Utah Science Core Curriculum
Eight Grade Integrated Science

Introduction

Science is a way of knowing, a process for gaining knowledge and understanding of the natural world. The Science Core Curriculum places emphasis on understanding and using skills. Students should be active learners. It is not enough for students to read about science; they must do science. They should observe, inquire, question, formulate and test hypotheses, analyze data, report, and evaluate findings. The students, as scientists, should have hands-on, active experiences throughout the instruction of the science curriculum.

The Science Core describes what students should know and be able to do at the end of each course. It was developed, critiqued, piloted, and revised by a community of Utah science teachers, university science educators, State Office of Education specialists, scientists, expert national consultants, and an advisory committee representing a wide diversity of people from the community. The Core reflects the current philosophy of science education that is expressed in national documents developed by the American Association for the Advancement of Science and the National Academies of Science. This Science Core has the endorsement of the Utah Science Teachers Association. The Core reflects high standards of achievement in science for all students.

Organization of the Science Core

The Core is designed to help teachers organize and deliver instruction. Elements of the Core include the following:

- ✓ Each grade level begins with a brief course description.
- ✓ The INTENDED LEARNING OUTCOMES (ILOs) describe the goals for science skills and attitudes. They are found at the beginning of each grade, and are an integral part of the Core that should be included as part of instruction.
- ✓ The SCIENCE BENCHMARKS describe the science content students should know. Each grade level has three to five Science Benchmarks. The ILOs and Benchmarks intersect in the Standards, Objectives and Indicators.
- ✓ A STANDARD is a broad statement of what students are expected to understand. Several Objectives are listed under each Standard.
- ✓ An OBJECTIVE is a more focused description of what students need to know and be able to do at the completion of instruction. If students have mastered the Objectives associated with a given Standard, they are judged to have mastered that Standard at that grade level. Several Indicators are described for each Objective.
- ✓ An INDICATOR is a measurable or observable student action that enables one to judge whether a student has mastered a particular Objective. Indicators are not meant to be classroom activities, but they can help guide classroom instruction.
- ✓ SCIENCE LANGUAGE STUDENTS SHOULD USE is a list of terms that students and teachers should integrate into their normal daily conversations around science topics. These are **not** vocabulary lists for students to memorize.

Seven Guidelines Were Used in Developing the Science Core

Reflects the Nature of Science: Science is a way of knowing, a process for gaining knowledge and understanding of the natural world. The Core is designed to produce an integrated set of Intended Learning Outcomes (ILOs) for students.

As described in these ILOs, students will:

- Use science process and thinking skills.
- Manifest science interests and attitudes.
- Understand important science concepts and principles.
- Communicate effectively using science language and reasoning.
- Demonstrate awareness of the social and historical aspects of science.
- Understand the nature of science.

Coherent: The Core has been designed so that, wherever possible, the science ideas taught within a particular grade level have a logical and natural connection with each other and with those of earlier grades. Efforts have also been made to select topics and skills that integrate well with one another and with other subject areas appropriate to grade level. In addition, there is an upward articulation of science concepts, skills, and content. This spiraling is intended to prepare students to understand and use more complex science concepts and skills as they advance through their science learning.

Developmentally Appropriate: The Core takes into account the psychological and social readiness of students. It builds from concrete experiences to more abstract understandings. The Core describes science language students should use that is appropriate to their grade level. A more extensive vocabulary should not be emphasized. In the past, many educators may have mistakenly thought that students understood abstract concepts (such as the nature of the atom) because they repeated appropriate names and vocabulary (such as “electron” and “neutron”). The Core resists the temptation to describe abstract concepts at inappropriate grade levels; rather, it focuses on providing experiences with concepts that students can explore and understand in depth to build a foundation for future science learning.

Encourages Good Teaching Practices: It is impossible to accomplish the full intent of the Core by lecturing and having students read from textbooks. The Science Core emphasizes student inquiry. Science process skills are central in each standard. Good science encourages students to gain knowledge by doing science: observing, questioning, exploring, making and testing hypotheses, comparing predictions, evaluating data, and communicating conclusions. The Core is designed to encourage instruction with students working in cooperative groups. Instruction should connect lessons with students’ daily lives. The Core directs experiential science instruction for all students, not just those who have traditionally succeeded in science classes. The vignettes listed on the Utah Science Home Page at http://www.usoe.k12.ut.us/curr/science for each of the Core standards provide examples, based on actual practice, that demonstrate that excellent teaching of the Science Core is possible.

Comprehensive: The Science Core does not cover all topics that have traditionally been in the science curriculum; however, it does provide a comprehensive background in science. By emphasizing depth rather than breadth, the Core seeks to empower students rather than intimidate them with a collection of isolated and forgettable facts. Teachers are free to add related concepts and skills, but they are expected to teach all the standards and objectives specified in the Core for their grade level.

Useful and Relevant: This curriculum relates directly to student needs and interests. It is grounded in the natural world in which we live. Relevance of science to other endeavors enables students to transfer skills gained from science instruction into their other school subjects and into their lives outside the classroom.

Encourages Good Assessment Practices: Student achievement of the standards and objectives in this Core is best assessed using a variety of assessment instruments. The purpose of an assessment should be clear to the teacher as it is planned, implemented, and evaluated. Performance tests are particularly appropriate to evaluate student mastery of science processes and problem-solving skills. Teachers should use a variety of classroom assessment approaches in conjunction with standard assessment instruments to inform their instruction. Sample test items, keyed to each Core Standard, may be located on the Utah Science Home Page http://www.usoe.k12.ut.us/curr/science. Observation of students engaged in science activities is highly recommended as a way to assess students' skills as well as attitudes in science. The nature of the questions posed by students provides important evidence of students' understanding of and interest in science.

Intended Learning Outcomes for Eighth Grade Integrated Science

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 main intent of science instruction in Utah is that students will value and use science as a process of obtaining knowledge based upon observable evidence.

By the end of seventh and eight grades students will be able to:

1. Use Science Process 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. Develop and use categories to classify subjects studied.
d. Select the appropriate instrument; measure, calculate, and record in metric units, length, volume, temperature and mass, to the accuracy of instruments used.
e. When given a problem, plan and conduct experiments in which they:
    - 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, diagram) to summarize data obtained.
    - Analyze data and construct reasonable conclusions.
    - Prepare written and oral reports of their investigation.
f. Distinguish between factual statements and inferences.
g. Use field guides or other keys to assist in the identification of subjects studied.

2. Manifest Scientific Attitudes and Interests

a. Read and look at books and other science materials voluntarily.
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. Accept and use scientific evidence to help resolve ecological problems.

3. Demonstrate Understanding of Science Concepts and Principles

a. Know and explain science information specified for their grade level.
b. Distinguish between examples and non-examples of concepts that have been taught.
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 their inferences and conclusions.
b. Use precise scientific language in oral and written communication.
c. Use correct English in oral and written reports.
d. Use reference sources to obtain information and cite the sources.
e. Use mathematical reasoning to communicate information.
f. Construct models to describe concepts and principles.

5. Demonstrate Awareness of Social and Historical Aspects of Science

a. Cite examples of how science affects life.
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 knowledge that have been made by both men and women.

6. Demonstrate Understanding of the Nature of Science

a. Science is a way of knowing 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; understand that there is not just one "scientific method."
c. Science findings are based upon evidence.
d. Understand that science conclusions are tentative and therefore never final. Understandings based upon these conclusions are subject to revision in light of new evidence.
e. 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.
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

Eighth Grade Integrated Science Core Curriculum

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.

Theme

The themes for Eighth Grade Integrated Science are change and energy. The "Benchmarks" in the eighth grade Core emphasize **change** as an organizing concept to understand **matter** and **energy**. Eighth graders should understand the relationship between energy and changes in matter. When matter combines, energy is absorbed or released and matter is rearranged to make new substances with new properties. The essential change that occurs in living organisms involves photosynthesis and respiration. The processes of change that shape and reshape the Earth continue today as in the past and require energy. Objects require energy to move, and this motion can be described, measured, and predicted.

Inquiry

Eighth grade students should design and perform experiments, and value inquiry as the fundamental scientific process. They should be encouraged to maintain an open and questioning mind to pose their own questions about objects, events, processes, and results. They should have the opportunity to plan and conduct their own experiments, and come to their own conclusions as they read, observe, compare, describe, infer, and draw conclusions. The results of their experiments need to be compared for reasonableness to multiple sources of information. It is important for students at this age to begin to formalize the processes of science and be able to identify the variables in a formal experiment.

Good science instruction requires hands-on science investigations in which student inquiry is an important goal. Teachers should provide opportunities for **all** students to experience many things. Eighth graders should investigate living organisms at the cellular level through firsthand observations. Students can find excitement through identifying things such as insects, plants, and rocks by using field guides. Students should enjoy science as a process of discovering the natural world.

Relevance

Eighth grade Core concepts should be integrated with concepts and skills from other curriculum areas. Reading, writing, and mathematics skills should be emphasized as integral to the instruction of science. Personal relevance of science in students' lives is an important part of helping students to value science and should be emphasized at this grade level. Developing students' writing skills in science should be an important part of science instruction in the eighth grade. Students should regularly write descriptions of their observations and experiments. Lab journals are an effective way to emphasize the importance of writing in science.

Providing opportunities for students to gain insights into science related careers adds to the relevance of science learning. Some of the eighth grade Core objectives require that students design and build things; it is important for students to understand not only the skills of science but also simple concepts of engineering. Resources related to careers in science may be found at the Utah Science Home Page at http://www.usoe.k12.ut.us/curr/science .

Character
Value for honesty, integrity, self-discipline, respect, responsibility, punctuality, dependability, courtesy, cooperation, consideration, and teamwork should be emphasized as an integral part of science learning. These relate to the care of living things, safety and concern for self and others, and environmental stewardship. Honesty in all aspects of research, experimentation, data collection, and reporting is an essential component of science.

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

The Eighth Grade Integrated Science Core has three online resources designed to help with classroom instruction. These resources include the *Sci-ber Text*, an electronic science textbook; web resources listed by Core objective; and the science test item pool. This pool includes multiple-choice questions, performance tasks, and interpretive items aligned to the standards and objectives of the Eighth Grade Integrated Science Core. These resources are all aligned to the Core and available on the Utah Science Home Page at http://www.usoe.k12.ut.us/curr/science

Safety Precaution
The hands-on nature of science learning increases the need for teachers to use appropriate precautions in the classroom and field. Proper handling and disposal of chemicals and is crucial for a safe classroom. The chemistry described in the eighth grade can be accomplished using safe household chemicals and microchemistry techniques. It is important that all students understand the rules for a safe classroom.

Appropriate Use of Living Things in the Science Classroom
It is important to maintain a safe, humane environment for animals in the classroom. Field activities should be well thought out and use appropriate and safe practices. Student collections should be done under the guidance of the teacher with attention to the impact on the environment. The number and size of the samples taken for the collections should be considered in light of the educational benefit. Some organisms should not be taken from the environment, but rather observed and described using photographs, drawings, or written descriptions to be included in the student's collection. **Teachers must adhere to the published guidelines** for the proper use of living things, equipment, and chemicals in the classroom. These guidelines are available on the Utah Science Home Page.

The Most Important Goal
Science instruction should cultivate and build on students' curiosity and sense of wonder. Effective science instruction engages students in enjoyable learning experiences. Science instruction should be as thrilling an experience for a student as opening a rock and seeing a fossil, watching the colors change in a chemical reaction, or observing the consistent sequence of color in a rainbow. Science is not just for those who have traditionally succeeded in the subject, and it is not just for those who will choose science-related careers. In a world of rapidly expanding knowledge and technology, all students must gain the skills they will need to understand and function responsibly and successfully in the world. The Core provides skills in a context that enables students to experience the joy of doing science.

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 the 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. Differentiate between chemical and physical properties.
b. Classify substances based on their chemical and physical properties (e.g., reacts with water, does not react with water, flammable or nonflammable, hard or soft, flexible or nonflexible, evaporates or melts at room temperature).
c. 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 or light given off, change in odor, gas given off).
c. Observe and describe chemical reactions involving atmospheric oxygen (e.g., rust, fire, respiration, photosynthesis).
d. Investigate the effects of chemical change on physical properties of substances (e.g., cooking a raw egg, iron rusting, 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 undergoes 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, mixing vinegar and antacid, mixing 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 describe the presence of the same atoms in both the reactants and products.
b. Cite examples of common significant chemical reactions (e.g., 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 and weigh the solutions before and after mixing).
d. Experiment with variables affecting the relative rates of chemical changes (e.g., heating, cooling, stirring, crushing, concentration).
e. Research and report on how scientists or engineers have applied principles of chemistry to an application encountered in daily life (e.g., heat-resistant plastic handles on pans, rust-resistant paints on highway bridges).

Science language students should use:	chemical properties, physical properties, chemical change, physical change, reaction, reactants, products, respiration, photosynthesis, temperature, 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 relationships 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 that 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 a process that converts food energy into mechanical and heat energy.
c. Trace the path of energy from the sun to mechanical energy in an organism (e.g., sunlight - light energy to plants by photosynthesis to sugars - stored chemical energy to respiration in muscle cell - usable chemical energy to muscle contraction- mechanical energy).

Objective 2: Generalize the dependent relationships between organisms.

a. Categorize the relationships between organisms (i.e., producer/consumer/decomposer, 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 wetlands and nesting boxes that increase the number and range of wood ducks, acid rain damages amphibian eggs and reduces population of frogs, clear cutting forests affects squirrel populations, suburban sprawl reduces 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 of flow energy in an ecosystem.

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

Science Benchmark

Earth is a dynamic planet. Processes that change 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 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 mountain building, weathering, erosion, and deposition. Small changes that repeatedly occur over very long time periods can add up to major changes in Earth's surface.

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

Objective 1: Compare rocks and minerals and describe how they are related.

a. Recognize that most 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.
f. Describe and model the processes of fossil formation.

Objective 3: Describe how rock and fossil evidence is used to infer Earth's history.

a. Describe how the deposition of rock materials produces layering of sedimentary rocks over time.
b. Identify the assumptions scientists make to determine relative ages of rock layers.
c. Explain why some sedimentary rock layers may not always appear with youngest rock on top and older rocks below (i.e., folding, faulting).
d. Research how fossils show evidence of the changing surface of the Earth.
e. 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's surface.

a. Describe how energy from the Earth's interior causes changes to Earth's surface (i.e., earthquakes, volcanoes).
b. Describe how earthquakes and volcanoes transfer energy from Earth's interior to the surface (e.g., seismic waves transfer mechanical energy, flowing magma transfers heat and mechanical energy).
c. Model the process of energy buildup and release in earthquakes.
d. Investigate and report possible reasons why the best engineering or ecological practices are not always followed in making decisions about building roads, dams, and other structures.
e. Model how small changes over time add up to major changes to Earth's surface.

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

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: Investigate the transfer of energy through various materials.

a. Relate the energy of a wave to wavelength.
b. Compare the transfer of energy (i.e., sound, light, earthquake waves, heat) through various mediums.
c. Describe the spread of energy away from an energy-producing source.
d. Compare the transfer of heat by conduction, convection, and radiation and provide examples of each.
e. 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 upon 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. Design and build structures to support a load.
e. Engineer (design and build) a machine that uses gravity to accomplish a task.

Objective 3: Investigate the application of forces that act on objects, and the resulting motion.

a. Calculate the mechanical advantage created by a lever.
b. Engineer a device that uses levers or inclined planes to create a mechanical advantage.
c. Engineer a device that uses friction to control the motion of an object.
d. Design and build a complex machine capable of doing a specified task.
e. Investigate the principles used to engineer changes in forces and motion.

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

a. Analyze the cyclic nature of potential and kinetic energy (e.g., a bouncing ball, a pendulum).
b. Trace the conversion of energy from one form of energy to another (e.g., light to chemical to mechanical).
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, human response to motion, sound, light, insects' response to changes in light intensity).
e. Investigate and describe how engineers have developed devices to help us sense various types of energy (e.g., seismographs, eyeglasses, telescopes, hearing aids).

Science language students should use:	energy, potential energy, kinetic energy, force, gravity, complex machine, wave, friction, amplitude