2020 Colorado Academic Standards

Family and Community Guides

High School

Colorado Academic Standards

Science

To support families, communities, and teachers in realizing the goals of the Colorado Academic Standards (CAS), this guide provides an overview of the learning expectations for preschool. This guide offers some learning experiences students may engage in at school that may also be supported at home.

Science

The science standards for high school build upon the foundation for students to work as scientists by asking testable questions, collecting and analyzing different types of evidence, and by providing rationale for their interpretations through reasoning and/or argumentation. Mastery of these standards will result in students deepening their understanding of science through an application and development of scientific knowledge to the solution of practical problems. Students will experience all three "strands" of the science standards during their secondary years across multiple courses.

Physical Science: Students studying physical science continue to develop their understanding of the four core ideas in the discipline. These ideas include the most fundamental concepts from chemistry and physics, but are intended to leave room for expanded study in upper-level high school courses. The high school evidence outcomes in Physical Science build on the middle school ideas and skills and allow high school students to explain more in-depth phenomena central not only to the physical sciences, but to life and earth and space sciences as well. Students will study content across the following core ideas: (1) Structure and Properties of Matter, (2) Chemical Reactions, (3) Forces and Interactions, (4) Energy, and (5) Waves and Electromagnetic Energy. Students may encounter these standards across a variety of courses, including but not limited to Chemistry, Physics, and Physical Science.

Life Science: Students in high school life science courses will develop an understanding of key concepts that help them make sense of life science. The ideas are building upon students' science understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts from earlier grades. There are five life science topics in high school: 1) Structure and Function, 2) Inheritance and Variation of Traits, 3) Matter and Energy in Organisms and Ecosystems, 4) Interdependent Relationships in Ecosystems, and 5) Natural Selection and Evolution. These include the most fundamental concepts in life science, but are intended to leave room for expanded study in upper-level high school courses. Students may encounter these standards across a variety of courses including, but not limited to Biology and Environmental Science.

Earth and Space Science: Students in high school continue to develop their understanding of the three disciplinary core ideas in the Earth and Space Sciences. The high school evidence outcomes in Earth and Space Science build on the middle school ideas and skills and allow high school students to explain more in-depth phenomena central not only to the earth and space sciences, but to life and physical sciences as well. These evidence outcomes blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing usable knowledge to explain ideas across the science disciplines. Students will study content across the following core ideas: (1) Earth's Place in the Universe, (2) Earth's Systems, (3) Earth and Human Activity. Students may encounter these standards across a variety of courses including, but not limited to Environmental Science and Physics.

Expectations for Students in Physical Science:

- Understand that the sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter.
- Recognize that chemical processes, their rates, their outcomes, and whether or not energy is stored or released can be understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by the properties of elements involved.
- Analyze how strong nuclear interaction in an atom provides the primary force that holds nuclei together. Nuclear processes including fusion, fission, and radioactive decay of unstable nuclei involve changes in nuclear binding energies.
- Explain how Newton's second law and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.
- Recognize that Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them.
- Recognize that energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.
- Understand that energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems, and that although energy cannot be destroyed, it can be converted to less useful forms as it is captured, stored and transferred.
- Explain how force fields (gravitational, electric, and magnetic) contain energy and can transmit energy across space from one object to another.
- Explain how waves have characteristic properties and behaviors, and understand that both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation.
- Understand how multiple technologies that are part of everyday experiences are based on waves and their interactions with matter

Throughout Physical Sciences You May Find Students:

- Using the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy levels of atoms.
- Constructing and revising an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- Refining the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
- Developing models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
- Applying scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
- Planning and conducting an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

- Creating a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- Developing and using a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
- Using mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
- Communicating technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Expectations for Students in Life Science:

- Understand that DNA codes for the complex hierarchical organization of systems that enable life's functions and that growth and division of cells in complex organisms occurs by mitosis, which differentiates specific cell types.
- Recognize that organisms use matter and energy to live and grow, and that organisms interact with the living and nonliving components of the environment to obtain matter and energy. Explain how matter and energy which are necessary for life, are conserved as they move through ecosystems.
- Understand how a complex set of interactions determine how ecosystems respond to disturbances, and how organisms interact in groups to benefit the species.
- Understand how the characteristics of one generation are dependent upon the genetic information inherited from previous generations, and that variation between individual's results from genetic and environmental factors.
- Understand how evidence of common ancestry and diversity between species can be determined by examining variations including genetic, anatomical and physiological differences, and that genetic variation among organisms affects survival and reproduction.
- Recognize that environment influences survival and reproduction of organisms over multiple generations, and that as humans, we have complex interactions with ecosystems and have the ability to influence biodiversity on the planet.

Throughout Life Science You May Find Students:

- Analyzing and interpreting data on genes; demonstrating how DNA processes are the same in all organisms; developing, communicating, and justifying an explanation of how cells form specialized tissues.
- Using a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- Planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- Developing an explanation that shows how ecosystems follow the laws of conservation of matter and energy; analyzing how energy flows through trophic levels (food webs); describing how various cycles work (carbon, nitrogen, phosphorus, and water).
- Using mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

- Evaluating claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Expectations for Students in Earth and Space Science:

- Recognize that all stars, including the sun, undergo stellar evolution, and the study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.
- Develop explanations of and predictions about the motions of orbiting objects are described by the laws of physics.
- Understand that the rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.
- Recognize that Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes, and these effects occur on different time scales, from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.
- Understand that plate tectonics can be viewed as the surface expression of mantle convection, which is driven by heat from radioactive decay within Earth's crust and mantle.
- Explain how the planet's dynamics are greatly influenced by water's unique chemical and physical properties; and how the biosphere and Earth's other systems have many interconnections that cause a continual co-evolution of Earth's surface and life on it.
- Understand the role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.
- Explain how resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.
- Recognize that natural hazards and other geological events have shaped the course of human history at local, regional, and global scales.
- Understand that the sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
- Understand how Global climate models are used to predict future climate change continue to improve our understanding of the impact of human activities on the global climate system.

Throughout Earth and Space Science You May Find Students:

- Developing a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
- Evaluating evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
- Using a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

- Planning and conducting an investigation of the properties of water and its effects on Earth materials and surface processes.
- Evaluating competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- Evaluating or refining a technological solution that reduces impacts of human activities on natural systems.