from *A Framework for K-12 Science Education* (NRC 2012). The performance expectations build logically from Grades K-4 to Grades 5-8. The performance expectations clarify what students need to know and be able to do at the end of each grade. Student performance expectations consist of three dimensions: science and engineering practices, disciplinary core ideas, and crosscutting concepts. Engineering performance expectations are meant to be integrated into science instruction to support the learning of science phenomena at all levels from Kindergarten to Grade 12.

As part of teaching the Arkansas K-12 Science Standards, it will be important to instruct and guide students in adopting appropriate safety precautions for their student-directed science investigations. Reducing risk and preventing accidents in science classrooms begin with planning. There are four recommended steps in carrying out a hazard and risk assessment for any planned lab investigation.

- 1) Identify all hazards. Hazards may be physical, chemical, health, or environmental.
- 2) Evaluate the type of risk associated with each hazard.
- 3) Write the procedure and all necessary safety precautions in such a way as to eliminate or reduce the risk associated with each hazard.
- 4) Prepare for any emergency that might arise in spite of all of the required safety precautions.

According to Arkansas Code Annotated § 6-10-113 (2012) for eye protection, every student and teacher in public schools participating in any chemical or combined chemical-physical laboratories involving caustic or explosive chemicals or hot liquids or solids is required to wear industrial-quality eye protective devices (eye goggles) at all times while participating in science investigations.

### Notes:

1. Student Performance Expectations (PEs) may be taught in any sequence or grouping within a grade level.
2. An asterisk (\*) indicates an engineering connection to a practice, core idea, or crosscutting concept.
3. The Clarification Statements are examples and additional guidance for the instructor. **AR** indicates Arkansas-specific Clarification Statements.
4. The Assessment Boundaries delineate content that may be taught but not assessed in large-scale assessments. **AR** indicates Arkansas-specific Assessment Boundaries.
5. The examples given (e.g.,) are suggestions for the instructor.
6. Throughout this document, connections are provided to the nature of science as defined by *A Framework for K-12 Science Education* (NRC 2012).
7. Throughout this document, connections are provided to Engineering, Technology, and Applications of Science as defined by *A Framework for K-12 Science Education* (NRC 2012).
8. Each set of PEs lists connections to other disciplinary core ideas (DCIs) within the Arkansas K-12 Science Standards and to the Arkansas Mathematics Standards, Arkansas English Language Arts Standards, and Arkansas Disciplinary Literacy Standards.

**Grade 6 Learning Progression by Topic**

Grade 6					
PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES		
Energy	Structure, Function, and Information Processing	Growth, Development, and Reproduction of Organisms	Earth's Systems	Human Impacts	Weather and Climate
6-PS3-3 <b>AR</b>	6-LS1-1	6-LS1-4	6-ESS2-4	6-ESS3-3	6-ESS2-5
6-PS3-4	6-LS1-2	6-LS1-5		6-ESS3-4	6-ESS2-6
6-PS3-5 <b>AR</b>	6-LS1-3	6-LS3-2			6-ESS3-5
	6-LS1-8				
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 6-ETS1-1, 6-ETS1-2, 6-ETS1-3, 6-ETS1-4					

Arkansas Clarification Statement (**AR**)

**Grade 6 Learning Progression by Disciplinary Core Idea**

Grade 6				
PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES	
Energy	From Molecules to Organisms: Structures and Processes	Heredity: Inheritance and Variation of Traits	Earth's Systems	Earth and Human Activity
6-PS3-3	6-LS1-1	6-LS3-2	6-ESS2-4	6-ESS3-3
6-PS3-4	6-LS1-2		6-ESS2-5	6-ESS3-4
6-PS3-5 <b>AR</b>	6-LS1-3		6-ESS2-6	6-ESS3-5
	6-LS1-4			
	6-LS1-5			
	6-LS1-8			
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 6-ETS1-1, 6-ETS1-2, 6-ETS1-3, 6-ETS1-4				

Arkansas Clarification Statement (**AR**)

## **Grade Six Standards Overview**

The Arkansas K-12 Science Standards are based on *A Framework for K-12 Science Education* (NRC 2012) and are meant to reflect a new vision for science education. The following conceptual shifts reflect what is new about these science standards. The Arkansas K-12 Science Standards

- reflect science as it is practiced and experienced in the real world,
- build logically from Kindergarten through Grade 12,
- focus on deeper understanding as well as application of content,
- integrate practices, crosscutting concepts, and core ideas, and
- make explicit connections to literacy and math.

### **Science and Engineering Practices**

Students are expected to demonstrate grade-appropriate proficiency in

- analyzing and interpreting data,
- developing and using models,
- constructing explanations and designing solutions,
- engaging in argument from evidence,
- obtaining, evaluating, and communicating information,
- using mathematics and computational thinking, and
- planning and carrying out investigations.

Students are expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

### **Crosscutting Concepts**

Students are expected to demonstrate grade-appropriate understanding of

- cause and effect,
- scale, proportion and quantity,
- structure and function,
- systems and system models,
- stability and change,
- patterns, and
- the influence of engineering, technology, and science on society and the natural world as organizing concepts for the disciplinary core ideas.

### **Disciplinary Core Ideas**

Students are expected to continually build on and revise their knowledge of

- PS3- Energy,
- LS1- Molecules to Organisms: Structures and Processes,
- LS3- Heredity: Inheritance and Variation of Traits,
- ESS2- Earth's Systems,
- ESS3- Earth and Human Activity, and
- ETS1- Engineering Design in a 6-8 developmental learning progression.

### Physical Sciences (PS)

The (PS) performance expectations in sixth grade help students formulate answers to the question, “How can energy be transferred from one object or system to another?” Students are expected to develop understanding of energy and energy transfer.

### Life Sciences (LS)

The (LS) performance expectations in sixth grade help students explore the questions, “How do the structures of organisms contribute to life’s functions?”, “How can one explain the ways cells contribute to the function of living organisms?”, and “How do organisms grow, develop, and reproduce?” Students are expected to develop understanding of structure, function, and information processing as well as growth, development, and reproduction.

### Earth and Space Sciences (ESS)

The (ESS) performance expectations help students investigate the questions, “How is water cycled on Earth?”, “How have human activity of land, energy, and water resources impacted Earth’s systems?”, and “How are complex weather systems related to the sun’s energy and the force of gravity?” Students are expected to develop understanding of Earth systems, weather and climate, and consequences of human activity.

### Engineering, Technology, and Applications of Science (ETS)

Engineering design performance expectations in middle school continue to engage students in numerous design experiences. The goal at this level is to define problems more precisely, conduct a more thorough process for choosing the best solution, and optimize the final design. Students are able to develop these capabilities in various scientific contexts. The engineering design process involves three stages:

- **Defining and delimiting engineering problems with precision** involves thinking more deeply than is expected in the earlier grades about the needs a problem is intended to address or the goals a design is intended to reach. Students now are expected to consider not only the end user, but also the broader society and the environment. Every technological change is likely to have both intended and unintended effects. It is up to the designer to try to anticipate the effects it may have and to behave responsibly in developing a new or improved technology. These considerations may take the form of either criteria or constraints on possible solutions.
- **Designing solutions to engineering problems is a two stage process** in middle school of evaluating the different ideas that have been proposed by using a systematic method, such as a tradeoff matrix, to determine which solutions are most promising, and by testing different solutions. Then designers combine the best ideas into a new solution that may be better than any of the preliminary ideas.
- **Optimizing the engineering design** involves an iterative process in which students test the best design, analyze the results, modify the design accordingly, and then re-test and modify the design again. Students may go through this cycle multiple times in order to reach the best possible result.

In the sixth grade students begin to develop the ability to achieve all four performance expectations (6-ETS1-1, 6-ETS1-2, 6-ETS1-3, 6-ETS1-4) related to a single problem in order to understand the interrelated processes of engineering design. Students can use tools and materials to solve problems, use visual or physical representations to convey solutions, and optimize solutions to a problem, test them, and determine which is best. These component ideas do not always follow in order. At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that is not working.

## GRADE SIX

### Energy

Students who demonstrate understanding can:

- 6-PS3-3** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.\* [AR Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a polystyrene foam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]
- 6-PS3-4** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice have melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]
- 6-PS3-5** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [AR Clarification Statement: Examples of empirical evidence used in arguments could include a diagram, flowchart, or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object.] [Assessment Boundary: Assessment does not include calculations of energy.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

#### Science and Engineering Practices

##### Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

- Plan 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 many data are needed to support a claim. (6-PS3-4)

##### Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (6-PS3-3)

##### Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds.

- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (6-PS3-5)

#### Disciplinary Core Ideas

##### PS3.A: Definitions of Energy

- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (6-PS3-3, 6-PS3-4)

##### PS3.B: Conservation of Energy and Energy Transfer

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (6-PS3-5)
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (6-PS3-4)
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (6-PS3-3)

#### Crosscutting Concepts

##### Scale, Proportion, and Quantity

- 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. (6-PS3-4)

##### Energy and Matter

- Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion). (6-PS3-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (6-PS3-3)

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**Connections to Nature of Science**

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based upon logical and conceptual connections between evidence and explanations (6-PS3-4, 6-PS3-5)

**ETS1.A: Defining and Delimiting an Engineering Problem**

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (6-PS3-3)

**ETS1.B: Developing Possible Solutions**

- A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (6-PS3-3)

*Connections to other DCIs in sixth grade:* 6.ESS2.D (6-PS3-3, 6-PS3-4); 6.ESS3.D (6-PS3-4)

*Connections to other DCIs across grade levels:* 4.PS3.B (6-PS3-3); 4.PS3.C (6-PS3-4, 6-PS3-5); 7.PS1.B (6-PS3-4); 8.PS3.A (6-PS3-4, 6-PS3-5); 8.PS3.B (6-PS3-3, 6-PS3-4, 6-PS3-5)

*Connections to the Arkansas Disciplinary Literacy Standards –*

- RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (6-PS3-5)
- RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (6-PS3-3, 6-PS3-4)
- RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- WHST.6-8.1** Write arguments focused on discipline-specific content. (6-PS3-5)
- WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (6-PS3-3, 6-PS3-4)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships. (6-PS3-4, 6-PS3-5)
- 6.PR.1** Use precise ratio language and notation to describe a ratio as a relationship between two quantities. (6-PS3-5)
- 6.SP.3** Determine which measure of center (mean or median) is more appropriate to describe the center of data and justify the choice. (6-PS3-4)
- 6.SP.4** Describe how the mean or median is affected by outliers of a numerical data set. (6-PS3-4) Calculate and interpret the measure of variation [range and interquartile range (IQR)] of a numerical data set. (6-PS3-4)
- 6.SP.5** Determine which measure of variation (range or interquartile range) is more appropriate to describe the shape; justify the choice. (6-PS3-4)
- 6.SP.6**

## GRADE SIX

### Structure, Function, and Information Processing

Students who demonstrate understanding can:

- 6-LS1-1** Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on gathering evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]
- 6-LS1-2** Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]
- 6-LS1-3** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment is limited to circulatory, excretory, digestive, respiratory, muscular, and nervous systems. Assessment does not include the mechanism of one body system independent of others.]
- 6-LS1-8** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> <li>▪ Develop and use a model to describe phenomena. (6-LS1-2)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use <u>multiple variables</u> and provide evidence to support explanations or solutions.</p> <ul style="list-style-type: none"> <li>▪ Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (6-LS1-1)</li> </ul>	<p><b>LS1.A: Structure and Function</b></p> <ul style="list-style-type: none"> <li>▪ All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (6-LS1-1)</li> <li>▪ Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (6-LS1-2)</li> <li>▪ In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (6-LS1-3)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>▪ Cause and effect relationships may be used to predict phenomena in natural systems. (6-LS1-8)</li> </ul> <p><b>Scale, Proportion, and Quantity</b></p> <ul style="list-style-type: none"> <li>▪ Phenomena that can be observed at one scale may not be observable at another scale. (6-LS1-1)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>▪ Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (6-LS1-3)</li> </ul> <p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>▪ Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore complex natural structures/systems can be analyzed to determine how they function. (6-LS1-2)</li> </ul>

<p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (6-LS1-3)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.</p> <ul style="list-style-type: none"> <li>Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (6-LS1-8)</li> </ul>	<p><b>LS1.D: Information Processing</b></p> <ul style="list-style-type: none"> <li>Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (6-LS1-8)</li> </ul>	<p>-----</p> <p><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Interdependence of Science, Engineering, and Technology</b></p> <ul style="list-style-type: none"> <li>Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (6-LS1-1)</li> </ul> <p>-----</p> <p><b>Connections to Nature of Science</b></p> <p><b>Science is a Human Endeavor</b></p> <ul style="list-style-type: none"> <li>Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (6-LS1-3)</li> </ul>
<p><i>Connections to other DCIs in sixth grade:</i> N/A</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>4.LS1.A</b> (6-LS1-2); <b>4.LS1.D</b> (6-LS1-8)</p>		
<p><i>Connections to the Arkansas Disciplinary Literacy Standards –</i></p>		
<p><b>RST.6-8.1</b></p>	<p>Cite specific textual evidence to support analysis of science and technical texts. (6-LS1-3)</p>	
<p><b>RI.6.8</b></p>	<p>Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (6-LS1-3)</p>	
<p><b>WHST.6-8.1</b></p>	<p>Write arguments focused on discipline-specific content. (6-LS1-3)</p>	
<p><b>WHST.6-8.7</b></p>	<p>Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (6-LS1-1)</p>	
<p><b>WHST.6-8.8</b></p>	<p>Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (6-LS1-8)</p>	
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p>		
<p><b>6.CC.7.SLC</b></p>	<p>Describe how non-textual information enhances the understanding of a topic, text, or issue. (6-LS1-2)</p>	
<p><i>Connections to the Arkansas Mathematics Standards –</i></p>		
<p><b>7.ALG.4</b></p>	<p>Write an equation to express two quantities in terms of the dependent and independent variables. (6-LS1-1, 6-LS1-2, 6-LS1-3)</p>	
<p><b>7.ALG.5</b></p>	<p>Describe the relationship between the dependent and independent variables in an equation using tables and graphs, relating these to the equation. (6-LS1-1, 6-LS1-2, 6-LS1-3)</p>	

## GRADE SIX

### Growth, Development, and Reproduction of Organisms

Students who demonstrate understanding can:

- 6-LS1-4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.** [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]
- 6-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.** [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]
- 6-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.** [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

#### Science and Engineering Practices

##### Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (6-LS3-2)

##### Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (6-LS1-5)

#### Disciplinary Core Ideas

##### LS1.B: Growth and Development of Organisms

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (6-LS3-2)
- Animals engage in characteristic behaviors that increase the odds of reproduction. (6-LS1-4)
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (6-LS1-4)
- Genetic factors as well as local conditions affect the growth of the adult plant. (6-LS1-5)
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (6-LS3-2)

#### Crosscutting Concepts

##### Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems. (6-LS3-2)
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (6-LS1-4, 6-LS1-5)

<p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (6-LS1-4)</li> </ul>	<p><b>LS3.B: Variation of Traits</b></p> <ul style="list-style-type: none"> <li>In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (6-LS3-2)</li> </ul>	
<p><i>Connections to other DCIs in sixth grade:</i> N/A</p>		
<p><i>Connections to other DCIs across grade levels:</i> <b>3.LS1.B</b> (6-LS1-4, 6-LS1-5); <b>3.LS3.A</b> (6-LS1-5, 6-LS3-2); <b>3.LS3.B</b> (6-LS3-2); <b>7.LS2.A</b> (6-LS1-4, 6-LS1-5); <b>7.LS2.D</b> (6-LS1-4); <b>8.LS3.A</b> (6-LS3-2)</p>		
<p><i>Connections to the Arkansas Disciplinary Literacy Standards –</i></p>		
<b>RST.6-8.1</b>	Cite specific textual evidence to support analysis of science and technical texts. (6-LS1-4, 6-LS1-5, 6-LS3-2)	
<b>RST.6-8.2</b>	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (6-LS1-5)	
<b>RST.6-8.4</b>	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to Grades 6-8 texts and topics. (6-LS3-2)	
<b>RST.6-8.7</b>	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (6-LS3-2)	
<b>RI.6.8</b>	Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (6-LS1-4)	
<b>WHST.6-8.1</b>	Write arguments focused on discipline-specific content. (6-LS1-4)	
<b>WHST.6-8.2</b>	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (6-LS1-5)	
<b>WHST.6-8.9</b>	Draw evidence from informational texts to support analysis, reflection, and research. (6-LS1-5)	
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p>		
<b>6.CC.12.P</b>	Include multimedia and visuals to clarify information. (6-LS3-2)	
<p><i>Connections to the Arkansas Mathematics Standards –</i></p>		
<b>AR.M.4</b>	Select and use relationships and tools. (6-LS3-2)	
<b>6.SP.2</b>	Calculate and interpret any measure of center (mean, median, and mode) of a numerical data set. (6-LS1-4, 6-LS1-5)	
<b>6.SP.7</b>	Represent numerical data on a number line, histogram, and box plot. (6-LS1-4, 6-LS1-5)	
<b>6.SP.3</b>	Determine which measure of center (mean or median) is more appropriate to describe the center of data and justify the choice. (6-LS3-2)	
<b>6.SP.4</b>	Describe how the mean or median is affected by outliers of a numerical data set. (6-LS3-2)	
<b>6.SP.5</b>	Calculate and interpret the measure of variation [range and interquartile range (IQR)] of a numerical data set. (6-LS3-2)	
<b>6.SP.6</b>	Determine which measure of variation (range or interquartile range) is more appropriate to describe the shape; justify the choice. (6-LS3-2)	

## GRADE SIX

### Earth's Systems

Students who demonstrate understanding can:

- 6-ESS2-4**     **Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> <li>Develop a model to describe unobservable mechanisms. (6-ESS2-4)</li> </ul>	<p><b>ESS2.C: The Roles of Water in Earth's Surface Processes</b></p> <ul style="list-style-type: none"> <li>Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (6-ESS2-4)</li> <li>Global movements of water and its changes in form are propelled by sunlight and gravity. (6-ESS2-4)</li> </ul>	<p><b>Energy and Matter</b></p> <ul style="list-style-type: none"> <li>Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (6-ESS2-4)</li> </ul>

*Connections to other DCIs in sixth grade:* **6.PS3.D** (6-ESS2-4)

*Connections to other DCIs across grade levels:* **3.PS2.A** (6-ESS2-4); **4.PS3.B** (6-ESS2-4); **5.PS2.B** (6-ESS2-4); **5.ESS2.C** (6-ESS2-4); **7.ESS2.C** (6-ESS2-4); **8.PS2.B** (6-ESS2-4); **8.PS3.B** (6-ESS2-4); **8.PS4.B** (6-ESS2-4)

*Connections to the Arkansas Disciplinary Literacy Standards –*

- RST.6-8.7**     Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (6-ESS2-4)
- WHST.6-8.2**     Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (6-ESS2-4)
- WHST.6-8.9**     Draw evidence from informational texts to support analysis, reflection, and research. (6-ESS2-4)

*Connections to the Arkansas English Language Arts Standards –*

- 6.CC.12.P**     Include multimedia and visuals to clarify information. (6-ESS2-4)
- 6.CC.7.SLC**     Describe how non-textual information enhances the understanding of a topic, text, or issue. (6-ESS2-4)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.4**             Select and use relationships and tools. (6-ESS2-4)

## GRADE SIX

<b>Human Impacts</b>	
Students who demonstrate understanding can:	
<b>6-ESS3-3</b>	<b>Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*</b> [Clarification Statement: Examples of the design process could include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts could include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]
<b>6-ESS3-4</b>	<b>Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems.</b> [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations or the rates of consumption of food and natural resources (such as freshwater, minerals, or energy). Examples of impacts could include changes to the appearance, composition, or structure of Earth’s systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :	

<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> <li>▪ Apply scientific principles to design an object, tool, process or system. (6-ESS3-3)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>▪ Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (6-ESS3-4)</li> </ul>	<p><b>ESS3.C: Human Impacts on Earth Systems</b></p> <ul style="list-style-type: none"> <li>▪ Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things. (6-ESS3-3)</li> <li>▪ Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (6-ESS3-3, 6-ESS3-4)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>▪ Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (6-ESS3-3)</li> <li>▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (6-ESS3-4)</li> </ul> <hr style="border: 0.5px dashed black;"/> <p style="text-align: center;"><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (6-ESS3-4)</li> <li>▪ The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (6-ESS3-3)</li> </ul>

		<p style="text-align: center;">-----</p> <p style="text-align: center;"><b>Connections to Nature of Science</b></p> <p><b>Science Addresses Questions About the Natural and Material World</b></p> <ul style="list-style-type: none"> <li>▪ Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (6-ESS3-4)</li> </ul>
<p><i>Connections to other DCIs in sixth grade: N/A</i></p>		
<p><i>Connections to other DCIs across grade levels: 3.LS2.C (6-ESS3-3, 6-ESS3-4); 3.LS4.D (6-ESS3-3, 6-ESS3-4); 5.ESS3.C (6-ESS3-3, 6-ESS3-4); 7.LS2.A (6-ESS3-4); 7.LS2.C (6-ESS3-3, 6-ESS3-4); ); 7.ESS2.C (6-ESS3-3); 7.ESS3.A (6-ESS3-4); 8.LS4.C (6-ESS3-3, 6-ESS3-4); 8.LS4.D (6-ESS3-3, 6-ESS3-4)</i></p>		
<p><i>Connections to the Arkansas Disciplinary Literacy Standards –</i></p> <p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts. (6-ESS3-4)</p> <p><b>WHST.6-8.1</b> Write arguments focused on discipline-specific content. (6-ESS3-4)</p> <p><b>WHST.6-8.7</b> Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (6-ESS3-3)</p> <p><b>WHST.6-8.8</b> Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (6-ESS3-3)</p> <p><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research. (6-ESS3-4)</p> <p><i>Connections to the Arkansas Mathematics Standards –</i></p> <p><b>6.PR.1</b> Use precise ratio language and notation to describe a ratio as a relationship between two quantities. (6-ESS3-3, 6-ESS3-4)</p> <p><b>6.PR.3</b> Give examples of unit rates as a ratio that compares two quantities with different units of measure, limited to non-complex fractions (6-ESS3-3, 6-ESS3-4)</p> <p><b>6.ALG.1</b> Read and write expressions in real-world or mathematical problems in which letters stand for numbers. (6-ESS3-3, 6-ESS3-4)</p> <p><b>6.ALG.7</b> Write and solve one-step equations in real-world and mathematical problems, involving positive rational numbers and zero. (6-ESS3-3, 6-ESS3-4)</p>		

## GRADE SIX

### Weather and Climate

Students who demonstrate understanding can:

- 6-ESS2-5** **Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.** [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, or visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]
- 6-ESS2-6** **Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.** [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models could be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]
- 6-ESS3-5** **Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.** [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, or agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence could include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide or methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

#### Science and Engineering Practices

##### Asking Questions and Defining Problems

Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Ask questions to identify and clarify evidence of an argument. (6-ESS3-5)

##### Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (6-ESS2-6)

##### Planning and Carrying Out Investigations

Planning and carrying out investigations in 6–8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (6-ESS2-5)

#### Disciplinary Core Ideas

##### ESS2.C: The Roles of Water in Earth’s Surface Processes

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (6-ESS2-5)
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (6-ESS2-6)

##### ESS2.D: Weather and Climate

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (6-ESS2-6)
- Because these patterns are so complex, weather can only be predicted probabilistically. (6-ESS2-5)

#### Crosscutting Concepts

##### Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (6-ESS2-5)

##### 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. (6-ESS2-6)

##### Stability and Change

- Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (6-ESS3-5)

- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (6-ESS2-6)

**ESS3.D: Global Climate Change**

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (6-ESS3-5)

*Connections to other DCIs in sixth grade: N/A*

*Connections to other DCIs across grade levels: 3.PS2.A (6-ESS2-6); 3.ESS2.D (6-ESS2-5),(6-ESS2-6); 5.ESS2.A (6-ESS2-5, 6-ESS2-6); 7.ESS2.A (6-ESS2-6, 6-ESS3-5); 7.ESS2.C (6-ESS2-5); 8.PS2.B (6-ESS2-6); 8.PS3.B (6-ESS2-6, 6-ESS3-5); 8.PS4.B (6-ESS3-5); 8.ESS1.B (6-ESS2-6)*

*Connections to the Arkansas Disciplinary Literacy Standards –*

- RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (6-ESS2-5, 6-ESS3-5)
- RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (6-ESS2-5)
- WHST.6-8.8** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (6-ESS2-5)

*Connections to the Arkansas English Language Arts Standards –*

- 6.CC.12.P** Include multimedia and visuals to clarify information. (6-ESS2-6)

*Connections to the Arkansas Mathematics Standards –*

- AR.M.2** Applying reasoning about quantities and relationships. (6-ESS2-5, 6-ESS3-5)
- 6.NCC.1** Explain positive and negative integers as being opposite values or directions and the meaning of 0 in a real world context.. (6-ESS2-5)
- 6.ALG.1** Read and write expressions in real-world or mathematical problems in which letters stand for numbers. (6-ESS3-5)
- 6.ALG.7** Write and solve one-step equations in real-world and mathematical problems, involving positive rational numbers and zero. (6-ESS2-5)

## GRADE SIX

### Engineering, Technology, and Applications of Science

Students who demonstrate understanding can:

- 6-ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. [AR Clarification Statement: Examples could include designing an insulated coffee mug or lunch box or designing an energy efficient home, etc.]
  
- 6-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. [AR Clarification: Examples could include evaluating a community's designs for protecting different aspects of an ecosystem.]
  
- 6-ETS1-3** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. [AR Clarification Statement: Examples could include determining best materials to use for a building's roof or windows, etc.]
  
- 6-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. [AR Clarification Statement: Examples could be using graphs or models to support material choices for a design project.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

#### Science and Engineering Practices

##### Asking Questions and Defining Problems

Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (6-ETS1-1)

##### Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to generate data to test idea: about designed systems, including those representing inputs and outputs. (6-ETS1-4)

##### Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (6-ETS1-3)

#### Disciplinary Core Ideas

##### ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (6-ETS1-1)

##### ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (6-ETS1-4)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (6-ETS1-2, 6-ETS1-3)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (6-ETS1-3)
- Models of all kinds are important for testing solutions. (6-ETS1-4)

##### ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process, some of those characteristics may be incorporated into the new design. (6-ETS1-3)

#### Crosscutting Concepts

##### Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (6-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (6-ETS1-1)

<p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.</p> <ul style="list-style-type: none"> <li>Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (6-ETS1-2)</li> </ul>	<ul style="list-style-type: none"> <li>The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (6-ETS1-4)</li> </ul>	
<p><i>Connections to 6-8.ETS1.A: Defining and Delimiting Engineering Problems include: <b>Physical Science:</b> (6-PS3-3)</i>  <i>Connections to 6-8.ETS1.B: Developing Possible Solutions Problems include: <b>Physical Science:</b> (7-PS1-6, 6-PS3-3); <b>Life Science:</b> (7-LS2-5)</i>  <i>Connections to 6-8.ETS1.C: Optimizing the Design Solution include: <b>Physical Science:</b> (7-PS1-6)</i></p>		
<p><i>Connections to other DCIs across grade levels: <b>3-5.ETS1.A</b> (6-ETS1-1, 6-ETS1-2, 6-ETS1-3); <b>3-5.ETS1.B</b> (6-ETS1-2, 6-ETS1-3, 6-ETS1-4); <b>3-5.ETS1.C</b> (6-ETS1-1, 6-ETS1-2, 6-ETS1-3, 6-ETS1-4)</i></p>		
<p><i>Connections to the Arkansas Disciplinary Literacy Standards –</i></p>		
<p><b>RST.6-8.1</b></p>	<p>Cite specific textual evidence to support analysis of science and technical texts. (6-ETS1-1, 6-ETS1-2, 6-ETS1-3)</p>	
<p><b>RST.6-8.7</b></p>	<p>Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (6-ETS1-3)</p>	
<p><b>RST.6-8.9</b></p>	<p>Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (6-ETS1-2, 6-ETS1-3)</p>	
<p><b>WHST.6-8.7</b></p>	<p>Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (6-ETS1-2)</p>	
<p><b>WHST.6-8.8</b></p>	<p>Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (6-ETS1-1)</p>	
<p><b>WHST.6-8.9</b></p>	<p>Draw evidence from informational texts to support analysis, reflection, and research. (6-ETS1-2)</p>	
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p>		
<p><b>6.CC.12.P</b></p>	<p>Include multimedia and visuals to clarify information. (6-ESS2-6)</p>	
<p><i>Connections to the Arkansas Mathematics Standards –</i></p>		
<p><b>AR.M.2</b></p>	<p>Applying reasoning about quantities and relationships. (6-ESS2-5, 6-ESS3-5)</p>	

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