ARKANSAS

K-12 SCIENCE STANDARDS

EDUCATION FOR A NEW GENERATION

Grades K-5
Learning Progressions and Standards Overviews

2015

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Kindergarten				
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Kindergarten 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,
- 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.

Physical Sciences (PS)

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.

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 Trails	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 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.

Physical Sciences (PS)

The (PS) performance expectations in second grade help students formulate answers to the questions, “How do the properties of materials determine their use?”, “How are materials similar and different from one another?”, and “How many types of organisms live in a place?” 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 question, “What do plants need to grow?” 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 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**AR**	3-LS2-1**AR**	3-LS1-1	3-ESS2-1
3-PS2-2	3-LS4-1	3-LS3-1	3-ESS2-2
3-PS2-3	3-LS4-3**AR**	3-LS3-2	3-ESS3-1
3-PS2-4	3-LS4-4	3-LS4-2**AR**	
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 3-ETS1-1, 3-ETS1-2, 3-ETS1-3			

Arkansas Clarification Statement (**AR**)

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**AR**	3-LS1-1	3-LS2-1**AR**	3-LS3-1	3-LS4-1	3-ESS2-1	3-ESS3-1
3-PS2-2			3-LS3-2	3-LS4-2**AR**	3-ESS2-2	
3-PS2-3				3-LS4-3**AR**		
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 (**AR**)

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.

Physical Sciences (PS)

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?", "What happens to organisms when their environment changes?", 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 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 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**AR**	5-LS1-1
5-ESS3-1	5-ESS1-2	5-PS1-3	5-LS2-1
		5-PS1-4**AR**	
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 5-ETS1-1, 5-ETS1-2, 5-ETS1-3			

Arkansas Clarification Statement/Assessment Boundary (**AR**)

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-ESS1-2	5-ESS2-2		5-PS1-2**AR**				
			5-PS1-3				
			5-PS1-4**AR**				
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 5-ETS1-1, 5-ETS1-2, 5-ETS1-3							

Arkansas Clarification Statement/Assessment Boundary (**AR**)

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.

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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. 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.

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?" 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.

Reference:

NGSS Lead States, (2013). *Next Generation Science Standards: For States, By States*. Washington, D.C.: The National Academies Press.