

**STANDARD 1: SCIENCE AS INQUIRY**

**Eighth Grade**

**As a result of these activities, all USD 312 eighth graders will develop the abilities to do scientific inquiry, be able to demonstrate how scientific inquiry is applied, and develop understandings about scientific inquiry.**

**State Benchmark 1: The students will demonstrate abilities necessary to do the processes of scientific inquiry.**

Eighth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none"> <li>1. ▲ identifies questions that can be answered through scientific investigations.</li> <li>2. ▲ designs and conducts a scientific investigation safely using appropriate tools, mathematics, technology, and techniques to gather, analyze, and interpret data.</li> <li>3 ▲ identifies the relationship between evidence and logical conclusions.</li> </ol> <p>❖ Emphasize the interpretation of charts and graphs throughout indicators 1, 2, and 3.</p>	<p>The student...</p> <ol style="list-style-type: none"> <li>1. explores properties and phenomena of various materials and based on their observations generates testable questions to investigate.</li> <li>2a. designs and conducts an investigation on the question, "Which paper towel absorbs the most water?" (Materials include different kinds of paper towels, water, and a measuring cup. Components of the investigation may include background and hypothesis, identification of independent variable, dependent variable, constants, list of materials, procedures, collection and analysis of data, and conclusions.)</li> <li>2b. given an investigative question, determines what to measure and how to measure.</li> <li>2c. displays in a graph or other appropriate graphic format.</li> <li>2d. converts from English measurement to metric measurement.</li> <li>2e. demonstrates complete knowledge of the metric system.</li> <li>2f. define mass, weight, area, density, volume, and gravity.</li> <li>2g. memorize formulas for volume, density, and weight (force).</li> <li>3a. checks data to determine: Was the question addressed? Was the hypothesis supported/not supported? Did this design work? How could this experiment be improved? What other questions could be investigated?</li> <li>3b. looks for patterns from the mean of multiple trials, such as the rate of dissolving relative to different temperatures.</li> <li>3c. uses observations for inductive and deductive reasoning, such as explaining a person's energy level after a change in eating habits (e.g., uses Likert-type scale).</li> <li>3d. states relationships in data, such as variables, which vary directly or inversely.</li> <li>3e. presents a report of his/her investigation so that others understand it and can replicate the design.</li> </ol>

TEACHER NOTES:

Given appropriate curriculum and adequate instruction, students can develop the skills of investigation and the understanding that scientific inquiry is guided by knowledge, observations, questions, and a design which identifies and controls variables to gather evidence to formulate an answer to an original question. Students are to be provided opportunities to engage in full and partial inquiries in order to develop the skills of inquiry.

Teachers can facilitate success by providing guidelines or boundaries for studying inquiry. Teachers assist students in choosing interesting questions, monitoring design plans, providing relevant examples of effective observation and organization strategies, and checking and improving skills in the use of instruments, technology, and techniques. Students at the middle level need special guidance in using evidence to build explanations, inferences, and models, guidance to think critically and logically, and to see the relationships between evidence and explanations.

▲ = Recommended Grade 7 State Assessed Indicator (Grade 8: Also see Grade 10 Assessed indicators in Science Standards for Gr. 9-12.)

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**State Benchmark 2: The students will apply different kinds of investigations to different kinds of questions.**

Eighth Grade Indicators	Instructional Examples
The student... 1. develops questions and adapts ( <i>frames</i> ) the inquiry process to guide the appropriate type of investigation.	The student... 1a. after reading a science news article, identifies variables and writes an appropriate investigative question related to the topic of the article. 1b. adapts an existing lab or activity to write a different question, identify another variable, and/or adapt the procedure to guide a new investigation.

**TEACHER NOTES:**

Some investigations involve observing and describing objects, organisms or events. Investigations can also involve collecting specimens, experiments, seeking more information, discovering new objects and phenomena, and creating models to explain the phenomena. Instructional activities of scientific inquiry need to engage students in identifying and shaping questions for investigations. Different kinds of questions suggest different kinds of investigations. Many processes or objects in science cannot be directly observed due to size distance or other constraints. However, scientific evidence can be used to draw conclusions and develop a model or picture of the process or object .

To help focus, students need to frame questions such as “What do we want to find out?” “How can we make the most accurate observations?” “If we do this, then what do we expect to happen?” Students need instruction to develop the ability to refine and refocus broad and ill-defined questions.

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***State Benchmark 3: The students will analyze how science advances through the interaction of new ideas, scientific investigations, skepticism, and examinations of evidence of varied explanations***

Eighth Grade Indicators	Instructional Examples
The student... 1. after having done an investigation, generates alternative methods of investigation and/or further questions for inquiry.	The student... 1. asks "What would happen if...?" questions to generate new ideas for investigation.

**TEACHER NOTES:**

Scientific investigations often result in new ideas and phenomena for study. These generate new investigations in the scientific community. Science advances through legitimate skepticism. Asking questions and querying other scientists' explanations is part of scientific inquiry. Scientists evaluate the proposed explanations by examining and comparing evidence, identifying faulty reasoning, and suggesting other alternatives.

Much time can be spent asking students to scrutinize evidence and explanations, but to develop critical thinking skills students must be allowed this time. Data that are carefully recorded and communicated can be reviewed and revisited frequently providing insights beyond the original investigative period. This teaching and learning strategy allows students to discuss, debate, question, explain, clarify, compare, and propose new thinking through social discourse. Students will apply this strategy to their own investigations and to scientific theories.

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## STANDARD 2: PHYSICAL SCIENCE

## Eighth Grade

As a result of these activities, all USD 312 seventh graders will apply process skills to develop an understanding of physical science including: properties, changes of properties of matter, motion and forces, and transfer of energy.

**State Benchmark 1: The students will observe, compare, and classify properties of matter.**

Seventh Grade Indicators	Instructional Examples
The student... 1. ▲ measures and graphs the effects of temperature on matter.	The student... 1. will convert from one temperature scale to another. 2. will use appropriate units to identify scientific measurements (Newtons, Joules, meters, grams, liters, kilo-, deca-, milli-, hecta-, hecto-, centi-, deci-)

### TEACHER NOTES:

Substances have characteristic properties. Substances often are placed in categories if they react or act in similar ways. An example of a category is metals. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and non-living substances we encounter. Middle level students have the capability of understanding relationships among properties of matter. For example, they are able to understand that density is a ratio of mass to volume, boiling point is affected by atmospheric pressure, and solubility is dependent on pressure and temperature.

These relationships are developed by concrete activities that involve hands-on manipulation of apparatus, making quantitative measurements, and interpreting data using graphs. It is important to connect characteristics of matter to common experiences so that concepts can be reconstructed. Some relevant questions, are "What happens in a pressure cooker?" "Why does adding oil to boiling rice and pasta keep it from boiling over?" "What is in antifreeze and how does it keep your radiator from freezing?" "Why do bridges have metal expansion joints?"

▲ = Recommended HS State Assessed Indicator

**STANDARD 2: PHYSICAL SCIENCE****Eighth Grade**

**As a result of these activities, all USD 312 eighth grades will apply process skills to develop an understanding of physical science including: properties, changes of properties of matter, motion and forces, and transfer of energy.**

**State Benchmark 2: The students will observe, measure, infer, and classify changes in properties of matter.**

Eighth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none"><li>1. understands that total mass is conserved in chemical reactions.</li></ol>	<p>The student...</p> <ol style="list-style-type: none"><li>1a. measures the mass of an Alka Seltzer tablet, water, and a container with a lid. Then drops in a tablet, close tightly, and measures the mass after the reaction.</li><li>1b. identifies chemical and physical property changes.</li><li>1c. defines chemical formulas.</li><li>1d. identifies common chemical formulas.</li><li>1e. calculates the oxidation number for common elements</li><li>1f. diagrams the electron levels (valences or outer shells) for common elements.</li><li>1g. balances simple chemical equations.</li><li>1h. defines acid and base.</li><li>1i. identifies common acids and bases.</li></ol>

**TEACHER NOTES:**

Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. Middle level students have the capability of inferring characteristics that are not directly observable and stating their reasons for their inferences. Students need opportunities to form relationships between what they can see and their inferences of characteristics of matter.

We cannot always see the products of chemical reactions, so the teacher can provide opportunities for students to measure reactants and products to build the concept of conservation of mass. "Is mass lost when baking soda (solid) and vinegar (liquid) react to produce a gas?" "How could we design an experiment which would (safely) contain the reaction in a closed container in order to measure the materials before and after the reaction?" Students need to engage in activities that lead to these understandings.

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**STANDARD 3: LIFE SCIENCE**

**Eighth Grade**

**As a result of these activities, all USD 312 eighth graders will apply process skills to explore and understand structure and function in living systems, reproduction and heredity, regulation and behavior, populations and ecosystems, and diversity and adaptations of organisms.**

**State Benchmark 1: The students will model structures of organisms and relate functions to the structures.**

Eighth Grade Indicators	Instructional Examples
<p>The student...</p> <p>1. ▲ relates the structure of organs, tissues, organ systems, and whole organisms to their functions and concludes that breakdowns in structure or function may be caused by disease, damage, heredity, or aging.</p>	<p>The student...</p> <p>1a. identifies human body organs and characteristics. Then relates their characteristics to function.</p> <p>1b. maps human body systems, researches their functions and shows how each supports the health of the human body.</p> <p>1c. relates an organism's structure to how it works.</p> <p>1d. compares lung capacity of smokers with that of non-smokers and graphs the results.</p> <p>1e. will compare and contrast plant and animal cells.</p> <p>1f. diagrams plant and animal cells.</p> <p>1g. will use Venn diagrams to compare and contrast plant and animal cells.</p> <p>1h. diagrams and label stages of mitosis and meiosis.</p>

**TEACHER NOTES:**

Living things at all levels of organization demonstrate the complimentary nature of structure and function. Disease is a breakdown in structure or function of an organism. It is useful for middle level students to think of life as being organized from simple to complex, such as a complex organ system includes simpler structures. Understanding the structure and function of a cell can help explain what is happening in more complex systems. Students must also understand how parts relate to the whole, such as each structure is distinct and has a set of functions that serves the whole.

Teachers can help students understand this organization of life by comparing and contrasting the levels of organization in both plants and animals. Teachers reinforce understanding of the cellular nature of life by providing opportunities to observe live cultures, such as pond water, creating models of cells, and using the Internet to observe and describe electron micrographs. Early adolescence is an ideal time to investigate the human body systems as an example of relating structure and function of parts to the whole.

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**Eighth Grade**

**As a result of these activities, all USD 312 eighth graders will apply process skills to explore and understand structure and function in living systems, reproduction and heredity, regulation and behavior, populations and ecosystems, and diversity and adaptations of organisms.**

**State Benchmark 2: The students will understand the role of reproduction and heredity for all living things.**

Eighth Grade Indicators	Instructional Examples
The student... 1. understands how hereditary information contained in the genes of each cell is passed from one generation to the next (eg. not all traits are single gene traits).	The student... 1a. in a cooperative setting, traces parent characteristics with those of an offspring using Punnett squares. 1b.uses coin tossing to predict the probability of traits being passed on.

**TEACHER NOTES:**

Reproduction is an activity of all living systems to ensure the continuation of every species. Organisms reproduce sexually and/or asexually. Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another. Students need to clarify misconceptions about reproduction, specifically about the role of the sperm and egg, and the sexual reproduction of flowering plants. In learning about heredity, younger middle level students will focus on observable traits, and older students will gain understanding that genetic material carries coded information.

Teachers should provide opportunities for students to observe a variety of organisms and their sexual and asexual methods of reproduction by culturing bacteria, yeast cells, paramecia, hydra, mealworms, guppies, or frogs. Tracing the origin of students' own development back to sperm and egg reinforces how an organism develops from a combination of male and female sex cells. Discussions with students about traits they possess from their father and mother lead to understanding of how an organism receives genetic information from both parents and how new combinations result in the students' unique characteristics.

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**State Benchmark 5: The students will observe the diversity of living things and relate their adaptations to their survival or extinction.**

Eighth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none"> <li>concludes that millions of species of animals, plants, and microorganisms may look dissimilar on the outside but have similarities in internal structures, developmental characteristics, chemical processes, and genomes.</li> </ol>	<p>The student...</p> <ol style="list-style-type: none"> <li>researches numerous organisms and creates a classification system based on observations of similarities and differences. Compares this system with a dichotomous key used by scientists.</li> <li>explores various ways animals take in oxygen and give off carbon dioxide.</li> </ol>

**TEACHER NOTES:**

Millions of species of animals, plants and microorganisms are alive today. Animals and plants vary in body plans and internal structures. Biological evolution, gradual changes of characteristics of organisms over many generations, has resulted in variations among populations and species. Therefore, a structural characteristic, process, or behavior that helps an organism survive in its environment is called an adaptation. When the environment changes and the adaptive characteristics are insufficient, the species becomes extinct.

As they investigate different types of organisms, teachers guide students toward thinking about similarities and differences. Students can compare similarities between organisms in different parts of the world, such as tigers in Asia and mountain lions in North America to explore the concept of common ancestry. Instruction needs to be designed to uncover and correct misconceptions about natural selection. Students tend to think of all individuals in a population responding to change quickly rather than over a long period of time. Using examples such as Darwin’s finches help develop understanding of natural selection over time. Providing students with fossil evidence and allowing them time to construct their own explanations is important in developing middle level students’ understanding of extinction as a natural process that has affected earth’s species over time.

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**STANDARD 4: EARTH and SPACE SCIENCE**

**Eighth Grade**

**As a result of these activities, all USD 312 eighth graders will apply process skills to explore and develop an understanding of the structure of the earth system, earth’s history, and earth in the solar system.**

**State Benchmark 1: The students will understand that the structure of the earth system is constantly changing due to earth's physical and chemical processes.**

Eighth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none"><li>1. predicts patterns from data collected to model constructive and destructive forces in nature.</li></ol>	<p>The student...</p> <ol style="list-style-type: none"><li>1a. maps the movement of weather systems and predicts the local weather conditions.</li><li>1b. builds wood block models of plate boundary interaction: subduction, translation, and spreading.</li><li>1c. plots the location of earth’s plate boundaries and compares with recent volcano and earthquake activity in the Ring of Fire. Refers to US Geologic Survey data available on the Internet.</li></ol>

**TEACHER NOTES:**

Earth has four major interacting systems: the geosphere, the atmosphere, the hydrosphere, and the biosphere. Earth (geosphere) material is constantly being reworked and changed. Physical forces, chemical reactions, heat, energy, and biological processes power the rock cycle, the water cycle, and the carbon cycle. The outermost layer of the earth is the lithosphere. Under the lithosphere is a hot, convecting mantle and a dense, metal-rich core. Massive lithospheric plates containing continents and oceans move slowly in response to movement in the mantle. These plate motions also result in earthquakes, volcanoes, and mountain building. Constructive and destructive forces change earth’s landforms. Constructive forces include crustal formation by plate movement, volcanic eruptions, earthquakes, and deposition of sediments. Destructive forces include weathering, erosion, and glacial action.

Students learn about the major earth systems and their relationships through direct and indirect evidence. First-hand observations of weather, rocks, soil, oceans, and gases lead students to make inferences about some of those major systems. Indirect evidence is used when determining the composition and movement in earth’s mantle and core.

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**STANDARD 4: EARTH and SPACE SCIENCE**

**Eighth Grade**

**As a result of these activities, all USD 312 eighth graders will apply process skills to explore and develop an understanding of the structure of the earth system, earth’s history, and earth in the solar system.**

**State Benchmark 2: The students will understand past and present earth processes and their similarity.**

Eighth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none"> <li>1. models geologic time to scale and relates geologic evidence to a record of earth’s history.</li> <li>2. understands that matching coastlines, similarities in rock types, similarities in fossils and life forms suggest that today’s continents are separated parts of what was long ago a single continent.</li> </ol>	<p>The student...</p> <ol style="list-style-type: none"> <li>1a. plots the major events (last ice age, beginning of Paleozoic Era, etc.) of earth history on a roll of adding machine tape.</li> <li>1b. locates the same rock layer in two local road cuts; gives fossil evidence and other kinds of evidence that the layer is the same in both exposures.</li> <li>1c. compares the types of organisms shown in the fossils found in a Kansas shale (mudstone) and a Kansas limestone and infers the ocean depositional environment from which the rock layer was formed.</li> <li>2. cuts out continents from a world map and slides them together to see how they fit. Plots each continental plate’s latitude and longitude through earth’s history. Compares the current arrangement of the continents with the arrangement of continents throughout earth’s history.</li> </ol>

**TEACHER NOTES:**

The constructive and destructive forces we see today are similar to those that occurred in the past. Earth’s history is written in the layers of the rocks, and clues in the rocks can be used to piece together a story and picture. Geologic processes that form rocks and mountains today are similar to processes that formed rocks and mountains over a long period of time in the distant past.

Teachers can provide opportunities for students to observe and research evidence of changes that can be found in earth’s crust. Sedimentary rocks, such as limestone, sandstone, and shale show deposition of sediments over time. Volcanic flows of ancient volcanoes and earthquake damage can show us what to expect from modern day catastrophes. Glacial deposits show past ice ages and global warming and cooling. Some fossil beds enable the matching of rocks from different continents, and other fossil beds show how organisms developed over a long period of time. Students will need to apply knowledge of earth’s past to make decisions relative to earth’s future.

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**Benchmark 3: The students will identify and classify stars, planets and other solar system components.**

Eighth Grade Indicators	Instructional Examples
The student... 1. identifies past and present methods used to explore space..	The student... 1. researches ancient observations and explanations of the heavens and compares with today’s knowledge and methods such as, how we learn about phenomena/objects we can’t observe directly. Ex. Spectral analysis to determine the chemistry of stars.

**TEACHER NOTES:**

The solar system consists of the sun, which is an average-sized star in the middle of its life cycle, and the nine planets and their moons, asteroids, and comets, which travel in elliptical orbits around the sun. The sun, the central and largest body in the system, radiates energy outward. Earth is the third of nine planets in the system, and has one moon. Other stars in our galaxy are visible from earth, as are distant galaxies, but are so distant they appear as pinpoints of light. Scientists have discovered much about the composition and size of stars, and how they move in space. Space and the solar system are of high interest to middle level students. Teachers can help students take advantage of the many print and on-line resources, as well as by becoming amateur sky-watchers.

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