

## Second Grade: Focus on Systems and System Models; Energy and Matter

By the end of second grade, students understand the basic concept that energy can change the phase of matter and is necessary for life. Students begin to understand energy and matter, the formation of Earth’s surface features, water cycles and energy flow, changes in the environment, patterns in the sky, and the conditions necessary for life on Earth. **Student investigations focus on collecting and making sense of observational data and simple measurements** using the **science and engineering practices**: ask questions and define problems, develop and use models, plan and carry out investigations, analyze and interpret data, use mathematics and computational thinking, construct explanations and design solutions, engage in argument from evidence, and obtain, evaluate, and communicate information. While individual lessons may include connections to any of the crosscutting concepts, the standards in second grade focus on helping students understand phenomena through **systems and system models** and **energy and matter**.

Core Ideas for Knowing Science*	Core Ideas for Using Science*
<p><b>Physical Science</b></p> <p>P1: All matter in the Universe is made of very small particles.</p> <p>P2: Objects can affect other objects at a distance.</p> <p>P3: Changing the movement of an object requires a net force to be acting on it.</p> <p>P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event.</p> <p><b>Earth and Space Science</b></p> <p>E1: The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth’s surface and its climate.</p> <p>E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe.</p> <p><b>Life Science</b></p> <p>L1: Organisms are organized on a cellular basis and have a <b>finite life span</b>.</p> <p>L2: <b>Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.</b></p> <p>L3: Genetic information is passed down from one generation of organisms to another.</p> <p>L4: <b>The unity and diversity of organisms</b>, living and extinct, is the result of evolution.</p>	<p>U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised.</p> <p>U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.</p> <p>U3: <b>Applications of science often have both positive and negative ethical, social, economic, and/or political implications.</b></p>

\*Adapted from *Working with Big Ideas in Science Education*<sup>2</sup>

Arizona Science Standards

**Physical Sciences: Students develop an understanding of observable properties of matter and how changes in energy (heating or cooling) can affect matter or materials.**

Physical Science Standards	Learning Progressions, Key Terms, and Crosscutting Concepts
<p><b>2.P1U1.1</b></p>	
<p><u>Plan and carry out an investigation</u> to determine that matter has mass, takes up space, and is recognized by its observable properties; use the collected evidence to <u>develop and support an explanation</u>.</p>	<p>All the ‘stuff’ encountered in everyday life, including <b>air</b>, water and different kinds of <b>solid substances</b>, is called <b>matter</b> because it has <b>mass</b>, and therefore <b>weight</b> on Earth, and takes up space. Different materials are recognizable by their <b>properties</b>, some of which are used to classify them as being in the <b>solid, liquid</b> or <b>gas state</b>.<sup>2</sup>(p. 20) Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature.<sup>4</sup> (p. 108))</p>
<p><b>2.P1U1.2</b></p>	
<p><u>Plan and carry out investigations</u> to gather evidence to support an explanation on how heating or cooling can cause a phase change in matter.</p>	<p>Crosscutting Concepts: cause and effect; scale, proportion, and quantity; <b>systems and system models; energy and matter</b>; stability and change<sup>4</sup></p>
<p><b>2.P4U1.3</b></p>	
<p><u>Obtain, evaluate and communicate</u> information about ways heat energy can cause change in objects or materials.</p>	<p>There are various ways of causing an event or bringing about change in objects or materials. Heating can cause <b>change</b>, as in cooking, <b>melting solids</b> or changing water to <b>vapor</b>.<sup>2</sup>(p. 23)</p> <p>Crosscutting Concepts: cause and effect; scale, proportion, and quantity; <b>systems and system models; energy and matter</b>; stability and change<sup>4</sup></p>

## Arizona Science Standards

**Earth and Space Sciences: Students develop an understanding of the distribution and role of water and wind in weather, shaping the land, and where organisms live. Wind and water can also change environments, and students learn humans and other organisms can change environments too. Students develop an understanding of changing patterns in the sky including the position of Sun, Moon, and stars, and the apparent shape of the Moon.**

Earth and Space Standards	Learning Progressions, Key Terms, and Crosscutting Concepts
<b>2.E1U1.4</b>	
<b>Observe and investigate</b> how wind and water change the shape of the land resulting in a variety of landforms.	<p><b>Wind</b> and <b>water</b> can change the shape of the land. The resulting <b>landforms</b>, together with the materials on the land, provide homes for living things.<sup>4</sup>(p. 180) Water is found in the <b>ocean, rivers, lakes, and ponds</b>. Water exists as <b>solid</b> ice and in <b>liquid</b> form. It carries soil and rocks from one place to another and determines the variety of life forms that can live in a particular location.<sup>4</sup> (p. 184)</p> <p>Crosscutting Concepts: patterns; cause and effect; scale, proportion, and quantity; <b>systems and system models</b>; stability and change<sup>4</sup></p>
<b>2.E1U1.5</b>	
<b>Develop and use models</b> to represent that water can exist in different states and is found in oceans, glaciers, lakes, rivers, ponds, and the atmosphere.	
<b>2.E1U2.6</b>	
<b>Analyze patterns</b> in weather conditions of various regions of the world and <b>design, test, and refine solutions</b> to protect humans from severe weather conditions.	<p><b>Weather</b> is the combination of <b>sunlight, wind, snow or rain, and temperature</b> in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice <b>patterns</b> over time.<sup>4</sup>(p. 188) Designs can be conveyed through <b>sketches, drawings, or physical models</b>.<sup>4</sup>(p. 207) Because there is always more than one possible solution to a problem, it is useful to <b>compare</b> designs, <b>test</b> them, and <b>discuss</b> their <b>strengths</b> and <b>weaknesses</b>.<sup>4</sup>(p. 209)</p> <p>Crosscutting Concepts: patterns; cause and effect; scale, proportion, and quantity; <b>systems and system models</b>; structure and function; stability and change<sup>4</sup></p>

## Arizona Science Standards

<b>2.E1U3.7</b>	
<b>Construct an argument from evidence</b> regarding positive and negative changes in water and land systems that impact humans and the environment.	Plants and animals (including humans) depend on the <b>land, water, and air</b> to live and grow. They in turn can change their <b>environment</b> (e.g., the shape of land, the flow of water). <sup>4</sup> (p. 190)  Crosscutting Concepts: cause and effect; scale, proportion, and quantity; <b>systems and system models</b> ; structure and function; stability and change <sup>4</sup>
<b>2.E2U1.8</b>	
<b>Observe and explain</b> the Sun’s position at different times during a twenty-four-hour period and changes in the apparent shape of the Moon from one night to another.	There are patterns in the position of the <b>Sun</b> seen at different times of the <b>day</b> and in the shape of the <b>Moon</b> from one <b>night</b> to another. <sup>2</sup> (p. 25)  Crosscutting Concepts: patterns; cause and effect; <b>systems and system models</b> ; stability and change <sup>4</sup>

**Life Sciences: Students develop an understanding that life on Earth depends on energy from the Sun or **energy from other organisms to survive.****

Life Science Standards	Learning Progressions, Key Terms, and Crosscutting Concepts
<b>2.L2U1.9</b>	
<b>Obtain, analyze, and communicate evidence</b> that organisms need a source of energy, air, water, and certain temperature conditions to survive.	All living things need food as their source of <b>energy</b> as well as air, water, and certain temperature conditions. Plants containing chlorophyll can use <b>sunlight</b> to make the food they need and can store food that they do not immediately use. <b>Animals need food that they can break down, which comes either directly by eating plants (herbivores) or by eating animals (carnivores) which have eaten plants or other animals.</b> Animals are ultimately dependent on plants for their survival. The relationships among organisms can be represented as <b>food chains and food webs.</b> <sup>2</sup> (p. 27)
<b>2.L2U1.10</b>	
<b>Develop a model</b> representing how life on Earth depends on energy from the Sun and energy from other organisms.	All animals need food in order to live and grow. They obtain their food from <b>plants or from other animals.</b> Plants need water and light to live and grow. <sup>4</sup> (p. 147)  Crosscutting Concepts: cause and effect; <b>systems and system models</b> ; <b>energy and matter</b> ; structure and function; stability and change <sup>4</sup>