

Science

Colorado Sample Graduation Competencies and Evidence Outcomes

Science Graduation Competency 1

Physical Science

Students know and understand common properties, forms, and changes in matter and energy.

Elementary School

- a. Describe how mixtures of matter can be separated regardless of how they were created.
- b. Identify and explain different forms of energy, such as light, heat, sound, magnetic, chemical, and electrical.
- c. Observe and explain changes in states of matter (solids, liquids, gases) by heating and cooling.
- d. Describe how forces (such as pushes and pulls) change the speed or direction of motion.

Middle School

- a. Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion.
- b. Distinguish between physical and chemical changes, noting that mass is conserved during any change.
- c. Describe common characteristics and unique properties of different types of waves.
- d. Distinguish among, explain, and apply the relationships among mass, weight, volume, and density.

High School

- a. Use Newton's laws of motion and gravitation to describe the relationships among forces acting on and between objects, their masses, and changes in their motion.
- b. Apply laws of conservation of mass and energy to determine changes in matter through chemical or nuclear reactions.
- c. Quantify and/or experimentally determine various forms of energy, such as mechanical, chemical, electrical, radiant, thermal, and nuclear.



Science Graduation Competency 2

Life Science

Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.

Elementary School

- a. Describe how all organisms, including the human body, have structures and systems with separate functions.
- b. Describe and classify living things by characteristics and differences.
- c. Demonstrate interaction and interdependence between and among living and nonliving components of systems.

Middle School

- a. Analyze how human activities deliberately or inadvertently alter ecosystems and their resiliency.
- b. Explain how organisms reproduce and transmit genetic information (genes) to offspring and how genes influences individuals' traits in the next generation.
- c. Analyze why organisms with certain traits are more likely than others to survive and have offspring in a specific environment.
- d. Describe the function and interactions of atoms, molecules, cells, tissues, organs, and organ systems in the human body.
- e. Use evidence to explain the evolution of organisms over geologic time.
- f. Analyze how changes in environmental conditions can affect the survival of individual organisms, populations, and entire species.
- g. Describe how organisms interact with each other and their environment in various ways that create a flow of energy and cycling of matter in an ecosystem.

High School

- a. Describe how matter is cycled within an ecosystem, including how energy is transformed and eventually exits an ecosystem.
- b. Analyze the size and persistence of populations based on their interactions with each other and on the abiotic factors in an ecosystem.
- c. Describe the interrelated processes of photosynthesis and cellular respiration.
- d. Analyze how cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments.
- e. Analyze evolutionary changes in the heritable characteristics of populations and adaptations to their environment across generations.



Science Graduation Competency 3

Earth Systems Science

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Elementary School

- a. Describe the diversity of renewable and nonrenewable resources provided by Earth and the Sun.
- b. Describe how weather conditions change because of the uneven heating of Earth's surface by the Sun's energy.
- c. Measure differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation
- d. Identify the bodies in the solar system and explain how they orbit the sun.
- e. Analyze the impact of weather and the changing seasons on the environment and organisms such as humans, plants, and other animals
- f. Compare and classify Earth's materials based on their properties.

Middle School

- a. Describe how complex interactions of Earth's atmosphere, land and water, that are driven by energy from the sun result in weather, and how weather can be predicted and described through complex models
- b. Use the relative positions and motions of Earth, Moon, and Sun to explain observable effects such as seasons, eclipses, and Moon phases.
- c. Describe the relationships between major geologic events (such as earthquakes, volcanic eruptions, mid-ocean ridges, and mountain formation) and plate boundaries and plate motions
- d. Use evidence from fossils and successive sedimentation, folding, faulting, and uplifting of layers of sedimentary rock to describe Geologic time.
- e. Describe the distribution and circulation of water on Earth through oceans, glaciers, rivers, ground water, and the atmosphere
- f. Distinguish between renewable, recyclable, and nonrenewable natural resources and how they provide the foundation for human society's physical needs.

High School

- a. Use evidence left from past events to describe inferences about the history of the universe, solar system and Earth.
- b. Describe how Earth interacts with various forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways.
- c. Use the theory of plate tectonics to explain geological, physical, and geographical features of Earth.
- d. Analyze the transfer of energy through the atmosphere, hydrosphere, geosphere, and biosphere to explain different climates.
- e. Construct an argument regarding the costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.
- f. Analyze the local, national and global impacts of natural hazards such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms.



Science Graduation Competency 4

Questioning and Investigation

Students can develop and use relevant scientific questions to investigate phenomena, test a hypothesis, conduct an experiment or solve a problem.

Elementary School

- a. Develop questions from observations, phenomena, prior knowledge and data.
- b. Make predictions about phenomena based on observations, prior knowledge, and data.
- c. Test predictions using a clear process.

Middle School

- a. Construct questions to determine cause/effect relationships between variables.
- b. Develop testable questions into hypotheses in order to conduct an experiment or solve a problem.
- c. Plan an investigation using an experimental design that fits hypothesis and goals and will produce evidence.
- d. Select and use appropriate tools, laboratory equipment and techniques to gather data and make observations.

High School

- a. Ask questions to clarify an explanation, challenge a scientific argument or refine a model or design.
- b. Evaluate questions based on relevance, usefulness, and specificity.
- c. Formulate a testable hypothesis for an investigation that demonstrates relationships between variables and connections to scientific concepts.
- d. Conduct investigations safely and ethically, using appropriate protocols.
- e. Evaluate and refine experiments and design solutions as needed to improve reliability and relevance.



Science Graduation Competency 5

Modeling and Data Analysis

Students can analyze and interpret scientific data and construct and use models to represent and analyze phenomena and systems.

Elementary School

- a. Compare and contrast data sets to examine consistency of measurement and observations.
- b. Demonstrate patterns and relationships in data sets by constructing representations through graphical displays.

Middle School

- a. Analyze data using tools, technologies and/or mathematical models in order to make valid and reliable scientific claims and predictions.
- b. Analyze and interpret data sets by applying concepts of statistics and probability.
- c. Design and use scientific models to represent, explain and predict scientific phenomena.

High School

- a. Apply a range of mathematical techniques and computations, including limitations, to make sense and interpret data.
- b. Design and use models to represent and predict interactions between natural and designed systems or between components of a system.
- c. Develop and use multiple types of models to represent similar phenomena or systems.
- d. Evaluate and refine scientific models based on evidence, limitations and reliability.

Science Graduation Competency 6



Explanation & Argumentation

Students can develop, evaluate and critique scientific claims/explanations, arguments and solutions based on evidence from the natural and designed world.

Elementary School

- a. Construct a scientific claim/explanation that describes phenomena.

Middle School

- a. Construct a scientific claim/explanation that describes phenomena or relationships between variables.
- b. Apply both scientific ideas and data from evidence to explain phenomena, results and issues of credibility, bias and validity.

High School

- a. Evaluate solutions to complex, real-world problems based on evidence and design criteria.
- b. Construct and present oral and written arguments supported by a variety of evidence and scientific reasoning to defend or refute scientific claims/explanations.
- c. Critique and evaluate arguments and rebuttals for a scientific topic based on appropriate criteria.

