ARKANSAS
K-12 SCIENCE STANDARDS

EDUCATION FOR A NEW GENERATION

Grade 7

2015

Re-aligned Fall 2016 to the Arkansas Mathematics Standards, Arkansas English Language Arts Standards, and Arkansas Disciplinary Literacy Standards

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How to Read
Arkansas K-12 Science Standards

Topic

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

GRADE TWO

Interdependent Relationships in Ecosystems
Students who demonstrate understanding can: **2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [Assessment Boundary: Assessment is limited to testing one variab...] **2-LS2-2. Develop a simple model that mimics the function o... eeds or pollinating plants.** * **2-LS4-1. Make observations of plants and animals to compa... fferent habitats.** [Clarification Statement: Emphasis is on the diversity of living thing... in a variety of habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]
The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Student Performance Expectations (PEs)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. ▪ Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ Plan and conduct an investig... collaboratively to produce da... as the basis for evidence to a... question. (2-LS2-1) ▪ Make observations (firsthand or from media) to collect data that can be used to make comparisons. (2-LS4-1) --- **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** ▪ Scientists look for patterns and order when making observations about the world. (2-LS4-1)	**LS2.A: Interdependent Relationships in Ecosystems** ▪ Plants depend on water and light to grow. (2-LS2-1) ▪ Plants depend on animals for pollination or to move their seeds around. (2-LS2-2) **LS4.D: Biodiversity and Humans** ▪ There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1) **ETS1.B: Developing Possible Solutions** ▪ Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (2-LS2-2) ▪	**Cause and Effect** ▪ Events have causes that generate observable patterns. (2-LS2-1) **Structure and Function** ▪ The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)
Connections to other DCIs in second grade: N/A		
Connections to other DCIs across grade levels: **K.LS1.C** (2-LS2-1); **K-ESS3.A** (2-LS2-1); **K-2.ETS1.A** (2-LS2-2); **3.LS4.C** (2-LS4-1); **3.LS4.D** (2-LS4-1); **5.LS1.C** (2-LS2-1); **5.LS2.A** (2-LS2-2, 2-LS4-1)		

Designates which PE uses this practice

Designates which PE incorporates this disciplinary core idea (DCI)

Designates which PE incorporates this crosscutting concept (CC)

Connections to the Nature of Science

DCI codes from *A Framework for K-12 Science Education* in boldface type.

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

Arkansas K-12 Science Standards Overview

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

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

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

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

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

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

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

Science and Engineering Practices

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

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

Crosscutting Concepts

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

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

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

Disciplinary Core Ideas

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

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

Connections to the Arkansas English Language Arts Standards

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

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

Connections to the Arkansas Disciplinary Literacy Standards

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

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

Connections to the Arkansas Mathematics Standards

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

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

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

Grades 5-8 Science Core Ideas and Topics Overview

Grade 5	PHYSICAL SCIENCES	LIFE SCIENCES	EARTH and SPACE SCIENCES	
	5. Structure and Properties of Matter	5. Matter and Energy in Organisms and Ecosystems	5. Earth's Systems	5. Space Systems
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE 5. Engineering Design				

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

Science Grades 5-8 Overview

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

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

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

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

Notes:

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

Grade 7 Learning Progression by Topic

Grade 7						
PHISICAL SCIENCES		LIFE SCIENCES		EARTH and SPACES SCIENCES		
Structures and Properties of Matter	Chemical Reactions	Interdependent Relationships in Ecosystems	Matter and Energy in Organisms and Ecosystems	Earth's Systems	History of Earth	Human Impacts
7-PS1-1	7-PS1-2**AR**	7-LS2-2	7-LS1-6	7-ESS2-1**AR**	7-ESS2-2	7-ESS3-2
7-PS1-3	7-PS1-5	7-LS2-5	7-LS1-7	7-ESS3-1	7-ESS2-3	
7-PS1-4	7-PS1-6**AR**		7-LS2-1			
			7-LS2-3			
			7-LS2-4			
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 7-ETS1-1, 7-ETS1-2, 7-ETS1-3, 7-ETS1-4						

Arkansas Clarification Statement (**AR**)

Grade 7 Learning Progression by Disciplinary Core Idea

Grade 7				
PHYSICAL SCIENCES	LIFE SCIENCES		EARTH and SPACE SCIENCES	
Matter and Its Interactions	From Molecules to Organisms: Structures and Processes	Ecosystems: Interactions, Energy, and Dynamics	Earth's Systems	Earth and Human Activity
7-PS1-1	7-LS1-6	7-LS2-1	7-ESS2-1**AR**	7-ESS3-1
7-PS1-2**AR**	7-LS1-7	7-LS2-2	7-ESS2-2	7-ESS3-2
7-PS1-3		7-LS2-3	7-ESS2-3	
7-PS1-4		7-LS2-4		
7-PS1-5		7-LS2-5		
7-PS1-6**AR**				
ENGINEERING, TECHNOLOGY, and APPLICATIONS of SCIENCE Engineering Design 7-ETS1-1, 7-ETS1-2, 7-ETS1-3, 7-ETS1-4				

Arkansas Clarification Statement (**AR**)

Grade Seven Standards Overview

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

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

Science and Engineering Practices

Students are expected to demonstrate grade-appropriate proficiency in

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

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

Crosscutting Concepts

Students are expected to demonstrate grade-appropriate understanding of

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

Disciplinary Core Ideas

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

- PS1 - Matter and Its Interactions,
- LS1 - Molecules to Organisms: Structures and Processes,
- LS2 - Ecosystems: Interactions, Energy, and Dynamics,
- ESS2 - Earth's Systems,
- ESS3 - Earth and Human Activity, and
- ETS1 - Engineering Design in a 6-8 developmental learning progression

Physical Sciences (PS)

The (PS) performance expectations in seventh grade help students formulate answers to the questions, “How can particles combine to produce substances with different properties?”, “What stays the same and what changes in a chemical reaction?”, and “What happens when new materials are formed?” Students are expected to develop understanding of the structures and properties of matter and chemical reactions.

Life Sciences (LS)

The (LS) performance expectations in seventh grade help students explore the questions, “How does matter and energy move through an ecosystem?” and “How do organisms interact with other organisms in the physical environment to obtain energy?” Students are expected to develop understanding of interdependent relationships in ecosystems and matter and energy in organisms and ecosystems.

Earth and Space Sciences (ESS)

The (ESS) performance expectations in seventh grade help students investigate the questions, “How has Earth developed and changed over time?”, and “How have humans been able to forecast catastrophic events and mitigate their effects?” Students are expected to develop understanding of Earth systems, history of the Earth, and human impacts.

Engineering, Technology, and Applications of Science (ETS)

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

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

In the seventh grade students are still developing the ability to achieve all four performance expectations (7-ETS1-1, 7-ETS1-2, 7-ETS1-3, 7-ETS1-4) related to a single problem in order to understand the interrelated processes of engineering design. Students can use tools and materials to solve problems, use visual or physical representations to convey solutions, and optimize solutions to a problem, test them, and determine which is best. These component ideas do not always follow in order. At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that is not working.

GRADE SEVEN

Structure and Properties of Matter
Students who demonstrate understanding can: **7-PS1-1** **Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3-D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.] **7-PS1-3** **Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form a synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.] **7-PS1-4** **Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.** [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings or diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]
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
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to predict and/or describe phenomena. (7-PS1-1, 7-PS1-4) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. ▪ Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (7-PS1-3)	**PS1.A: Structure and Properties of Matter** ▪ Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (7-PS1-1) ▪ Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (7-PS1-3) ▪ Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (7-PS1-4) ▪ In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (7-PS1-4) ▪ Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (7-PS1-1) ▪ The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (7-PS1-4)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (7-PS1-4) **Scale, Proportion, and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (7-PS1-1) **Structure and Function** ▪ Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (7-PS1-3)

	PS1.B: Chemical Reactions ▪ Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (7-PS1-3) **PS3.A: Definitions of Energy** ▪ The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to 7-PS1-4) ▪ The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(*7-PS1-4)	-- **Connections to Engineering, Technology, and Applications of Science** **Interdependence of Science, Engineering, and Technology** ▪ Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (7-PS1-3) **Influence of Science, Engineering and Technology on Society and the Natural World** ▪ The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (7-PS1-3)

Connections to other DCIs in seventh grade: **7.ESS2.C** (7-PS1-1),(7-PS1-4); **7.ESS3.A** (7-PS1-3)

Connections to other DCIs across grade levels: **5.PS1.A** (7-PS1-1); **8.PS3.A** (7-PS1-4); **8.LS4.D** (7-PS1-3); **8.ESS1.A** (7-PS1-1)

Connections to the Arkansas Disciplinary Literacy Standards –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (7-PS1-3)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-PS1-1, 7-PS1-4)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (7-PS1-3)

Connections to the Arkansas Mathematics Standards –

MP.2 Reason abstractly and quantitatively. (7-PS1-1)

MP.4 Model with mathematics. (7-PS1-1)

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (7-PS1-1)

6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values, explaining the meaning of 0. (7-PS1-4)

Chemical Reactions
Students who demonstrate understanding can:
7-PS1-2 **Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.** [**AR** Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrochloric acid.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]
7-PS1-5 **Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]
7-PS1-6 **Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*** [**AR** Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical processes such as dissolving ammonium chloride or calcium chloride or chemical reactions such as burning.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]
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
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to describe unobservable mechanisms. (7-PS1-5) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze and interpret data to determine similarities and differences in findings. (7-PS1-2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. ▪ Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (7-PS1-6) ---	**PS1.A: Structure and Properties of Matter** ▪ Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (7-PS1-2) ▪ **PS1.B: Chemical Reactions** ▪ Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (7-PS1-2, 7-PS1-5) ▪ The total number of each type of atom is conserved, and thus the mass does not change. (7-PS1-5) ▪ Some chemical reactions release energy, others store energy. (7-PS1-6)	**Patterns** ▪ Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (7-PS1-2) **Energy and Matter** ▪ Matter is conserved because atoms are conserved in physical and chemical processes. (7-PS1-5) ▪ The transfer of energy can be tracked as energy flows through a designed or natural system. (7-PS1-6)

Connections to Nature of Science		
Scientific Knowledge is Based on Empirical Evidence ▪ Science knowledge is based upon logical and conceptual connections between evidence and explanations. (7-PS1-2) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ▪ Laws are regularities or mathematical descriptions of natural phenomena. (7-PS1-5)	**ETS1.B: Developing Possible Solutions** ▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (7-PS1-6) **ETS1.C: Optimizing the Design Solution** ▪ Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (7-PS1-6) ▪ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (7-PS1-6)	

Connections to other DCIs in seventh grade: **7.LS2.B** (7-PS1-5); **7.ESS2.A** (7-PS1-2),(7-PS1-5)

Connections to other DCIs across grade levels: **5.PS1.B** (7-PS1-2, 7-PS1-5); **6.PS3.D** (7-PS1-6); **8.PS3.A** (7-PS1-6); **8.PS3.B** (7-PS1-6)

Connections to the Arkansas Disciplinary Literacy Standards –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (7-PS1-2)
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (7-PS1-6)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-PS1-2, 7-PS1-5)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (7-PS1-6)

Connections to the Arkansas Mathematics Standards –

MP.2	Reason abstractly and quantitatively. (7-PS1-2, 7-PS1-5)
MP.4	Model with mathematics. (7-PS1-5)
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. (7-PS1-2, 7-PS1-5)
6.SP.B.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (7-PS1-2)
6.SP.B.5	Summarize numerical data sets in relation to their context. (7-PS1-2)

Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:

7-LS2-2 **Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

7-LS2-5 **Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*** [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, or prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

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

Constructing Explanations and Designing Solutions

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

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (7-LS2-2)

Engaging in Argument from Evidence

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

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (7-LS2-5)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (7-LS2-2)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (7-LS2-5)

LS4.D: Biodiversity and Humans

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (7-LS2-5)

ETS1.B: Developing Possible Solutions

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (7-LS2-5)

Crosscutting Concepts

Patterns

- Patterns can be used to identify cause and effect relationships. (7-LS2-2)

Stability and Change

- Small changes in one part of a system might cause large changes in another part. (7-LS2-5)

Connections to Engineering, Technology, and Applications of Science

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

- The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (7-LS2-5)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the

		decisions that society takes. (7-LS2-5)

Connections to other DCIs in seventh grade: N/A

Connections to other DCIs across grade levels: **1.LS1.B** (7-LS2-2); **6.ESS3.C** (7-LS2-5); **6.ESS3.D** (7-LS2-5); **8.LS4.D** (7-LS2-5)

Connections to the Arkansas Disciplinary Literacy Standards –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (7-LS2-2)
RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (7-LS2-5)
RI.7.8 Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (7-LS2-5)
WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (7-LS2-2)
WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (7-LS2-2)

Connections to the Arkansas English Language Arts Standards –

SL.7.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on Grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. (7-LS2-2)
SL.7.4 Present claims and findings, emphasizing primary points in a focused, coherent manner with pertinent descriptions, facts, details and examples; use appropriate eye contact, adequate volume, and clear pronunciation. (7-LS2-2)

Connections to the Arkansas Mathematics Standards –

MP.4 Model with mathematics. (7-LS2-5)
6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (7-LS2-5)
6.SP.B.5 Summarize numerical data sets in relation to their context. (7-LS2-2)

GRADE SEVEN

Matter and Energy in Organisms and Ecosystems	
Students who demonstrate understanding can:	
7-LS1-6	**Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.** [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]
7-LS1-7	**Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.** [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]
7-LS2-1	**Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]
7-LS2-3	**Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]
7-LS2-4	**Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.** [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]
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
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to describe phenomena. (7-LS2-3) ▪ Develop a model to describe unobservable mechanisms. (7-LS1-7) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze and interpret data to provide evidence for phenomena. (7-LS2-1)	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (7-LS1-6) ▪ Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (7-LS1-7) **LS2.A: Interdependent Relationships in Ecosystems** ▪ Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (7-LS2-1) ▪ In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (7-LS2-1)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (7-LS2-1) **Energy and Matter** ▪ Matter is conserved because atoms are conserved in physical and chemical processes. (7-LS1-7) ▪ Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (7-LS1-6) ▪ The transfer of energy can be tracked as energy flows through a natural system. (7-LS2-3) **Stability and Change** ▪ Small changes in one part of a system might cause large changes in another part. (7-LS2-4)

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. ▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (7-LS1-6) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). ▪ Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (7-LS2-4) **--** **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** ▪ Science knowledge is based upon logical connections between evidence and explanations. (7-LS1-6) ▪ Science disciplines share common rules of obtaining and evaluating empirical evidence. (7-LS2-4)	▪ Growth of organisms and population increases are limited by access to resources. (7-LS2-1) **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** ▪ Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (7-LS2-3) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ▪ Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (7-LS2-4) **PS3.D: Energy in Chemical Processes and Everyday Life** ▪ The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (7-LS1-6) ▪ Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (7-LS1-7)	**---------------------------------** **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (7-LS2-3)

Connections to other DCIs in seventh grade: **7.PS1.B** (7-LS1-6, 7-LS1-7, 7-LS2-3); **7.ESS2.A** (7-LS1-6, 7-LS2-3, 7-LS2-4); **7.ESS3.A** (7-LS2-1, 7-LS2-4)

Connections to other DCIs across grade levels: **3.LS2.C** (7-LS2-1, 7-LS2-4); **3.LS4.D** (7-LS2-1, 7-LS2-4); **5.PS3.D** (7-LS1-6, 7-LS1-7); **5.LS1.C** (7-LS1-6, 7-LS1-7); **5.LS2.A** (7-LS1-6, 7-LS2-1, 7-LS2-3); **5.LS2.B** (7-LS1-6, 7-LS1-7, 7-LS2-3); **6.LS1.C** (7-LS1-6, 7-LS1-7, 7-LS2-3); **6.ESS2.D** (7-LS1-6); **6.ESS2.E** (7-LS2-4); **6.ESS3.C** (7-LS2-4); **8.PS3.B** (7-LS2-3); **8.LS4.C** (7-LS2-1, 7-LS2-4); **8.LS4.D** (7-LS2-1, 7-LS2-4)

Connections to the Arkansas Disciplinary Literacy Standards –	
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (7-LS1-6, 7-LS2-1, 7-LS2-4)
RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (7-LS1-6)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-LS2-1)
RI.7.8	Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (7-LS2-4)
WHST.6-8.1	Write arguments focused on discipline-specific content. (7-LS2-4)
WHST.6-8.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (7-LS1-6)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (7-LS1-6, 7-LS2-4)
Connections to the Arkansas English Language Arts Standards –	
SL.7.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize the primary points. (7-LS1-7, 7-LS2-3)
Connections to the Arkansas Mathematics Standards –	
6.EE.C.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another**.** Write an equation to express one quantity, thought as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the question. (7-LS1-6, 7-LS2-3)

Earth's Systems
Students who demonstrate understanding can: **7-ESS2-1** **Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.** [**AR** Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. Arkansas specific examples of geologic materials include Karst, bauxite, and diamonds.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.] **7-ESS3-1** **Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]
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
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop and use a model to describe phenomena. (7-ESS2-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (7-ESS3-1)	**ESS2.A: Earth's Materials and Systems** ▪ All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (7-ESS2-1) **ESS3.A: Natural Resources** ▪ Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (7-ESS3-1)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (7-ESS3-1) **Stability and Change** ▪ Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (7-ESS2-1) -- **Connections to Engineering, Technology, and Applications of Science** **Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (7-ESS3-1)

Connections to other DCIs in seventh grade: **7.PS1.A** (7-ESS2-1, 7-ESS3-1); **7.PS1.B** (7-ESS2-1, 7-ESS3-1); **7.LS2.B** (7-ESS2-1); **7.LS2.C** (7-ESS2-1)

Connections to other DCIs across grade levels: **4.PS3.B** (7-ESS2-1); **4.PS3.D** (7-ESS3-1); **4.ESS2.A** (7-ESS2-1); **4.ESS3.A** (7-ESS3-1); **5.ESS2.A** (7-ESS2-1); **6.LS1.C** (7-ESS2-1, 7-ESS3-1); **6.ESS2.E** (7-ESS2-1); **8.PS3.B** (7-ESS2-1, 7-ESS3-1); **8.PS4.B** (7-ESS2-4)

Connections to the Arkansas Disciplinary Literacy Standards –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (7-ESS3-1)

WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (7-ESS3-1)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (7-ESS3-1)

Connections to the Arkansas English Language Arts Standards –

SL.7.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize the primary points. (7-ESS2-1)

Connections to the Arkansas Mathematics Standards –

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number or any number in a specified set. (7-ESS3-1)

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem. Construct simple equations and inequalities to solve problems by reasoning about the quantities. Solve word problems leading to equations of these forms $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Write an algebraic solution of identifying the sequence of the operations used to mirror the arithmetic solution. Solve word problems leading to inequalities of the form $px + q >$ or $px + q < r$ where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. (7-ESS3-1)

History of Earth

Students who demonstrate understanding can:

7-ESS2-2 **Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.** [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

7-ESS2-3 **Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.** [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, or trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

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

Science and Engineering Practices

Analyzing and Interpreting Data

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

- Analyze and interpret data to provide evidence for phenomena. (7-ESS2-3)

Constructing Explanations and Designing Solutions

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

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.(7-ESS2-2)

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

- Science findings are frequently revised and/or reinterpreted based on new evidence. (7-ESS2-3)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (7-ESS2-3)

ESS2.A: Earth's Materials and Systems

- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (7-ESS2-2)

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

- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (7-ESS2-3)

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

- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (7-ESS2-2)

Crosscutting Concepts

Patterns

- Patterns in rates of change and other numerical relationships can provide information about natural systems. (7-ESS2-3)

Scale Proportion and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (7-ESS2-2)

Connections to other DCIs in seventh grade: **7.PS1.B** (7-ESS2-2); **7.LS2.B** (7-ESS2-2)

Connections to other DCIs across grade levels: **3.LS4.A** (7-ESS2-3); **3.ESS3.B** (7-ESS2-3); **4.ESS1.C** (7-ESS2-2, 7-ESS2-3); **4.ESS2.A** (7-ESS2-2); **4.ESS2.B** (7-ESS2-3); **4.ESS2.E** (7-ESS2-2); **4.ESS3.B** (7-ESS2-3); **5.ESS2.A** (7-ESS2-2); **6.PS3.D** (7-ESS2-2); **6.ESS2.D** (7-ESS2-2); **6.ESS2.E** (7-ESS2-2); **6.ESS3.D** (7-ESS2-2); **8.LS4.A** (7-ESS2-3); **8.LS4.C** (7-ESS2-3); **8.ESS1.C** (7-ESS2-2, 7-ESS2-3)

Connections to the Arkansas Disciplinary Literacy Standards –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (7-ESS2-2, 7-ESS2-3)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-ESS2-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (7-ESS2-3)

WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (7-ESS2-2)

Connections to the Arkansas English Language Arts Standards –

SL.7.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize the primary points. (7-ESS2-2)

Connections to the Arkansas Mathematics Standards –

MP.2 Reason abstractly and quantitatively. (7-ESS2-2, 7-ESS2-3)

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (7-ESS2-2, 7-ESS2-3)

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem. Construct simple equations and inequalities to solve problems by reasoning about the quantities. Solve word problems leading to equations of these forms $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Write an algebraic solution of identifying the sequence of the operations used to mirror the arithmetic solution. Solve word problems leading to inequalities of the form $px + q >$ or $px + q < r$ where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem (7-ESS1-4, 7-ESS2-2, 7-ESS2-3)

Human Impacts

Students who demonstrate understanding can:

7-ESS3-2 **Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.** [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

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
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze and interpret data to determine similarities and differences in findings. (7-ESS3-2)	**ESS3.B: Natural Hazards** ▪ Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (7-ESS3-2)	**Patterns** ▪ Graphs, charts, and images can be used to identify patterns in data. (7-ESS3-2) -- **Connections to Engineering, Technology, and Applications of Science** **Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (7-ESS3-2)

Connections to other DCIs in seventh grade: N/A

Connections to other DCIs across grade levels: **3.ESS3.B** (7-ESS3-2); **4.ESS3.B** (7-ESS3-2); **6.ESS2.D** (7-ESS3-2); **6.ESS3.D** (7-ESS3-2)

Connections to the Arkansas Disciplinary Literacy Standards –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (7-ESS3-2)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-ESS3-2)

Connections to the Arkansas Mathematics Standards –

MP.2 Reason abstractly and quantitatively. (7-ESS3-2)

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number or any number in a specified set. (7-ESS3-2)

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem. Construct simple equations and inequalities to solve problems by reasoning about the quantities. Solve word problems leading to equations of these forms $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Write an algebraic solution identifying the sequence of the operations used to mirror the arithmetic solution. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution of the inequality and interpret it in the context of the problem. (7-ESS3-2)

Engineering, Technology, and Applications of Science

Students who demonstrate understanding can:

7-ETS1-1 **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.** [**AR** Clarification Statement: Examples could include designing technologies (e.g., levees, dams, storm shelters) and determining their ability to mitigate the effects of future weather events.

7-ETS1-2 **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** [**AR** Clarification Statement: Examples could include evaluating human technologies (e.g., levees, dams, storm shelters) and determining their ability to mitigate the effects of future weather events.]

7-ETS1-3 **Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.** [**AR** Clarification Statement: Examples could include performing a school energy audit, evaluating the recycling program in the school or local area, or determining alternative transportation options for residents in rural or urban areas.]

7-ETS1-4 **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.** [**AR** Clarification Statement: Examples could include creating a variety of devices that perform an assortment of tasks (such as design and test airplane wings and determine the success of the design by how far the airplane can be piloted]

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
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. ▪ Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (7-ETS1-1) **Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (7-ETS1-4) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (7-ETS1-1) **ETS1.B: Developing Possible Solutions** ▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (7-ETS1-4) ▪ There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (7-ETS1-2, 7-ETS1-3) ▪ Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (7-ETS1-3) ▪ Models of all kinds are important for testing solutions. (7-ETS1-4) **ETS1.C: Optimizing the Design Solution**	**Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (7-ETS1-1) ▪ The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (7-ETS1-1)

▪ Analyze and interpret data to determine similarities and differences in findings. (7-ETS1-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. ▪ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (7-ETS1-2)	▪ Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (7-ETS1-3) ▪ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (7-ETS1-4)	

Connections to 6-8.ETS1.A: Defining and Delimiting Engineering Problems include: **Physical Science:** (6-PS3-3)
Connections to 6-8.ETS1.B: Developing Possible Solutions Problems include: **Physical Science:** (7-PS1-6, 6-PS3-3); **Life Science:** (7-LS2-5)
Connections to 6-8.ETS1.C: Optimizing the Design Solution include: **Physical Science**: (7-PS1-6)

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

Connections to the Arkansas Disciplinary Literacy Standards –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (7-ETS1-1, 7-ETS1-2, 7-ETS1-3)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-ETS1-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (7-ETS1-2, 7-ETS1-3)

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (7-ETS1-2)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (7-ETS1-1)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (7-ETS1-2)

Connections to the Arkansas English Language Arts Standards –

SL.7.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize the primary points. (7-ETS1-4)

Connections to the Arkansas Mathematics Standards –

MP.2 Reason abstractly and quantitatively. (7-ETS1-1, 7-ETS1-2, 7-ETS1-3, 7-ETS1-4)

7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form using tools strategically. Apply properties of operations to calculate with numbers in any form. Convert between forms as appropriate. Assess the reasonableness of answers using mental computation and estimation strategies. (7-ETS1-1, 7-ETS1-2, 7-ETS1-3)

7.SP.C.7 Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. Develop a uniform probability model, assigning equal probability to all outcomes, and use the model to determine probabilities of events. Develop a probability model, which may not be uniform, by observing frequencies in data generated from a chance process. (7-ETS1-4)

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