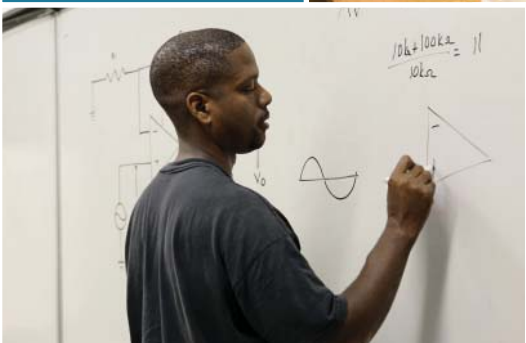


# Colorado Academic STANDARDS

## Second 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?*

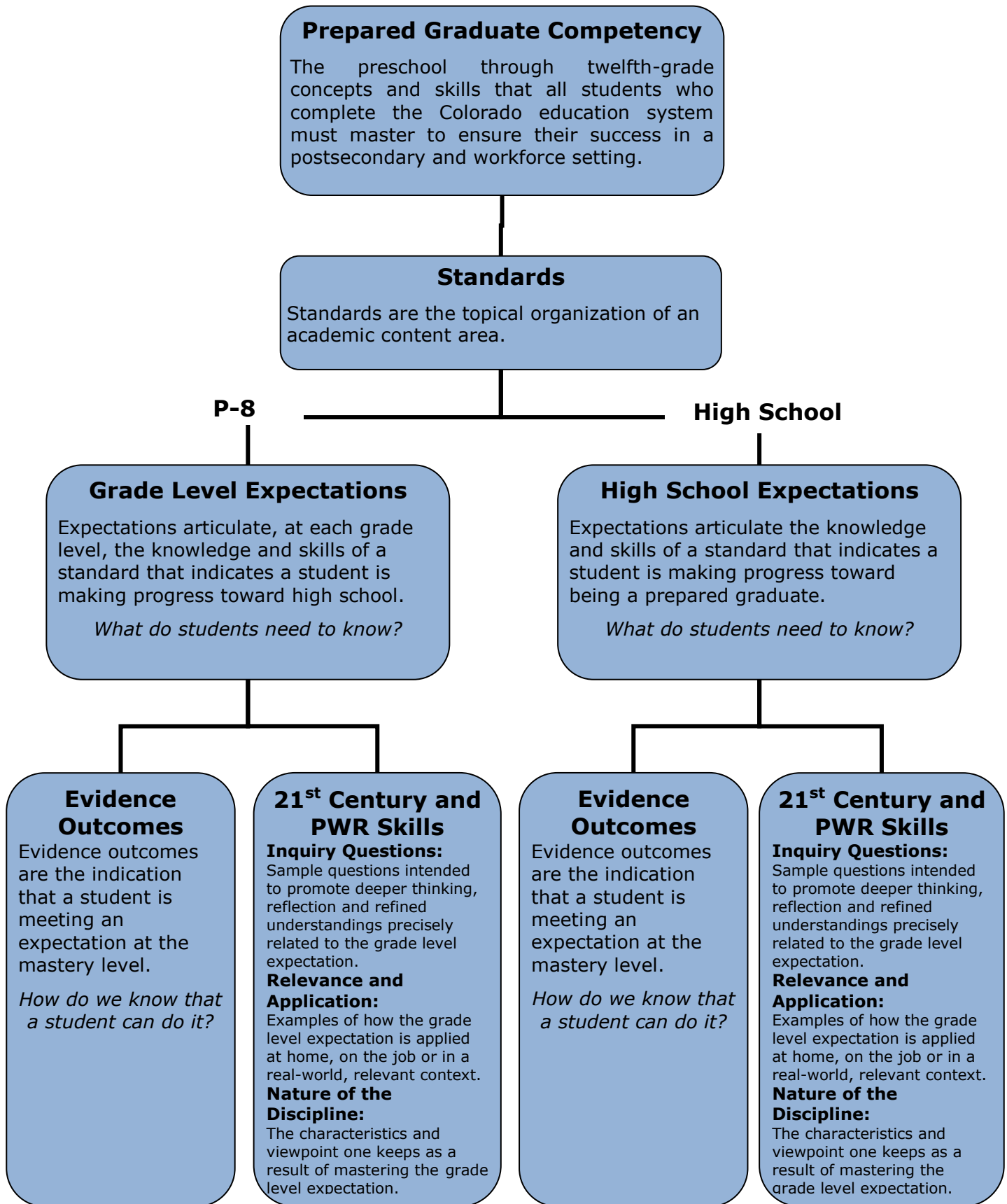
**Grade Level Expectations:** The articulation (at each grade level), concepts, and skills of a standard that indicate a student is making progress toward being ready for high school. *What do students need to know from preschool through eighth grade?*

**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>Second Grade</b>      |                                                                                                                                                                               |
| 1. Physical Science      | 1. Changes in speed or direction of motion are caused by forces such as pushes and pulls.                                                                                     |
| 2. Life Science          | 1. Organisms depend on their habitat's nonliving parts to satisfy their needs<br>2. Each plant or animal has different structures or behaviors that serve different functions |
| 3. Earth Systems Science | 1. Weather and the changing seasons impact the environment and organisms such as humans, plants, and other animals                                                            |

## **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:**

- 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

**Grade Level Expectation: Second Grade**

**Concepts and skills students master:**

1. Changes in speed or direction of motion are caused by forces such as pushes and pulls

**Evidence Outcomes**

**Students can:**

- a. Identify and predict how the direction or speed of an object may change due to an outside force (DOK 1-2)
- b. Analyze and interpret observable data about the impact of forces on the motion of objects (DOK 1-2)

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

**Inquiry Questions:**

1. What must be known about a force to predict how it will change an object's motion?
2. How does applying a force affect the way an object moves?
3. How do an object's properties affect how it will move when a force is applied?

**Relevance and Application:**

1. Technology makes our lives easier by applying what we know about how forces can affect objects such as tires, bicycles, and snow throwers.
2. In many recreational activities, such as tug-of-war, there is a relationship between forces and changes in motion.

**Nature of Science:**

1. Select appropriate tools for data collection. (DOK 1-2)
2. Measure the change in speed or direction of an object using appropriate units. (DOK 1-2)
3. Collaboratively design an experiment, identifying the constants and variables. (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: Second Grade**

**Concepts and skills students master:**

1. Organisms depend on their habitat's nonliving parts to satisfy their needs

**Evidence Outcomes**

**Students can:**

- a. Use evidence to develop a scientific explanation about how organisms depend on their habitat. (DOK 2-3)
- b. Analyze and interpret data about nonliving components of a habitat (DOK 1-2)
- c. Assess and provide feedback on other scientific explanations regarding why an organism can survive in its habitat (DOK 1-3)
- d. Use instruments to make observations about habitat components – for example, data can be collected from a fish tank to assess the environmental health (dissolved oxygen, pH, Nitrogen content). (DOK 1-2)

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

**Inquiry Questions:**

1. What are the basic needs of plants and animals?
2. How are the basic needs of all living things similar and different?
3. How do living things depend on their environment?
4. How does an organism respond when basic needs are not met?

**Relevance and Application:**

1. Living things depend on the health of their habitats.
2. Different organisms have different needs.

**Nature of Science:**

1. Describe different ways that scientists seek to understand about organisms and their interactions with the environment. (DOK 1)
2. Collaborate with other students in developing a scientific explanation about how organisms depend on their habitat. (DOK 1-2)

**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: Second Grade**

**Concepts and skills students master:**

2. Each plant or animal has different structures or behaviors that serve different functions

**Evidence Outcomes**

**Students can:**

- a. Use evidence to develop an explanation as to why a habitat is or is not suitable for a specific organism (DOK 1-3)
- b. Analyze and interpret data about structures or behaviors of a population that help that population survive (DOK 1-2)

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

**Inquiry Questions:**

1. What different structures do plants and animals have that perform the same functions? For example, what different structure do plants and animals have to get water?

**Relevance and Application:**

1. A single environment can support a variety of living things that use different kinds and amounts of resources.
2. Body designs, such as the skull of a woodpecker or the nose of a dog, serves specific and unique jobs.

**Nature of Science:**

1. Give feedback regarding the advantages of specific structures and behaviors. (DOK 2-3)
2. Share observations, and provide and respond to feedback on ideas about the advantages of specific structures and behaviors. (DOK 1-3)

# 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: Second Grade**

**Concepts and skills students master:**

1. Weather and the changing seasons impact the environment and organisms such as humans, plants, and other animals

**Evidence Outcomes**

**Students can:**

- a. Use evidence to develop a scientific explanation for how the weather and changing seasons impacts the organisms such as humans, plants, and other animals – and the environment (DOK 1-3)
- b. Analyze and interpret data such as temperatures in different locations (Sun or shade) at different times and seasons as evidence of how organisms and the environment are influenced by the weather and changing seasons (DOK 1-3)
- c. Analyze ways in which severe weather contributes to catastrophic events such as floods and forest fires (DOK 1-2)

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

**Inquiry Questions:**

1. How does the temperature change at different times during the day (morning, noon, and evening) and from day to day?
2. What changes do we make in our daily lives based on changes in the weather?
3. How do weather patterns change throughout the year?

**Relevance and Application:**

1. The weather and changing seasons impact organisms such as humans, plants, and other animals – and the environment.
2. Organisms and the environment are influenced by the weather and changing seasons.

**Nature of Science:**

1. Ask testable questions about weather and the seasons. (DOK 2)
2. Make predictions, share thinking, and ask others how they know that organisms and the environment are influenced by the weather and changing seasons. (DOK 2-3)
3. Select and use appropriate tools to measure, record, and communicate data about the weather using appropriate units. (DOK 1-2)



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