

STANDARD 1: SCIENCE AS INQUIRY

Fifth Grade

As a result of these activities, all USD 312 fifth 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.

Fifth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none"> 1. ▲ identifies questions that can be answered through scientific investigations. 2. ▲ designs and conducts a scientific investigation safely using appropriate tools, mathematics, technology, and techniques to gather, analyze, and interpret data. 3. ▲ identifies the relationship between evidence and logical conclusions. <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"> 1. explores properties and phenomena of various materials and based on their observations generates testable questions to investigate. 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.) 2b. given an investigative question, determines what to measure and how to measure. 2c. Displays in a graph or other appropriate graphic format. 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? 3b. looks for patterns from the mean of multiple trials, such as the rate of dissolving relative to different temperatures. 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). 3d. states relationships in data, such as variables, which vary directly or inversely.

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

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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

Fifth 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.

▲ = Recommended Grade 7 State Assessed Indicator

STANDARD 2: PHYSICAL SCIENCE

Fifth Grade

As a result of these activities, all USD 312 fifth 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.

Fifth Grade Indicators	Instructional Examples
The student... 1. identifies the physical properties of a given substance (smell, taste, feel, color, shape, etc.)	The student... 1a. perform the sugar and salt experiment 1b. investigate shells for smell, feel, color, shape, etc. 1c. utilize cross curricular investigations – i.e. 6-trait writing; popcorn reminisce

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?”

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STANDARD 3: LIFE SCIENCE

Fifth Grade

As a result of these activities, all USD 312 fifth 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.

Fifth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none">1. ▲ understands that all organisms are composed of one or more cells and compares organisms composed of single cells with organisms that are multi-cellular.2. ▲ relates the structure of cells to their functions and concludes that breakdowns in structure or function may be caused by disease, damage, heredity, or aging.	<p>The student...</p> <ol style="list-style-type: none">1. creates and compares two models: the major parts and their functions of a single-cell organism and the major parts and their functions of a multi-cellular organism, e.g. amoeba and hydra.2. draws, identifies, and defines the parts of plant and animal cells (cell wall, membrane, cytoplasm, and nucleus).3. identifies similarities and differences in animal and plant cells.

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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State Benchmark 3: The students will describe the effects of a changing external environment on the regulation/balance of internal conditions and processes of organisms.

Fifth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none">1. ▲ understands the effects of internal and/or environmental conditions on the behavior/response of an organism.2. ▲ explains that all organisms must be able to maintain and regulate stable internal conditions to survive in a constantly changing external environment.3. ▲ investigates the effects of human activities on the environment and bases decisions on knowledge of benefits and risks.	<p>The student...</p> <ol style="list-style-type: none">1a. selects a variable to alter the environment (e.g., temperature, light, moisture, gravity) and observes the effects on an organism (e.g., pillbug or earthworm). Thinks of his/her own behaviors and determines environmental conditions that affect behavior.1b. observes the response of the body when competing in a running event. (In order to maintain body temperature, various systems begin cooling through such processes as sweating and cooling the blood at the surface of the skin.)2. investigates the effects of various stimuli on plants and how they adapt their growth: phototropism, geotropism, and thermotropism are examples.3a. counts the number of cars that pass the school during a period of time. Investigates the effects of traffic volume on environmental quality (e.g., water and air quality, plant health).3b. Investigates the effects of repeatedly walking off the sidewalks. Discusses the implications for the environment.3c. participates in an environmental Internet study.3d. evaluates the benefits of burning fossil fuels to meet energy needs against the risks of global warming.3e. investigate how oil spills affect ecosystems.3f. investigate how the food chain can be affected by farming practices on the plains.

TEACHER NOTES:

All organisms perform similar processes to maintain life. They take in food and gases, eliminate wastes, grow and progress through their life cycle, reproduce, and maintain stable internal conditions while living in a constantly changing environment. An organism's behavior changes as its environment changes. Students need opportunities to investigate a variety of organisms to realize that all living things have similar fundamental needs. After observing an organism's way of moving, obtaining food, and responding to danger, students can alter the environment and observe the effects on the organism.

This is an appropriate time to study the human nervous and endocrine systems. Students can compare and contrast how messages are sent through the body and how the body responds. An example is how fright causes changes within the body, preparing it for fighting or fleeing.

When an area becomes overpopulated by a species, the environment will change due to the increased use of resources. Middle level students need opportunities to learn about concepts of carrying capacity. They need to gather evidence and analyze effects of human interactions with the environment.

Teachers can help their students understand these global issues by starting locally. "What changes in the atmosphere are caused by all the cars we use in our community?" Ground level ozone indicators provide an opportunity to quantify the effect. "After a heavy rain, where does the water go that runs off your lawn?" "What happens to that water source if your lawn was fertilized just before the rain?" The role of the teacher is to help students apply scientific understanding, gained through their own investigations, of environmental issues. Teachers should help students base environmental decisions on understanding, not emotion.

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State Benchmark 4: The students will identify and relate interactions of populations of organisms within an ecosystem.

Fifth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none"> 1. ▲ recognizes that all populations living together (biotic resources) and the physical factors (abiotic resources) with which they interact compose an ecosystem having limiting factors which contribute to the growth, decline, and survival of each species. 2. ▲ traces the energy flow from the sun (source of radiant energy) to producers (via photosynthesis – chemical energy) to consumers and decomposers in food webs. 	<p>The student...</p> <ol style="list-style-type: none"> 1a. creates a classroom terrarium and identifies the interactions between the populations and physical conditions needed for survival. 1b. participates in a field study examining the living and non-living parts of a community. 1c. changes variables such as wheat crop yield, mice, or a predator, and charts the possible outcomes. (For example, how would a low population of mice affect the population of the predator over time?) 2a. explores populations at a stream, pond, field, forest floor, and/or rotting log. Identifies the various food webs and observes that organisms in a system are classified by their function. 2b. role-plays the interactions and energy flow of organisms in a food web. e.g. Passes a ball of string among a circle of students who represent parts of a food web (green plants, the sun, insects, etc.). (The string connecting students represents the relationships among food web components, resulting in a web-like model.) 2c. investigates the importance of photosynthesis to all life.

TEACHER NOTES:

A population consists of all individuals of a species that occur together at a given time and place. All populations living together and the physical factors with which they interact compose an ecosystem. Populations can be categorized by the functions they serve in an ecosystem: producers (make their own food), consumers (obtain food by eating other organisms), and decomposers (use waste materials). The major source of energy for ecosystems is sunlight. This energy enters the ecosystem as sunlight and is transformed by producers into food (chemical) energy which then passes from organism to organism, which we observe as food webs. The resources of an ecosystem, biotic and abiotic, determine the number of organisms within a population that can be supported.

Middle level students understand populations and ecosystems best when they have an opportunity to explore them actively. Taking students to a pond or a field, or even having them observe life under a rotting log, allows them to identify and observe interactions between populations and identify the physical conditions needed for their survival. A classroom terrarium, aquarium, or river tank can serve as an excellent model for observing ecosystems and changes and interactions that occur over time between populations of organisms and changes in physical conditions. Constructing their own food webs, given a set of organisms, helps students to see multiple relationships more clearly.

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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.

Fifth Grade Indicators	Instructional Examples
The student... 1. ▲ associates extinction of a species with environmental changes and insufficient adaptive characteristics.	The student... 1. uses various objects to model bird beaks, such as spoons, toothpicks, clothespins. Uses “beaks” to “eat” several types of food, such as cereal, raisins, noodles. (When “food” sources change, those species that have not adapted die.)

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

Fifth Grade

As a result of these activities, all USD 312 fifth 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.

Fifth Grade Indicators	Instructional Examples
The student... 1. ▲ identifies properties of the atmosphere. 2.	1a. maps major climate zones and relates to ocean currents. 1b. compares heating and cooling over land and water. 1c. identifies the atmospheric layers of the earth and their properties.

TEACHER NOTES:

Earth has four major interacting systems: the geosphere, the atmosphere, the hydrosphere, and the biosphere.

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.

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STANDARD 7: HISTORY AND NATURE OF SCIENCE

Fifth Grade

As a result of these activities, all USD 312 fifth graders will examine and develop an understanding of science as a historical human endeavor.

State Benchmark 2: The students will research contributions to science throughout history.

Fifth Grade Indicators	Instructional Examples
<p>The student...</p> <ol style="list-style-type: none">1. ▲ recognizes that new knowledge leads to new questions and new discoveries, replicates historic experiments to understand principles of science, and relates contributions of men and women to the fields of science.	<p>The student...</p> <ol style="list-style-type: none">1. researches the contributions of men and women of science, creates a timeline to demonstrate the ongoing contributions of dedicated scientists across ethnic, religious, and gender lines.

TEACHER NOTES:

Scientific knowledge is not static. New knowledge leads to new questions and new discoveries that may be beneficial or harmful. Contributions to scientific knowledge can be met with resistance, causing a need for replication and open sharing of ideas. Scientific contributions have been made over an expanse of time by individuals from varied cultures, ethnic backgrounds, and across gender and economic boundaries.

Students should engage in research realizing that the process may be a small portion of a larger process or of an event that takes place over a broad historical context. Teachers should focus on the contributions of scientists and how the culture of the time influenced their work. Reading biographies, interviews with scientists, and analyzing vignettes are strategies for understanding the role of scientists and the contributions of science throughout history.

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