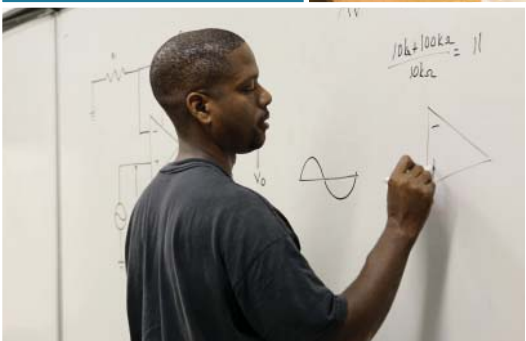
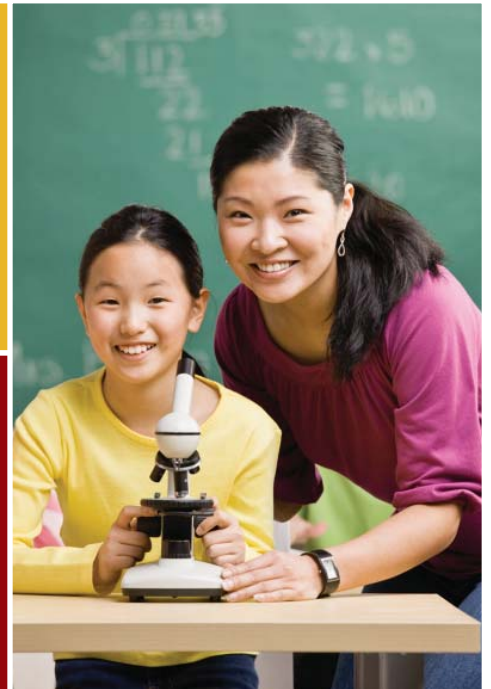


Colorado Academic STANDARDS

Sixth Grade

Science



Colorado Academic Standards Science

"Science is facts; just as houses are made of stone, so is science made of facts; but a pile of stones is not a house, and a collection of facts is not necessarily science." --*Jules Henri Poincaré (1854-1912) French mathematician.*

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High expectations in education are essential for the U.S. to continue as a world leader in the 21<sup>st</sup> century. In order to be successful in postsecondary education, the workforce, and in life, students need a rigorous, age-appropriate set of standards that include finding and gathering information, critical thinking, and reasoning skills to evaluate information, and use information in social and cultural contexts. Students must learn to comprehend and process information, analyze and draw conclusions, and apply the results to everyday life.

A quality science education embodies 21<sup>st</sup> century skills and postsecondary and workforce readiness by teaching students critical skills and thought processes to meet the challenges of today's world. Scientifically literate graduates will help to ensure Colorado's economic vitality by encouraging the development of research and technology, managing and preserving our environmental treasures, and caring for the health and well-being of our citizens.

Science is both a body of knowledge that represents the current understanding of natural systems, and the process whereby that body of knowledge has been established and is continually extended, refined, and revised. Because science is both the knowledge of the natural world and the processes that have established this knowledge, science education must address both of these aspects.

At a time when pseudo-scientific ideas and outright fraud are becoming more common place, developing the skepticism and critical thinking skills of science gives students vital skills needed to make informed decisions about their health, the environment, and other scientific issues facing society. A major aspect of science is the continual interpretation of evidence. All scientific ideas constantly are being challenged by new evidence and are evolving to fit the new evidence. Students must understand the collaborative social processes that guide these changes so they can reason through and think critically about popular scientific information, and draw valid conclusions based on evidence, which often is limited. Imbedded in the cognitive process, students learn and apply the social and cultural skills expected of all citizens in school and in the workplace. For example, during class activities, laboratory exercises, and projects, students learn and practice self-discipline, collaboration, and working in groups.

The Colorado Academic Standards in science represent what all Colorado students should know and be able to do in science as a result of their preschool through twelfth-grade science education. Specific expectations are given for students who complete each grade from preschool through eighth grade and for high school. These standards outline the essential level of science content knowledge and the application of the skills needed by all Colorado citizens to participate productively in our increasingly global, information-driven society.

## Standards Organization and Construction

As the subcommittee began the revision process to improve the existing standards, it became evident that the way the standards information was organized, defined, and constructed needed to change from the existing documents. The new design is intended to provide more clarity and direction for teachers, and to show how 21<sup>st</sup> century skills and the elements of school readiness and postsecondary and workforce readiness indicators give depth and context to essential learning.

The “Continuum of State Standards Definitions” section that follows shows the hierarchical order of the standards components. The “Standards Template” section demonstrates how this continuum is put into practice.

The elements of the revised standards are:

**Prepared Graduate Competencies:** The preschool through twelfth-grade concepts and skills that all students who complete the Colorado education system must master to ensure their success in a postsecondary and workforce setting.

**Standard:** The topical organization of an academic content area.

**High School Expectations:** The articulation of the concepts and skills of a standard that indicates a student is making progress toward being a prepared graduate. *What do students need to know in high school?*

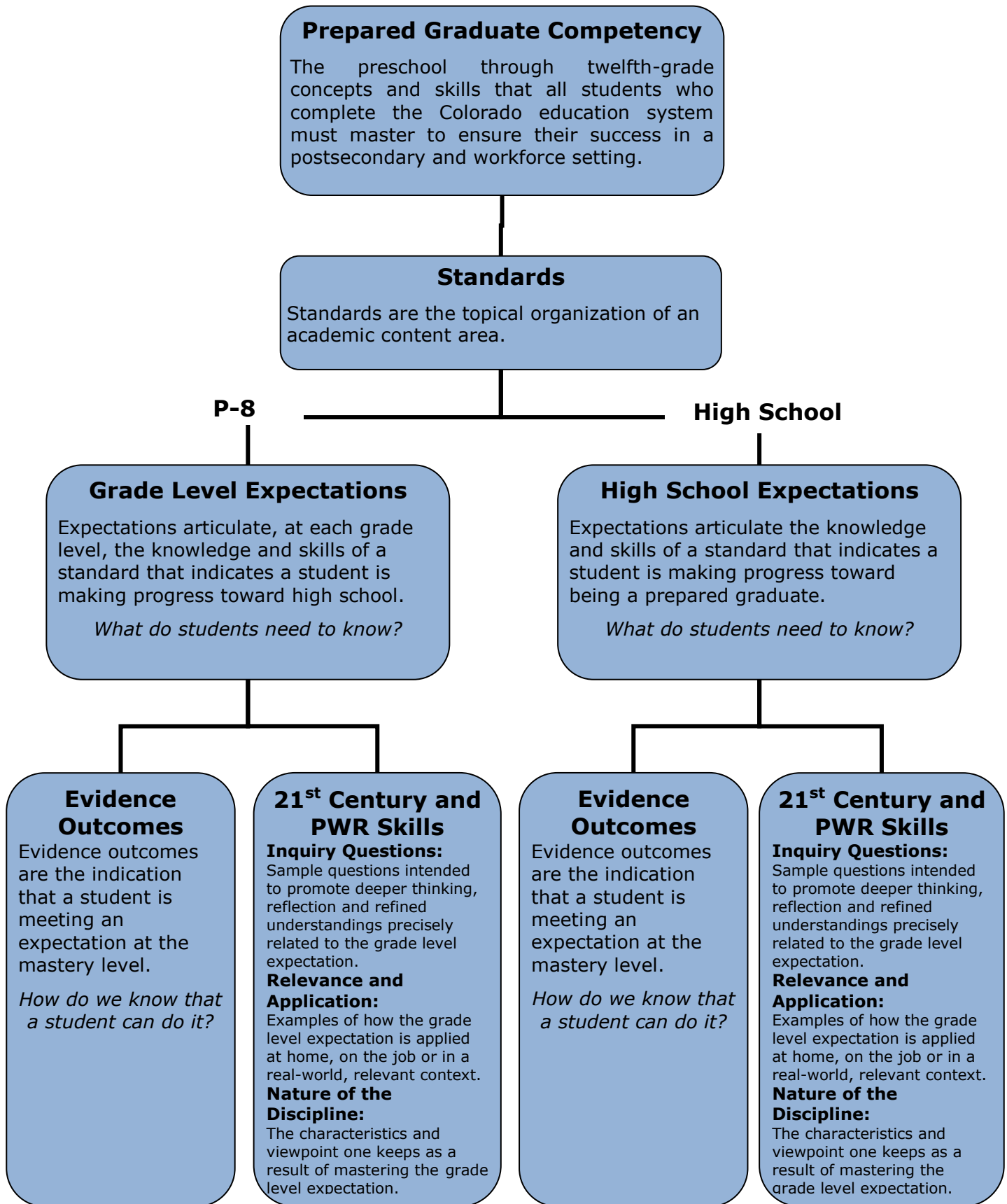
**Grade Level Expectations:** The articulation (at each grade level), concepts, and skills of a standard that indicate a student is making progress toward being ready for high school. *What do students need to know from preschool through eighth grade?*

**Evidence Outcomes:** The indication that a student is meeting an expectation at the mastery level. *How do we know that a student can do it?*

**21<sup>st</sup> Century Skills and Readiness Competencies:** Includes the following:

- ***Inquiry Questions:***  
Sample questions are intended to promote deeper thinking, reflection and refined understandings precisely related to the grade level expectation.
- ***Relevance and Application:***  
Examples of how the grade level expectation is applied at home, on the job or in a real-world, relevant context.
- ***Nature of the Discipline:***  
The characteristics and viewpoint one keeps as a result of mastering the grade level expectation.

# Continuum of State Standards Definitions



## STANDARDS TEMPLATE

**Content Area: NAME OF CONTENT AREA**

**Standard:** The topical organization of an academic content area.

**Prepared Graduates:**

- The preschool through twelfth-grade concepts and skills that all students who complete the Colorado education system must master to ensure their success in a postsecondary and workforce setting.

### High School and Grade Level Expectations

**Concepts and skills students master:**

Grade Level Expectation: High Schools: The articulation of the concepts and skills of a standard that indicates a student is making progress toward being a prepared graduate.

Grade Level Expectations: The articulation, at each grade level, the concepts and skills of a standard that indicates a student is making progress toward being ready for high school.

*What do students need to know?*

**Evidence Outcomes**

**Students can:**

Evidence outcomes are the indication that a student is meeting an expectation at the mastery level.

*How do we know that a student can do it?*

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

Sample questions intended to promote deeper thinking, reflection and refined understandings precisely related to the grade level expectation.

**Relevance and Application:**

Examples of how the grade level expectation is applied at home, on the job or in a real-world, relevant context.

**Nature of the Discipline:**

The characteristics and viewpoint one keeps as a result of mastering the grade level expectation.

## Prepared Graduate Competencies in Science

The preschool through twelfth-grade concepts and skills that all students who complete the Colorado education system must master to ensure their success in a postsecondary and workforce setting.

Prepared Graduates:

- Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects
- Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions
- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable
- Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection
- Explain and illustrate with examples how living systems interact with the biotic and abiotic environment
- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment
- Explain how biological evolution accounts for the unity and diversity of living organisms
- Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet
- Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system
- Describe how humans are dependent on the diversity of resources provided by Earth and Sun

## Standards in Science

Standards are the topical organization of an academic content area. The three standards of science are:

**1. Physical Science**

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

**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.

**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.

## Science Grade Level Expectations at a Glance

| Standard                 | Grade Level Expectation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sixth Grade</b>       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 1. Physical Science      | <ol style="list-style-type: none"> <li>1. All matter is made of atoms, which are far too small to see directly through a light microscope. Elements have unique atoms and thus, unique properties. Atoms themselves are made of even smaller particles</li> <li>2. Atoms may stick together in well-defined molecules or be packed together in large arrangements. Different arrangements of atoms into groups compose all substances.</li> <li>3. The physical characteristics and changes of solid, liquid, and gas states can be explained using the particulate model</li> <li>4. Distinguish among, explain, and apply the relationships among mass, weight, volume, and density</li> </ol> |
| 2. Life Science          | <ol style="list-style-type: none"> <li>1. Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species</li> <li>2. Organisms interact with each other and their environment in various ways that create a flow of energy and cycling of matter in an ecosystem</li> </ol>                                                                                                                                                                                                                                                                                                                                                                |
| 3. Earth Systems Science | <ol style="list-style-type: none"> <li>1. Complex interrelationships exist between Earth's structure and natural processes that over time are both constructive and destructive</li> <li>2. Water on Earth is distributed and circulated through oceans, glaciers, rivers, ground water, and the atmosphere</li> <li>3. Earth's natural resources provide the foundation for human society's physical needs. Many natural resources are nonrenewable on human timescales, while others can be renewed or recycled</li> </ol>                                                                                                                                                                     |

## **21<sup>st</sup> Century Skills and Readiness Competencies in Science**

### **Colorado's Description of 21st Century Skills**

Colorado's description of 21st century skills is a synthesis of the essential abilities students must apply in our rapidly changing world. Today's students need a repertoire of knowledge and skills that are more diverse, complex, and integrated than any previous generation. These skills do not stand alone in the standards, but are woven into the evidence outcomes, inquiry questions, and application and are within the nature of science. Science inherently demonstrates each of Colorado's 21<sup>st</sup> century skills, as follows:

#### Critical Thinking and Reasoning

Science requires students to analyze evidence and draw conclusions based on that evidence. Scientific investigation involves defining problems and designing studies to test hypotheses related to those problems. In science, students must justify and defend scientific explanations and distinguish between correlation and causation.

#### Information Literacy

Understanding science requires students to research current ideas about the natural world. Students must be able to distinguish fact from opinion and truth from fantasy. Science requires a degree of skepticism because the ideas of science are subject to change. Science students must be able to understand what constitutes reliable sources of information and how to validate those sources. One key to science is understanding that converging different lines of evidence from multiple sources strengthens a scientific conclusion.

#### Collaboration

Science students must be able to listen to others' ideas, and engage in scientific dialogs that are based on evidence – not opinion. These types of conversations allow them to compare and evaluate the merit of different ideas. The peer review process helps to ensure the validity of scientific explanations.

#### Self-Direction

Students in science must have persistence and perseverance when exploring scientific concepts. Students must generate their own questions, and design investigations to find the answers. Students must be open to revising and redefining their thinking based on evidence.

#### Invention

Designing investigations and engineering new products involves a large degree of invention. Scientists and engineers often have to think "outside the box" as they push the limits of our current knowledge. They must learn from their failures to take the next steps in understanding. Science students also must integrate ideas from multiple disciplines to formulate an understanding of the natural world. In addition to using invention to design investigations, scientists also use findings from investigations to help them to invent new products.



## **Colorado’s Description for School Readiness**

*(Adopted by the State Board of Education, December 2008)*

School readiness describes both the preparedness of a child to engage in and benefit from learning experiences, and the ability of a school to meet the needs of all students enrolled in publicly funded preschools or kindergartens. School readiness is enhanced when schools, families, and community service providers work collaboratively to ensure that every child is ready for higher levels of learning in academic content.

## **Colorado’s Description of Postsecondary and Workforce Readiness**

*(Adopted by the State Board of Education, June 2009)*

Postsecondary and workforce readiness describes the knowledge, skills, and behaviors essential for high school graduates to be prepared to enter college and the workforce and to compete in the global economy. The description assumes students have developed consistent intellectual growth throughout their high school career as a result of academic work that is increasingly challenging, engaging, and coherent. Postsecondary education and workforce readiness assumes that students are ready and able to demonstrate the following without the need for remediation: Critical thinking and problem-solving; finding and using information/information technology; creativity and innovation; global and cultural awareness; civic responsibility; work ethic; personal responsibility; communication; and collaboration.

## **How These Skills and Competencies are Embedded in the Revised Standards**

Three themes are used to describe these important skills and competencies and are interwoven throughout the standards: *inquiry questions; relevance and application; and the nature of each discipline*. These competencies should not be thought of stand-alone concepts, but should be integrated throughout the curriculum in all grade levels. Just as it is impossible to teach thinking skills to students without the content to think about, it is equally impossible for students to understand the content of a discipline without grappling with complex questions and the investigation of topics.

**Inquiry Questions** – Inquiry is a multifaceted process requiring students to think and pursue understanding. Inquiry demands that students (a) engage in an active observation and questioning process; (b) investigate to gather evidence; (c) formulate explanations based on evidence; (d) communicate and justify explanations, and; (e) reflect and refine ideas. Inquiry is more than hands-on activities; it requires students to cognitively wrestle with core concepts as they make sense of new ideas.

**Relevance and Application** – The hallmark of learning a discipline is the ability to apply the knowledge, skills, and concepts in real-world, relevant contexts. Components of this include solving problems, developing, adapting, and refining solutions for the betterment of society. The application of a discipline, including how technology assists or accelerates the work, enables students to more fully appreciate how the mastery of the grade level expectation matters after formal schooling is complete.

**Nature of Discipline** – The unique advantage of a discipline is the perspective it gives the mind to see the world and situations differently. The characteristics and viewpoint one keeps as a result of mastering the grade level expectation is the nature of the discipline retained in the mind’s eye.

# 1. Physical Science

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

## Prepared Graduates

The preschool through twelfth-grade concepts and skills that all students who complete the Colorado education system must master to ensure their success in a postsecondary and workforce setting.

### Prepared Graduate Competencies in the Physical Science standard:

- Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects
- Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions
- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

## Content Area: Science

### Standard: 1. Physical Science

#### Prepared Graduates:

- Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

#### Grade Level Expectation: Sixth Grade

##### Concepts and skills students master:

1. All matter is made of atoms, which are far too small to see directly through a light microscope. Elements have unique atoms and thus, unique properties. Atoms themselves are made of even smaller particles

#### Evidence Outcomes

#### 21<sup>st</sup> Century Skills and Readiness Competencies

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Students can:</b></p> <ol style="list-style-type: none"> <li>Identify evidence that suggests there is a fundamental building block of matter (DOK 1)</li> <li>Use the particle model of matter to illustrate characteristics of different substances (DOK 1-2)</li> <li>Develop an evidence based scientific explanation of the atomic model as the foundation for all chemistry (DOK 1-3)</li> <li>Find and evaluate appropriate information from reference books, journals, magazines, online references, and databases to compare and contrast historical explanations for the nature of matter (DOK 1-2)</li> </ol> | <p><b>Inquiry Questions:</b></p> <ol style="list-style-type: none"> <li>In the world of science what makes something a building block?</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p><b>Relevance and Application:</b></p> <ol style="list-style-type: none"> <li>Living things consist of the same matter as the rest of the universe.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p><b>Nature of Science:</b></p> <ol style="list-style-type: none"> <li>Work in groups using the writing process to effectively communicate an understanding of the particle model of matter. (DOK 1-2)</li> <li>Use technology to share research findings about historical explanations for the nature of matter and to publish information to various audiences. (DOK 1-2)</li> <li>Create models that explain the particle theory of matter. (DOK 2-3)</li> <li>Recognize and describe the ethical traditions of science: value peer review, truthful reporting of methods and outcomes, making work public, and sharing a lens of professional skepticism when reviewing others work.</li> </ol> |

**Content Area: Science**

**Standard: 1. Physical Science**

**Prepared Graduates:**

- Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

**Grade Level Expectation: Sixth Grade**

**Concepts and skills students master:**

- 2. Atoms may stick together in well-defined molecules or be packed together in large arrays. Different arrangements of atoms into groups compose all substances

**Evidence Outcomes**

**Students can:**

- a. Explain the similarities and differences between elements and compounds (DOK 1-2)
- b. Identify evidence suggesting that atoms form into molecules with different properties than their components (DOK 1-2)
- c. Find and evaluate information from a variety of resources about molecules (DOK 1-2)

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

- 1. Why do substances behave differently? For example, why does water pour rapidly while syrup pours slowly?

**Relevance and Application:**

- 1. Different arrangements of atoms provide different properties.
- 2. Very small devices consist of large numbers of arranged groups of atoms that perform a specific function.

**Nature of Science:**

- 1. Use models and/or electronic media to show and understand how molecules are made of atoms. (DOK 1-2)
- 2. Investigate how our current understanding of matter has developed through centuries of scientific investigations. (DOK 2-3)

**Content Area: Science**

**Standard: 1. Physical Science**

**Prepared Graduates:**

- Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

**Grade Level Expectation: Sixth Grade**

**Concepts and skills students master:**

- 3. The physical characteristics and changes of solid, liquid, and gas states can be explained using the particulate model

**Evidence Outcomes**

**Students can:**

- a. Explain how the arrangement and motion of particles in a substance such as water determine its state (DOK 1-2)
- b. Distinguish between changes in temperature and changes of state using the particle model of matter (DOK 1-2)

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

- 1. What determines whether matter is in the form of a solid, liquid, or gas?
- 2. What is the kinetic molecular theory, and how does temperature affect the behavior of particles in a gas?

**Relevance and Application:**

- 1. Solids, liquids, and gasses all have unique properties that make them useful in different situations. For example, solids are useful building materials.

**Nature of Science:**

- 1. Use models and technology tools to help visualize what is happening at the molecular level during phase changes. (DOK 1-2)
- 2. Understand and apply the difference between scientific laws, theories and hypotheses. (DOK 1-2)
- 3. Work in groups using the writing process to communicate an understanding how the particle model of matter explains various states of matter. (DOK 1-2)

**Content Area: Science**

**Standard: 1. Physical Science**

**Prepared Graduates:**

- Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

**Grade Level Expectation: Sixth Grade**

**Concepts and skills students master:**

4. Distinguish among, explain, and apply the relationships among mass, weight, volume, and density

**Evidence Outcomes**

**Students can:**

- Explain that the mass of an object does not change, but its weight changes based on the gravitational forces acting upon it (DOK 1)
- Predict how changes in acceleration due to gravity will affect the mass and weight of an object (DOK 1-2)
- Predict how mass, weight, and volume affect density (DOK 1-2)
- Measure mass and volume, and use these quantities to calculate density (DOK 1)
- Use tools to gather, view, analyze, and report results for scientific investigations about the relationships among mass, weight, volume, and density (DOK 1-2)

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

- Which of the following is the best recommendation for a person trying to lose weight and why?
  - Reduce the number of calories he or she eats.
  - Exercise more.
  - Go to the Moon.
- If weight and mass are not the same thing, why might people use the words interchangeably?
- Describe a situation in which mass would be the most useful information to know about an object? Do the same for weight, volume, and density.

**Relevance and Application:**

- Mass, weight, and gravitational forces are critical for space travel, future visits to outer space, and possibly the colonization of places like the Moon or Mars.

**Nature of Science:**

- Calculate the density of a sample, predict its ability to float or sink in a liquid of known density, design and perform the experiment, and justify discrepancies in the experimental outcome. (DOK 1-4)
- Ask testable questions and make a falsifiable hypothesis about density and design an inquiry based method to find an answer. (DOK 2-4)
- Select proper tools to measure the mass and volume of an object and use appropriate units. (DOK 1-2)

## 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.

### **Prepared Graduates**

The preschool through twelfth-grade concepts and skills that all students who complete the Colorado education system must master to ensure their success in a postsecondary and workforce setting.

#### **Prepared Graduate Competencies in the Life Science standard:**

- Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection
- Explain and illustrate with examples how living systems interact with the biotic and abiotic environment
- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment
- Explain how biological evolution accounts for the unity and diversity of living organisms

**Content Area: Science**  
**Standard: 2. Life Science**

**Prepared Graduates:**

- Explain and illustrate with examples how living systems interact with the biotic and abiotic environment

**Grade Level Expectation: Sixth Grade**

**Concepts and skills students master:**

1. Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species

**Evidence Outcomes**

**Students can:**

- a. Interpret and analyze data about changes in environmental conditions – such as climate change – and populations that support a claim describing why a specific population might be increasing or decreasing
- b. Develop, communicate, and justify an evidence-based explanation about how ecosystems interact with and impact the global environment (DOK 1-3)
- c. Model equilibrium in an ecosystem, including basic inputs and outputs, to predict how a change to that ecosystem such as climate change might impact the organisms, populations, and species within it such as the removal of a top predator or introduction of a new species
- d. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate how environmental conditions affect the survival of individual organisms (DOK 1-2)

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

1. How do ecosystem changes affect biodiversity?
2. How does biodiversity contribute to an ecosystem’s equilibrium?

**Relevance and Application:**

1. The development and application of technologies intended to aid some populations and ecosystems.

**Nature of Science:**

1. Ask testable questions and make a falsifiable hypothesis about how environmental conditions affect organisms, populations, or entire species and design a method to find the answer. (DOK 2-4)
2. Recognize and describe the ethical traditions of science: value peer review; truthful reporting of methods and outcomes; making work public; and sharing a lens of professional skepticism when reviewing the work of others.
3. Use models and technology tools to show what might happen to individuals, populations, and species as environmental conditions change. (DOK 1-2)



**Content Area: Science**  
**Standard: 2. Life Science**

**Prepared Graduates:**

- Explain and illustrate with examples how living systems interact with the biotic and abiotic environment

**Grade Level Expectation: Sixth Grade**

**Concepts and skills students master:**

2. Organisms interact with each other and their environment in various ways that create a flow of energy and cycling of matter in an ecosystem

**Evidence Outcomes**

**Students can:**

- a. Develop, communicate, and justify an evidence-based explanation about why there generally are more producers than consumers in an ecosystem (DOK 1-3)
- b. Design a food web diagram to show the flow of energy through an ecosystem (DOK 1-2)
- c. Compare and contrast the flow of energy with the cycling of matter in ecosystems (DOK 2)

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

1. How do different ecosystems cycle matter differently?
2. What "jobs" do organisms do to facilitate the flow of energy and cycling of matter?

**Relevance and Application:**

1. Humans use an understanding of the cycling of matter and energy to help mitigate environmental problems. For example, they treat waste water and clean up oil spills.

**Nature of Science:**

1. Scientists work from the assumption that the universe is a single system in which the basic rules are the same everywhere – that energy follows the same rules in an ecosystem as it does in physics experiments. (DOK 1)
2. Generate solutions to help mitigate environmental problems based on an understanding of the cycling of matter and energy. (DOK 2-4)
3. Create and evaluate models that show how interactions create a flow of energy and a cycling of matter in an ecosystem. (DOK 2-3)

# 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.

## **Prepared Graduates:**

The preschool through twelfth-grade concepts and skills that all students who complete the Colorado education system must master to ensure their success in a postsecondary and workforce setting.

### **Prepared Graduate Competencies in the Earth Systems Science standard:**

- Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet
- Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system
- Describe how humans are dependent on the diversity of resources provided by Earth and Sun

**Content Area: Science**

**Standard: 3. Earth Systems Science**

**Prepared Graduates:**

- Evaluate evidence that Earth’s geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system

**Grade Level Expectation: Sixth Grade**

**Concepts and skills students master:**

1. Complex interrelationships exist between Earth’s structure and natural processes that over time are both constructive and destructive

| <b>Evidence Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>21<sup>st</sup> Century Skills and Readiness Competencies</b>                                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Students can:</b></p> <ol style="list-style-type: none"><li>a. Gather, analyze, and communicate an evidence-based explanation for the complex interaction between Earth’s constructive and destructive forces (DOK 2-3)</li><li>b. Gather, analyze and communicate evidence form text and other sources that explains the formation of Earth’s surface features (DOK 1-3)</li><li>c. Use a computer simulation for Earth’s changing crust (DOK 1-2)</li></ol> | <p><b>Inquiry Questions:</b></p> <ol style="list-style-type: none"><li>1. How do forces inside Earth and on the surface build, destroy, and change Earth’s crust?</li><li>2. How does Earth's surface change over time?</li></ol>                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p><b>Relevance and Application:</b></p> <ol style="list-style-type: none"><li>1. There are costs and benefits to building in areas that are prone to constructive and destructive forces such as earthquakes and landslides.</li><li>2. Harbors, glaciers, and geysers change over time based on geologic and natural events.</li></ol>             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p><b>Nature of Science:</b></p> <ol style="list-style-type: none"><li>1. Practice the collaborative inquiry process that scientists use to identify local evidence of Earth’s constructive and destructive processes. (DOK 2-3)</li><li>2. Create and compare models that show how natural processes affect Earth’s structures. (DOK 2-3)</li></ol> |

**Content Area: Science**

**Standard: 3. Earth Systems Science**

**Prepared Graduates:**

- Describe how humans are dependent on the diversity of resources provided by Earth and Sun

**Grade Level Expectation: Sixth Grade**

**Concepts and skills students master:**

- 2. Water on Earth is distributed and circulated through oceans, glaciers, rivers, ground water, and the atmosphere

**Evidence Outcomes**

**Students can:**

- a. Gather and analyze data from a variety of print resources and investigations to account for local and world-wide water circulation and distribution patterns (DOK 1-3)
- b. Use evidence to model how water is transferred throughout the earth (DOK 1-3)
- c. Identify problems, and propose solutions related to water quality, circulation, and distribution – both locally and worldwide (DOK 1-4)
- d. Identify the various causes and effects of water pollution in local and world water distributions (DOK 1-2)
- e. Describe where water goes after it is used in houses or buildings (DOK 1-2)

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

- 1. How is water cycled on Earth?
- 2. How does the lack or abundance of water impact human civilizations and populations?
- 3. How do your daily decisions impact the quality of water in the water cycle?

**Relevance and Application:**

- 1. Home water quality and consumption affects for health and conservation policies.
- 2. Water systems affect local, regional, and world population development.
- 3. Water-use irrigation patterns in Colorado affect economic development in the state.

**Nature of Science:**

- 1. Ask testable questions and make falsifiable hypotheses research about water distribution. (DOK 2)
- 2. Create and evaluate models; identifying the strengths and weaknesses of the model in representing water circulation and distribution. (DOK 2-3)

**Content Area: Science**

**Standard: 3. Earth Systems Science**

**Prepared Graduates:**

- Describe how humans are dependent on the diversity of resources provided by Earth and Sun

**Grade Level Expectation: Sixth Grade**

**Concepts and skills students master:**

- 3. Earth’s natural resources provide the foundation for human society’s physical needs. Many natural resources are nonrenewable on human timescales, while others can be renewed or recycled

**Evidence Outcomes**

**Students can:**

- a. Research and evaluate data and information to learn about the types and availability of various natural resources, and use this knowledge to make evidence-based decisions (DOK 2-3)
- b. Identify and evaluate types and availability of renewable and nonrenewable resources (DOK 1-2)
- c. Use direct and indirect evidence to determine the types of resources and their applications used in communities (DOK 1-2)
- d. Research and critically evaluate data and information about the advantages and disadvantages of using fossil fuels and alternative energy sources (DOK 2-3)

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

- 1. What resources are found and used in our community?
- 2. How can natural resources be identified and classified?
- 3. How can we make responsible choices about the resources we use on a daily basis?

**Relevance and Application:**

- 1. Natural resources come from a variety of locations and have to be mined or harvested, depending on the type.
- 2. A resource can be used in a variety of ways, depending on the product being made. For example plastics, textiles, medications, and fertilizers are produced from petroleum.
- 3. Resources in Colorado directly affect the state economy and society by providing employment and sources of revenue.

**Nature of Science:**

- 1. Recognize and describe the ethical traditions of science: value peer review; truthful reporting of methods and outcomes; making work public; and sharing a lens of professional skepticism when reviewing the work of others.

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