STANDARD 1: SCIENCE AS INQUIRY – The student will develop the abilities to do *scientific inquiry*, be able to demonstrate how *scientific inquiry* is applied, and develop understandings about *scientific inquiry*.

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

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. ▲ identifies questions that can be answered through scientific investigations.	1. explores properties and phenomena of various materials and generates testable questions to investigate.
2. ▲ designs and conducts *scientific investigations* safely using appropriate tools, mathematics, *technology*, and techniques to gather, analyze, and interpret data.	2 a. 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 graduated cylinder. 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). b. given an investigative question, determines what to measure and how to measure. c. displays data collected from performing in investigation using tables, graphs, diagrams and other graphic organizers.
3. ▲ identifies the relationship between evidence and logical conclusions.	3 a. 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? b. looks for patterns from the mean of multiple trials, such as the rate of dissolving relative to different temperatures. c. 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). d. states relationships in data, such as variables, which vary directly or inversely.

4. communicates scientific procedures, results and explanations.	3. presents a report of his/her investigation so that others understand it and can replicate the design.

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.

Scientific inquiry – The diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world. Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative (scientific) explanations. Students will engage in selected aspects of inquiry (partial or guided inquiry) as they learn the scientific way of knowing the natural world, but they also should develop the capacity to conduct complete investigations (full inquiry). (From the National Education Standards, p. 23)

Scientific investigation – A scientific investigation uses scientific inquiry to ask an answer a question.

Technology - Creates products to meet human needs by applying scientific principles. Science and technology are reciprocal. Science helps drive technology. Technology is essential to science, because it provides instruments and techniques that promote scientific inquiry.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 1: SCIENCE AS INQUIRY – The student will develop the abilities to do scientific inquiry, be able to demonstrate how scientific inquiry is applied, and develop understandings about scientific inquiry.

Benchmark 2: The student will apply different kinds of investigations to different kinds of questions.

Grades 5-7 Indicators	Instructional Examples
The student….	The student…
1. develops questions and adapts (frames) the inquiry process to guide the appropriate type of investigation.	1 a. after reading a science news article, identifies variables and writes an appropriate investigative question related to the topic of the article. b. adapts an existing lab or activity to write a different question, identify another variable, and/or modify the procedure to guide a new investigation.
2. differentiates between qualitative and quantitative data in an investigation	2. observes a decomposing compost pile, and determines how to collect quantitative (numerical, measurable) data and qualitative (descriptive) data. Identifies a question that produces quantitative date. (e.g., is the temperature constant throughout the compost pile?) Identifies a question that produces qualitative data. (e.g., does the color of the compost pile change over time?) With the class, analyzes all questions to classify as qualitative or quantitative.

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.

STANDARD 1: SCIENCE AS INQUIRY – The student will develop the abilities to do scientific inquiry, be able to demonstrate how scientific inquiry is applied, and develop understandings about scientific inquiry.

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

Grades 5-7 Indicators	Instructional Examples
The student… 1. after completing an investigation, generates alternative methods of investigation and/or further questions for inquiry. 2. ▲ evaluates the work of others to determine evidence which scientifically supports or contradicts the results, identifying faulty reasoning or conclusions that go beyond evidence and/or are not supported by data.	The student… 1. asks "What would happen if…?" questions to generate new ideas for investigation. 2 a. examines and analyzes a scientific breakthrough (such as a Hubble discovery) using multiple scientific sources. b. explains how a reasonable conclusion is supported. c. analyzes evidence and data which supports or contradicts various theories (e.g. theory of continental drift, spontaneous generation, etc...).

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 Assessed Indicator

STANDARD 2: PHYSICAL SCIENCE – The student 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.

Benchmark 1: The student will observe, compare, and classify properties of matter.

Grades 5-7 Indicators	Instructional Examples
The student… 1. ▲ identifies and communicates properties of matter (including but not limited to, phases of matter, boiling point, solubility, and density), distinguishes components of various types of mixtures and categorizes chemicals.	The student… 1 a. measures and graphs the boiling point temperatures for several different liquids. b. graphs the cooling curve of a freezing ice cream mixture. c. observes substances that dissolve (sugar) and substances that do not dissolve (sand). d. separates sand, iron filings, and salt using a magnet and water. e. observes properties of kitchen powders (baking soda, salt, sugar, flour). Mixes in various combinations, then identifies by properties.

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 Grade 7 Assessed Indicator

STANDARD 2: PHYSICAL SCIENCE – The student 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.

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

Grades 5-7 Indicators	Instructional Examples
The student… 1. ▲ understands the relationship of atoms to elements and elements to compounds. 2. ▲ measures and graphs the effects of temperature on matter.	The student… 1. draws a diagram to show how different compounds are composed of elements in various combinations. 2. changes water from solid to liquid to gas using heat. Measures and graphs temperature changes. Observes changes in volume occupied.

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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 2: PHYSICAL SCIENCE – The student 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.

Benchmark 3: The student will investigate motion and forces.

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. understands that a force (e.g., gravity and friction) is a push or a pull.	1. explores the variables of (wheel and ramp) surfaces that would allow a powered car to overcome the forces of gravity and friction to climb an inclined plane.
2. ▲ describes, measures, and represents data on a graph showing the motion of an object (position, direction of motion, speed, potential and kinetic energy).	2 a. follows the path of a toy car down a ramp that is first covered with tile and then with sandpaper. b. traces the force, direction, and speed of a baseball, from leaving the pitcher's hand and returning back to the pitcher through one of many possible paths. c. rolls a marble down a ramp. Makes adjustments to the board or to the marble's position in order to hit a target located on the floor. Measures and graphs the results.
3. ▲ recognizes and describes examples of Newton's Laws of Motion.	3 a. places a small object on a rolling toy vehicle, stops the vehicle abruptly, observes the motion of the small object. Relates to personal experience - stopping rapidly in a car. b. with a ping pong ball and 2 straws, investigates the effects of the force of air through two straws on the ping-pong ball with the straws at the same side of the ball, on opposite sides, and at other angles. Illustrates results with vectors (force arrows). c. researches safety equipment, such as seat belts and safety helmets, and the role they play related to inertia.
4. ▲ investigates how simple machines multiply force at the expense of distance.	4 a. investigates the load (force) that can be moved as the number of pulleys in a system is increased. b. investigates how bicycle gears work.

TEACHER NOTES:

All matter is subjected to forces that affect its position and motion. Relating motions to direction, amount of force, and/or speed allows students to graphically represent data for making comparisons. A moving object that is not being subjected to a force will continue to move in a straight line at a constant speed. The principle of inertia helps to explain many events such as sports actions, household accidents, and space walks. If more than one force acts upon an object moving along a straight line, the forces may reinforce each other or cancel each other out, depending on their direction and magnitude.

Students experience forces and motions in their daily lives when kicking balls, riding in a car, and walking on ice. Teachers should provide hands-on opportunities for students to experience these physical principles. The forces acting on natural and human-made structures can be analyzed using - computer simulations, physical models, and games such as pool, soccer, bowling, and marbles.

Weight – The response of mass to the pull of gravity. Weight is a measure of force. Note: Weight is often confused with mass. Mass is the amount matter (stuff) an object has and is not dependent on the object's location. Weight is a measure of force and is not constant because the pull of gravity on an object's mass varies with location. An object would weight less on Earth than on Jupiter because Jupiter has greater mass than Earth; Jupiter's mass would have a greater gravitational attraction for the object.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 2: PHYSICAL SCIENCE – The student 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.

Benchmark 4: The student will understand and demonstrate the transfer of energy.

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. ▲ understands that when work is done energy is transformed from one form to another, including mechanical, heat, light, sound, electrical, chemical, and nuclear energy, yet is conserved.	1 a. sequences the transmission of energy through various real-life systems. b. designs an energy-transfer device using various forms of energy that will accomplish a simple task, such as popping a balloon. c. explores wave motion using a spring. d. draws a chart of energy flow through a telephone from the caller's voice to the listener's ear.
2. observes and communicates how light (electromagnetic) energy interacts with matter: transmitted, reflected, refracted, and absorbed.	2. classifies classroom objects as to how they interact with light: a window transmits; black paper absorbs; a projector lens refracts; a mirror reflects.
3. ▲ understands that heat energy can be transferred from hot to cold by radiation, convection, and conduction.	3. adds colored warm water to cool water. Observes convection. Measures and graphs temperature over time.

TEACHER NOTES:
Energy forms, such as heat, light, electricity, mechanical (motion), sound, and chemical energy are properties of substances. Energy can be transformed from one form to another. The sun is the ultimate source of energy for life systems, while heat convection currents deep within the earth are energy sources for gradually shaping the earth's surface. Energy cycles through physical and living systems. Energy can be measured and predictions can be made based on these measurements.

Students can explore light energy using lenses and mirrors, then connect with real-life applications such as cameras, eyeglasses, telescopes, and bar code scanners. Students connect the importance of energy transfer with sources of energy for their homes, such as chemical, nuclear, solar, and mechanical sources. Teachers provide opportunities for students to explore and experience energy forms, energy transfers, and make measurements to describe relationships.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 3: LIFE SCIENCE – The student 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.

Benchmark 1: The student will model structures of organisms and relate functions to the structures.

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. ▲ understands that organisms are composed of one or more cells and compares organisms composed of single cells with organisms that are multi-cellular.	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. ▲ relates the structure of cells, 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.	2 a. identifies human body organs and characteristics. Then relates their characteristics to function. b. maps human body systems, researches their functions and shows how each supports the health of the human body. c. relates an organism's structure to how it works. d. compares lung capacity of smokers with that of non-smokers and graphs the results. e. compare and contrast plant and animal cells.

TEACHER NOTES:
The cell theory states that organisms are made of cells, cells are the basic unit of life, and cells come from other cells. 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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 3: LIFE SCIENCE – The student 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.

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

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. ▲ differentiates between asexual and sexual reproduction of organisms. .	1 a. compares the regeneration of a planarian to the reproduction of an earthworm. b. compares the propagation of new plants from cuttings, which skips a portion of the life cycle, with the process of producing a new plant from fertilization of an ovum. c. observes and communicates the life cycle of an organism.
2. understands how hereditary information of each cell is passed from one generation to the next	2 a. in a cooperative setting, traces parent characteristics with those of an offspring using Punnett squares. b. uses coin tossing to predict the probability of traits being passed on.
3. infers that the characteristics of an organism result from heredity and interactions with the environment	3. chooses an organism. Researches its characteristics. Infers if these characteristics result from heredity, environment, or both.

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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 3: LIFE SCIENCE – The student 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.

Benchmark 3: The student will describe homeostasis, the regulation and balance of internal conditions in response to a changing external environment. .

Grades 5-7 Indicators	Instructional Examples
The student… 1. ▲ understands that internal and/or environmental conditions affect an organism's behavior and/or response in order to maintain and regulate stable internal conditions to survive in a continually changing environment.	The student… 1 a. 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. b. 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). c. investigates the effects of various stimuli on plants and how they adapt their growth: phototropism, geotropism, and thermotropism are examples. d. examine surface area (skin) to volume (body size).

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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 3: LIFE SCIENCE – The student 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.

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

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
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.	1 a. creates a classroom terrarium and identifies the interactions between the populations and physical conditions needed for survival. b. participates in a field study examining the living and non-living parts of a community. c. 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)?
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.	2 a. 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. b. 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). c. 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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 3: LIFE SCIENCE – The student 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.

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

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. concludes that species of animals, plants, and microorganisms may look dissimilar on the outside but have similarities in internal structures, developmental characteristics, chemical processes, and genomes.	1 a. researches numerous organisms and creates a classification system based on observations of similarities and differences. b. uses a field guide and/or dichotomous key to identify an organism. c. explores various ways animals take in oxygen and give off carbon dioxide.
2. ▲ understands that adaptations of organisms (changes in structure, function, or behavior that accumulate over successive generations) contribute to biological diversity.	2. compares characteristics of birds such as beaks, wings, and feet, with how a bird behaves in its environment. Then works in a cooperative group to design different parts of an imaginary bird. Relates characteristics and behaviors of that bird with its structures.
3. ▲ associates extinction of a species with environmental changes and insufficient adaptive characteristics.	3. 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. The theory of biological evolution explains how gradual changes of characteristics of organisms over many generations have 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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 4: EARTH and SPACE SCIENCE – The student 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.

Benchmark 1: The student will understand that the structure of the earth system is continuously changing due to earth's physical and chemical processes.

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. ▲ identifies properties of the solid earth, the oceans and fresh water, and the atmosphere.	1 a. classifies rocks, minerals, and soil by properties. b. creates a concept map of earth materials using links to show connections, such as water causing erosion of solid rock, wind evaporating water, etc… c. measures sediment load in a nearby stream. d. investigates water's major role in changing the solid surface of earth, such as the effect of oceans on climates and water as an erosion force. e. maps major climate zones and relates to ocean currents. f. compares heating and cooling over land and water. g. compares the densities of salt and fresh water.
2. ▲ models earth's cycles, constructive and destructive processes, and weather systems.	2 a. creates rock cycle and water cycle dioramas. b. illustrates global ocean and wind currents. c. investigates weathering, erosion, and deposition.

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 and the water 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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 4: EARTH and SPACE SCIENCE – The student 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.

Benchmark 2: The student will understand past and present earth processes and their similarity.

Grades 5-7 Indicators	Instructional Examples
The student… 1. ▲ understands that earth processes observed today (including movement of lithospheric plates and changes in atmospheric conditions) are similar to those that occurred in the past; earth history is also influenced by occasional catastrophes, such as the impact of a comet or asteroid.	The student… 1 a. constructs models of rock types using food. (Peanut brittle without the peanuts can illustrate a molten material crystallizing to form a solid substance similar to an igneous rock). b. uses an acid (vinegar or dilute HCl) to show the chemical similarity of limestone rock and fossilized shells. c. takes a piece of sandstone and applies destructive forces to change it into sand. d. observes the effects of weathering on various rock types.

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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 4: EARTH and SPACE SCIENCE – The student 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.

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

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. ▲ compares and contrasts the characteristics of stars, planets, moons, comets, and asteroids.	1 a. identifies the sun as a star and compares its characteristics to those of other stars. b. classifies bright stars visible from earth by color, temperature, age, apparent brightness, and distance from earth. c. sequences the life cycle of a star. d. creates a graphic organizer to visualize comparisons of planets. e. identifies and classifies characteristics of asteroids and comets.
2. models spatial relationships of the earth/moon/planets/sun system to scale.	2. models the solar system to scale in a long hallway or school yard using rocks for rocky planets and balloons for gaseous planets. Designates a large object as the sun. Models the earth/moon/sun system to scale with the question: If earth were the size of a tennis ball, how big would the moon be? How big would the sun be? How far apart would they be?
3. identifies past and present methods used to explore space..	4. 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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 4: EARTH and SPACE SCIENCE – The student 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.

Benchmark 4: The student will model motions and identify forces that explain earth phenomena.

Grades 5-7 Indicators	Instructional Examples
The student…	The student...
1. ▲ demonstrates and models object/space/time relationships that explain phenomena such as the day, the month, the year, seasons, phases of the moon, eclipses and tides.	1 a. uses an earth/moon/sun model to demonstrate a day, a month, a year, and the seasons. b. uses students to demonstrate the relative positions of the sun, earth, and moon to create eclipses, phases of the moon, and tides using a circle of students representing the fluid water.
2. understands the effect of the angle of incidence of solar energy striking earth's surface on the amount of heat energy absorbed at earth's surface.	2. places a piece of graph paper on the surface of a globe at the equator. Holds a flashlight 10 cm. from the paper perpendicular to the globe. Marks the lighted area of the paper. Then, places the graph paper at a high latitude. Again holds the flashlight perpendicular to the paper 10 cm from the paper. Compares the areas lit at the equator and at the high latitude, with the same amount of light energy. Identifies where each lighted square of paper receive the most energy?

TEACHER NOTES:
There are many motions and forces that affect earth. Most objects in the solar system have regular motions, which can be tracked, measured, analyzed, and predicted. These motions can explain such phenomena as the day, year, seasons, tides, phases of the moon, and eclipses of the sun and moon. The force that governs the motions within the solar system, keeps the planets in orbit around the sun, and the moon in orbit around the earth is gravity. Phenomena on earth's surface, such as winds, ocean currents, the water cycle, and the growth of plants, receive their energy from the sun.

Misconceptions abound among middle level students about concepts such as the cause of the seasons and the reasons for the phases of the moon. Hands-on activities, role-playing, models, and computer simulations are helpful for understanding the relative motion of the planets and moons. Many ideas are misconceptions which could be considered in a series of "what if" questions: What if the sun's energy did not cause cloud formation and other parts of the water cycle? What if the earth rotated once a month? What if the earth's axis were not tilted?

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 5: SCIENCE AND TECHNOLOGY – The student will demonstrate abilities of technological design and understandings about science and technology.

Benchmark 1: The student will demonstrate abilities of technological design.

Grades 5-7 Indicators	Instructional Examples
The student… 1. ▲ identifies appropriate problems for technological design, designs a solution or product, implements the proposed design, evaluates the product, and communicates the process of technological design.	The student… 1 a. designs a measurement instrument (e.g., weather instrument) for a science question that students are investigating. b. selects and researches a current technology, then projects how it might change in the next twenty years. c. designs, creates and evaluates a product that meets a need or solves a problem in a student's life. d. keeps a log of designing (and building) a technology, then uses the log to explain the process.

TEACHER NOTES:

Technological design focuses on meeting human needs, solving human problems or developing a product. Students need to develop abilities to identify specific needs and design solutions for those needs. The tasks of technological design include addressing a range of needs, materials, and aspects of science. Suitable experiences could include designing inventions that meet a need in the student's life.

Building a tower of straws is a good start for collaboration and work in design preparation and construction. Students need to develop criteria for evaluating their inventions/products. These questions could help develop criteria: Who will be the users of the product? How will we know if the product meets their needs? Are there any risks to the design? What is the cost? How much time will it take to build? Using their own criteria, students can design several ways of solving a problem and evaluate the best approach. Students could keep a log of their designs and evaluations to communicate the process of technological design. The log might address these questions: What is the function of the device? How does the device work? How did students come up with the idea? What were the sequential steps taken in constructing the design? What problems were encountered?

For more information see pages 161 - 166 of the National Science Education Standards.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 5: SCIENCE AND TECHNOLOGY – The student will demonstrate abilities of technological design and understandings about science and technology.

Benchmark 2: The student will develop understandings of the similarities, differences, and relationships in science and technology.

Grades 5-7 Indicators	Instructional Examples
The student…	The student…
1. compares the work of scientists with that of applied scientists and technologists.	1. reads about a scientist that studies air pressure. (A technologist designs an airplane wing.) Completes a Venn diagram to compare the processes of scientists and technologists.
2. evaluates benefits, risks, limitations and trade-offs of technological solutions.	2. selects a technology to evaluate using a graphic organizer listing uses, limitations, and possible consequences.
3. identifies contributions to science and technology by many people and many cultures.	3. using a map of the world, marks the locations for people and events that have contributed to science.
TEACHER NOTES: The primary difference between science and technology is that science investigates to answer questions about the natural world and technology creates a product to meet human needs by applying scientific principles. Middle level students are able to evaluate the impact of technologies, recognizing that most have both benefits and risks to society. Science and technology have advanced through contributions of many different people, in different cultures, at different times in history. Students may compare and contrast scientific discoveries with advances in technological design. Students may select a device they use, such as a radio, microwave, or television, and compare it to one their grandparents used.	

STANDARD 6: SCIENCE IN PERSONAL AND ENVIRONMENTAL PERSPECTIVES – The student will apply process skills to explore and develop an understanding of issues of personal health, population, resources and environment, and natural hazards.

Benchmark 1: The student will understand scientific knowledge relative to personal health.

Grades 5-7 Indicators	Instructional Examples
The student… 1. ▲ identifies individual nutrition, exercise, and a rest needs based on science and uses a scientific approach to thinking critically about personal health, lifestyle choices, risks and benefits.	The student… 1 a. designs, implements, and self-evaluates a personal nutrition and exercise program. b. compares and contrasts immediate benefits of eating junk food to long term benefits of a lifetime of healthy eating. c. evaluates the risks and benefits of foods, medicines, and personal products. d. evaluates and compares the nutritional and toxic properties of various natural and synthetic foods.

TEACHER NOTES:
Regular exercise, rest, and proper nutrition are important to the maintenance and improvement of human health. Injury and illness are risks to maintaining health. Middle level students need opportunities to apply scientific knowledge to their understanding of personal health and science-based decision-making related to health risks.

Teachers should understand that the decision making capacities of ten, eleven, twelve and thirteen year-old children are not fully developed, are subject to significant interference from hormonal changes, and otherwise lack the experience and maturity of an adult that may be necessary for wise and prudent decisions about their lives. Accordingly, teachers should work to reinforce normative parental and legal expectations designed to optimize their personal health. The challenge to teachers is to show students how science validates legal and normative parental expectations and requirements about health issues such as smoking, use of alcohol, disease, healthy eating, and the wearing of seat belts and helmets and why it is in their best personal interests to comply with these healthy expectations and requirements.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 6: SCIENCE IN PERSONAL AND ENVIRONMENTAL PERSPECTIVES – The student will apply process skills to explore and develop an understanding of issues of personal health, population, resources and environment, and natural hazards.

Benchmark 2: The student will understand the impact of human activity on resources and environment.

Grades 5-7 Indicators	Instructional Examples
The student… 1. ▲ investigates the effects of human activities on the environment and bases decisions on knowledge of benefits and risks.	The student… 1 a. 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). b. Investigates the effects of repeatedly walking off the sidewalks. Discusses the implications for the environment. c. participates in an environmental study, such as stream monitoring. d. evaluates the benefits of burning fossil fuels to meet energy needs against the risks of increased air pollution, etc…

TEACHER NOTES:
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.

▲ = Recommended Grade 7 Assessed Indicator

STANDARD 6: SCIENCE IN PERSONAL AND ENVIRONMENTAL PERSPECTIVES – The student will apply process skills to explore and develop an understanding of issues of personal health, population, resources and environment, and natural hazards.

Benchmark 3: The student will understand that natural hazards are dynamic examples of earth processes which cause us to evaluate risks.

Grades 5-7 Indicators	Instructional Examples
The student… 1. recognizes patterns of natural processes and human activities that may cause/contribute to natural hazards then evaluates risks and defines appropriate actions associated with the natural hazard.	The student… 1 a. finds news articles that show inadvisable risks taken in a natural hazard situation. b. sees how channeling a stream may promote flooding downstream. Could use a County Conservation Commission's stream trailer to investigate the dynamics of a stream and the effects of human interaction with the stream. c. investigates appropriate safety procedures for dealing with various natural hazards e.g. Tornados, floods, lightning, etc…

TEACHER NOTES:
California has earthquakes. Florida has hurricanes. Kansas has tornadoes. Natural hazards can also be caused by human interaction with the environment, such as channeling a stream. Middle level students need opportunities to identify the causes and human risks and challenges of natural hazards.

Teachers can help students use data on frequency of occurrence of natural hazard events both to dispel unnatural fears for some students and overcome the common middle level student misconception of invincibility (it won't happen to me). "What would you need in a tornado survival kit to keep in the basement for your family?" This question would cause students to assess the kinds of damage caused by a tornado (need a flashlight because electrical lines may be down) and the kinds of support services available in the community.

STANDARD 7: HISTORY AND NATURE OF SCIENCE – The student will examine and develop an understanding of science as a historical human endeavor.

Benchmark 1: The student will develop scientific habits of mind.

Grades 5-7 Indicators	Instructional Examples
The student… 1. practices intellectual honesty, demonstrates skepticism appropriately, displays open-mindedness to new ideas, and bases decisions on evidence.	The student… 1 a. analyzes news articles to determine whether data/statistics presented adequately and objectively support conclusions that are made. b. analyzes data and recognizes that a hypothesis not supported by data should not be perceived as a right or wrong answer. c. attempts to replicate an investigation to support or refute a conclusion. d. shares interpretations that differ from currently held explanations on topics such as global warming and dietary claims. Evaluates the validity of results and accuracy of stated conclusions. e. reviews results of individual, group, or peer investigations to assess the accuracy of conclusions based upon data collection and analysis and use of evidence to reach a conclusion.

TEACHER NOTES:
Science requires varied abilities depending on the field of study, type of inquiry, and cultural context. The abilities characteristic of those engaged in scientific investigations include: reasoning, intellectual honesty, tolerance of ambiguity, appropriate skepticism, open-mindedness, and the ability to make logical conclusions based on current evidence.

Teachers can support the development of scientific habits of mind by providing students with on-going instruction using inquiry as a framework. Students can apply science concepts in investigations. They can work individually and on teams while conducting inquiry. They can share their work through varied media, and they can self-evaluate their learning. High expectations for accuracy, reliability, and openness to differing opinions should be exercised.

STANDARD 7: HISTORY AND NATURE OF SCIENCE – The student will examine and develop an understanding of science as a historical human endeavor.

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

Grades 5-7 Indicators	Instructional Examples
The student… 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.	The student… 1 a. discusses discoveries that replaced previously held knowledge, such as safety of Freon or saccharine use, knowledge concerning the transmission of AIDS, cloning, Pluto's status as a planet. b. rediscovers principles of electromagnetism by replicating Oersted's compass needle experiment. (Compass needle deflects perpendicular to current carrying wire.) c. 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.

▲ = Recommended Grade 7 Assessed Indicator