

Utah Science Core Curriculum Seventh 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 Seventh 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
---------------------------------------	---

Seventh 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 theme for Seventh Grade Science is **structure**. The concept of density is used to help understand the sorting and distribution of matter on Earth. Seventh graders should begin to relate the structure of matter to the properties of materials. The "Benchmarks" in the seventh grade Core emphasize "structure" as an organizing concept to understand matter. All substances are made of smaller parts and are themselves parts of larger wholes. When parts come together, the whole often has properties that are very different from its parts. Inherited traits are carried on structures called genes. Structure is used to classify plants, animals, rocks, stars, and other things. Classification is a way to give a unique description to all things.

Inquiry

Seventh 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. Seventh 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

Seventh 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 seventh 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 Seventh Grade Science Core objectives expose students to fundamental concepts of genetics; this is an excellent opportunity for students to broaden their understanding of careers in genetics. 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, co-operation, 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 Sciences' *National Science Education Standards* as guides to determine appropriate content and skills.

The Seventh 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 Seventh 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 Precautions

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 microorganisms is crucial 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.

Seventh Grade Integrated Science Core Curriculum

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 (i.e., solid, liquid, gas).
- d. Describe the limitations of using models to represent atoms (e.g., distance between particles in atoms cannot be represented to scale in models, the motion of electrons cannot be described in most models).
- 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 as it relates 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. Formulate and test a hypothesis on the relationship between temperature and motion.
- e. Describe the impact of expansion and contraction of solid materials on the design of buildings, highways, and other structures.

STANDARD II: Students will understand the relationship between properties of matter and Earth's structure.

Objective 1: Examine the effects of density and particle size 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 based on density and particle size (e.g., sorting grains of sand of the same size with different densities, sort materials of different particle size with equal densities).
- d. Relate the sorting of materials that can be observed in streambeds, road cuts, or beaches to the density and particle size of those materials.
- e. Design and conduct an experiment that provides data on the natural sorting 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 models of Earth with accurate and inaccurate attributes.

Science language students should use:	atmosphere, atom, 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 that the organs in an organism are made of cells that have structures and perform specific life functions.

Objective 1: Observe and describe cellular structures and functions.

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

Objective 2: Identify and describe the function and interdependence 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. Relate the structure of an organ to its component parts and the larger system of which it is a part.
- d. Describe how the needs of organisms at the cellular level for food, air, and waste removal are met by tissues and organs (e.g., lungs provide oxygen to cells, kidneys remove wastes from cells).

STANDARD IV: Students will understand that offspring inherit traits that make them more or less suitable to survive in the environment.

Objective 1: 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, fungi, cuttings from house plants).
- d. Compare inherited structural traits of offspring and their parents.

Objective 2: 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 manmade influences (e.g., mimicry in insects, plant hybridization to develop a specific trait, breeding of dairy cows to produce more milk).
- d. Relate the 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, hollow structure of hair insulates animals from hot or cold, dense root structure allows plants to grow in compact soil, fish fins aid fish in moving in water).

Science language students should use:	acquired trait, asexual reproduction, genetics, nucleus, organ, organism, osmosis, system, tissue, inherited trait, offspring, sexual reproduction, cytoplasm, diffusion, 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 V: Students will understand that structure is used to develop classification systems.

Objective 1: Classify based on observable properties.

- a. Categorize nonliving objects based on external structures (e.g., hard, soft).
- b. Compare living, once living, and nonliving 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: Classify organisms using an orderly pattern based upon structure.

- a. Identify types of organisms that are not 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, organism, species
---------------------------------------	--