

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-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.

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.

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Earth's Systems		
<p>Students who demonstrate understanding can:</p> <p>5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [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>5-ESS2-2 Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]</p> <p>5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.</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 align="center">Science and Engineering Practices</p> <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 example to describe a scientific principle. (5-ESS2-1) <p>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.</p> <ul style="list-style-type: none"> Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2) <p>Obtaining, Evaluating, and Communicating Information 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"> Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1) 	<p align="center">Disciplinary Core Ideas</p> <p>ESS2.A: Earth Materials and Systems</p> <ul style="list-style-type: none"> 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) <p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS3.C: Human Impacts on Earth Systems</p> <ul style="list-style-type: none"> 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) 	<p align="center">Crosscutting Concepts</p> <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Standard units are used to measure and describe physical quantities such as weight, and volume. (5-ESS2-2) <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. (5-ESS2-1, 5-ESS3-1) <p align="center">-----</p> <p>Connections to Nature of Science</p> <p>Science Addresses Questions About the Natural and Material World</p> <ul style="list-style-type: none"> Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)
<p><i>Connections to other Disciplinary Core Ideas (DCIs) in fifth grade:</i> N/A</p>		
<p><i>Connections to other DCIs across grade levels:</i> 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)</p>		

Connections to the Arkansas English Language Arts Standards –

- RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)
- RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1, 5-ESS2-2, 5-ESS3-1)
- RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
- W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources. Summarize or paraphrase information in notes and finished work. Provide a list of sources. (5-ESS2-2, 5-ESS3-1)
- W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)
- SL.5.5** Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1, 5-ESS2-2)

Connections to the Arkansas Mathematics Standards–

- MP.2** Reason abstractly and quantitatively. (5-ESS2-1, 5-ESS2-2, 5-ESS3-1)
- MP.4** Model with mathematics. (5-ESS2-1, 5-ESS2-2, 5-ESS3-1)
- 5.G.2** Represent real world and mathematical problems by graphing points in the first quadrant and on the non-negative x- and y- axes of the coordinate plane. Interpret coordinate values of points in the context of the situation. (5-ESS2-1)

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Space Systems		
<p>Students who demonstrate understanding can:</p> <p>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.]</p> <p>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).]</p> <p>5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [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.]</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 align="center">Science and Engineering Practices</p> <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"> Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2) <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"> Support an argument with evidence, data, or a model. (5-PS2-1, 5-ESS1-1) 	<p align="center">Disciplinary Core Ideas</p> <p>PS2.B: Types of Interactions</p> <ul style="list-style-type: none"> The gravitational force of Earth acting on an object near Earth’s surface pulls that object toward the planet’s center. (5-PS2-1) <p>ESS1.A: The Universe and its Stars</p> <ul style="list-style-type: none"> 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) <p>ESS1.B: Earth and the Solar System</p> <ul style="list-style-type: none"> 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) 	<p align="center">Crosscutting Concepts</p> <p>Patterns</p> <ul style="list-style-type: none"> Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. (5-ESS1-2) <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1) <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Natural objects exist from the very small to the immensely large. (5-ESS1-1)
<p><i>Connections to other DCIs in fifth grade:</i> N/A</p>		
<p><i>Connections to other DCIs across grade levels:</i> 1.ESS1.A (5-ESS1-2); 1.ESS1.B (5-ESS1-2); 3.PS2.A (5-PS2-1, 5-ESS1-2); 3.PS2.B (5-PS2-1); 8.PS2.B (5-PS2-1); 8.ESS1.A (5-ESS1-1, 5-ESS1-2); 8.ESS1.B (5-PS2-1, 5-ESS1-1, 5-ESS1-2); 7.ESS2.C (5-PS2-1)</p>		

Connections to the Arkansas English Language Arts Standards –

- RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-PS2-1, 5-ESS1-1)
- RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS1-1)
- RI.5.8** Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). (5-ESS1-1)
- RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-PS2-1, 5-ESS1-1)
- W.5.1** Write opinion pieces on topics or texts, supporting the opinion with reasons and information. (5-PS2-1, 5-ESS1-1)
- SL.5.5** Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS1-2)

Connections to the Arkansas Mathematics Standards –

- MP.2** Reason abstractly and quantitatively. (5-ESS1-1, 5-ESS1-2)
- MP.4** Model with mathematics. (5-ESS1-1, 5-ESS1-2)
- 5.NBT.A.2** Students understand why multiplying or dividing by a power of 10 shifts the value of the digits of a whole number or decimal.
 - AR.5.NBT.A.2.A**
Explain patterns in the number of zeros of the product when multiplying a whole number by powers of 10.
 - AR.5.NBT.A.2.B**
Explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10.
 - AR.5.NBT.A.2.C**
Use whole-number exponents to denote powers of 10.
- 5.G.A.2** Represent real world and mathematical problems by graphing points in the first quadrant and on the non-negative x- and y-axes of the coordinate plane. Interpret coordinate values of points in the context of the situation. (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	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. (5-PS1-1) <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"> ▪ 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) 	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> ▪ 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) <p>PS1.B: Chemical Reactions</p> <ul style="list-style-type: none"> ▪ 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) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> ▪ Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4) <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> ▪ 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) <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">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. (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 –

- RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS1-1)
- W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-2, 5-PS1-3, 5-PS1-4)
- W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources. Summarize or paraphrase information in notes and finished work. Provide a list of sources. (5-PS1-2, 5-PS1-3, 5-PS1-4)
- W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-2, 5-PS1-3, 5-PS1-4)

Connections to the Arkansas Mathematics Standards –

- MP.2** Reason abstractly and quantitatively. (5-PS1-1, 5-PS1-2, 5-PS1-3)
- MP.4** Model with mathematics. (5-PS1-1, 5-PS1-2, 5-PS1-3)
- MP.5** Use appropriate tools strategically. (5-PS1-2, 5-PS1-3)
- 5.NBT.A.1** Recognize that in a multi-digit number, a digit in one 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)
- 5.NF.B.7** Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. Interpret division of a unit fraction by a natural number, and compute such quotients. Interpret division of a whole number by a unit fraction, and compute such quotients. Solve real world problems involving division of unit fractions by natural numbers and (5-PS1-1)
- 5.MD.A.1** Convert among different-sized standard measurement units within the metric system. Convert among different-sized standard measurement units within the customary system. Use these conversions in solving multi-step, real world problems. (5-PS1-2)
- 5.MD.C.3** Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1)
A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume. A solid figure, which can be packed without gaps or overlaps using n unit cubes, is said to have a volume of n cubic units.
- 5.MD.C.4** Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft., and improvised units. (5-PS1-1)

Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can:

- 5-PS3-1** 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. [Clarification Statement: Examples of models could include diagrams and flow charts.]
- 5-LS1-1** Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]
- 5-LS2-1** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [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 *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"> ▪ Use models to describe phenomena. (5-PS3-1) ▪ Develop a model to describe phenomena. (5-LS2-1) <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"> ▪ Support an argument with evidence, data, or a model. (5-LS1-1) <p>-----</p> <p>Connections to Nature of Science</p> <p>Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena</p> <ul style="list-style-type: none"> ▪ Science explanations describe the mechanisms for natural events. (5-LS2-1) 	<p>PS3.D: Energy in Chemical Processes and Everyday Life</p> <ul style="list-style-type: none"> ▪ 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) <p>LS1.C: Organization for Matter and Energy Flow in Organisms</p> <ul style="list-style-type: none"> ▪ 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) ▪ Plants acquire their material for growth chiefly from air and water. (5-LS1-1) <p>LS2.A: Interdependent Relationships in Ecosystems</p> <ul style="list-style-type: none"> ▪ 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) 	<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. (5-LS2-1) <p>Energy and Matter</p> <ul style="list-style-type: none"> ▪ Matter is transported into, out of, and within systems. (5-LS1-1) ▪ Energy can be transferred in various ways and between objects. (5-PS3-1)

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 –

- RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-LS1-1)
- RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS3-1, 5-LS2-1)
- RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1)
- W.5.1** Write opinion pieces on topics or texts, supporting the opinion with reasons and information. (5-LS1-1)
- SL.5.5** Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-PS3-1, 5-LS2-1)

Connections to the Arkansas Mathematics Standards –

- MP.2** Reason abstractly and quantitatively. (5-LS1-1, 5-LS2-1)
- MP.4** Model with mathematics. (5-LS1-1, 5-LS2-1)
- MP.5** Use appropriate tools strategically. (5-LS1-1)
- 5.MD.A.1** Convert among different-sized standard measurement units within the metric system. Convert among different-sized standard measurements units within the customary system. Use these conversions in solving multi-step, real world problems. (5-LS1-1)

GRADE FIVE

Engineering, Technology, and Applications of Science	
Students who demonstrate understanding can:	
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.
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.
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.

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. (5-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. (5-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. (5-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. (5-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. (5-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. (5-ETS1-2) 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) <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. (5-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. (5-ETS1-1) Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (5-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 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 –

- RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ETS1-2)
- RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ETS1-2)
- RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ETS1-2)
- W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-ETS1-1, 5-ETS1-3)
- W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources. Summarize or paraphrase information in notes and finished work. Provide a list of sources. (5-ETS1-1, 5-ETS1-3)
- W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ETS1-1, 5-ETS1-3)

Connections to the Arkansas Mathematics Standards –

- 3.0A** Operations and Algebraic Thinking (3-ETS1-1, 3-ETS1-2)
- MP.2** Reason abstractly and quantitatively. (5-ETS1-1, 5-ETS1-2, 5-ETS1-3)
- MP.4** Model with mathematics. (5-ETS1-1, 5-ETS1-2, 5-ETS1-3)
- MP.5** Use appropriate tools strategically. (5-ETS1-1, 5-ETS1-2, 5-ETS1-3)
- 3-5.OA** Operations and Algebraic Thinking (5-ETS1-1, 5-ETS1-2)