

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 ^{AR}	4-PS4-1	4-PS3-1	4-ESS 1-1
4-LS1-2 ^{AR}	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 (^{AR})

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 ^{AR}	4-PS3-1	4-PS4-1	4-ESS1-1	4-ESS2-1	4-ESS3-1
4-LS1-2 ^{AR}	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 (^{AR})

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>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.</p> <ul style="list-style-type: none"> ▪ Develop a model to describe phenomena. (4-PS4-2) ▪ Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2) <p>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 world(s).</p> <ul style="list-style-type: none"> ▪ Construct an argument with evidence, data, and/or a model. (4-LS1-1) 	<p>PS4.B: Electromagnetic Radiation</p> <ul style="list-style-type: none"> ▪ An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2) <p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> ▪ Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1) <p>LS1.D: Information Processing</p> <ul style="list-style-type: none"> ▪ 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) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> ▪ Cause and effect relationships are routinely identified. (4-PS4-2) <p>Systems and System Models</p> <ul style="list-style-type: none"> ▪ A system can be described in terms of its components and their interactions. (4-LS1-1, 4-LS1-2)

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 –

- W.4.1** Write opinion pieces on topics or texts, supporting the opinion with reasons and information. (4-LS1-1)
- SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-2, 4-LS1-2)

Connections to the Arkansas Mathematics Standards –

- MP.4** Model with mathematics. (4-PS4-2)
- 4.G.A.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2)
- 4.G.A.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (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>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.</p> <ul style="list-style-type: none"> Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) <p>Constructing Explanations and Designing Solutions 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"> 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) <hr/> <p style="text-align: center;">Connections to Nature of Science</p> <p>Scientific Knowledge is Based on Empirical Evidence</p> <ul style="list-style-type: none"> Science findings are based on recognizing patterns. (4-PS4-1) 	<p>PS4.A: Wave Properties</p> <ul style="list-style-type: none"> 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) Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) <p>PS4.C: Information Technologies and Instrumentation</p> <ul style="list-style-type: none"> 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) <p>ETS1.C: Optimizing The Design Solution</p> <ul style="list-style-type: none"> 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) 	<p>Patterns</p> <ul style="list-style-type: none"> Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1) Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) <hr/> <p style="text-align: center;">Connections to Engineering, Technology, and Applications of Science</p> <p>Interdependence of Science, Engineering, and Technology</p> <ul style="list-style-type: none"> Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

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 –

- RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS4-3)
- RI.4.9** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)
- SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1)

Connections to the Arkansas Mathematics Standards –

- MP.4** Model with mathematics. (4-PS4-1)
- 4.G.A.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-1)

GRADE FOUR

Energy	
Students who demonstrate understanding can:	
4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object. [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.]
4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide. [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.]
4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* [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.]
4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. [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>Asking Questions and Defining Problems 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"> Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3) <p>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.</p> <ul style="list-style-type: none"> 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) 	<p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> The faster a given object is moving, the more energy it possesses. (4-PS3-1) Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2, 4-PS3-3) <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> 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) Light also transfers energy from place to place. (4-PS3-2) 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) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1) <p>Energy and Matter</p> <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects. (4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4) <p style="text-align: center;">-----</p> <p style="text-align: center;">Connections to Engineering, Technology, and Applications of Science</p> <p>Interdependence of Science, Engineering, and Technology</p> <ul style="list-style-type: none"> Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1) <p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> <ul style="list-style-type: none"> Over time, people’s needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1) Engineers improve existing technologies or develop new ones. (4-PS3-4)

<p>Constructing Explanations and Designing Solutions 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"> Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1) Apply scientific ideas to solve design problems. (4-PS3-4) <p>Obtaining, Evaluating, and Communicating Information 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"> Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1) 	<p>PS3.C: Relationship Between Energy and Forces</p> <ul style="list-style-type: none"> When objects collide, the contact forces transfer energy so as to change the objects’ motions. (4-PS3-3) <p>PS3.D: Energy in Chemical Processes and Everyday Life</p> <ul style="list-style-type: none"> The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4) <p>ESS3.A: Natural Resources</p> <ul style="list-style-type: none"> 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) <p>ETS1.A: Defining Engineering Problems</p> <ul style="list-style-type: none"> 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) 	<p>----- Connections to Nature of Science</p> <p>Science is a Human Endeavor</p> <ul style="list-style-type: none"> Most scientists and engineers work in teams. (4-PS3-4) Science affects everyday life. (4-PS3-4)
<p><i>Connections to other DCIs in fourth grade:</i> N/A</p>		
<p><i>Connections to other DCIs across grade levels:</i> K.PS2.B (4-PS3-3); K-2.ETS1.A (4-PS3-4); K-2.ETS1.B (4-PS3-4); 3.PS2.A (4-PS3-3); 5.PS3.D (4-PS3-4); 5.LS1.C (4-PS3-4); 5.ESS3.C (4-ESS3-1); 8.PS2.A (4-PS3-3); 8.PS2.B (4-PS3-2); 8.PS3.A (4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4); 8.PS3.B (4-PS3-2, 4-PS3-3, 4-PS3-4); 6.PS3.C (4-PS3-3); 6.PS3.D (4-ESS3-1); 6.ESS3.C (4-ESS3-1); 6.ESS3.D (4-ESS3-1); 6-8.ETS1.B (4-PS3-4); 6-8.ETS1.C (4-PS3-4); 7.ESS2.A (4-ESS3-1); 7.ESS3.A (4-ESS3-1); 8.PS4.B (4-PS3-2)</p>		

Connections to the Arkansas English Language Arts Standards –

- RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)
- RI.4.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1)
- RI.4.9** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1)
- W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)
- W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2, 4-PS3-3, 4-PS3-4, 4-ESS3-1)
- W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources. Take notes and categorize information. Provide a list of sources. (4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4, 4-ESS3-1)
- W.4.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1, 4-ESS3-1)

Connections to the Arkansas Mathematics Standards –

- MP.2** Reason abstractly and quantitatively. (4-ESS3-1)
- MP.4** Model with mathematics. (4-ESS3-1)
- 4.OA.A.1** Interpret a multiplication equation as a comparison (e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5). Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1)
- 4.OA.A.3** Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4)

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	Disciplinary Core Ideas	Crosscutting Concepts
<p>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.</p> <ul style="list-style-type: none"> ▪ Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1) <p>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.</p> <ul style="list-style-type: none"> ▪ Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2) 	<p>ESS1.C: The History of Planet Earth</p> <ul style="list-style-type: none"> ▪ 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) <p>ESS2.A: Earth Materials and Systems</p> <ul style="list-style-type: none"> ▪ 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) <p>ESS2.B: Plate Tectonics and Large-Scale System Interactions</p> <ul style="list-style-type: none"> ▪ 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) <p>ESS2.E: Biogeology</p> <ul style="list-style-type: none"> ▪ Living things affect the physical characteristics of their regions. (4-ESS2-1) 	<p>Patterns</p> <ul style="list-style-type: none"> ▪ Patterns can be used as evidence to support an explanation. (4-ESS1-1, 4-ESS2-2) <p>Cause and Effect</p> <ul style="list-style-type: none"> ▪ Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1, 4-ESS3-2) <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">Connections to Engineering, Technology, and Applications of Science</p> <p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> <ul style="list-style-type: none"> ▪ 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>Constructing Explanations and Designing Solutions 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"> Identify the evidence that supports particular points in an explanation. (4-ESS1-1) 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) 	<p>ESS3.B: Natural Hazards</p> <ul style="list-style-type: none"> 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) <p>ETS1.B: Designing Solutions to Engineering Problems</p> <ul style="list-style-type: none"> Testing a solution involves investigating how well it performs under a range of likely conditions. 	<p>Connections to Nature of Science</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</p> <ul style="list-style-type: none"> Science assumes consistent patterns in natural systems. (4-ESS1-1)
<p><i>Connections to other DCIs in fourth grade:</i> 4.ETS1.C (4-ESS3-2)</p>		
<p><i>Connections to other DCIs across grade levels:</i> K-2.ETS1.A (4-ESS3-2); 2.ESS1.C (4-ESS1-1, 4-ESS2-1); 2.ESS2.A (4-ESS2-1); 2.ESS2.B (4-ESS2-2); 2.ESS2.C (4-ESS2-2); K-2.ETS1.B (4-ESS3-2); K-2.ETS1.C (4-ESS3-2); 3.LS4.A (4-ESS1-1); 5.ESS2.A (4-ESS2-1); 5.ESS2.C (4-ESS2-2); 6.ETS1.B (4-ESS3-2); 7.ESS2.A (4-ESS1-1, 4-ESS2-2, 4-ESS3-2); 7.ESS2.B (4-ESS1-1, 4-ESS2-2); 7.ESS3.B (4-ESS3-2); 8.LS4.A (4-ESS1-1); 8.ESS1.C (4-ESS1-1, 4-ESS2-2)</p>		
<p><i>Connections to the Arkansas English Language Arts Standards –</i></p>		
<p>RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)</p> <p>RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)</p> <p>RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)</p> <p>W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1, 4-ESS2-1)</p> <p>W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources. Take notes and categorize information. Provide a list of sources. (4-ESS1-1, 4-ESS2-1)</p> <p>W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1)</p>		
<p><i>Connections to the Arkansas Mathematics Standards –</i></p>		
<p>MP.2 Reason abstractly and quantitatively. (4-ESS1-1, 4-ESS2-1, 4-ESS3-2)</p> <p>MP.4 Model with mathematics. (4-ESS1-1, 4-ESS2-1, 4-ESS3-2)</p> <p>MP.5 Use appropriate tools strategically. (4-ESS2-1)</p> <p>4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec; yd, ft, in; gal, qt, pt, c. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1, 4-ESS2-1)</p> <p>4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including the ability to make change; including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1, 4-ESS2-2)</p> <p>4.OA.A.1 Interpret a multiplication equation as a comparison (e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5). Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-2)</p>		

GRADE FOUR

Engineering, Technology, and Applications of Science

Students who demonstrate understanding can:

- 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.

- 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.

- 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.

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>Asking Questions and Defining Problems</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"> ▪ 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) <p>Planning and Carrying Out Investigations</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"> ▪ 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) <p>Constructing Explanations and Designing Solutions</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"> ▪ 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) 	<p>ETS1.A: Defining and Delimiting Engineering Problems</p> <ul style="list-style-type: none"> ▪ 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) <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> ▪ 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) ▪ 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) ▪ 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) <p>ETS1.C: Optimizing the Design Solution</p> <ul style="list-style-type: none"> ▪ 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) 	<p>Influence of Science, Engineering, and Technology on Society and the Natural World</p> <ul style="list-style-type: none"> ▪ People’s needs and wants change over time, as do their demands for new and improved technologies. (4-ETS1-1) ▪ Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (4-ETS1-2)

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

Connections to the Arkansas English Language Arts Standards –

- RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (3-ETS1-2)
- RI.4.7** Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ETS1-2)
- RI.4.9** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ETS1-2)
- W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ETS1-1, 4-ETS1-3)
- W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources. Take notes and categorize information. Provide a list of sources. (4-ETS1-1, 4-ETS1-3)
- W.4.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ETS1-1, 4-ETS1-3)

Connections to the Arkansas Mathematics Standards –

- MP.2** Reason abstractly and quantitatively. (4-ETS1-1, 4-ETS1-2, 4-ETS1-3)
- MP.4** Model with mathematics. (4-ETS1-1, 4-ETS1-2, 4-ETS1-3)
- MP.5** Use appropriate tools strategically. (4-ETS1-1, 4-ETS1-2, 4-ETS1-3)
- 3-5.OA** Operations and Algebraic Thinking (4-ETS1-1, 4-ETS1-2)

