Intended Learning Outcomes for Diocesan Middle School Integrated Science

Middle School Science Graduate Profile

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should learn and demonstrate as a result of science instruction. They are an essential part of the Science Core Curriculum and provide teachers with a standard for evaluation of student learning in science. Instruction should include significant science experiences that lead to student understanding using the ILOs.

The role of science in Catholic education is essential. The main intent of science instruction in Utah Catholic Schools is that students will value and use science as a process of obtaining knowledge based upon observable evidence. Reason and faith are an integral part of our Catholic education. It is essential that science education explore the manifestation of God's presence in our world and God's gifts to his people.

"The work of predicting, controlling and governing nature, which science today renders more practical than in the past, is itself a part of the Creator's plan." Pope Benedict XVI

We live on a self-contained planet. All that we will ever have is already here. We are the custodians of God's gift to the world.

Intended Learning Outcomes

1. Use Science Processes and Thinking Skills

a. Observe objects and events for patterns and record both qualitative and quantitative information.

b. Sort and sequence data according to a given criterion.

c. As applicable use Inquiry Based Data Acquisition
   - Develop and use categories to classify subjects studied.
   - Select the appropriate instrument; measure, calculate, and record in metric units, length, volume, temperature and mass, to the accuracy of instruments used.

d. When given a problem, plan and conduct experiments in accordance with the scientific method:
   - Form research questions.
   - Discuss possible outcomes of investigations.
   - Identify variables.
   - Plan procedures to control independent variable(s).
   - Collect data on the dependent variable(s).
   - Select appropriate format (e.g., graph, chart, technology tools, diagram) to summarize data obtained.
   - Analyze data and construct reasonable conclusions.
   - Prepare written and oral reports of their investigation.
   - As applicable use Inquiry Based Data Acquisition

e. Distinguish between factual statements and inferences.

f. Use field guides or other keys to assist in the identification of subjects studied.

2. Manifest Scientific Attitudes and Interests

a. Utilize primary and secondary sources and other scientific materials.

b. Raise questions about objects, events, and processes that can be answered through scientific investigation.

c. Maintain an open and questioning mind toward ideas and alternative points of view.

d. Check reports of observations for accuracy.

e. Use evidence to resolve problems.

f. Utilize multi-media resources.

3. Demonstrate Understanding of Science Concepts and Principles

a. Know and explain science information specified for their grade level.
b. Transfer and apply concepts across disciplines.
c. Compare concepts and principles based upon specific criteria.
d. Solve problems appropriate to grade level by applying scientific principles and procedures.

4. Communicate Effectively Using Science Language and Reasoning

a. Provide relevant data to support inferences and conclusions.
b. Use precise scientific language in oral and written communication.
c. Use proper grammar in oral and written reports.
d. Use a variety of reference sources to obtain information and cite the sources.
e. Effective integration of mathematical reasoning.
f. Construct models to describe concepts and principles.
g. Preparation and replication of experimental procedures.
h. Interpret and analyze scientific data.

5. Demonstrate Awareness of Social and Historical Aspects of Science

a. Recognizes how science is an integral part of our lives.
b. Give instances of how technological advances have influenced the progress of science and how science has influenced advances in technology.
c. Understand the cumulative nature of the development of science knowledge.
d. Recognize contributions to science that have been made by both men and women from many cultures.

6. Demonstrate Understanding of the Nature of Science

a. Science is a way of thinking that is used by many people, not just scientists.
b. Understand that science investigations use a variety of methods and do not always use the same set of procedures.
c. Science findings are based upon evidence.
d. Understand that scientific conclusions are based on the assumption that natural laws operate today as they did in the past and that they will continue to do so in the future.
e. Understand that science conclusions are tentative and therefore never final. Understandings based upon these conclusions are subject to revision in light of new evidence.
f. Understand that various disciplines of science are interrelated and share common rules of evidence to explain phenomena in the natural world.

Science language students should use:	generalize, conclude, hypothesis, theory, variable, measure, evidence, data, inference, infer, compare, predict, interpret, analyze, relate, calculate, observe, describe, classify, technology, experiment, investigation, tentative, assumption

SCIENCE LEVEL 6

Science Benchmark

The appearance of the lighted portion of the moon changes in a predictable cycle as a result of the relative positions of Earth, moon, and sun. Earth turns on an axis that is tilted relative to the plane of Earth's yearly orbit. The tilt causes sunlight to fall more intensely on different parts of the Earth during various parts of the year. The differences in heating of Earth's surface and length of daylight hours produce the seasons.

STANDARD I: Students will understand that the appearance of the moon changes in a predictable cycle as it orbits Earth and as Earth rotates on its axis.

Objective 1: Explain patterns of changes in the appearance of the moon as it orbits Earth.

a. Describe changes in the appearance of the moon during a month.
b. Identify the pattern of change in the moon's appearance.
c. Use observable evidence to explain the movement of the moon around Earth in relationship to Earth turning on its axis and the position of the moon changing in the sky.
d. Design an investigation, construct a chart, and collect data depicting the phases of the moon.

Objective 2: Demonstrate how the relative positions of Earth, the moon, and the sun create the appearance of the moon's phases.

a. Identify the difference between the motion of an object rotating on its axis and an object revolving in orbit.
b. Compare how objects in the sky (moon, planets, stars) change in relative position over the course of the day or night.
c. Model the movement and relative positions of Earth, the moon, and the sun.

STANDARD II: Students will understand how Earth tilt on its axis changes the length of daylight and creates the seasons.

Objective 1: Describe the relationship between the tilt of Earth's axis and its yearly orbit around the sun.

a. Describe the yearly revolution (orbit) of Earth around the sun.
b. Explain that Earth's axis is tilted relative to its yearly orbit around the sun.
c. Investigate the relationship between the amount of heat absorbed and the angle to the light source.

Objective 2: Explain how the relationship between the tilt of Earth's axis and its yearly orbit around the sun produces the seasons.

a. Compare Earth's position in relationship to the sun during each season.
b. Compare the hours of daylight and illustrate the angle that the sun's rays strikes the surface of Earth during summer, fall, winter, and spring in the Northern Hemisphere.
c. Use collected data to compare patterns relating to seasonal daylight changes.
d. Use a drawing and/or model to explain that changes in the angle at which light from the sun strikes Earth, and the length of daylight, determine seasonal differences in the amount of energy received.
e. Use a model to explain why the seasons are reversed in the northern and southern hemispheres.

Science language	Earth's tilt, seasons, axis of rotation, orbits, phases of the moon,

students should use:	revolution reflection

Science Benchmark

The solar system consists of planets, moons, and other smaller objects including asteroids and comets that orbit the sun. Planets in the solar system differ in terms of their distance from the sun, number of moons, size, composition, and ability to sustain life. Every object exerts gravitational force on every other object depending on the mass of the objects and the distance between them. The sun's gravitational pull holds Earth and other planets in orbit. Earth's gravitational force holds the moon in orbit. The sun is one of billions of stars in the Milky Way Galaxy, that is one of billions of galaxies in the universe. Scientists use a variety of tools to investigate the nature of stars, galaxies, and the universe. Historically, cultures have observed objects in the sky and understood and used them in various ways.

STANDARD III: Students will understand the relationship and attributes of objects in the solar system.

Objective 1: Describe and compare the components of the solar system.

a. Identify the planets in the solar system by name and relative location from the sun.
b. Using references compare the physical properties of the planets (e.g., size, solid or gaseous).
c. Use models and graphs that accurately depict scale to compare the size and distance between objects in the solar system.
d. Describe the characteristics of comets, asteroids, and meteors.
e. Research and report on the use of manmade satellites orbiting Earth and various planets.

Objective 2: Describe the use of technology to observe objects in the solar system and relate this to science understanding of the solar system.

a. Describe the use of instruments to observe and explore the moon and planets.
b. Describe the role of computers in understanding the solar system (e.g., collecting and interpreting data from observations, predicting motion of objects, operating space probes).
c. Relate science's understanding of the solar system to the technology used to investigate it.
d. Find and report on the different ways technology has been and is being used to investigate the solar system.

Objective 3: Describe the forces that keep objects in orbit in the solar system.

a. Describe the forces holding Earth in orbit around the sun, and the moon in orbit around Earth.
b. Relate a celestial object's mass to its gravitational force on other objects.
c. Identify the role gravity plays in the structure of the solar system.

STANDARD IV: Students will understand the scale of size, distance between objects, movement, and apparent motion (due to Earth's rotation) of objects in the universe and how cultures have understood, related to and used these objects in the night sky.

Objective 1: Compare the size and distance of objects within systems in the universe.

a. Use the speed of light as a measuring standard to describe the relative distances to objects in the universe (e.g., 4.3 light years to nearest star Alpha Centauri; 0.00001 light years to the sun)
b. Compare the size of Earth to the size of the solar system.
c. Compare the size of the solar system to the size of the Milky Way galaxy.
d. Compare the size of the Milky Way galaxy to the size of the known universe.
e. Understand measure of astronomical unit (AU).

Objective 2: Describe the appearance and apparent motion of groups of stars in the night sky relative to Earth and how various cultures have understood and used them.

a. Locate and identify stars that are grouped in patterns in the night sky.
b. Identify ways people have historically grouped stars in the night sky.
c. Recognize that stars in a constellation are not all the same distance from Earth.
d. Relate the seasonal change in the appearance of the night sky to Earth's position.
e. Describe ways that familiar groups of stars may be used for navigation and calendars.

Science language students should use:	asteroids, celestial object, comets, galaxy, planets, satellites, star**,** distance, force, gravity, gravitational force, mass, scale, solar system, constellation, Milky Way galaxy, speed of light, telescope, universe, sun, light years

Science Benchmark

Microorganisms are those living things that are visible as individual organisms only with the aid of magnification. Microorganisms are components of every ecosystem on Earth. Microorganisms range in complexity from single to multi-cellular organisms. Most microorganisms do not cause disease and many are beneficial. Microorganisms require food, water, air, ways to dispose of waste, and an environment in which they can live. Investigation of microorganisms is accomplished by observing organisms using direct observation with the aid of magnification, observation of colonies of these organisms and their waste, and observation of microorganism's effects on an environment and other organisms.

***Standard V: Students will understand that microorganisms range from simple to complex, are found almost everywhere, and are both helpful and harmful.**

Objective 1: Observe and summarize information about microorganisms.

a. Examine and illustrate size, shape, and structure of organisms found in an environment such as pond water.
b. Compare characteristics common in observed organisms (e.g., color, movement, appendages, shape) and infer their function (e.g., green color found in organisms that are producers, appendages help movement).
c. Research and report on a microorganism's requirements (i.e., food, water, air, waste disposal, temperature of environment, reproduction).

Objective 2: Demonstrate the skills needed to plan and conduct an experiment to determine a microorganism's requirements in a specific environment.

a. Formulate a question about microorganisms that can be answered with a student experiment.
b. Develop a hypothesis for a question about microorganisms based on observations and prior knowledge.
c. Plan and carry out an investigation on microorganisms. {Note: Teacher must examine plans and procedures to assure the safety of students; for additional information, you may wish to read microbe safety information on Utah Science Home Page.}
d. Display results in an appropriate format (e.g., graphs, tables, diagrams).
e. Prepare a written summary or conclusion to describe the results in terms of the hypothesis for the investigation on microorganisms.

Objective 3: Identify positive and negative effects of microorganisms and how science has developed positive uses for some microorganisms and overcome the negative effects of others.

a. Describe in writing how microorganisms serve as decomposers in the environment.
b. Identify how microorganisms are used as food or in the production of food (e.g., yeast helps bread rise, fungi flavor cheese, algae are used in ice cream, bacteria are used to make cheese and yogurt).
c. Identify helpful uses of microorganisms (e.g., clean up oil spills, purify water, digest food in digestive tract, antibiotics) and the role of science in the development of understanding that led to positive uses (i.e., Pasteur established the existence, growth, and control of bacteria; Fleming isolated and developed penicillin).
d. Relate several diseases caused by microorganisms to the organism causing the disease (e.g., athlete's foot - fungi, streptococcus throat - bacteria, giardia - protozoa).
e. Observe and report on microorganisms' harmful effects on food (e.g., causes fruits and vegetables to rot, destroys food bearing plants, make milk sour).

Science language students should use:	algae, fungi, microorganism, decomposer, single-celled, organism, bacteria, protozoan, producer, hypothesis, experiment, investigation, variable, control, budding, culture

Science Benchmark

Heat, light, and sound are all forms of energy. Heat can be transferred by radiation, conduction and convection. Visible light can be produced, reflected, refracted, and separated into light of various colors. Sound is created by vibration and cannot travel through a vacuum. Pitch is determined by the vibration rate of the sound source.

STANDARD VI: Students will understand properties and behavior of heat, light, and sound.

Objective 1: Investigate the movement of heat between objects by conduction, convection, and radiation.

a. Compare materials that conduct and materials that insulate the transfer of heat energy.
b. Describe the movement of heat from warmer objects to cooler objects.
c. Describe the movement of heat across space from the sun to Earth by radiation.
d. Observe and describe, with the use of models, heat energy being transferred through a fluid medium (liquid and/or gas) by convection currents.
e. Design and conduct an investigation on the movement of heat energy.

Objective 2: Describe how light can be produced, reflected, refracted, and separated into visible light of various colors.

a. Compare light from various sources.
b. Compare the reflection of light from various surfaces (e.g., loss of light from various surfaces, angle of incidence and reflection, color).
c. Investigate and describe the refraction of light passing through various materials (e.g., prisms, water).
d. Predict and test the behavior of light interacting with various fluids (e.g., light transmission through fluids, refraction of light).
e. Predict and test the appearance of various materials when light of different colors is shone on the material.

Objective 3: Describe the production of sound in terms of vibration of objects that create vibrations in other materials.

a. Describe how sound is made from vibration and moves in all directions from the source in waves.
b. Explain the relationship of the size and shape of a vibrating object to the pitch of the sound produced.
c. Relate the volume of a sound to the amount of energy used to create the vibration of the object producing the sound.
d. Make a musical instrument and report on how it produces sound.
e. Explain how light waves and sound waves are different.

Science language students should use:	angle of incidence, angle of reflection, conduction, conductor, convection, medium, pitch, prism, radiation, reflection, refraction, spectrum, vibration

7th – 8th Grade Integrated Science

Introduction

Seventh Grade Integrated Science focuses on the theme of "structure." Physical, earth, and life science content are integrated in a curriculum with two primary goals: (1) students will value and use science as a process of obtaining knowledge based on observable evidence, and (2) students' curiosity will be sustained as they develop the abilities associated with scientific inquiry.

Eighth Grade Integrated Science focuses on the themes of change and energy. Physical, earth, and life science content are integrated in a curriculum with two primary goals: (1) students will value and use science as a process of obtaining knowledge based on observable evidence, and (2) students' curiosity will be sustained as they develop the abilities associated with scientific inquiry.

Core concepts should be taught using integrated instruction of science with skills from other curriculum areas, reading, writing and mathematics skills should be emphasized as integral to the instruction of science. Technology issues and the nature of science are significant components of this Core. Personal relevance of science in student's lives is always an important part of helping students to value science and should be emphasized at this grade-level.

The Core was designed using the American Association for the Advancement of Science's Project 2061: Benchmarks For Science Literacy and the National Academies of Science National Science Education Standards as guides to determine appropriate content and skills.

The goals stated in the "Intended Learning Outcomes" should guide instruction. Instruction should extend beyond the Core to meet student needs. The content and processes are designed to articulate with the rest of the science Core Curriculum K-12.

Developmentally appropriate instruction should include hands-on, student-centered activities emphasizing the student as scientist. When given a problem that is clearly described, students should have the opportunity to plan and conduct their own experiments and come to conclusions appropriate to the student. Student conclusions should then be compared with accepted science theory. The hands-on nature of this Core increases the need for teachers to use appropriate precautions in the laboratory and field. Guidelines for proper use of animals, equipment, and chemicals in the classroom should be observed.

SCIENCE LEVEL 7

Science Benchmark

All matter is made up of atoms that are far too small to see. Atoms are in perpetual motion and the more energy they contain the faster they move. Atoms combine to form molecules. Matter is made up of atoms and molecules that have measurable mass, volume, and density. Density is a measure of the compactness of matter. Density determines the way materials in a mixture are sorted. This property of matter results in the layering and structure of Earth's atmosphere, water, crust and interior.
Models are used to describe the structure of Earth.

Standard I Students will understand the structure of matter.

Objective 1: Describe the structure of matter in terms of atoms and molecules.

a. Recognize that atoms are too small to see.
b. Relate atoms to molecules (e.g., atoms combine to make molecules).
c. Diagram the arrangement of particles in the physical states of matter.
d. Describe the limitations of the models used to represent atoms.
e. Investigate and report how our knowledge of the structure of matter has been developed over time.

Objective 2: Accurately measure the characteristics of matter in different states.

a. Use appropriate instruments to determine mass and volume of solids and liquids and record data.
b. Use observations to predict the relative density of various solids and liquids.
c. Calculate the density of various solids and liquids.
d. Describe the relationship between mass and volume to density.
e. Design a procedure to measure mass and volume of gases.

Objective 3: Investigate the motion of particles.

a. Identify evidence that particles are in constant motion.
b. Compare the motion of particles at various temperatures by measuring changes in the volume of gases, liquids, or solids.
c. Design and conduct an experiment investigating the diffusion of particles.
d. Describe the impact of expansion and contraction of solid materials on the design of buildings, highways and other structures.
e. Formulate and test a hypothesis about the properties of matter (e.g., water, air, iron) and the motion of the particle that make up that matter.

Standard II Students will understand the relationship between density and Earth's structure.

Objective 1: Examine the effects of density on the behavior of materials in mixtures.

a. Compare the density of various objects to the density of known earth materials.
b. Calculate the density of Earth materials (e.g., rocks, water, air).
c. Observe and describe the sorting of Earth materials in a mixture due to density.
d. Relate the sorting of materials in streambeds, road cuts or beaches to the density of those materials.
e. Design and conduct an experiment that provides data on relative density of various earth materials.

Objective 2: Analyze how density affects Earth's structure.

a. Compare the densities of Earth's atmosphere, water, crust, and interior layers.
b. Relate density to the relative positioning of Earth's atmosphere, water, crust and interior.
c. Model the layering of Earth's atmosphere, water, crust, and interior due to density differences.
d. Distinguish between accurate and inaccurate attributes for models of Earth.

Science language students should use:	• Atmosphere • Atom • Core • Crust • Density • Diffusion • Gas • Liquid	• Models • Mass • Matter • Molecule • Particle • Solid • Temperature (heat energy) • Volume

Science Benchmark

Living things are made of smaller structures whose functions enable the organisms to survive. The basic unit of structure in all living things is the cell. Cells combine to form tissues that combine to form organs. While all cells have common structures, there are differences between plant and animal cells. Cell details are usually visible only through a microscope.
Reproduction passes information from parent to offspring. Asexual reproduction requires one parent and produces nearly identical offspring. Sexual reproduction requires two parents, and provides variety in a species. This variety may allow the species to adapt to changes in the environment and help the species survive. A species may change due to the passing of traits naturally or by techniques used and developed by science. Genetic information is passed on in a predictable manner.

Standard III Students will understand the cellular theory of life and that the organs in an organism are made of cells that have structure and perform specific life functions.

Objective 1: Observe and describe cellular theory, cellular structures and functions.

a. Research the origin of the cellular theory.
b. Use appropriate instruments to observe, describe and compare various types of cells (e.g., plant, hair).
c. Observe and distinguish the cell wall, cell membrane, nucleus, chloroplast, and cytoplasm of cells.
d. Differentiate between plant and animal cells based on cell wall and cell membrane.
e. Model the cell processes of diffusion and osmosis and relate this motion to the motion of particles.
f. Gather information to report on how the basic functions of organisms are carried out within cells (e.g., extract energy from food, remove waste).

Objective 2: Identify and describe the function and inter-dependence of various organs and tissues.

a. Order the levels of organization from simple to complex (e.g., cell, tissue, organ, system, organism).
b. Match a particular structure to the appropriate level (e.g. heart to organ, cactus to organism, muscle to tissue).
c. Analyze a particular body structure in terms of its component parts, and the larger systems of which it is a part (tissue -cells and organs, heart – tissues and circulatory system).

d. Describe how cellular needs of organisms for food, air, and waste removal are met by tissues and organs (e.g. lungs provide oxygen to cells, kidneys remove wastes from cells).

Objective 3: Compare how sexual and asexual reproduction passes genetic information from parent to offspring.

a. Distinguish between inherited and acquired traits.
b. Contrast the exchange of genetic information in sexual and asexual reproduction (e.g. number of parents, variation of genetic material).
c. Cite examples of organisms that reproduce sexually (e.g., rats, mosquitoes, salmon, sunflowers) and those that reproduce asexually (e.g., hydra, planaria, bacteria).
d. Compare inherited structural traits of offspring and their parents.
e. Describe the role of DNA in heredity.

Objective 4: Relate the adaptability of organisms in an environment to their inherited traits and structures.

a. Predict why certain traits (e.g., structure of teeth, body structure, coloration) are more likely to offer an advantage for survival of an organism.
b. Cite examples of traits that provide an advantage for survival in one environment but not other environments.
c. Cite examples of changes in genetic traits due to natural and man-made influences.
d. Relate the density or structure of organs to an organism's ability to survive in a specific environment (e.g., hollow bird bones allow them to fly in air, and hollow structure of hair insulates animals from hot or cold, dense root structure to grow in dense soil, fish fins to move in water).

Science language students should use:	• Acquired trait • Asexual Reproduction • Genetics • Nucleus • Organ • Organism • Osmosis • System • Tissue • Punnett Square • DNA	• Inherited trait • Offspring • Sexual Reproduction • Species • Cytoplasm • Diffusion • Cell Membrane • Chloroplast • Cell • Cell Wall

Science Benchmark

Classification schemes reflect orderly patterns and observable distinctions among objects and organisms. One of the most general distinctions among organisms is between plants and animals. Biologists consider an organism's structural features more important for classifying organisms than behavior or general appearance. Geologists classify earth materials based upon structure. Chemists classify matter based upon structure. Classification systems may change as science develops new knowledge.

Standard IV Students will understand that structure is used to develop classification systems.

Objective 1: Classify based on observable properties.

a. Categorize non-living objects based on external structures.
b. Compare living, dead, and non-living things.
c. Defend the importance of observation in scientific classification.
d. Demonstrate that there are many ways to classify things.

Objective 2: Use and develop a simple classification system.

a. Using a provided classification scheme, classify things (e.g., shells, leaves, rocks, bones, fossils, weather, clouds, stars, planets).
b. Develop a classification system based on observed structural characteristics.
c. Generalize rules for classification.
d. Relate the importance of classification systems to the development of science knowledge.
e. Recognize that classification is a tool made by science to describe perceived patterns in nature.

Objective 3: Recognize that classification is the process of using orderly patterns to identify organisms.

a. Identify organisms that cannot be classified as either plant or animal.
b. Arrange organisms according to kingdom (i.e., Plant, animal, monera, fungi, protist).
c. Use a classification key or field guide to identify organisms.
d. Report on changes in classification systems as a result of new information or technology.

Science language students should use:	• Classification • Classification Key • Kingdom • Offspring	• Organism • Species

SCIENCE LEVEL 8

Science Benchmark

Chemical change is a primary way that matter on earth changes from one form to another. Energy is involved in chemical and physical change. When chemical or physical changes occur, the total amount of matter and energy remains the same; this is the law of conservation of matter and energy.
Matter can change state through physical change. In a physical change the identity of the atoms does not change.
In a chemical change the identity of the atoms does not change, but the atoms are recombined into a new substance. Evidence for a chemical reaction may include; color change, gas given off, and heat or light given off or absorbed. Changing the amount of energy in a chemical system alters reaction rate.
Changing the surface area and/or concentration of reactants changes the rate of chemical reaction.

Standard I: Students will understand the nature of changes in matter.

Objective 1: Describe the chemical and physical properties of various substances.

a. Define the difference between element, compound and mixture.
b. Differentiate between chemical and physical properties.
c. Classify substances based on their chemical and physical properties (e.g. highly reactive metals, less reactive metals, non-metals, and noble gasses).
d. Investigate and report on the chemical and physical properties of a particular substance.

Objective 2: Observe and evaluate evidence of chemical and physical change.

a. Identify observable evidence of a physical change (e.g., change in shape, size, phase).
b. Identify observable evidence of a chemical change (e.g., color change, heat and/or light being given off or taken in by reactants, gas being given off, a change in odor).
c. Observe and describe chemical reactions involving atmospheric oxygen (e.g., rust, fire, respiration, and photosynthesis).
d. Investigate the effects of chemical change on physical properties of substances (e.g., cooking a raw egg, iron rusting, and polymerization of a resin).

Objective 3: Investigate and measure the effects of increasing or decreasing the amount of energy in a physical or chemical change and relate the kind of energy added to the motion of the particles.

a. Identify the kinds of energy (e.g., heat, light, sound) given off or taken in when a substance undergoing a chemical or physical change.
b. Relate the amount of energy added or taken away from a substance to the motion of molecules in the substance.
c. Measure and graph the relationship between the states of water and changes in its temperature.
d. Cite evidence showing that heat may be given off or taken in during a chemical change (e.g. striking a match, vinegar and antacid, ammonium chloride and water).
e. Plan and conduct an experiment and report the effect of adding or removing energy on the chemical and physical changes.

Objective 4: Identify the observable features of chemical reactions.

a. Identify the reactants and products in a given chemical change and relate the presence of the same atoms in both the reactants and products.
b. Cite examples of common significant chemical reactions (i.e., photosynthesis, respiration, combustion, rusting) in daily life.

c. Demonstrate that mass is conserved in a chemical reaction (e.g. mix two solutions that result in a color change or formation of a precipitate, weigh the solutions before and after mixing).
d. Experiment with variables affecting the relative rates of chemical changes (e.g., heating, cooling, stirring, crushing, and concentration).

Science language students should use:	chemical properties, physical properties, chemical change, physical change,, chemical reaction, reaction, reactants, products, respiration, photosynthesis, temperature, mechanical energy, molecules, heat energy, chemical energy, atoms, energy,

Science Benchmark

The sun is the source for essentially all biological energy. Plants store captured light energy as chemical energy in sugars. Animals eat plants to obtain the energy and matter that they need. The energy from food is used for mechanical and heat energy. The matter is used to build the cells of the organism. Food chains and food webs are models used to show the transfer of energy and matter among organisms. These models can be used to show relationship among organisms. Organisms, including humans, influence the ability of other organisms to live in a specific environment.

Standard II: Students will understand that energy from sunlight is changed to chemical energy in plants, transfers between living organisms, and that changing the environment may alter the amount of energy provided to living organisms.

Objective 1: Compare ways plants and animals obtain and use energy.
a. Recognize the importance of photosynthesis in using light energy as part of the chemical process that builds plant materials.
b. Explain how respiration in animals is the process of converting food energy into mechanical and heat energy.
c. Trace the path of energy from the sun to mechanical energy in an organism.

Objective 2: Generalize the dependent relationships between organisms.
a. Categorize the relationships between organisms (i.e., producer/consumer, predator/prey, mutualism, parasitism) and provide examples of each.
b. Use models to trace the flow of energy in food chains and food webs.
c. Formulate and test a hypothesis on the effects of air, temperature, water, or light on plants (e.g., seed germination, growth rates, seasonal adaptations).
d. Research multiple ways that different scientists have investigated the same ecosystem.

Objective 3: Analyze human influence on the capacity of an environment to sustain living things.
a. Describe specific examples of how humans have changed the capacity of an environment to support specific life forms (e.g., people create wet lands and nesting boxes – increase number and range of wood ducks, acid rain -damages amphibian eggs and reduces population of frogs, clear cutting forests – squirrel populations reduced, suburban sprawl –reduce mule deer winter range thus decreasing numbers of deer).
b. Distinguish between inference and evidence in a newspaper or magazine article relating to the effect of humans on the environment.
c. Infer the potential effects of humans on a specific food web.

d. Evaluate and present arguments for and against allowing a specific species of plant or animal to become extinct and relate the argument to the flow energy in an ecosystem.
e. Promote sustainability by Christian stewardship and healthy life styles.

Science language students should use:	food web, food chain, energy transformation, photosynthesis, respiration, predator, energy flow, solar energy, chemical energy, mechanical energy, producer, consumer, prey mutualism, parasitism, competition, environment, capacity, food pyramid

Science Benchmark

Earth is a dynamic planet. Processes that change the Earth's surface operated in the past much as they do today. Evidence of past surface and climatic changes are indicated in the rock and fossil records. Rocks are composed of minerals. Rocks and minerals cycle through processes that change their form. Several processes contribute to changing the Earth's surface. Earth's surface is changed by heat flowing from Earth's hot interior toward the cooler surface and by atmospheric processes. Earth's surface can change abruptly through volcanoes and earthquakes. Earth's surface can change gradually through rock formation, mountain building, weathering, and erosion. Small changes that repeatedly occur over very long time periods can add up to major changes to Earth's surface.

Standard III: Students will understand the processes of rock and fossil formation.

Objective 1: Compare rocks and minerals and how they are related.
a. Recognize that rocks are composed of minerals.
b. Observe and describe the minerals found in rocks (e.g. shape, color, luster, texture, hardness).
c. Categorize rock samples as sedimentary, metamorphic, or igneous.

Objective 2: Describe the nature of the changes that rocks undergo over long periods of time.
a. Diagram and explain the rock cycle.
b. Describe the role of energy in the processes that change rock materials over time.
c. Use a model to demonstrate how erosion changes the surface of Earth.
d. Relate gravity to changes in Earth's surface.
e. Identify the role of weathering of rocks in soil formation.

Objective 3: Describe how rock and fossil evidence is used to infer Earth's history.
a. Describe the layering of sedimentary rocks over time.
b. Identify the assumptions scientists make to determine relative age of rock layers.
c. Explain why some sedimentary rock layers may not always appear with youngest rock on top and older rocks below (e.g., folding, faulting, non-conformity).
d. Model sedimentation and fossil formation.
e. Research how fossils show evidence of the changing surface of the Earth.
f. Propose why more recently deposited rock layers are more likely to contain fossils resembling existing species than older rock layers.

Objective 4: Compare rapid and gradual changes to Earth Surface.

a. Describe how energy from the Earth's interior causes changes to Earth's surface (i.e., earthquakes and volcanoes).
b. Describe how earthquakes volcanoes transfer energy from Earth's interior to the surface (e.g., seismic waves- transfer mechanical energy, flowing magma- transfer heat and mechanical energy).
c. Model the process of energy build up and release in earthquakes.
d. Compare abrupt changes (e.g., landslides, volcanoes, earthquakes) to gradual changes (e.g., mountain building, erosion) of the Earth's surface and their effects.
e. Model how small changes over time add up to major changes to Earth's surface.
f. Model plate tectonics.

Science language students should use:	volcano, earthquake, weathering, minerals, fossils, sedimentary, magma, metamorphic, rock cycle, igneous, sedimentation

Science Benchmark

Movement involves one form of energy being transformed into another form. Energy has the potential to exert a force over a distance. Waves transfer energy such as sound, heat, light, and earthquakes, through different mediums. Sound and light waves allow organisms to "hear" and "see" the world around them. Energy is classified as either kinetic or potential energy.
Every object exerts a gravitational force on every other object. The distance between objects and mass of the objects determine the force of gravity between them. This force is difficult to measure unless one of the objects has a very large mass. Unbalanced forces cause change in the motion of objects, while balanced forces do not.

Standard IV: Students will understand the relationships among energy, force and motion.

Objective 1: Compare the behavior of waves traveling through various materials.

a. Identify the relationship between the energy of a wave and its amplitude.
b. Compare sound, light, heat and earthquake waves as to speed and type of wave and the effects of medium on the properties of the waves. ***(e.g., speed and type of wave, effects of medium on wave properties).***
c. Describe the spread of energy away from an energy-producing source.
d. Demonstrate how white light can be separated into the visible color spectrum.

Objective 2: Examine the force exerted on objects by gravity.

a. Distinguish between mass and weight.
b. Cite examples of how Earth's gravitational force on an object depends on the mass of the object.
c. Describe how Earth's gravitational force on an object depends upon the distance of the object from Earth.
d. Investigate and compare gravity on Earth and the moon.
e. Design and build a machine that uses gravity to accomplish a task.

Objective 3: Analyze the forces that act on objects.

a. Calculate the mechanical advantage created by a lever.
b. Categorize simple machines such as levers or inclined planes, pulleys, wheel and axle.
c. Demonstrate the effect of friction on moving objects (e.g. slowing, heat, sound).
d. Design, and build a complex machine capable of doing a specified task.
e. Model how unbalanced forces acting on an object changes its speed or direction of motion or both.

Objective 4: Analyze various forms of energy and how living organisms sense energy.

a. Analyze the cyclic nature of potential and kinetic energy (e.g., a bouncing ball).
b. Trace the conversion of energy from one form of energy to another (e.g., light to chemical to mechanical, introduce simple electrical circuits and electromagnets).
c. Cite examples of how organisms sense various types of energy.
d. Investigate and report the response of various organisms to changes in energy (e.g., plant response to light and gravity, human response to motion, sound, light, insect response to changes in light intensity).

Science language students should use:	energy, potential energy, kinetic energy, force, unbalanced forces, balanced forces, gravity, simple machine, complex machine, wave