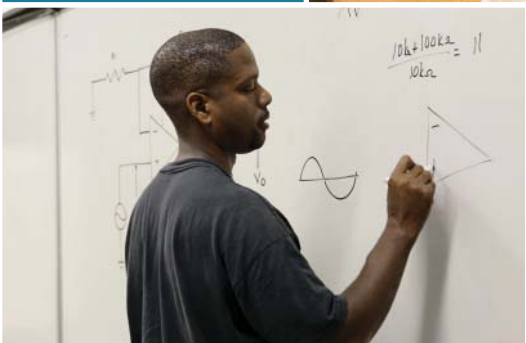


Colorado Academic STANDARDS

Fifth 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?*

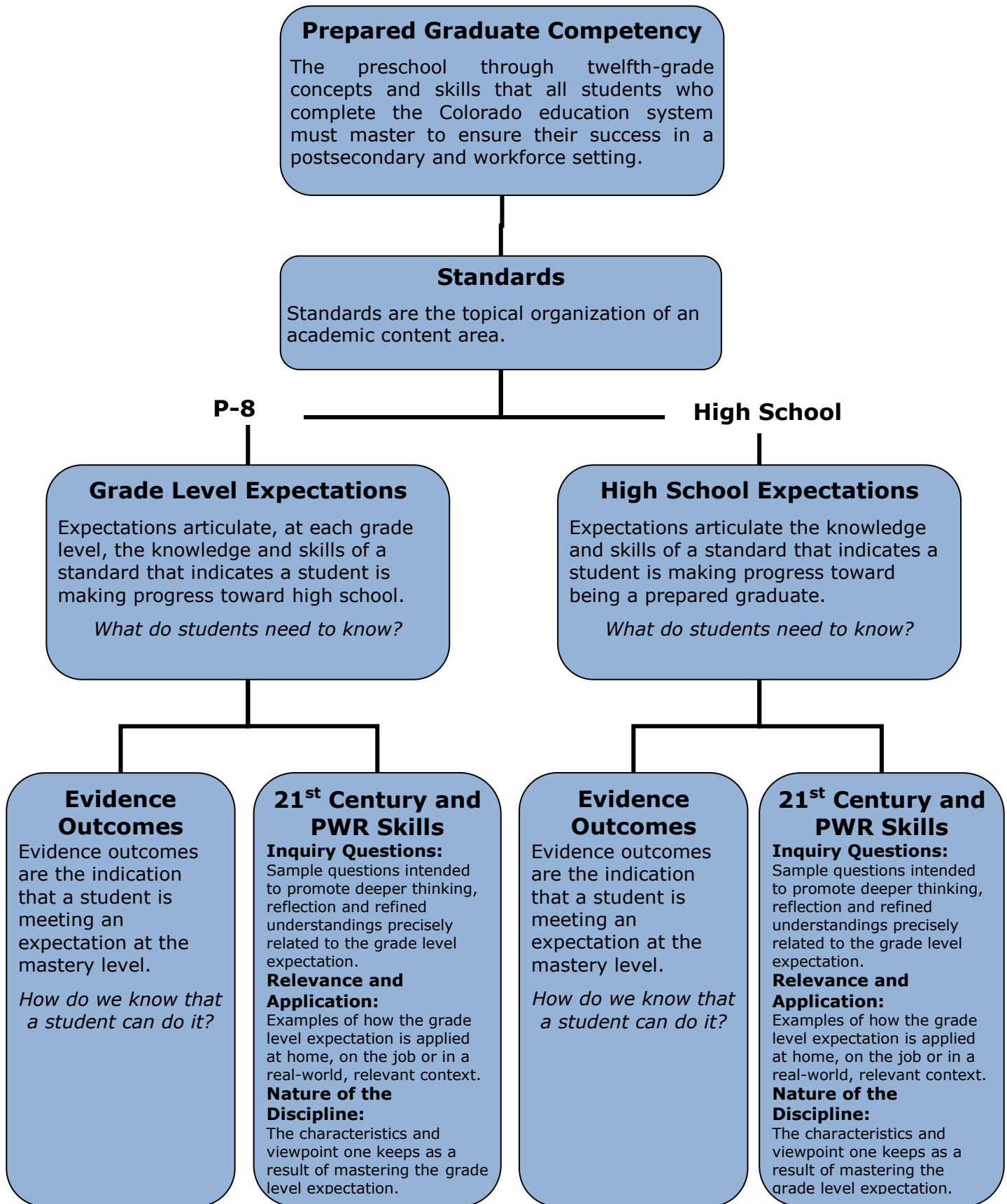
**Grade Level Expectations:** The articulation (at each grade level), concepts, and skills of a standard that indicate a student is making progress toward being ready for high school. *What do students need to know from preschool through eighth grade?*

**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>Fifth Grade</b>       |                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1. Physical Science      | 1. Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts                                                                                                                                                                                                                                     |
| 2. Life Science          | 1. All organisms have structures and systems with separate functions<br>2. Human body systems have basic structures, functions, and needs                                                                                                                                                                                                                                                                  |
| 3. Earth Systems Science | 1. Earth and sun provide a diversity of renewable and nonrenewable resources<br>2. Earth's surface changes constantly through a variety of processes and forces<br>3. Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation |

## **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: Fifth Grade**

**Concepts and skills students master:**

1. Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts

**Evidence Outcomes**

**Students can:**

- a. Develop, communicate, and justify a procedure to separate simple mixtures based on physical properties (DOK 1-3)
- b. Share evidence-based conclusions and an understanding of the impact on the weight/mass of a liquid or gas mixture before and after it is separated into parts (DOK 1-3)

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

**Inquiry Questions:**

1. How do mixtures act similarly and differently from their original materials?
2. What are some ways that mixtures can be separated?

**Relevance and Application:**

1. Knowing properties helps determine how to separate mixtures.
2. Mixtures make up Earth's layers. For example, rocks are mixtures of minerals, and minerals are mixtures of elements and compounds.

**Nature of Science:**

1. Ask testable questions about mixtures, make a falsifiable hypothesis, design an inquiry based method of finding the answer, collect data, and form a conclusion. (DOK 2-4)
2. Select appropriate tools to conduct an experiment, use them correctly, and report the data in proper units. (DOK 1-2)
3. Share results of experiments with others and respectfully discuss results that are not expected. (DOK 2-3)
4. Review and analyze information presented by peers and provide feedback on their evidence and scientific reasoning about the separation of mixtures and how the separation impacts its total weight/mass. (DOK 2-3)

## 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:**

- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment

**Grade Level Expectation: Fifth Grade**

**Concepts and skills students master:**

1. All organisms have structures and systems with separate functions

**Evidence Outcomes**

**Students can:**

- a. Develop and communicate an evidence-based scientific explanation of the role of different organs or structures that are important for an organism’s survival – in both plants and animals (DOK 1-3)
- b. Analyze and interpret data to generate evidence that all organisms have structures that are required for survival in both plants and animals (DOK 1-2)
- c. Create and evaluate models of plant and/or animal systems or parts (DOK 2-3)

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

**Inquiry Questions:**

1. How do plants and animals carry out processes necessary for life?
2. What different structures do plants and animals use to carry out the same functions?
3. What adaptations or characteristics help humans survive?

**Relevance and Application:**

1. Different organism structures are adapted to different functions to ensure survival, and humans often manipulate these different structures for their own uses such as making building materials, food, and medicines.
2. Humans have long exploited animals and plants through fishing, herding, and agriculture in order to manage them as renewable food resources.
3. There are tools and materials – such as Velcro – made by humans that were inspired by animal or plant adaptations.

**Nature of Science:**

1. Review and analyze information presented by peers and provide feedback on their evidence regarding the importance of various structures to plants and animals. (DOK 2-3)

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

**Prepared Graduates:**

- Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection

**Grade Level Expectation: Fifth Grade**

**Concepts and skills students master:**

2. Human body systems have basic structures, functions, and needs

**Evidence Outcomes**

**Students can:**

- a. Develop and communicate an evidence-based scientific explanation regarding how humans address basic survival needs (DOK 1-3)
- b. Analyze and interpret data to generate evidence that human systems are interdependent (DOK 1-2)
- c. Assess further scientific explanations regarding basic human body system functions (DOK 1-3)
- d. Create and evaluate models of human body systems and organs (DOK 2-3)
- e. Compare and contrast a human system to that of another organism, and provide hypotheses about why the similarities and differences exist (DOK 2-3)

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

**Inquiry Questions:**

1. How are human body systems similar to and different from those found in other organisms?
2. How are organs impacted when different body systems fail to work correctly?

**Relevance and Application:**

1. People can create goals about their own lifestyle such as exercising every day and eating healthy foods based on an understanding of human body systems.
2. Societal norms and practices that are intended to protect our health such as wearing a bicycle helmet can be based on scientific evidence.

**Nature of Science:**

1. Review and analyze information presented by peers on the structure and function of the human body and provide feedback on their evidence and scientific conclusions. (DOK 2-3)
2. Critically evaluate models of the human body, identifying the strengths and weaknesses of the model in representing complex natural phenomena. (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:**

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

**Grade Level Expectation: Fifth Grade**

**Concepts and skills students master:**

1. Earth and Sun provide a diversity of renewable and nonrenewable resources

**Evidence Outcomes**

**Students can:**

- a. Develop and communicate a scientific explanation addressing a question of local relevance about resources generated by the sun or Earth (DOK 1-3)
- b. Analyze and interpret a variety of data to understand the origin, utilization, and concerns associated with natural resources (DOK 1-3)

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

**Inquiry Questions:**

1. How can the Sun be used as an energy source?
2. How can wind be used as an energy source?
3. What types of energy sources exist on Earth?

**Relevance and Application:**

1. Mining operations provide nonrenewable resources.
2. Resources are not distributed evenly and require transportation systems to move them to where they are needed.
3. Towns and laws are often built around resource extraction.

**Nature of Science:**

1. Review and analyze scientific explanations about natural resources presented by their peers, and provide feedback to push their peers to be scientifically accurate and base their claims on adequate and reasonable scientific evidence, not opinion.
2. Earth and Sun provide a variety of renewable and nonrenewable resources. (DOK 1)



**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: Fifth Grade**

**Concepts and skills students master:**

2. Earth’s surface changes constantly through a variety of processes and forces

**Evidence Outcomes**

**Students can:**

- a. Analyze and interpret data identifying ways Earth’s surface is constantly changing through a variety of processes and forces such as plate tectonics, erosion, deposition, solar influences, climate, and human activity
- b. Develop and communicate an evidence based scientific explanation around one or more factors that change Earth’s surface (DOK 2-3)

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

**Inquiry Questions:**

- 1. How does Earth’s surface change?
- 2. How do changes on Earth’s surface impact humans?

**Relevance and Application:**

- 1. There are benefits and dangers to humans as Earth’s surface constantly changes.
- 2. Communities take into account the effects of the changing Earth in a variety of ways. For example, they might use springs, stilts, drainage techniques, or build off the ground because of frost heaving.
- 3. Some cities have emergency plans for earthquakes, flooding, eruptions, and tornadoes.
- 4. The development of technology led to tools that made the establishment of measurement standards – the Richter Scale – possible.

**Nature of Science:**

- 1. Ask testable questions about how the earth surface changes. (DOK 2)
- 2. Utilize a variety of media sources to collect data for analysis regarding Earth processes and the changing surface. (DOK 1-2)
- 3. Assess and provide feedback on other’s scientific explanations about factors that change Earth’s surface, pushing for reasoning based on evidence and scientific principles (DOK 2-3)

**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: Fifth Grade**

**Concepts and skills students master:**

3. Weather conditions change because of the uneven heating of Earth’s surface by the Sun’s energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation

**Evidence Outcomes**

**Students can:**

- Develop and communicate an evidence-based scientific explanation for changes in weather conditions (DOK 1-3)
- Gather, analyze, and interpret data such as temperature, air pressure, wind, and humidity in relation to daily weather conditions (DOK 1-3)
- Describe weather conditions based on data collected using a variety of weather tools (DOK 1-2)
- Use data collection tools and measuring devices to gather, organize, and analyze data such as temperature, air pressure, wind, and humidity in relation to daily weather conditions (DOK 1-2)

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

**Inquiry Questions:**

- Why does the Sun heat different surfaces at different rates?
- Why does the weather change from day to day?

**Relevance and Application:**

- The Sun’s energy helps change daily weather by influencing the water cycle, air movement, and temperature.
- Gliders and birds exploit updrafts created by thermals.
- Deicing airplanes in the winter is sometimes necessary so that they can fly.
- Weather satellites generate data that measure and monitor changes in weather.

**Nature of Science:**

- Support explanations of weather using evidence. (DOK 2-3)
- Understand how weather maps are utilized to predict the weather from day to day. (DOK 1-2)
- Assess and provide feedback on other student’s scientific explanations about weather, pushing for reasoning based on evidence and scientific principles. (DOK 2-3)

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