ARKANSAS

K-12 SCIENCE STANDARDS

EDUCATION FOR A NEW GENERATION

Fundamental Science Content
7th Grade

2023

The Arkansas K-12 Science Standards are available here. The standards are three-dimensional, consisting of a Science and Engineering Practice (SEP), a Disciplinary Core Idea (DCI), and a Cross Cutting Concept (CCC). By the end of the grade level, students should be able to demonstrate the full scope of the standard. Example:

The focus of this document is specifically on the science core ideas in 7th grade. In Arkansas K-12 Science Standards, science content is found in the DCI portion of each standard. Three-dimensional learning and assessment best prepares students for success so that students have the opportunity to demonstrate both what they know *and* can do in science. Refer to the full standards document to find the corresponding science and engineering practice and cross cutting concept for each standard. The core ideas are organized into the following domains of science:

- Physical Science
- Life Science
- Earth & Space Science
- Engineering Technology & Applications of Science

Each domain contains core ideas organized into component ideas. By the end of 7th grade, students are expected to know the bulleted information under each component idea. Standards that address the bulleted information are included in parentheses and those with an asterisk include an engineering component.

3-Dimensions of Science Learning

What Students Do:

1. Asking Questions and Defining Problems
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 and Designing Solutions
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information

What Students Should Know:

Physical Science
PS 1: Matter & its Interactions
PS 2: Motion & Stability: Forces & Interactions
PS 3: Energy
PS 4: Waves & Their Applications in Technologies for Information Transfer

Life Sciences
LS 1: From Molecules to Organisms: Structures & Processes
LS 2: Ecosystems: Interactions, Energy, & Dynamics
LS 3: Heredity: Inheritance & Variation of Traits
LS 4: Biological Evolution: Unity & Diversity

Earth & Space Sciences
ESS 1: Earth's Place in the Universe
ESS 2: Earth's Systems
ESS 3: Earth & Human Activity

Engineering, Technology, & the Application of Science
ETS 1: Engineering Design
ETS 2: Links Among Engineering, Technology, Science, & Society

How Students Make Sense:

1. Patterns
2. Cause and Effect
3. Scale, Proportion, and Quantity
4. Systems and System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Physical Science

*Asterisks indicate best opportunities to integrate ETS performance expectations into content.

Matter
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)
• Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (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-PS1-2, 7-PS1-3)
• 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)
• Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (7-PS1-4)
• 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)
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-PS1-3, 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, while others store energy. (7-PS1-6)*
Energy
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)
Energy in 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 involves 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)

Life Science

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Molecules to Organisms
Organization of Matter & Energy Flow
• 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, support growth, or to release energy. (7-LS1-7)
Ecosystems
Interdependent Relationships
• 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)
• 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)
Cycles of Matter & Energy Transfer
• 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 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)
Ecosystem Dynamics
• 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)

• 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)*
Biological Evolution
Biodiversity & 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)*

Earth & Space Science

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Earth's Place in the Universe
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)
Earth's Systems
Earth's Materials
• 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)
• 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)
Plate Tectonics
• 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)
Roles of Water on Earth's 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)
Earth and Human Activity
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)
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)

Engineering, Technology, and Applications of Science

Engineering Design
Defining Engineering Problems
• Precisely defining a design task's criteria and constraints, can lead to a more successfully designed solution. Design constraints include consideration of scientific principles and relevant knowledge that could limit possible solutions. (7-ETS1-1)
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)
• Processes for evaluating solutions with respect to meeting the criteria and constraints of a problem should be considered. (7-ETS1-2, 7-ETS1-3, 7-ETS2-5)
• Sometimes parts of different solutions can be combined to create a better solution than any of its predecessors. (7-ETS1-3)
• Models of all kinds are important for testing solutions. (7-ETS1-4)
• A solution needs to be tested and then modified on the basis of the test results, in order to improve it. (7-ETS1-4, 7-PS1-6)
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 those characteristics may be incorporated into the new design. (7-ETS1-3, 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-ETS1-4, 7-PS1-6)