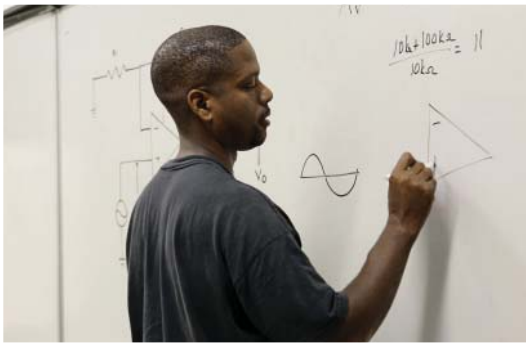
cde Improving Academic Achievement

Colorado Academic STANDARDS

Science

Science



Overview of Changes
Science Standards

Principles of the Standards Review Process

The Colorado Model Content Standards revision process was informed by these guiding principles:

- Begin with the end in mind; define what prepared graduates need in order to be successful using 21st century skills in our global economy.
- Align K-12 standards with early childhood expectations and higher education.
- In order to be globally competitive, international and national benchmarking strongly informs the new standards.
- Change is necessary.
- Standards will be deliberately designed for clarity, rigor, and coherence.
- There will be fewer, higher, and clearer standards.
- Standards will be actionable.

Notable Changes to the Colorado Model Content Standards in Science

The most evident changes to the Colorado standards are replacing grade-band expectations (K-4, 5-8, and 9-12) with grade-level specific expectations. These are explained here in addition to other changes that are apparent upon comparison between the current science standards and the proposed changes.

1. **Embedding scientific inquiry and scientific process skills.** The largest change to the science standards is acknowledging that scientific inquiry, science process skills, and content cannot be taught separately. These important aspects of science were integrated into the three science content standards.

2. **Readiness competencies.** Another change is the realization that there are other important aspects of science such as the general nature of science and application of science concepts that also cannot be separated easily from the content. These are represented as cross cutting themes. They differ significantly in their nature from evidence outcomes and their ability to be assessed. They are essential elements of the new Colorado Academic Standards and are addressed directly.

3. **Impact of standards articulation by grade level.** The original Colorado Model Content Standards for science provided learning benchmarks at grades 3, 5, 8, and 12. The science standards revision subcommittee was charged with defining at what grade students should master various concepts and skills in science. The committee members articulated expectations at appropriate each grade level through eighth grade based on national works such as *Benchmarks for Science Literacy* and the *Atlas for Science Literacy* so that students would build their knowledge of various topics.

4. **Articulation of high school standards.** High school standards are articulated by standard, not grade level. This is intended to allow districts flexibility in designing high school curriculum and courses. The standards represent what is sufficient for a high school graduate to know and be able to do in science and is not intended to suggest there be three years of science or three science courses in high school. For many students, the standards will represent only a foundation for more advanced studies in science.

5. **Integration of P-2 Council's recommendations.** The science subcommittee integrated the skills from the *Building Blocks to the Colorado K-12 Standards* into P-12 science standards, with the inclusion of six preschool science standards.

Below is a quick guide to other changes in the science standards:

Area	Summary of Changes	
	Current Standards	**Proposed Revision**
Number of standards	Five standards	By embedding and using readiness competencies the proposed number of standards is three.
Names of standards	**Standard 1** Scientific Investigations **Standard 2** Physical Science **Standard 3** Life Science **Standard 4** Earth Science **Standard 5** Nature of Science	**Standard 1** Physical Science **Standard 2** Life Science **Standard 3** Earth Systems Science
Integration of 21st century and postsecondary workforce readiness skills	• These skills primarily are associated with the scientific investigations and nature of science standards (1 and 5).	• These skills were embedded in every grade level expectation.
P-2	• Standards articulated for grade band beginning with kindergarten. • Benchmarks articulated K-3.	• Preschool included. • Grade level expectations articulated for each elementary grade. • Clear expectations articulated for grades P-2.
Number of grade level expectations (GLE)	• There are 155 benchmarks.	• There 82 grade level expectations.

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Scott Marion, Ph.D. is Vice President of the National Center for the Improvement in Educational Assessment, Inc., where his current projects include developing and implementing a framework for evaluating the technical quality of state alternate assessment systems; exploring the instructional usefulness of interim assessment approaches; and helping states design valid accountability systems. Marion coordinates and serves on six state technical advisory committees and is an expert panelist for three major national initiatives. He is a regular advisor to the U.S. Department of Education for a host of assessment and accountability issues and is a member of the department's National Technical Advisory Committee. Marion currently serves on a national research committee investigating the issues and challenges associated with incorporating value-added measures in educational accountability systems. A former field biologist for eight years and high school science teacher, Marion earned a bachelor's degree in biology from the State University of New York and a master's in science education from the University of Maine. He received his Ph.D. in measurement and evaluation from the University of Colorado, Boulder. Prior to joining the National Center for the Improvement in Educational Assessment, Inc., six years ago, Marion had been the director of assessment and accountability for the Wyoming Department of Education. He was responsible for overseeing the Wyoming Comprehensive Assessment System and designing the technical and policy structures to implement the Body of Evidence assessment system, a multiple-measures, locally-created collection of evidence used to determine whether high school students met the state graduation requirements. Marion regularly presents the results of his work at several national conferences such as those of the American Educational Research Association, National Council on Measurement in Education, and Council of Chief State School Officers. He also has published dozens of articles in peer-reviewed journals and edited volumes.

References

The subcommittee used a variety of resources representing a broad range of perspectives to inform their work. Those references include:

- *Science for all Americans* (AAAS)
- Benchmarks for Science Literacy *(*AAAS)
- *The Atlas for Science Literacy* (AAAS)
- *National Science Standards (NAS)*
- *Taking Science to School (*National Research Council)
- *Ready, Set, Science (*National Research Council)
- *Systems for States Science Assessment (*Committee on Test Design for K–12 Science Achievement)
- *Before It's Too Late (*National Commission on Mathematics and Science Teaching for the 21st Century)
- *Science Education that Makes Sense (*American Educational Research Association)
- Science Frameworks (NAEP)
- Singapore National Curriculum
- Massachusetts Curriculum Framework
- Virginia Standards of Learning
- Finland – National Core Curriculum
- WestEd Colorado Model Content Standards Review
- Building Blocks to the Colorado K-12 Content Standards

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 21st 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 21st 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.
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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 21st 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?*

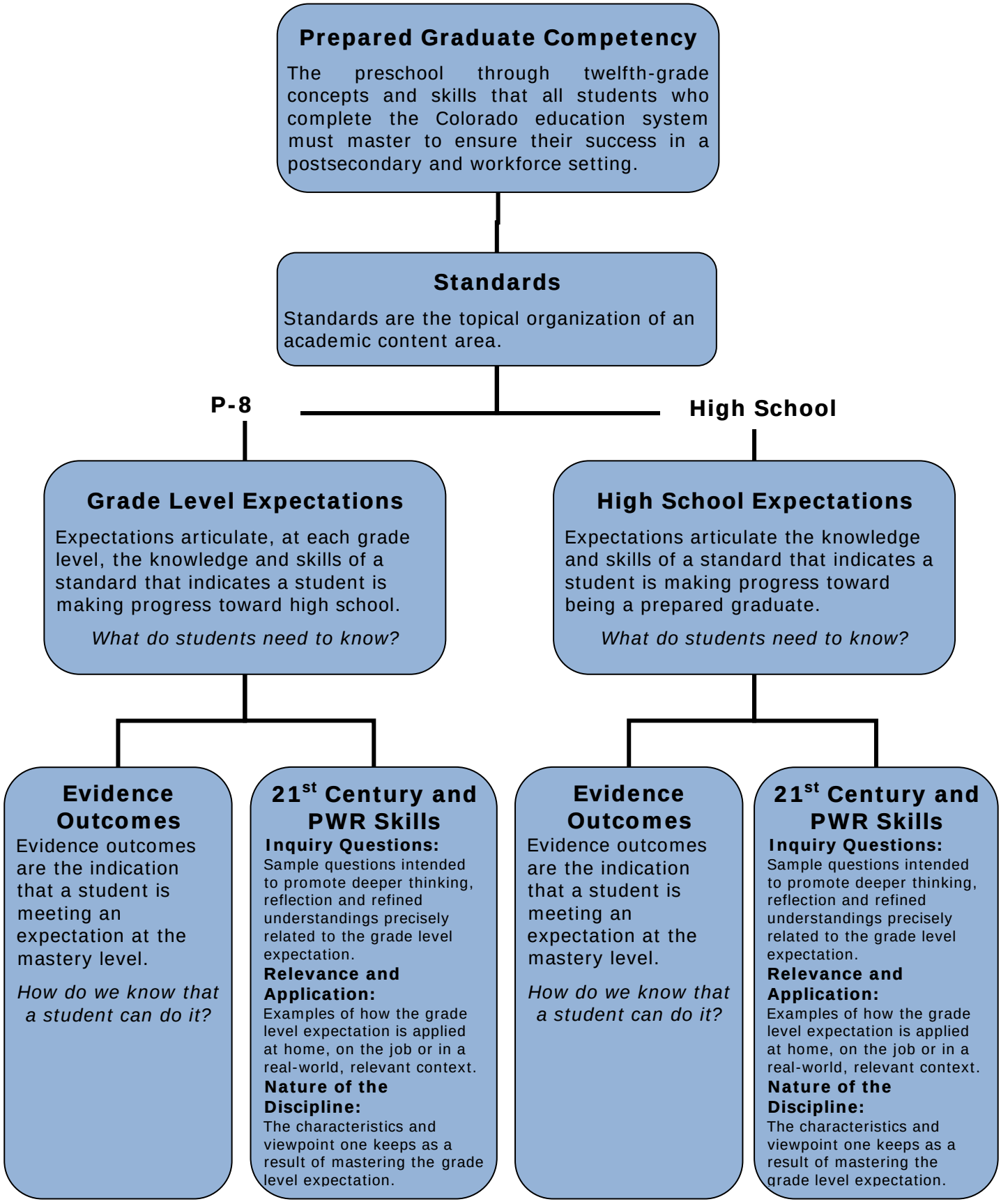
21st Century Skills and Readiness Competencies: Includes the following:

- ***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



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	21st Century Skills and Readiness Competencies
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?*	**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
High School	
1. Physical Science	1. Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations 2. Matter has definite structure that determines characteristic physical and chemical properties 3. Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy 4. Atoms bond in different ways to form molecules and compounds that have definite properties 5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined 6. When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases
2. Life Science	1. Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem 2. The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem 3. Cellular metabolic activities are carried out by biomolecules produced by organisms 4. The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken. 5. Cells use the passive and active transport of substances across membranes to maintain relatively stable intracellular environments 6. Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments 7. Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins 8. Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome 9. Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment

Science
Grade Level Expectations at a Glance

Standard	Grade Level Expectation
High School (continued)	
3. Earth Systems Science	1. The history of the universe, solar system and Earth can be inferred from evidence left from past events 2. As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways 3. The theory of plate tectonics helps to explain geological, physical, and geographical features of Earth 4. Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere 5. There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources 6. The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes 7. Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms
Eighth Grade	
1. Physical Science	1. Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion 2. There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved 3. Distinguish between physical and chemical changes, noting that mass is conserved during any change 4. Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties
2. Life Science	1. Human activities can deliberately or inadvertently alter ecosystems and their resiliency 2. Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation
3. Earth Systems Science	1. Weather is a result of complex interactions of Earth's atmosphere, land and water, that are driven by energy from the sun, and can be predicted and described through complex models 2. Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location 3. The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics 4. The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases

Science
Grade Level Expectations at a Glance

Standard	Grade Level Expectation
Seventh Grade	
1. Physical Science	1. Mixtures of substances can be separated based on their properties such as solubility, boiling points, magnetic properties, and densities
2. Life Science	1. Individual organisms with certain traits are more likely than others to survive and have offspring in a specific environment 2. The human body is composed of atoms, molecules, cells, tissues, organs, and organ systems that have specific functions and interactions 3. Cells are the smallest unit of life that can function independently and perform all the necessary functions of life 4. Photosynthesis and cellular respiration are important processes by which energy is acquired and utilized by organisms 5. Multiple lines of evidence show the evolution of organisms over geologic time
3. Earth Systems Science	1. Major geologic events such as earthquakes, volcanic eruptions, mid-ocean ridges, and mountain formation are associated with plate boundaries and attributed to plate motions 2. Geologic time, history, and changing life forms are indicated by fossils and successive sedimentation, folding, faulting, and uplifting of layers of sedimentary rock
Sixth Grade	
1. Physical Science	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 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. 3. The physical characteristics and changes of solid, liquid, and gas states can be explained using the particulate model 4. Distinguish among, explain, and apply the relationships among mass, weight, volume, and density
2. Life Science	1. Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species 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
3. Earth Systems Science	1. Complex interrelationships exist between Earth's structure and natural processes that over time are both constructive and destructive 2. Water on Earth is distributed and circulated through oceans, glaciers, rivers, ground water, and the atmosphere 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

Science
Grade Level Expectations at a Glance

Standard	Grade Level Expectation
Fifth Grade	
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 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 2. Earth's surface changes constantly through a variety of processes and forces 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
Fourth Grade	
1. Physical Science	1. Energy comes in many forms such as light, heat, sound, magnetic, chemical, and electrical
2. Life Science	1. All living things share similar characteristics, but they also have differences that can be described and classified 2. Comparing fossils to each other or to living organisms reveals features of prehistoric environments and provides information about organisms today 3. There is interaction and interdependence between and among living and nonliving components of systems
3. Earth Systems Science	1. Earth is part of the solar system, which includes the Sun, Moon, and other bodies that orbit the Sun in predictable patterns that lead to observable paths of objects in the sky as seen from Earth
Third Grade	
1. Physical Science	1. Matter exists in different states such as solids, liquids, and gases and can change from one state to another by heating and cooling
2. Life Science	1. The duration and timing of life cycle events such as reproduction and longevity vary across organisms and species
3. Earth Systems Science	1. Earth's materials can be broken down and/or combined into different materials such as rocks, minerals, rock cycle, formation of soil, and sand – some of which are usable resources for human activity
Second Grade	
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 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

Science
Grade Level Expectations at a Glance

Standard	Grade Level Expectation
First Grade	
1. Physical Science	1. Solids and liquids have unique properties that distinguish them
2. Life Science	1. Offspring have characteristics that are similar to but not exactly like their parents' characteristics 2. An organism is a living thing that has physical characteristics to help it survive
3. Earth Systems Science	1. Earth's materials can be compared and classified based on their properties
Kindergarten	
1. Physical Science	1. Objects can move in a variety of ways that can be described by speed and direction 2. Objects can be sorted by physical properties, which can be observed and measured
2. Life Science	1. Organisms can be described and sorted by their physical characteristics
3. Earth Systems Science	1. The sun provides heat and light to Earth
Preschool	
1. Physical Science	1. Objects have properties and characteristics 2. There are cause-and-effect relationships in everyday experiences
2. Life Science	1. Living things have characteristics and basic needs 2. Living things develop in predictable patterns
3. Earth Systems Science	1. Earth's materials have properties and characteristics that affect how we use those materials 2. Events such as night, day, the movement of objects in the sky, weather, and seasons have patterns

Science
Prepared Graduate Competencies at Grade Levels

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	
High School	• Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations
Eighth Grade	• Identify and calculate the direction and magnitude of the forces that act on an object, and explain the results in the object's change of motion
Second Grade	• Changes in speed or direction of motion are caused by forces such as pushes and pulls.
Kindergarten	• Objects can move in a variety of ways that can be described by speed and direction
Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions	
High School	• Matter has definite structure that determines characteristic physical and chemical properties • Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy • Atoms bond in different ways to form molecules and compounds that have definite properties
Eighth Grade	• Distinguish between physical and chemical changes, noting that mass is conserved during any change •
Seventh Grade	• Mixtures of substances can be separated based on their properties such as solubility, boiling points, magnetic properties, and densities
Sixth Grade	• All matter is made from 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 from even smaller particles. • Atoms may stick together in well-defined molecules or be packed together in large arrangements. Different arrangements of atoms into groups compose all substances. • The physical characteristics and changes of solid, liquid, and gas states can be explained using the particulate model • Distinguish among, explain, and apply the relationships among mass, weight, volume, and density
Fifth Grade	• 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
Third Grade	• Matter exists in different states and can change from one state to another by heating and cooling
First Grade	• Solids and liquids have unique properties that distinguish them
Kindergarten	• Objects can be sorted by physical properties, which can be observed and measured
Preschool	• Objects have properties and characteristics • There are cause-and-effect relationships in everyday experiences

Science
Prepared Graduate Competencies at Grade Levels

Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable	
High School	• Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined • When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases
Eighth Grade	• There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved • Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties
Fourth Grade	• Energy comes in many forms such as light, heat, sound, magnetic, chemical, and electrical
Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize livings systems' dependence on natural selection	
High School	• Cellular metabolic activities are carried out by biomolecules produced by organisms • The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken • Cells use the passive and active transport of substances across membranes to maintain relatively stable intracellular environments • Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments
Seventh Grade	• The human body is composed of atoms, molecules, cells, tissues, organs, and organ systems that have specific functions and interactions • Cells are the smallest unit of life that can function independently and perform all the necessary functions of life • Photosynthesis and cellular respiration are important processes by which energy is acquired and utilized by organisms
Fifth Grade	• Human body systems have basic structures, functions, and needs
Second Grade	• Each plant or animal has different structures or behaviors that serve different functions
First Grade	• An organism is a living thing that has physical characteristics to help it survive
Kindergarten	• Organisms can be described and sorted by their physical characteristics
Preschool	• Living things have characteristics and basic needs • Living things develop in predictable patterns

Science
Prepared Graduate Competencies at Grade Levels

Explain and illustrate with examples how living systems interact with the biotic and abiotic environment	
High School	• Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem • The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem
Eighth Grade	• Human activities can deliberately or inadvertently alter ecosystems and their resiliency
Sixth Grade	• Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species • Organisms interact with each other and their environment in various ways that create a flow of energy and cycling of matter in an ecosystem
Fourth Grade	• There is interaction and interdependence between and among living and nonliving components of ecosystems
Second Grade	• Organisms depend on their habitat's nonliving parts to satisfy their needs
Preschool	• Living things have characteristics and basic needs
	• Living things develop in predictable patterns
Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment	
High school	• Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins • Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome. •
Eighth Grade	• Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation
Fifth Grade	• All organisms have structures and systems with separate functions
Fourth Grade	• All living things share similar characteristics, but they also have differences that can be described and classified
Third Grade	• The duration and timing of life cycle events such as reproduction and longevity vary across organisms and species
First Grade	• Offspring have characteristics that are similar to but not exactly like their parents' characteristics
Preschool	• Living things develop in predictable patterns
Explain how biological evolution accounts for the unity and diversity of living organisms	
High School	• Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment
Seventh Grade	• Individual organisms with certain traits are more likely than others to survive and have offspring in specific environments • Multiple lines of evidence show the evolution of organisms over geologic time
Fourth Grade	• Comparing fossils to each other or to living organisms reveals features of prehistoric environments and provides information about organisms today

Science
Prepared Graduate Competencies at Grade Levels

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	
High School	• The history of the universe, solar system and Earth can be inferred from evidence left from past events • As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways
Eighth Grade	• The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics
Seventh Grade	• Geologic time, history, and changing life forms are indicated by fossils and successive sedimentation, folding, faulting, and uplifting of layers of sedimentary rock
Fourth Grade	• Earth is part of the solar system, which includes the sun, moon, and other bodies that orbit the sun in predictable patterns that lead to observable paths of objects in the sky as seen from Earth
Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system	
High School	• The theory of plate tectonics helps to explain geological, physical, and geographical features of Earth • Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere • The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes • Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms
Eighth Grade	• Weather is a result of complex interactions of Earth's atmosphere, land and water, that are driven by energy from the sun, and can be predicted and described through complex models • Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location
Sixth Grade	• Complex interrelationships exist between Earth's structure and natural processes that over time are both constructive and destructive
Fifth Grade	• Earth's surface changes constantly through a variety of processes and forces • 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
Third Grade	• Earth's materials can be broken down and/or combined into different materials such as rocks, minerals, rock cycle, formation of soil, and sand – of which are usable resources for human activity
Second Grade	• Weather and the changing seasons impact the environment and organisms such as humans, plants, and other animals

Science
Prepared Graduate Competencies at Grade Levels

Describe how humans are dependent on the diversity of resources provided by Earth and sun	
High school	• There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources
Sixth Grade	• Water on Earth is distributed and circulated through oceans glaciers, rivers, ground water, and the atmosphere • Earth's natural resources provide the foundation for human society's physical needs. Many natural resources are non-renewable on human time scales, while others can be renewed or recycled.
Fifth Grade	• Earth and Sun provide a diversity of renewable and nonrenewable resources
First Grade	• Earth's materials can be compared and classified based on their properties
Preschool	• Earth's materials have properties and characteristics that affect how we use those materials

21st 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 21st 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: High School

Concepts and skills students master:

1. Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Gather, analyze and interpret data and create graphs regarding position, velocity and acceleration of moving objects b. Develop, communicate and justify an evidence-based analysis of the forces acting on an object and the resultant acceleration produced by a net force c. Develop, communicate and justify an evidence-based scientific prediction regarding the effects of the action-reaction force pairs on the motion of two interacting objects d. Examine the effect of changing masses and distance when applying Newton's law of universal gravitation to a system of two bodies e. Identify the limitations of Newton's laws in extreme situations	**Inquiry Questions:** 1. How can forces be acting on an object without changing the object's motion? 2. Why do equal but opposite action and reaction forces not cancel? **Relevance and Application:** 1. Newton's laws are used in a variety of design processes such as vehicle safety, aerospace, bridge design and interplanetary probes. 2. An understanding of forces leads to safer building designs such as earthquake-safe buildings. 3. Forces present in the earth lead to plate tectonics. **Nature of Science:** 1. Use an inquiry approach to answer a testable question about an application of Newton's laws of motion. 2. Share experimental data, respectfully discuss conflicting results, and analyze ways to minimize error and uncertainty in measurement. 3. Differentiate between the use of the terms "law" and "theory" as they are defined and used in science compared to how they are used in other disciplines or common use. 4. Use technology to perform calculations and to organize, analyze and report data.

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: High School

Concepts and skills students master:

2. Matter has definite structure that determines characteristic physical and chemical properties

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation supporting the current model of an atom b. Gather, analyze and interpret data on chemical and physical properties of elements such as density, melting point, boiling point, and conductivity c. Use characteristic physical and chemical properties to develop predictions and supporting claims about elements' positions on the periodic table d. Develop a model that differentiates atoms and molecules, elements and compounds, and pure substances and mixtures	**Inquiry Questions:** 1. What patterns can be observed in the properties of elements and families in the periodic table? 2. What properties do nanoscale particles have that are different than those of macroscopic samples of the same substance? **Relevance and Application:** 1. The unique properties of various elements make them useful for specific applications. For example, metalloids and semiconductors are useful in electronic applications. 2. Alloys are created by combining metals with other elements to produce materials with useful properties that are not found in nature. For example, iron and carbon make steel. 3. Consumers can make informed decisions regarding the purchase of household chemicals when they understand chemical properties and their implications. For example, choosing lead based versus non-lead based paints weighs safety concerns against color and durability in applications. 4. The unique properties of nanoscale particles provide special benefits and dangers. **Nature of Science:** 1. Recognize that the current understanding of molecular structure related to the physical and chemical properties of matter has developed over time and become more sophisticated as new technologies have led to new evidence. 2. Ask testable questions about the nature of matter, and use an inquiry approach to investigate it.

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: High School

Concepts and skills students master:

3. Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Recognize, analyze, interpret, and balance chemical equations (synthesis, decomposition, combustion, and replacement) or nuclear equations (fusion and fission) b. Predict reactants and products for different types of chemical and nuclear reactions c. Predict and calculate the amount of products produced in a chemical reaction based on the amount of reactants d. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate the conservation of mass and energy	**Inquiry Questions:** 1. What patterns of chemical reactions exist? 2. How are chemical reactions distinguished from nuclear reactions?
	Relevance and Application: 1. Products formed in different types of reactions are useful to people. For example, polymerase reactions making nylon. 2. The use of chemicals can have both positive and negative environmental effects. For example, the use of lime to make acidic soils more productive or the use of CFCs causing the ozone hole. 3. When using radioactive substances, there are benefits such as medicine and energy production as well as dangers such as environmental and health concerns.
	Nature of Science: 1. Critically evaluate chemical and nuclear change models. 2. Identify the strengths and weaknesses of a model which represents complex natural phenomenon. 3. Use an inquiry approach to test predictions about chemical reactions. 4. Share experimental data, and respectfully discuss conflicting results.

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: High School

Concepts and skills students master:

4. Atoms bond in different ways to form molecules and compounds that have definite properties

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation supporting the current models of chemical bonding b. Gather, analyze, and interpret data on chemical and physical properties of different compounds such as density, melting point, boiling point, pH, and conductivity c. Use characteristic physical and chemical properties to develop predictions and supporting claims about compounds' classification as ionic, polar or covalent d. Describe the role electrons play in atomic bonding e. Predict the type of bonding that will occur among elements based on their position in the periodic table	**Inquiry Questions:** 1. How can various substances be classified as ionic or covalent compounds? 2. What role do electrons play in different types of chemical bonds? **Relevance and Application:** 1. Related compounds share some properties that help focus chemists when looking for a substance with particular properties for a specific application. For example, finding new super conductors. 2. Carbon atoms bond in ways that provide the foundation for a wide range of applications. For example, forming chains and rings such as sugars and fats that are essential to life and developing synthetic fibers and oils. 3. Living systems create and use various chemical compounds such as plants making sugars from photosynthesis and chemicals that can be used as medicine, and endocrine glands producing hormones. **Nature of Science:** 1. Recognize that the current understanding of molecular structure related to the physical and chemical properties of matter has developed over time and become more sophisticated as new technologies have led to new evidence. 2. Employ data-collection technology to gather, view, analyze, and interpret data about chemical and physical properties of different compounds.

Content Area: Science
Standard: 1. Physical Science

Prepared Graduates:

- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

Grade Level Expectation: High School

Concepts and skills students master:

5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation regarding the potential and kinetic nature of mechanical energy b. Use appropriate measurements, equations and graphs to gather, analyze, and interpret data on the quantity of energy in a system or an object c. Use direct and indirect evidence to develop predictions of the types of energy associated with objects d. Identify different energy forms, and calculate their amounts by measuring their defining characteristics	**Inquiry Questions:** 1. What factors can be measured to determine the amount of energy associated with an object? 2. What are the most common forms of energy in our physical world? 3. What makes an energy form renewable or nonrenewable? 4. What makes some forms of energy hard to measure?
	Relevance and Application: 1. Society and energy providers must conduct a cost-benefit analysis of different ways to provide electricity to our society. 2. An understanding of energy transformations is necessary when designing clean energy systems that convert any type of energy into electricity such as wind generators and solar cells. 3. There are advantages and disadvantages to using various energy sources such as gasoline, diesel, ethanol, hydrogen, and electricity as transportation fuel. 4. Politics plays a role in shaping energy policy such as balancing conflicting stakeholder needs. 5. Energy plays a role in living systems and Earth's systems. For example, cells convert sugar to ATP and then to energy, energy inside the earth drives plate tectonic phenomena such as earthquakes and volcanoes, and energy from the Sun drives weather.
	Nature of Science: 1. Critically evaluate scientific claims made in popular media or by peers regarding the application of energy forms, and determine if the evidence presented is appropriate and sufficient to support the claims. 2. Use the historical context and impact of early energy research and consider the potential implications for current energy studies on science and our society.

Content Area: Science
Standard: 1. Physical Science

Prepared Graduates:

- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

Grade Level Expectation: High School

Concepts and skills students master:

6. When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use direct and indirect evidence to develop and support claims about the conservation of energy in a variety of systems, including transformations to heat b. Evaluate the energy conversion efficiency of a variety of energy transformations c. Describe energy transformations both quantitatively and qualitatively d. Differentiate among the characteristics of mechanical and electromagnetic waves that determine their energy e. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate energy conservation and loss	**Inquiry Questions:** 1. Why is 100 percent efficiency impossible in an energy transformation? 2. How does the law of conservation of energy help us solve problems involving complex systems? 3. Scientists or engineers often say energy is "lost." Is there a word that might be better than "lost?" Why? **Relevance and Application:** 1. Incremental strides have been made in improving the efficiency of different forms of energy production and consumption. For example, today's engines are much more efficient than those from 50 years ago, and batteries are more powerful and last longer than those from just a few years ago. 2. Different technologies such as light-emitting diodes, compact fluorescent lights, and incandescent light bulbs have different efficiencies and environmental impacts. **Nature of Science:** 1. Critically evaluate scientific claims made in popular media or by peers regarding the application of energy transformations, and determine if the evidence presented is appropriate and sufficient to support the claims. 2. Ask testable questions and make a falsifiable hypothesis about the conservation of energy, and use an inquiry approach to find an answer. 3. Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists.

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: Eighth Grade

Concepts and skills students master:

1. Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Predict and evaluate the movement of an object by examining the forces applied to it b. Use mathematical expressions to describe the movement of an object c. Develop and design a scientific investigation to collect and analyze speed and acceleration data to determine the net forces acting on a moving object	**Inquiry Questions:** 1. What relationships exists among force, mass, speed, and acceleration? 2. What evidence indicates a force has acted on a system? Is it possible for a force to act on a system without having an effect? **Relevance and Application:** 1. Engineers take forces into account when designing moving objects such as car tires, roller coasters, and rockets. 2. Vehicles and their propulsion systems are designed by analyzing the forces that act on the vehicle. For example, the designs of propellers and jet engines are based on the aerodynamics of airplanes. **Nature of Science:** 1. Recognize that our current understanding of forces has developed over centuries of studies by many scientists, and that we will continue to refine our understanding of forces through continued scientific investigations and advances in data collection. 2. Find, evaluate, and select appropriate information from reference books, journals, magazines, online references, and databases to answer scientific questions about motion and acceleration.

Content Area: Science
Standard: 1. Physical Science

Prepared Graduates:

- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

Grade Level Expectation: Eighth Grade

Concepts and skills students master:

2. There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Gather, analyze, and interpret data to describe the different forms of energy and energy transfer b. Develop a research-based analysis of different forms of energy and energy transfer c. Use research-based models to describe energy transfer mechanisms, and predict amounts of energy transferred	**Inquiry Questions:** 1. Which forms of energy can be directly observed, and which forms of energy must be inferred? 2. What evidence supports the existence of potential and kinetic energy? 3. Is there a limit to how many times energy can be transferred? Explain your answer. **Relevance and Application:** 1. Photos and measurements of accident investigation provide evidence of energy transfers during such events. 2. Kinetic energy often is turned into heat such as when brakes are applied to a vehicle or when space vehicles re-enter Earth's atmosphere. 3. Energy transfers convert electricity to light, heat, or kinetic energy in motors. 4. There are ways of producing electricity using both nonrenewable resources such as such as coal or natural gas and renewable sources such as hydroelectricity or solar, wind, and nuclear power. **Nature of Science:** 1. Share experimental data, and respectfully discuss conflicting results. 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 tools to gather, view, analyze, and report results for scientific investigations designed to answer questions about energy transformations.

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: Eighth Grade

Concepts and skills students master:

3. Distinguish between physical and chemical changes, noting that mass is conserved during any change

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify the distinguishing characteristics between a chemical and a physical change b. Gather, analyze, and interpret data on physical and chemical changes c. Gather, analyze, and interpret data that show mass is conserved in a given chemical or physical change d. Identify evidence that suggests that matter is always conserved in physical and chemical changes e. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate physical and chemical changes	**Inquiry Questions:** 1. What evidence can indicate whether a change is physical or chemical? 2. Is it easier to observe the conservation of mass in physical or chemical changes? Why? 3. What would happen if mass were not conserved? **Relevance and Application:** 1. The freezing, thawing, and vaporization of Earth's water provide examples of physical changes. 2. An understanding of chemical changes have resulted in the design various products such as refrigerants in air conditioners and refrigerators. 3. Physical and chemical changes are involved in the collection and refinement of natural resources such as using arsenic in gold mining. 4. Living systems conserve mass when waste products from some organisms are nutrients for others. **Nature of Science:** 1. Evaluate the reproducibility of an experiment, and critically examine conflicts in experimental results. 2. Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists.

Content Area: Science
Standard: 1. Physical Science

Prepared Graduates:

- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

Grade Level Expectation: Eighth Grade

Concepts and skills students master:

4. Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Compare and contrast different types of waves b. Describe for various waves the amplitude, frequency, wavelength, and speed c. Describe the relationship between pitch and frequency in sound d. Develop and design a scientific investigation regarding absorption, reflection, and refraction of light	**Inquiry Questions:** 1. What are some different ways to describe waves?
	Relevance and Application: 1. Different vibrations create waves with different characteristics. For example, a vibrating low-pitch guitar string feels different to the touch than a high-pitch guitar string. 2. Dealing with different types of waves presents design challenges. For example, higher frequency waves have shorter wavelengths, which affect ships, buildings, and antenna design. 3. Energy from different types of waves can affect the environment. For example, natural waves cause different beach erosion and boat wakes 4. There are many applications of light and lasers such as using fiber optics in high speed communication and lasers in surgery. 5. Living organisms collect and use light and sound waves – such as for hearing and vision – to gather information about their surroundings.
	Nature of Science: 1. Evaluate models used to explain and predict wave phenomena that cannot be directly measured. 2. Understand that scientists work from the assumption that the universe is a single system in which the basic rules are the same everywhere. For example, the speed of light in a vacuum is constant across space and time. 3. Select and use technology tools to gather, view, analyze, and report results for scientific investigations about the characteristics and properties of waves.

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: Seventh Grade

Concepts and skills students master:

1. Mixtures of substances can be separated based on their properties such as solubility, boiling points, magnetic properties, and densities

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify properties of substances in a mixture that could be used to separate those substances from each other b. Develop and design a scientific investigation to separate the components of a mixture	**Inquiry Questions:** 1. What techniques can be used to separate mixtures of substances based their properties? 2. Which properties are the most useful in trying to separate mixtures of substances? 3. How much difference must there be among the properties of substances for the properties to be useful in separating the substances?
	Relevance and Application: 1. Materials are sorted based on their properties in a variety of applications. For example, water filtration systems rely on the solubility, density, and physical sizes of substances and recycling facilities use the properties of materials to separate substances in single-stream recycling systems. 2. Mining and oil refining processes use properties to separate materials. 3. The kidneys use properties to filter wastes from the blood.
	Nature of Science: 1. Ask testable questions and make a falsifiable hypothesis about using properties in perform separations, and design a method to find an answer. 2. Evaluate and critique experimental procedures designed to separate mixtures. 3. Share experimental data, and respectfully discuss inconsistent results. 4. Describe several ways in which scientists would study mixtures, and suggest ways that this has contributed to our understanding of materials.

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	21st Century Skills and Readiness Competencies
Students can: a. Identify evidence that suggests there is a fundamental building block of matter b. Use the particle model of matter to illustrate characteristics of different substances c. Develop an evidence based scientific explanation of the atomic model as the foundation for all chemistry d. 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	**Inquiry Questions:** 1. In the world of science what makes something a building block? **Relevance and Application:** 1. Living things consist of the same matter as the rest of the universe. **Nature of Science:** 1. Work in groups using the writing process to effectively communicate an understanding of the particle model of matter. 2. Use technology to share research findings about historical explanations for the nature of matter and to publish information to various audiences. 3. Create models that explain the particle theory of matter. 4. 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.

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	21st Century Skills and Readiness Competencies
Students can: a. Explain the similarities and differences between elements and compounds b. Identify evidence suggesting that atoms form into molecules with different properties than their components c. Find and evaluate information from a variety of resources about molecules	**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. 2. Investigate how our current understanding of matter has developed through centuries of scientific investigations.

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	21st Century Skills and Readiness Competencies
Students can: a. Explain how the arrangement and motion of particles in a substance such as water determine its state b. Distinguish between changes in temperature and changes of state using the particle model of matter	**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. 2. Understand and apply the difference between scientific laws, theories and hypotheses. 3. Work in groups using the writing process to communicate an understanding how the particle model of matter explains various states of matter.

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	21st Century Skills and Readiness Competencies
Students can: a. Explain that the mass of an object does not change, but its weight changes based on the gravitational forces acting upon it b. Predict how changes in acceleration due to gravity will affect the mass and weight of an object c. Predict how mass, weight, and volume affect density d. Measure mass and volume, and use these quantities to calculate density e. Use tools to gather, view, analyze, and report results for scientific investigations about the relationships among mass, weight, volume, and density	**Inquiry Questions:** 1. Which of the following is the best recommendation for a person trying to lose weight and why? o Reduce the number of calories he or she eats. o Exercise more. o Go to the Moon. 2. If weight and mass are not the same thing, why might people use the words interchangeably? 3. 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: 1. 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: 1. 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. 2. Ask testable questions and make a falsifiable hypothesis about density and design an inquiry based method to find an answer. 3. Select proper tools to measure the mass and volume of an object and use appropriate units.

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	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify a procedure to separate simple mixtures based on physical properties 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	**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. 2. Select appropriate tools to conduct an experiment, use them correctly, and report the data in proper units. 3. Share results of experiments with others and respectfully discuss results that are not expected. 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.

Content Area: Science
Standard: 1. Physical Science

Prepared Graduates:

- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

Grade Level Expectation: Fourth Grade

Concepts and skills students master:

1. Energy comes in many forms such as light, heat, sound, magnetic, chemical, and electrical

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify and describe the variety of energy sources b. Show that electricity in circuits requires a complete loop through which current can pass c. Describe the energy transformation that takes place in electrical circuits where light, heat, sound, and magnetic effects are produced d. Use multiple resources – including print, electronic, and human – to locate information about different sources of renewable and nonrenewable energy	**Inquiry Questions:** 1. How do we know that energy exists within a system such as in an electrical circuit? 2. How can heat be transferred from one object to another?
	Relevance and Application: 1. There are multiple energy sources, both renewable and nonrenewable. 2. Energy can be used or stored. For example, it can be stored in a battery and then used when running a portable media player such as an iPod. 3. Transportation, manufacturing, and technology are driven by energy.
	Nature of Science: 1. Ask testable questions about energy, make a falsifiable hypothesis and design an inquiry based method of finding the answer, collect data, and form a conclusion. 2. Understand that models are developed to explain and predict phenomena that cannot be directly observed. 3. Critically evaluate models of energy, identifying the strengths and weaknesses of the model in representing what happens in the real world. 4. Create plans to decrease electrical energy use for one week and evaluate the results.

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

Third Grade

Concepts and skills students master:

1. Matter exists in different states such as solids, liquids, and gases and can change from one state to another by heating and cooling

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Analyze and interpret observations about matter as it freezes and melts, and boils and condenses b. Use evidence to develop a scientific explanation around how heating and cooling affects states of matter c. Identify the state of any sample of matter	**Inquiry Questions:** 1. How can the state of matter of any object be decided? 2. Where around the school would snow take the longest to melt? Why?
	Relevance and Application: 1. Water is distributed on Earth in different forms such as vapor, ice or glaciers, rivers, and freshwater or saltwater oceans. 2. There is only a certain amount of water available for human use.
	Nature of Science: 1. Ask a testable question about the heating and cooling of a substance, design a method to find the answer, collect data, and form a conclusion. 2. Demonstrate the importance of keeping accurate observations and notes in science. 3. Share results of experiments with others, and respectfully discuss results that are not expected.

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	21st Century Skills and Readiness Competencies
Students can: a. Identify and predict how the direction or speed of an object may change due to an outside force b. Analyze and interpret observable data about the impact of forces on the motion of objects	**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. 2. Measure the change in speed or direction of an object using appropriate units. 3. Collaboratively design an experiment, identifying the constants and variables.

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: First Grade

Concepts and skills students master:

1. Solids and liquids have unique properties that distinguish them

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Analyze and interpret observations about solids and liquids and their unique properties b. Identify the similarities and differences of two or more groups of solids or liquids c. Classify solids and liquids based on their properties, and justify your choice based on evidence	**Inquiry Questions:** 1. What do all liquids have in common? What are some differences they can have and still be considered liquids? 2. What do all solids have in common? What are some differences they can have and still be considered solids? 3. What properties of liquids can be used to sort them? 4. What properties of solids can be used to sort them?
	Relevance and Application: 1. The properties of solids and liquids help us understand how to use matter. For example, we not build a bridge out of tissue because it is not strong enough. 2. There are practical reasons for sorting liquids or solids.
	Nature of Science: 1. Share results of experiments with others. 2. Recognize that observations are an important part of science. 3. Conduct collaborative experiments.

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: Kindergarten

Concepts and skills students master:

1. Objects can move in a variety of ways that can be described by speed and direction

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Observe, investigate, and describe how different objects move b. Describe the motion of a child who is playing	**Inquiry Questions:** 1. What can change how fast or slow an object travels? 2. What indicates which objects will be easier or harder to move?
	Relevance and Application: 1. People must push harder to move their bikes, skateboards, or scooters as they go faster or as they go up a hill. 2. Information about motion can be represented in pictures, illustrations, and simple charts.
	Nature of Science 1. Recognize that scientists try to be clear and specific when they describe things. 2. Make predictions about the motion of an object. 3. Ask testable questions about the movement of objects.

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: Kindergarten

Concepts and skills students master:

2. Objects can be sorted by physical properties, which can be observed and measured

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Observe, investigate, and describe how objects can be sorted using their physical properties b. Explain why objects are sorted into categories c. Sort a set of objects based on their physical characteristics, and then explain how the objects are sorted	**Inquiry Questions:** 1. How can objects belong to more than one group? 2. How do you decide which properties are most important when putting objects into groups?
	Relevance and Application: 1. Materials have uses based on properties such as whether they are glass or plastic. 2. Machines such as coin sorting machines can be designed to sort things efficiently.
	Nature of Science: 1. Recognize that scientists try to be clear and specific when they describe things. 2. Share observations with others; be clear and precise like scientists.

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: Preschool

Concepts and skills students master:

1. Objects have properties and characteristics

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use senses to gather information about objects b. Make simple observations, predictions, explanations, and generalizations based on real-life experiences c. Collect, describe, and record information through discussion, drawings, and charts	**Inquiry Questions:** 1. How are various objects similar and different?
	Relevance and Application: 1. Use scientific tools such as magnets, magnifying glasses, scales, and rulers in investigations and play.
	Nature of Science: 1. Be open to and curious about new tasks and challenges. 2. Explore and experiment. 3. Show capacity for invention and imagination. 4. Ask questions based on discoveries made while playing.

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: Preschool

Concepts and skills students master:

2. There are cause-and-effect relationships in everyday experiences

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Recognize and investigate cause-and-effect relationships in everyday experiences – pushing, pulling, kicking, rolling, or blowing objects	**Inquiry Questions:** 1. How do various objects react differently to the same cause?
	Relevance and Application: 1. Use scientific tools such as magnets, magnifying glasses, scales, and rulers in investigations and play.
	Nature of Science: 1. Be open to and curious about new tasks and challenges. 2. Explore and experiment. 3. Reflect on and interpret cause-and-effect relationships.

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: High School

Concepts and skills students master:

1. Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Analyze how energy flows through trophic levels b. Evaluate the potential ecological impacts of a plant-based or meat-based diet c. Analyze and interpret data from experiments on ecosystems where matter such as fertilizer has been added or withdrawn such as through drought d. Develop, communicate, and justify an evidence-based scientific explanation showing how ecosystems follow the laws of conservation of matter and energy e. Define and distinguish between matter and energy, and how they are cycled or lost through life processes f. Describe how carbon, nitrogen, phosphorus, and water cycles work g. Use computer simulations to analyze how energy flows through trophic levels	**Inquiry Questions:** 1. How does a change in abiotic factors influence the stability or progression of an ecosystem? 2. What happens when the cycling of matter in ecosystems is disrupted? 3. What energy transformations occur in ecosystems? 4. How does the process of burning carbon-rich fossil fuels compare to the oxidation of carbon biomolecules in cells? **Relevance and Application:** 1. When the matter or energy flow in an ecosystem is disturbed, there are measurable effects such as the eutrophication of water. 2. Matter and energy are cycled in natural systems such as wetlands in both similar and different ways than in human-managed systems such as waste water treatment plants. **Nature of Science:** 1. Address differences between experiments where variables can be controlled and those where extensive observations on a highly variable natural system are necessary to determine what is happening – such as dead zones in the Gulf of Mexico. 2. Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists. 3. Design ecological experiments in a closed system.

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: High School

Concepts and skills students master:

2. The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Analyze and interpret data about the impact of removing keystone species from an ecosystem or introducing non-native species into an ecosystem b. Describe or evaluate communities in terms of primary and secondary succession as they progress over time c. Evaluate data and assumptions regarding different scenarios for future human population growth and their projected consequences d. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate ecosystem interactions	**Inquiry Questions:** 1. How do keystone species maintain balance in ecosystems? 2. How does the introduction of a non-native species influence the balance of an ecosystem? 3. How is the succession of local organisms altered in an area that is disturbed or destroyed? **Relevance and Application:** 1. Earth's carrying capacity is limited, and as the human population grows, we must find ways to increase the production of resources all people need to live. 2. The extraction of resources by humans impacts nature ecosystems. **Nature of Science:** 1. Critically evaluate scientific explanations in popular media to determine if the research methodology and evidence presented are appropriate and sufficient to support the claims.

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: High School

Concepts and skills students master:

3. Cellular metabolic activities are carried out by biomolecules produced by organisms

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify biomolecules and their precursors/building blocks b. Develop, communicate, and justify an evidence-based explanation that biomolecules follow the same rules of chemistry as any other molecule c. Develop, communicate, and justify an evidence-based explanation regarding the optimal conditions required for enzyme activity d. Infer the consequences to organisms of suboptimal enzyme function – such as altered blood pH or high fever – using direct and indirect evidence e. Analyze and interpret data on the body's utilization of carbohydrates, lipids, and proteins	**Inquiry Questions:** 1. How are rates of enzyme activity in cells affected by various factors such as pH or temperature? 2. How does one know that enzymes speed up chemical reactions? **Relevance and Application:** 1. Apply knowledge of biomolecular structure and activity to make consumer decisions, especially about diet with respect to saturated and unsaturated fatty acids, essential and nonessential amino acids, and simple and complex carbohydrates. 2. Explain how high temperatures such as a fever may alter cellular enzyme activity. 3. Recognize that many biomolecules can be made in the lab and have the exact same structure and function as ones made by living organisms. **Nature of Science:** 1. Critically evaluate scientific explanations in popular media to determine if the research methodology and evidence presented are appropriate and sufficient to support the claims.

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: High School

Concepts and skills students master:

4. The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation the optimal environment for photosynthetic activity b. Discuss the interdependence of autotrophic and heterotrophic life forms such as depicting the flow of a carbon atom from the atmosphere, to a leaf, through the food chain, and back to the atmosphere c. Explain how carbon compounds are gradually oxidized to provide energy in the form of adenosine triphosphate (ATP), which drives many chemical reactions in the cell	**Inquiry Questions:** 1. What variables can be manipulated to change the rate of photosynthesis? 2. What variables affect the rate of cell respiration? 3. How does body heat relate to cellular respiration? **Relevance and Application:** 1. Agriculture is of great importance to humans. For example, most food comes from agriculture. 2. Various foods such as cheeses, yogurts, alcohol, and breads are produced by fermentation – anaerobic respiration – that is carried out by various organisms. 3. The experience of muscle fatigue after intense exercise is related to anaerobic respiration in muscle cells. 4. Primary producers such as marine phytoplankton and rainforest flora play an integral role in sustaining all life on Earth. **Nature of Science:** 1. Recognize that the current understanding of photosynthesis and cellular respiration has developed over time and become more sophisticated as new technologies have lead to new evidence. 2. Critically evaluate models for photosynthesis and cellular respiration, and identify their strengths and weaknesses.

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: High School

Concepts and skills students master:

5. Cells use passive and active transport of substances across membranes to maintain relatively stable intracellular environments

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Analyze and interpret data to determine the energy requirements and/or rates of substance transport across cell membranes b. Compare organisms that live in freshwater and marine environments, and identify the challenges of osmotic regulation for these organisms c. Diagram the cell membrane schematically, and highlight receptor proteins as targets of hormones, neurotransmitters, or drugs that serve as active links between intra and extracellular environments d. Use tools to gather, view, analyze, and interpret data produced during scientific investigations that involve passive and active transport e. Use computer simulations and models to analyze cell transport mechanisms	**Inquiry Questions:** 1. What variables affect the rate of transport across a membrane? 2. Why is it important that cell membranes are selectively permeable? **Relevance and Application:** 1. Osmotically balanced solutions such as intravenous and ophthalmic solutions are critical in medical settings. 2. Drugs target receptor proteins such as hormones and neurotransmitters in membranes and mimic the action of natural signals there. 3. Technology is used to support humans on dialysis. **Nature of Science:** 1. Ask testable questions and make a falsifiable hypothesis about how cells transport materials into and out of the cell and use an inquiry approach to find the answer. 2. Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists. 3. 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.

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: High School

Concepts and skills students master:

6. Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Discuss how two or more body systems interact to promote health for the whole organism b. Analyze and interpret data on homeostatic mechanisms using direct and indirect evidence to develop and support claims about the effectiveness of feedback loops to maintain homeostasis c. Distinguish between causation and correlation in epidemiological data, such as examining scientifically valid evidence regarding disrupted homeostasis in particular diseases d. Use computer simulations and models of homeostatic mechanisms	**Inquiry Questions:** 1. How can an experiment be designed and conducted to test for adaptive homeostasis during exercise and other body activities? 2. Where and when are negative versus positive feedback loops more effective in the human body? **Relevance and Application:** 1. The disruption of homeostatic mechanisms may lead to disease, and if severe enough, death. 2. Body systems differ when in a state of health and disease. For example, buildup and rupture of atherosclerotic plaque inside a blood vessel can cause a heart attack. 3. The regulatory responses of autoimmune diseases such as Type I diabetes, multiple sclerosis and rheumatoid arthritis are different than those of healthy immune systems. **Nature of Science:** 1. Research and present findings about the results of dietary deficiencies or excesses. 2. Research and present findings about how medical problems that impact life span have changed throughout history due to altered lifestyles and advances in medicine. 3. Differentiate between scientific evidence evaluated by the Food and Drug Administration (FDA) for drug approval and anecdotal evidence shared among individuals or in magazines/newspapers that a food or supplement is effective for a given problem.

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: High School

Concepts and skills students master:

7. Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Analyze and interpret data that genes are expressed portions of DNA. b. Analyze and interpret data on the processes of DNA replication, transcription, translation, and gene regulation, and show how these processes are the same in all organisms c. Recognize that proteins carry out most cell activities and mediate the effect of genes on physical and behavioral traits in an organism d. Evaluate data showing that offspring are not clones of their parents or siblings due to the meiotic processes of independent assortment of chromosomes, crossing over, and mutations e. Explain using examples how genetic mutations can benefit, harm, or have neutral effects on an organism	**Inquiry Questions:** 1. Why is it possible for a cell from one species to express genes from another species as in genetic modification of organisms? 2. Why are human offspring not genetic clones of their parents or siblings? 3. How is it possible to distinguish learned from instinctual behaviors such as imprinting etiquette, and suckling by mammals? **Relevance and Application:** 1. Recombinant DNA technology has many uses in society such as the development of new medical therapies and increased production of drugs. 2. Selective breeding differs from genetic modification, yet shares a common goal. 3. There are benefits and risks to having genetically modified organisms in the food supply. 4. There are implications to inheriting DNA replication errors. **Nature of Science:** 1. Recognizing that research on genetically modified organisms is done in university laboratories and seed companies, discuss the implications of different types of funding and 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. 2. Understand that scientists work from the assumption that the universe is a single system in which the basic rules are the same everywhere – that basic principles for genetics apply to all 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: High School

Concepts and skills students master:

8. Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation of how cells form specialized tissues due to the expression of some genes and not others b. Analyze and interpret data that show most eukaryotic deoxyribonucleic acid (DNA) does not actively code for proteins within cells c. Develop, communicate, and justify an evidence-based scientific explanation for how a whole organism can be cloned from a differentiated – or adult – cell d. Analyze and interpret data on medical problems using direct and indirect evidence in developing and supporting claims that genetic mutations and cancer are brought about by exposure to environmental toxins, radiation, or smoking	**Inquiry Questions:** 1. Why is it possible to clone a whole organism from an undifferentiated cell? 2. Why are stem cells sought by researchers as potential cures to medical problems? **Relevance and Application:** 1. Stem cells may be used to improve medical disorders such as diabetes, Parkinson's disease, torn cartilage, and damaged hearts. 2. Recent research and insights into DNA and genes have changed many aspects of society such as the criminal justice system, food supply, and medical treatments. **Nature of Science:** 1. Debate the advantages and disadvantages of bioengineering – cloning or genetically modifying – organisms in the food supply. 2. Science is influenced by the cultural norms of a society. Discuss the ethical and political issues associated with stem cell research and how these have impacted both the research done and its applications. 3. Debate the ethical and political issues associated with stem cell research and how these affect research.

Content Area: Science
Standard: 2. Life Science

Prepared Graduates:

- Explain how biological evolution accounts for the unity and diversity of living organisms

Grade Level Expectation: High School

Concepts and skills students master:

9. Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation for how Earth's diverse life forms today evolved from common ancestors b. Analyze and interpret multiple lines of evidence supporting the idea that all species are related by common ancestry such as molecular studies, comparative anatomy, biogeography, fossil record and embryology c. Analyze and interpret data suggesting that over geologic time, discrete bursts of rapid genetic changes and gradual changes have resulted in speciation d. Analyze and interpret data on how evolution can be driven by three key components of natural selection – heritability, genetic variation, and differential survival and reproduction e. Generate a model – an evolutionary tree – showing how a group of organisms is most likely diverged from common ancestry	**Inquiry Questions:** 1. How do subtle differences among closely-related fossil species provide evidence of environmental change and speciation? 2. How does studying extinct species contribute to our current understanding of evolution? 3. How can patterns of characteristics shared among organisms be used to categorize life's diversity according to relatedness? 4. How does modern agriculture affect biodiversity? **Relevance and Application:** 1. Resistance can occur when antibiotics and pesticides are overused or abused. 2. Human activities can generate selective pressures on organisms, such as breeding new kinds of dogs and improving livestock. **Nature of Science:** 1. Understand that all scientific knowledge is subject to new findings and that reproducible, corroborated, and converging lines of data yield a scientific theory. 2. Differentiate among the use of the terms "hypothesis," "theory," and "law" as they are defined and used in science compared to the usage of these terms in other disciplines or everyday use.

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: Eighth Grade

Concepts and skills students master:

1. Human activities can deliberately or inadvertently alter ecosystems and their resiliency

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific example of how humans can alter ecosystems b. Analyze and interpret data about human impact on local ecosystems c. Recognize and infer bias in print and digital resources while researching an environmental issue d. Use technology resources such as online encyclopedias, online databases, and credible websites to locate, organize, analyze, evaluate, and synthesize information about human impact on local ecosystems e. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate an environmental issue	**Inquiry Questions:** 1. Do humans have a unique responsibility to the ecosystems in which they live? 2. How can a young person be a steward of an ecosystem? **Relevance and Application:** 1. Human activities such as cutting down forests and polluting water or covering deserts with fields of solar panels are constantly changing various cycles and habitats in the natural world. 2. There are laws that preserve and protect wilderness areas such as national parks and other natural areas but such laws also limit the utilization of the natural resources in those areas. **Nature of Science:** 1. Critically evaluate scientific claims in popular media and peer generated explanations regarding interactions in ecosystems, and determine if the evidence presented is appropriate and sufficient to support the claims.

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: Eighth Grade

Concepts and skills students master:

2. Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation for how genetic information is passed to the next generation b. Use direct and indirect observations, evidence, and data to support claims about genetic reproduction and traits of individuals c. Gather, analyze, and interpret data on transmitting genetic information d. Use models and diagrams to predict the phenotype and genotype of offspring based on the genotype of the parents e. Use computer simulations to model and predict phenotype and genotype of offspring based on the genotype of the parents	**Inquiry Questions:** 1. How are traits passed from one generation to the next? 2. What traits can be passed to the next generation and what traits cannot? 3. How can patterns in the inheritance of traits be used to predict how frequently they appear in offspring? **Relevance and Application:** 1. There are benefits and risks to genetic engineering such as cloning, genetically modifying organisms, and replacing genes for therapy. 2. Genome sequencing has many potential applications to the field of medicine. **Nature of Science:** 1. Understand the interconnected nature of math and science by utilizing math in the prediction of future generations. 2. Recognize that current understanding of genetics has developed over time and become more sophisticated as new technologies have lead to new evidence. 3. Critically evaluate models used to represent deoxyribonucleic acid (DNA) and genes; identify strengths and weaknesses of these models for representing complex natural phenomena.

Content Area: Science
Standard: 2. Life Science

Prepared Graduates:

- Explain how biological evolution accounts for the unity and diversity of living organisms

Grade Level Expectation: Seventh Grade

Concepts and skills students master:

1. Individual organisms with certain traits are more likely than others to survive and have offspring in a specific environment

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based explanation for why a given organism with specific traits will or will not survive to have offspring in a given environment b. Analyze and interpret data about specific adaptations to provide evidence and develop claims about differential survival and reproductive success c. Use information and communication technology tools to gather information from credible sources, analyze findings, and draw conclusions to create and justify an evidence-based scientific explanation d. Use computer simulations to model differential survival and reproductive success associated with specific traits in a given environment	**Inquiry Questions:** 1. What is the relationship between an organism's traits and its potential for survival and reproduction? 2. How is the use of the word "adaptation" different in everyday usage than in biology? **Relevance and Application:** 1. Bacteria have evolved to survive in the presence of the environmental pressure of antibiotics – giving rise to antibiotic resistance. 2. Species that can live with humans –such as rats and pigeons – are more common around towns and cities. **Nature of Science:** 1. Create and use sound experimental designs to collect data around survival and genetic traits. 2. Describe several ways in which scientists would study genetics, and suggest ways that this has contributed to our understanding of survival and populations.

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: Seventh Grade

Concepts and skills students master:

2. The human body is composed of atoms, molecules, cells, tissues, organs, and organ systems that have specific functions and interactions

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop and design a scientific investigation about human body systems b. Develop, communicate, and justify an evidence-based scientific explanation regarding the functions and interactions of the human body c. Gather, analyze, and interpret data and models on the functions and interactions of the human body	**Inquiry Questions:** 1. How does each body system contribute to supporting the life of the organism? 2. How do organs and organ systems in the human body interact to perform specific functions?
	Relevance and Application: 1. There are technologies such as magnetic resonance imaging (MRI), computed tomography (CT) scans, and chemical lab tests that are related to the diagnosis and treatment of the human body's diseases
	Nature of Science: 1. Critically evaluate models, and identify the strengths and weaknesses of the model in representing our understanding of the human body

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: Seventh Grade

Concepts and skills students master:

3. Cells are the smallest unit of life that can function independently and perform all the necessary functions of life

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Gather, analyze, and interpret data and models on the different types of cells, their structures, components and functions b. Develop, communicate, and justify an evidence-based scientific explanation regarding cell structures, components, and their specific functions c. Compare and contrast the basic structures and functions of plant cells, animal cells, and single-celled organisms d. Employ tools to gather, view, analyze, and report results for the scientific investigations of cells	**Inquiry Questions:** 1. How is the basic structure of a cell related to its function? 2. How are the components – or organelles – of a cell related to the cell's function? 3. How are various cells unique, and what do they have in common with other cells?
	Relevance and Application: 1. Stem cells are undifferentiated cells that have potential use in medicine. 2. Cancer is caused by a cell that isn't functioning correctly. 3. Cells can be cultured to benefit humanity.
	Nature of Science: 1. Recognize that our current understanding of cells has developed over centuries of studies by many scientists, and that through continued scientific investigations and advances in data collection, we will continue to refine our understanding of cells.

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: Seventh Grade

Concepts and skills students master:

4. Photosynthesis and cellular respiration are important processes by which energy is acquired and utilized by organisms

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Gather, analyze, and interpret data regarding the basic functions of photosynthesis and cellular respiration b. Use direct and indirect evidence to describe the relationship between photosynthesis and cellular respiration within plants – and between plants and animals c. Use computer simulations to model the relationship between photosynthesis and cellular respiration within plants – and between plants and animals	**Inquiry Questions:** 1. What is the relationship between photosynthesis and cellular respiration? 2. What energy transformations occur in both the processes of photosynthesis and cellular respiration?
	Relevance and Application: 1. Plants are essential for human health and the health and survival of Earth's ecosystems. 2. The energy in food comes from Sunlight via photosynthesis and is the basis for most ecosystems on earth. 3. Fossil fuels come from the photosynthesis of organisms that lived millions of years ago.
	Nature of Science: 1. Ask a testable question and make a falsifiable hypothesis about photosynthesis or respiration and design an inquiry based method to find an answer. 2. Design an experiment to observe photosynthesis or respiration, and clearly define controls and variables. 3. Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists.

Content Area: Science
Standard: 2. Life Science

Prepared Graduates:

- Explain how biological evolution accounts for the unity and diversity of living organisms

Grade Level Expectation: Seventh Grade

Concepts and skills students master:

5. Multiple lines of evidence show the evolution of organisms over geologic time

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Interpret and analyze data from the fossil record to support a claim that organisms and environments have evolved over time b. Analyze and critique the evidence regarding the causes and effects of a mass extinction event c. Analyze and interpret data that show human evolution d. Use technology to share research findings about the evidence regarding the causes and effects of a mass extinction event	**Inquiry Questions:** 1. What might life on Earth have been like in the distant past, and what evidence is there for this? 2. How does the evidence about the way life has evolved on Earth from long ago tell us about Earth today?
	Relevance and Application: 1. There is growing concern over the current extinction of organisms around the world – and the consequences of these extinctions.
	Nature of Science: 1. Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists. 2. Cite various scientific arguments regarding the causes and effects of mass extinctions.

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	21st Century Skills and Readiness Competencies
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 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	**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. 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.

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	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based explanation about why there generally are more producers than consumers in an ecosystem b. Design a food web diagram to show the flow of energy through an ecosystem c. Compare and contrast the flow of energy with the cycling of matter in ecosystems	**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 physic's experiments. 2. Generate solutions to help mitigate environmental problems based on an understanding of the cycling of matter and energy. 3. Create and evaluate models that show how interactions create a flow of energy and a cycling of matter in an ecosystem.

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	21st Century Skills and Readiness Competencies
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 b. Analyze and interpret data to generate evidence that all organisms have structures that are required for survival in both plants and animals c. Create and evaluate models of plant and/or animal systems or parts	**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.

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	21st Century Skills and Readiness Competencies
Students can: a. Develop and communicate an evidence-based scientific explanation regarding how humans address basic survival needs b. Analyze and interpret data to generate evidence that human systems are interdependent c. Assess further scientific explanations regarding basic human body system functions d. Create and evaluate models of human body systems and organs e. Compare and contrast a human system to that of another organism, and provide hypotheses about why the similarities and differences exist	**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. 2. Critically evaluate models of the human body, identifying the strengths and weaknesses of the model in representing complex natural phenomena.

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: Fourth Grade

Concepts and skills students master:

1. All living things share similar characteristics, but they also have differences that can be described and classified

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use evidence to develop a scientific explanation of what plants and animals need to survive b. Use evidence to develop a scientific explanation for similarities and/or differences among different organisms (species) c. Analyze and interpret data representing variation in a trait d. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate questions about characteristics of living things	**Inquiry Questions:** 1. How have classification systems changed over time? 2. How are individuals in a related species similar and different?
	Relevance and Application: 1. Human beings have use technology in order to survive in a variety of climates, such as heating and air conditioning.
	Nature of Science: 1. Understand that all scientific knowledge is subject to new findings and that the presence of reproducible results yields a scientific theory. 2. Evaluate and provide feedback on evidence used by others to justify how they classified organisms.

Content Area: Science
Standard: 2. Life Science

Prepared Graduates:

- Explain how biological evolution accounts for the unity and diversity of living organisms

Grade Level Expectation: Fourth Grade

Concepts and skills students master:

2. Comparing fossils to each other or to living organisms reveals features of prehistoric environments and provides information about organisms today

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use evidence to develop a scientific explanation for: 1. What fossils tell us about a prehistoric environment 2. What conclusions can be drawn from similarities between fossil evidence and living organisms b. Analyze and interpret data to generate evidence about the prehistoric environment c. Evaluate whether reasoning and conclusions about given fossils are supported by evidence d. Use computer simulations that model and recreate past environments for study and entertainment	**Inquiry Questions:** 1. What are some things fossils can't tell us? 2. What conditions would most likely lead to something becoming a fossil?
	Relevance and Application: 1. Computers are used to model and recreate past environments for study and entertainment.
	Nature of Science: 1. Ask testable questions about past environments. 2. Make predictions about past environments based on fossil evidence. 3. Recognize that different interpretations of evidence are possible.

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: Fourth Grade

Concepts and skills students master:

3. There is interaction and interdependence between and among living and nonliving components of ecosystems

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use evidence to develop a scientific explanation on how organisms adapt to their habitat b. Identify the components that make a habitat type unique c. Compare and contrast different habitat types d. Create and evaluate models of the flow of nonliving components or resources through an ecosystem e. Make a plan to positively impact a local ecosystem f. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate endangered habitats	**Inquiry Questions:** 1. How are resources shared among organisms in a specific ecosystem or habitat? 2. How do nonliving components of an ecosystem influence living components? 3. What would happen if the Sun's energy no longer reached Earth? 4. What would happen if water were removed from an ecosystem? **Relevance and Application:** 1. Humans can have positive and negative impacts on an ecosystem. 2. Nonliving components are cycled and recycled through ecosystems and need to be protected and conserved. **Nature of Science:** 1. Understand that models are developed to explain and predict natural phenomena that cannot be directly observed because they happen over long periods of time. 2. Evaluate models that show interactions between living and nonliving components of ecosystems, identifying the strengths and weaknesses of the model in representing what happens in the real world.

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: Third Grade

Concepts and skills students master:

1. The duration and timing of life cycle events such as reproduction and longevity vary across organisms and species

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use evidence to develop a scientific explanation regarding the stages of how organisms develop and change over time b. Analyze and interpret data to generate evidence that different organisms develop differently over time c. Use a variety of media to collect and analyze data regarding how organisms develop	**Inquiry Questions:** 1. How are life cycles from a variety of organisms similar and different? 2. How does an organism change throughout its life cycle?
	Relevance and Application: 1. Living things may have different needs at different points in their life cycles.
	Nature of Science: 1. Ask a testable question about the life cycles of a variety of organisms. 2. Compare what is done in class to the work of scientists: a. Scientists evaluate and use data generated by other scientists to further their own ideas, just like students compare data in class. b. A community of scientists weaves together different evidence and ideas to deepen understanding, similar to how students do investigations and read books to deepen understanding about a concept.

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	21st Century Skills and Readiness Competencies
Students can: a. Use evidence to develop a scientific explanation about how organisms depend on their habitat. b. Analyze and interpret data about nonliving components of a habitat c. Assess and provide feedback on other scientific explanations regarding why an organism can survive in its habitat 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).	**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. 2. Collaborate with other students in developing a scientific explanation about how organisms depend on their habitat.

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	21st Century Skills and Readiness Competencies
Students can: a. Use evidence to develop an explanation as to why a habitat is or is not suitable for a specific organism b. Analyze and interpret data about structures or behaviors of a population that help that population survive	**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. 2. Share observations, and provide and respond to feedback on ideas about the advantages of specific structures and behaviors.

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: First Grade

Concepts and skills students master:

1. Offspring have characteristics that are similar to but not exactly like their parents' characteristics

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use evidence to analyze similarities and differences between parents and offspring in a variety of organisms including both plants and animals b. Analyze and interpret data regarding the similarities and differences between parents and offspring c. Question peers about evidence used in developing ideas about similarities and differences between parents and offspring d. Interpret information represented in pictures, illustrations, and simple charts	**Inquiry Questions:** 1. How are you like your parents? 2. In what ways do offspring resemble their parents?
	Relevance and Application: 1. Diversity – or variation – exists within populations of living organisms. 2. Family photographs often reveal similar physical traits. 3. Parents eye color can be different their child's.
	Nature of Science: 1. Compare and contrast data, recognizing that this is a process scientists would do in their work. 2. Question peers about the evidence used in developing their ideas about the similarities and differences between parents and offspring.

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: First Grade

Concepts and skills students master:

2. An organism is a living thing that has physical characteristics to help it survive

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify organisms and use evidence based scientific explanations for classifying them into groups b. Analyze and interpret data about the needs of plants and animals c. Use direct observations and other evidence to support ideas concerning physical characteristics that help plants and animals survive	**Inquiry Questions:** 1. How do the needs of plants and animals differ? 2. What helps a specific plant or animal survive?
	Relevance and Application: 1. Animals and plants have characteristics that help them survive in the local environment. For example, the thick fur of animals such as raccoons, bears, and mule deer helps them survive the cold winters in Colorado. 2. A living thing can be harmed if needed resources are lacking.
	Nature of Science: 1. Ask testable questions about the needs of an organism. 2. Predict the outcome for an organism if a need is removed.

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: Kindergarten

Concepts and skills students master:

1. Organisms can be described and sorted by their physical characteristics

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Sort a group of items based on observable characteristics b. Communicate and justify an evidence-based scientific rationale for sorting organisms into categories	**Inquiry Questions:** 1. What do living things have in common? 2. What characteristics are useful for sorting and classifying organisms?
	Relevance and Application: 1. There are patterns in the natural world. 2. There are many ways to classify a group of organisms.
	Nature of Science: 1. Ask questions about physical characteristics that will help them sort organisms. 2. Share scientific ideas verbally in a clear way. 3. Question peers about reasons for how they sort organisms, and encourage them to use evidence to support their ideas. 4. Use scientific tools such as magnifying glasses, sorting blocks, and rulers in investigations and play.

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

Grade Level Expectation: Preschool

Concepts and skills students master:

1. Living things have characteristics and basic needs

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use senses to gather information about living things b. Observe and explore the natural processes of growing, changing, and adapting to the environment c. Ask and pursue questions through simple investigations and observations of living things d. Collect, describe, and record information about living things through discussion, drawings, and charts	**Inquiry Questions:** 1. What do living things need to survive?
	Relevance and Application: 1. Mittens and hats keep people warm when the weather is cold. 2. Gills on a fish allow them to "breathe" under water.
	Nature of Science: 1. Be open to and curious about new tasks and challenges. 2. Explore and experiment.

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

Grade Level Expectation: Preschool

Concepts and skills students master:

2. Living things develop in predictable patterns

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify the common needs such as food, air, and water of familiar living things b. Predict, explain, and infer patterns based on observations and representations of living things, their needs, and life cycles c. Make and record by drawing, acting out, or describing observations of living things and how they change over time	**Inquiry Questions:** 1. How do different living things change over time? 2. What are some similarities and differences in how living things develop? 3. How do the adults of various animals compare to younger versions of those same animals? **Relevance and Application:** 1. Butterflies have a predictable growth cycle. 2. Leaves on a tree change color and fall every year. **Nature of Science:** 1. Show a capacity for invention and imagination when looking for patterns of development.

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 and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet

Grade Level Expectation: High School

Concepts and skills students master:

1. The history of the universe, solar system and Earth can be inferred from evidence left from past events

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation addressing questions about Earth's history b. Analyze and interpret data regarding Earth's history using direct and indirect evidence c. Analyze and interpret data regarding the history of the universe using direct and indirect evidence d. Seek, evaluate, and use a variety of specialized resources available from libraries, the Internet, and the community to find scientific information on Earth's history e. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate the history of the universe, solar system and Earth	**Inquiry Questions:** 1. How do we know the age of Earth, Sun and universe? 2. How did the formation of Earth help shape its features today? 3. How can we interpret the geologic history of an area? **Relevance and Application:** 1. Geologic principles such as original horizontality, superposition, cross-cutting relationships, unconformities, and index fossils allow us to accurately interpret geologic history. 2. Employ data-collection technology such as geographic mapping systems and visualization tools to gather and analyze data and scientific information about Earth's history. **Nature of Science:** 1. Understand that all scientific knowledge is subject to new evidence and that the presence of reproducible results yields a scientific theory. 2. Critically evaluate scientific claims in popular media and by peers regarding Earth's history, and determine if evidence presented is appropriate and sufficient to support the claims.

Content Area: Science
Standard: 3. Earth Systems Science

Prepared Graduates:

- 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

Grade Level Expectation: High School

Concepts and skills students master:

2. As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation addressing questions around the extraterrestrial forces and energies that influence Earth b. Analyze and interpret data regarding extraterrestrial forces and energies c. Clearly identify assumptions behind conclusions regarding extraterrestrial forces and energies and provide feedback on the validity of alternative explanations d. Use specific equipment, technology, and resources such as satellite imagery, global positioning systems (GPS), global information systems (GIS), telescopes, video and image libraries, and computers to explore the universe)	**Inquiry Questions:** 1. What influences Earth's position in the universe? 2. How does Earth get its energy? 3. How does the electromagnetic spectrum positively and negatively impact Earth's systems? **Relevance and Application:** 1. Fusion is the most common source of energy in the universe, and it provides the basis of Earth's energy through fusion reactions in the Sun. 2. Different types of telescopes have given us data about the universe, galaxy, and solar system. **Nature of Science:** 1. Understand the physical laws that govern Earth are the same physical laws that govern the rest of the universe. 2. Critically evaluate strengths and weaknesses of a model which represents complex natural phenomena.

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: High School

Concepts and skills students master:

3. The theory of plate tectonics helps explain geological, physical, and geographical features of Earth

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation about the theory of plate tectonics and how it can be used to understand geological, physical, and geographical features of Earth b. Analyze and interpret data on plate tectonics and the geological, physical, and geographical features of Earth c. Understand the role plate tectonics has had with respect to long-term global changes in Earth's systems such as continental buildup, glaciations, sea-level fluctuations, and climate change d. Investigate and explain how new conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics	**Inquiry Questions:** 1. How do the different types of plate boundaries create different landforms on Earth? 2. How have scientists "discovered" the layers of Earth? 3. What drives plate motion? 4. What might happen to Earth's landforms in the future? **Relevance and Application:** 1. New conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics. **Nature of Science:** 1. Understand that all scientific knowledge is subject to new findings and that the presence of reproducible results yields a scientific theory. 2. Ask testable questions and make a falsifiable hypothesis about plate tectonics and design a method to find an answer. 3. Share experimental data, and respectfully discuss conflicting results. 4. Recognize that the current understanding of plate tectonics has developed over time and become more sophisticated as new technologies have lead to new evidence.

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: High School

Concepts and skills students master:

4. Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation that shows climate is a result of energy transfer among the atmosphere, hydrosphere, geosphere and biosphere b. Analyze and interpret data on Earth's climate c. Explain how a combination of factors such as Earth's tilt, seasons, geophysical location, proximity to oceans, landmass location, latitude, and elevation determine a location's climate d. Identify mechanisms in the past and present that have changed Earth's climate e. Analyze the evidence and assumptions regarding climate change f. Interpret evidence from weather stations, buoys, satellites, radars, ice and ocean sediment cores, tree rings, cave deposits, native knowledge, and other sources in relation to climate change	**Inquiry Questions:** 1. How can changes in the ocean create climate change? 2. How is climate influenced by changes in Earth's energy balance? 3. How have climates changed over Earth's history? 4. How does climate change impact all of Earth's systems? 5. How have climate changes impacted human society? **Relevance and Application:** 1. Much of the data we receive about the ocean and the atmosphere is from satellites. 2. Human actions such as burning fossil fuels might impact Earth's climate. 3. Technological solutions and personal choices such as driving higher mileage cars and using less electricity could reduce the human impact on climate. **Nature of Science:** 1. Understand how observations, experiments, and theory are used to construct and refine computer models. 2. Examine how computer models are used in predicting the impacts of climate change. 3. Critically evaluate scientific claims in popular media and by peers regarding climate and climate change, and determine if the evidence presented is appropriate and sufficient to support the claims.

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: High School

Concepts and skills students master:

5. There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources b. Evaluate positive and negative impacts on the geosphere, atmosphere, hydrosphere, and biosphere in regards to resource use c. Create a plan to reduce environmental impacts due to resource consumption d. Analyze and interpret data about the effect of resource consumption and development on resource reserves to draw conclusions about sustainable use	**Inquiry Questions:** 1. How do humans use resources? 2. How can humans reduce the impact of resource use? 3. How are resources used in our community? 4. What are the advantages and disadvantages of using different types of energy? **Relevance and Application:** 1. Technologies have had a variety of impacts on how resources are located, extracted, and consumed. 2. Technology development has reduced the pollution, waste, and ecosystem degradation caused by extraction and use. **Nature of Science:** 1. Infer assumptions behind emotional, political, and data-driven conclusions about renewable and nonrenewable resource use. 2. Critically evaluate scientific claims in popular media and by peers, and determine if evidence presented is appropriate and sufficient to support the claims.

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: High School

Concepts and skills students master:

6. The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation addressing questions regarding the interaction of Earth's surface with water, air, gravity, and biological activity b. Analyze and interpret data, maps, and models concerning the direct and indirect evidence produced by physical and chemical changes that water, air, gravity, and biological activity create c. Evaluate negative and positive consequences of physical and chemical changes on the geosphere d. Use remote sensing and geographic information systems (GIS) data to interpret landforms and landform impact on human activity	**Inquiry Questions:** 1. How do Earth's systems interact to create new landforms? 2. What are positive changes on Earth's geosphere due to water, air, gravity, and biological activity? 3. What are negative changes on Earth's geosphere due to water, air, gravity, and biological activity? **Relevance and Application:** 1. Geologic, physical, and topographic maps can be used to interpret surface features 2. Recognize that landform models help us understand the interaction among Earth's systems. 3. Human activities such as agricultural practices have impacts on soil formation and soil loss.) **Nature of Science:** 1. Ask testable questions and make a falsifiable hypothesis about physical and chemical changes on the geosphere and use an inquiry based approach to find an answer. 2. Share experimental data, and respectfully discuss conflicting results. 3. Use appropriate technology to help gather and analyze data, find background information, and communicate scientific information on physical and chemical changes.

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: High School

Concepts and skills students master:

7. Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation regarding natural hazards, and explain their potential local and global impacts b. Analyze and interpret data about natural hazards using direct and indirect evidence c. Make predictions and draw conclusions about the impact of natural hazards on human activity – locally and globally	**Inquiry Questions:** 1. Why are some natural hazards difficult to predict, while others are easier to predict? 2. How are humans impacted by natural hazards? 3. How can we prepare for natural hazards? 4. How is climate change expected to change the incidence of natural hazards? **Relevance and Application:** 1. Engineers must know the hazards of a local area and design for it such as building safe structures in zones prone to earthquakes, hurricanes, tsunamis, or tornadoes. 2. Differing technologies are used to study different types of natural hazards. 3. Natural hazard zones affect construction or explain why monitoring natural hazards through air traffic safety, evacuations, and protecting property is important. 4. Science is used by disaster planners who work with the scientific community to develop diverse ways to mitigate the impacts of natural hazards on the human population and on a given ecosystem. **Nature of Science:** 1. Collaborate with local, national, and global organizations to report and review natural disaster data, and compare their conclusions to alternate explanations.

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: Eighth Grade

Concepts and skills students master:

1. Weather is a result of complex interactions of Earth's atmosphere, land and water, that are driven by energy from the sun, and can be predicted and described through complex models

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Differentiate between basic and severe weather conditions, and develop an appropriate action plan for personal safety and the safety of others b. Observe and gather data for various weather conditions and compare to historical data for that date and location c. Use models to develop and communicate a weather prediction	**Inquiry Questions:** 1. Why does weather vary from day to day? 2. What are the strengths and limitations of different types of weather models? 3. What are the variables that make predicting weather challenging? 4. How do weather patterns relate to climate?
	Relevance and Application: 1. Weather stations, buoys, satellites, radar, and computer modeling are examples of technology used to help forecast weather. 2. Weather prediction is based on the interaction of many variables. 3. Weather prediction can save lives, protect property, and conserve resources.
	Nature of Science: 1. Evaluate of the accuracy of various tools used in forecasting weather. 2. Use the historical context and impact of early weather research and consider the potential implications for current weather studies on science and our society.

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: Eighth Grade

Concepts and skills students master:

2. Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate and justify an evidence-based scientific explanation to account for Earth's different climates b. Research and evaluate direct and indirect evidence to explain how climates vary from one location to another on Earth c. Examine, evaluate, and question information from a variety of sources and media to investigate how climates vary from one location to another on Earth	**Inquiry Questions:** 1. How does the climate in one area compare and contrast with another area? 2. Why are there different climates on Earth? 3. How has Earth's climate changed over time? 4. What evidence supports and/or contradicts human influence on climate change? 5. What is the difference between weather and climate?
	Relevance and Application: 1. Data tables, charts, and graphs allow people to compare and contrast various climates around the globe. 2. Computer models help people understand past, present, and future climates.
	Nature of Science: 1. Ask testable questions and make a falsifiable hypothesis about earth's climate and use an inquiry based approach to find an answer. 2. Describe various techniques that scientists use to study climate, and suggest ways that each technique can be used to better understand various climates and changes in climate.

Content Area: Science
Standard: 3. Earth Systems Science

Prepared Graduates:

- 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

Grade Level Expectation: Eighth Grade

Concepts and skills students master:

3. The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Construct a scale model of the solar system, and use it to explain the motion of objects in the system such a planets, Sun, Moons, asteroids, comets, and dwarf planets b. Describe methods and equipment used to explore the solar system and beyond c. Design an investigation that involves direct observation of objects in the sky, and analyze and explain results d. Research, critique, and communicate scientific theories that explain how the solar system was formed e. Use computer data sets and simulations to explore objects in the solar system f. Recognize that mathematical models are used to predict orbital paths and events	**Inquiry Questions:** 1. How are the various bodies in the solar system similar and different? 2. How does investigating characteristics of the various bodies in the solar system provide clues to Earth's origin and evolution? 3. Why do objects such as satellites, Moons and planets stay in orbit? 4. How is the life cycle of a star such as the Sun similar to the cycle of life on Earth? **Relevance and Application:** 1. Various technological methods and equipment such as telescopes are used to investigate far-away objects in the solar system and beyond. 2. By representing galaxies and solar systems, planetariums allow people to simulate the experience of outer space. **Nature of Science:** 1. Understand that scientists work from the assumption that the universe is a single system in which the basic rules are the same everywhere – that planets follow the same rules about forces as other objects. 2. Recognize that our current understanding of the solar system has developed over centuries of studies by many scientists, and that through continued scientific investigations and advances in data collection, we will continue to refine our understanding of the solar system.

Content Area: Science
Standard: 3. Earth Systems Science

Prepared Graduates:

- 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

Grade Level Expectation: Eighth Grade

Concepts and skills students master:

4. The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based explanation using relative positions of Earth, Moon, and Sun to explain the following natural phenomenon: 1. Tides 2. Eclipses of the Sun and Moon 3. Different shapes of the Moon as viewed from Earth b. Analyze and interpret data to explain why we have seasons c. Use models to explain the relative motions of Earth, Moon, and Sun over time	**Inquiry Questions:** 1. Why do we observe changes in the relative positions of Earth, Moon, and Sun from Earth over time? 2. How do the relative positions of Earth, Moon and Sun affect natural phenomenon on Earth? **Relevance and Application:** 1. Different tools are used to help understand motion in the solar system. 2. Space missions can be planned because we understand planetary motion. **Nature of Science:** 1. Explore the global consequences of the interrelationships among science, technology and human activity. 2. Evaluate visual and print media for scientific evidence, bias, and conjecture related to the historical ideas about relative positions of the Earth, Moon 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: Seventh Grade

Concepts and skills students master:

1. Major geologic events such as earthquakes, volcanic eruptions, mid-ocean ridges, and mountain formation are associated with plate boundaries and attributed to plate motions

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Gather, analyze, and communicate data that explains Earth's plates, plate motions, and the results of plate motions b. Identify, interpret, and explain models of plates motions on Earth c. Use maps to locate likely geologic "hot spots", using evidence of earthquakes and volcanic activity d. Use web-based or other technology tools to show connections and patterns in data about tectonic plate boundaries and earthquakes, volcanic eruptions, and mountain formation	**Inquiry Questions:** 1. How can major geologic events be attributed to plate movement? 2. What evidence supports the theory of plate tectonics? 3. What are the effects of plate movement along plate boundaries?
	Relevance and Application: 1. Computer models and simulations help us understand and make informed decisions about major geologic events. 2. Building codes and emergency plans often reflect natural threats in an area.
	Nature of Science: 1. Construct a model to demonstrate how plate movement results in geologic events. 2. Trace the development of a scientific theory using the theory of plate tectonics. 3. 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.

Content Area: Science
Standard: 3. Earth Systems Science

Prepared Graduates:

- 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

Grade Level Expectation: Seventh Grade

Concepts and skills students master:

2. Geologic time, history, and changing life forms are indicated by fossils and successive sedimentation, folding, faulting, and uplifting of layers of sedimentary rock

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Describe the geologic time scale and why it is used b. Identify and describe the impact of major geologic events on life on Earth c. Identify and describe major events in Earth's geologic history d. Use direct and indirect evidence to determine the sequence of events in geologic time	**Inquiry Questions:** 1. How can we interpret data from layers of rock? 2. What is geologic time?
	Relevance and Application: 1. Knowledge of Earth's structure such as knowing where to mine for gold or drill for oil helps humans locate and extract resources. 2. Dating fossils absolutely and relatively helps assemble the story of the evolution of life on Earth.
	Nature of Science: 1. Ask testable questions and make falsifiable hypotheses on the history of the earth and design a method to find an answer. 2. Describe how scientists study fossils, and suggest ways that understanding fossil evidence contributed to our knowledge about life on Earth over geologic time.

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

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Gather, analyze, and communicate an evidence-based explanation for the complex interaction between Earth's constructive and destructive forces b. Gather, analyze and communicate evidence form text and other sources that explains the formation of Earth's surface features c. Use a computer simulation for Earth's changing crust	**Inquiry Questions:** 1. How do forces inside Earth and on the surface build, destroy, and change Earth's crust? 2. How does Earth's surface change over time?
	Relevance and Application: 1. There are costs and benefits to building in areas that are prone to constructive and destructive forces such as earthquakes and landslides. 2. Harbors, glaciers, and geysers change over time based on geologic and natural events.
	Nature of Science: 1. Practice the collaborative inquiry process that scientists use to identify local evidence of Earth's constructive and destructive processes. 2. Create and compare models that show how natural processes affect Earth's structures.

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	21st Century Skills and Readiness Competencies
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 b. Use evidence to model how water is transferred throughout the earth c. Identify problems, and propose solutions related to water quality, circulation, and distribution – both locally and worldwide d. Identify the various causes and effects of water pollution in local and world water distributions e. Describe where water goes after it is used in houses or buildings	**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. 2. Create and evaluate models; identifying the strengths and weaknesses of the model in representing water circulation and distribution.

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	21st Century Skills and Readiness Competencies
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 b. Identify and evaluate types and availability of renewable and nonrenewable resources c. Use direct and indirect evidence to determine the types of resources and their applications used in communities d. Research and critically evaluate data and information about the advantages and disadvantages of using fossil fuels and alternative energy sources	**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.

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	21st Century Skills and Readiness Competencies
Students can: a. Develop and communicate a scientific explanation addressing a question of local relevance about resources generated by the sun or Earth b. Analyze and interpret a variety of data to understand the origin, utilization, and concerns associated with natural resources	**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.

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	21st Century Skills and Readiness Competencies
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	**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. 2. Utilize a variety of media sources to collect data for analysis regarding Earth processes and the changing surface. 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

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	21st Century Skills and Readiness Competencies
Students can: a. Develop and communicate an evidence-based scientific explanation for changes in weather conditions b. Gather, analyze, and interpret data such as temperature, air pressure, wind, and humidity in relation to daily weather conditions c. Describe weather conditions based on data collected using a variety of weather tools d. 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	**Inquiry Questions:** 1. Why does the Sun heat different surfaces at different rates? 2. Why does the weather change from day to day? **Relevance and Application:** 1. The Sun's energy helps change daily weather by influencing the water cycle, air movement, and temperature. 2. Gliders and birds exploit updrafts created by thermals. 3. Deicing airplanes in the winter is sometimes necessary so that they can fly. 4. Weather satellites generate data that measure and monitor changes in weather. **Nature of Science:** 1. Support explanations of weather using evidence. 2. Understand how weather maps are utilized to predict the weather from day to day. 3. Assess and provide feedback on other student's scientific explanations about weather, pushing for reasoning based on evidence and scientific principles.

Content Area: Science
Standard: 3. Earth Systems Science

Prepared Graduates:

- 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

Grade Level Expectation: Fourth Grade

Concepts and skills students master:

1. Earth is part of the solar system, which includes the Sun, Moon, and other bodies that orbit the Sun in predictable patterns that lead to observable paths of objects in the sky as seen from Earth

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Gather, analyze, and interpret data about components of the solar system b. Utilize direct and indirect evidence to investigate the components of the solar system c. Gather, analyze, and interpret data about the Sunrise and Sunset, and Moon movements and phases d. Develop a scientific explanation regarding relationships of the components of the solar system	**Inquiry Questions:** 1. What are the patterns of movement for the Sun and Moon across the sky? 2. How does Earth compare to other objects orbiting the Sun? 3. How do we study the solar system? **Relevance and Application:** 1. Space exploration has produced data to answer questions about the solar system. 2. Comets are observable objects seen from Earth which provide scientists data about the solar system. 3. Orbits in a predictable pattern in space influence season's on Earth. **Nature of Science:** 1. Understand that models are developed to explain and predict natural phenomena that cannot be directly observed because they happen over long periods of time. 2. Critically evaluate models of the solar system, identifying the strengths and weaknesses of the model in representing what happens in the real solar system.

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: Third Grade

Concepts and skills students master:

1. Earth's materials can be broken down and/or combined into different materials such as rocks, minerals, rock cycle, formation of soil, and sand – some of which are usable resources for human activity

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Investigate and identify two or more ways that Earth's materials can be broken down and/or combined in different ways such as minerals into rocks, rock cycle, formation of soil, and sand b. Use evidence to develop a scientific explanation about one or more processes that break down and/or combine Earth materials c. Utilize a variety of media sources to collect and analyze data around Earth's materials and the processes by which they are formed	**Inquiry Questions:** 1. What are some of the ways that Earth's materials are formed? 2. Where do these different materials such as soil, sand, rocks, and oil come from? What is the process by which the materials were formed? 3. How is Earth's surface changing? 4. How do rocks "cycle?"
	Relevance and Application: 1. Many of Earth's materials are usable building or energy resources. Extended processes and time are required to convert fossil fuels and soil into useful material.
	Nature of Science: 1. Ask testable questions about the composition and formation of rocks. 2. Use models to demonstrate the rock cycle or other ways Earth's materials are broken down or combined.

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	21st Century Skills and Readiness Competencies
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 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 c. Analyze ways in which severe weather contributes to catastrophic events such as floods and forest fires	**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. 2. Make predictions, share thinking, and ask others how they know that organisms and the environment are influenced by the weather and changing seasons. 3. Select and use appropriate tools to measure, record, and communicate data about the weather using appropriate units.

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: First Grade

Concepts and skills students master:

1. Earth's materials can be compared and classified based on their properties

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify and represent similarities and differences such as the texture, size, color, and shape of various materials on Earth b. Sort, group, and classify Earth's materials based on observations and explorations c. Make predictions about how a material on Earth might be useful based on its properties d. Communicate ideas about the differences between soils from different places e. Use a variety of tools to observe, analyze, record, and compare Earth's materials f. Analyze the impact of reducing, reusing, and recycling various materials	**Inquiry Questions:** 1. How are various materials on Earth similar and different? 2. How do the properties of various materials on Earth affect the way we can use them? 3. How does soil differ from different places? **Relevance and Application:** 1. Humans use natural resources in our daily lives and in a variety of ways. For example, wood for building and furniture. 2. There are limits on resources and materials extracted from the natural environment. **Nature of Science:** 1. The same materials can be sorted in a number of ways based on different characteristics. 2. Scientists make predictions based on what they know.

Content Area: Science
Standard: 3. Earth Systems Science

Prepared Graduates:

- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable
- 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

Grade Level Expectation: Kindergarten

Concepts and skills students master:

1. The Sun provides heat and light to Earth

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Investigate, explain, and describe that the Sun provides heat and light to Earth b. Analyze and interpret temperature data between day (when the Sun shines on our area) and night (when the Sun does not shine on our area) c. Investigate and communicate findings about what happens when the Sun's light is blocked d. Investigate and communicate the effect of varying heat and light on the growth of plants through a scientific study	**Inquiry Questions:** 1. How does the Sun impact Earth? 2. What happens when the Sun's light is blocked? **Relevance and Application:** 1. Decisions about activities to do on school grounds can be based on the light and heat from the sun (i.e. read under a tree to stay cool or avoid the slide when it is too hot from the sun, etc.) 2. People make decisions about where to live based on temperature and how much sun that place gets. **Nature of Science:** 1. Question peers and encourage clarity of reasoning about why they think the Sun provides heat and light to Earth.

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: Preschool

Concepts and skills students master:

1. Earth's materials have properties and characteristics that affect how we use those materials

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use senses to gather information about Earth's materials b. Make simple observations, explanations, and generalizations about Earth's materials based on real-life experiences c. Describe how various materials might be used based on characteristics or properties	**Inquiry Questions:** 1. What are the similarities and differences among various earth materials? 2. How do scientists study and describe Earth's materials?
	Relevance and Application: 1. Use scientific tools in investigations, and play with materials such as rocks, soil, sand, and water.
	Nature of Science: 1. Ask testable question based on discoveries made while playing. 2. Collect, describe, and record information through discussions, drawings, and charts.

Content Area: Science
Standard: 3. Earth Systems Science

Prepared Graduates:

- 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

Grade Level Expectation: Preschool

Concepts and skills students master:

2. Events such as night, day, the movement of objects in the sky, weather, and seasons have patterns

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify, predict, and extend patterns based on observations and representations of objects in the sky, daily weather, and seasonal changes b. Observe and describe patterns observed over the course of a number of days and nights, possibly including differences in the activities or appearance of plants and animals	**Inquiry Questions:** 1. What natural patterns do you notice during the day? 2. What natural patterns do you notice at night? 3. What patterns do you notice in the seasons? 4. What patterns do you notice in weather?
	Relevance and Application: 1. Different activities of various animals – including humans – are aligned with daily and seasonal patterns.
	Nature of Science: 1. Be open to and curious about new tasks and challenges. 2. Explore and experiment.

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