

ST[EMpower]



Standards: Paleontology 5 - Speciation

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Contents:

Colorado Academic
Science Standards aligned
to 57.Paleontology 5:
Speciation Newsletter pg.
2

Standards Abbreviation
Chart pg.

Both Colorado and NGSS
K-5 Standards pg.

CO 2020 MS / HS Science
Standards pg.

2020 Colorado Science Standards & NGSS

This year's ST[EMpower] focus is paleontology. As a paleontologist, I am quite thrilled to unfold the multi-disciplined science that truly fascinates people. The first issue provides the basic concepts of life of the past. These are critical ideas, and I strongly urge you to include them in any paleontology program you present.

I have updated the alignment for K-5 to include Colorado and the Next Generation of Science Standards (NGSS).

The Grade Level Expectations are at the end of this document if you want the description

for the standards code. I like to have everything at my fingertips, so it is all here.

If you have any questions, or would like to brainstorm ideas for using the lessons in the ST[EMpower] Newsletter, I would be happy to meet with you.

Happy Sciencing! (Okay, I know that isn't a word, but it sounds good!)



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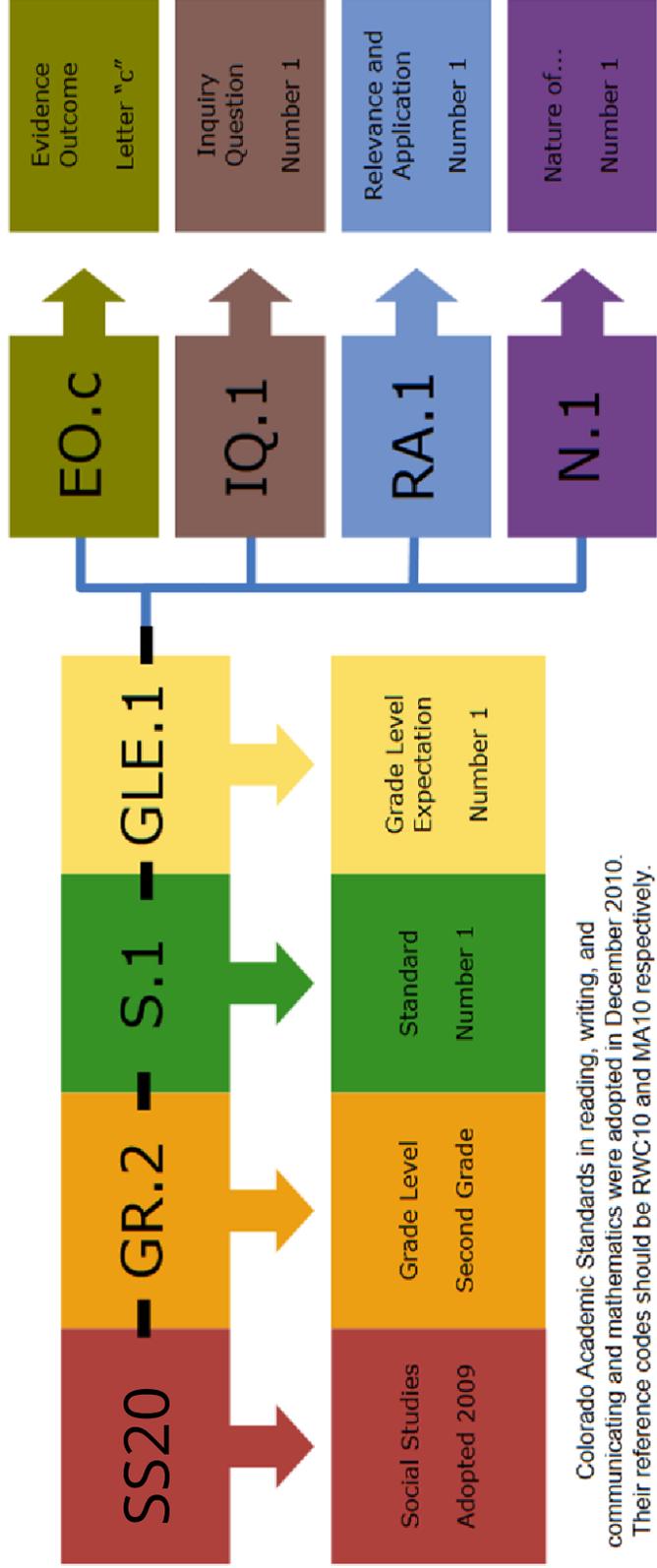
Colorado Academic Standards Reference System

Content Area Abbreviations

- DA09 Dance
- DT09 Drama and Theatre Arts
- CH09 Comprehensive Health
- PE09 Physical Education
- MA10 Mathematics
- MU09 Music
- RWC10 Reading, Writing and Communicating
- SC09 Science
- SS09 Social Studies
- VA09 Visual Arts
- WL09 World Languages

Content Area:	
Standard:	
Prepared Graduates:	➤
High School and Grade Level Expectations	
Concepts and skills students master:	
Evidence Outcomes	
Students can:	
	21 st Century Skills and Readiness Competencies
	Inquiry Questions:
	Relevance and Application:
	Nature of the Discipline:

STANDARDS TEMPLATE



Colorado Academic Standards in reading, writing, and communicating and mathematics were adopted in December 2010. Their reference codes should be RWC-10 and MA10 respectively.

Retrieved on 8/29/2018 from:

<https://www.cde.state.co.us/sites/default/files/documents/educatoreffectiveness/downloads/implementation%20resources/coding-the-cas.pdf>

Kindergarten	
2020 Standards	NGSS
GR.K-S.1-GLE.1. Pushes and pulls can have different strengths and directions, and can change the speed or direction of an object's motion or start or stop it.	K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
	K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.
GR.K-S.1-GLE.2. Sunlight effects the Earth's surface.	K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.
	K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.
GR.K-S.2-GLE.1. To live and grow; animals obtain food they need from plants or other animals, and plants need water and light.	K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.
GR.K-S.3-GLE.1. Patterns are observed when measuring the local weather, including how humans and other organisms impact their environment.	K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.
	K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.
	K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.
GR.K-S.3-GLE.2. Plants and animals meet their needs in their habitats and impact one another; people can prepare for severe weather.	K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
	K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
First Grade	
2020 Standards	NGSS
GR.1-S.1-GLE.1. Sound can make matter vibrate and vibrating matter can make sound.	1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
	1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.
	1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.

First Grade	
2020 Standards	NGSS
	1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.
GR.1-S.2-GLE.1. All organisms have external parts that they use to perform daily functions.	1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
GR.1-S.2-GLE.2. Young organisms are very much, but not exactly, like their parents, and also, resemble other organisms of the same kind.	1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.
	1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.
GR.1-S.3-GLE.1. Patterns of movement of the sun, moon, and the stars as seen from Earth can be observed, described, and predicted.	1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.
	1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.
Second Grade	
2020 Standards	NGSS
GR.2-S.1-GLE.1. Matter exists as different substances that have observable different properties.	2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
	2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
	2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.
	2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Second Grade

2020 Standards	NGSS
GR.2-S.2-GLE.1. Plants depend on water and light to grow and on animals for pollination or to move their seeds around.	2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.
	2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.
GR.2-S.2-GLE.2. A range of different organisms lives in different places.	2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.
GR.2-S.3-GLE.1. Some events on Earth occur quickly; others can occur very slowly.	2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
GR.2-S.3-GLE.2. Wind and water can change the shape of the land; models can show the shape and these changes to the land.	2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
	2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.
	2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Third Grade

2020 Standards	NGSS
GR.3-S.1-GLE.1. Patterns of motion can be used to predict future motion.	3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object
	3-PS2-2. Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.
GR.3-S.1-GLE.2. Objects in contact exert forces on each other; electric and magnetic forces between a pair of objects do not require contact.	3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
	3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.
GR.3-S.2-GLE.1. Organisms have unique and diverse life cycles.	

Third Grade	
2020 Standards	NGSS
GR.3-S.2-GLE.2. Being part of a group helps animals obtain food, defend themselves, and cope with changes.	3-LS2-1. Construct an argument that some animals form groups that help members survive.
GR.3-S.2-GLE.3. Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.	3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
GR.3-S.2-GLE.4. Some living organisms resemble organisms that once lived on Earth.	3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
GR.3-S.2-GLE.5. Sometimes differences in characteristics between individuals of the same species provide advantages in survival and reproduction.	
	3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
GR.3-S.3-GLE.1. Climate describes patterns of typical weather conditions over different scales and variations; historical weather patterns can be analyzed.	3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
	3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.
GR.3-S.3-GLE.2. A variety of weather hazards result from natural process; humans cannot eliminate weather related hazards but can reduce their impacts.	3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.
Fourth Grade	
2020 Standards	NGSS
GR.4-S.1-GLE.1. The faster an object moves the more energy it has.	4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Fourth Grade	
2020 Standards	NGSS
GR.4-S.1-GLE.2. Energy can be moved from place to place.	4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
GR.4-S.1-GLE.3. When objects collide contact forces transfer so as to change objects' motion.	4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.
GR.4-S.1-GLE.4. Energy can be produced, used, or released by converting stored energy.	4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
GR.4-S.1-GLE.5. Waves are regular patterns of motion.	4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
GR.4-S.1-GLE.6. An object can be seen when light reflected from its surface enters the eyes.	4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
GR.4-S.1-GLE.7. Patterns can encode, send, receive and decode information.	4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.
GR.4-S.2-GLE.1. Organisms have both internal and external structures that serve various functions.	4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
	4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.
GR.4-S.3-GLE.1. Earth has changed over time.	4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
GR.4-S.3-GLE.2. Four major earth systems interact.	4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
GR.4-S.3-GLE.3. Earth's physical features occur in patterns.	4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.
GR.4-S.3-GLE.4. Energy and fuels that humans use are derived from natural sources and their use affects the environment in multiple ways.	4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.

Fourth Grade	
2020 Standards	NGSS
GR.4-S.3-GLE.5. A variety of hazards result from natural process; humans cannot eliminate natural hazards but can reduce their impacts' effect.	4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
Fifth Grade	
2020 Standards	NGSS
GR.5-S.1-GLE.1. Matter exists as particles that are too small to be seen; measurements of a variety of observable properties can be used to identify particular materials.	5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.
	5-PS1-3. Make observations and measurements to identify materials based on their properties.
GR.5-S.1-GLE.2. Chemical Reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same.	5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
	5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
GR.5-S.1-GLE.3. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.
GR.5-S.1-GLE.4. The energy released from food was once energy from the sun.	5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.
GR.5-S.2-GLE.1. Plants acquire their material from growth chiefly from air and water.	5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.
GR.5-S.2-GLE.2. Matter cycles between air and soil and among plants, animals, and microbes as these organisms live and die.	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
GR.5-S.3-GLE.1. Stars range greatly in size and distance from Earth, and this can explain their relative brightness.	5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

Fifth Grade	
2020 Standards	NGSS
GR.5-S.3-GLE.2. Earth’s orbit and rotation and the orbit of the moon around earth cause observable patterns.	5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
GR.5-S.3-GLE.3. Earth’s major systems interact in multiple ways to affect Earth’s surface materials and processes.	5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
GR.5-S.3-GLE.4. Most of Earth’s water is in the ocean and much of Earth’s freshwater in glaciers or underground.	5-ESS2-2. Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
GR.5-S.3-GLE.5. Societal activities have had major effects on land, ocean, atmosphere, and even outer space.	5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

2020 Colorado State Academic Science Standards

Middle School

1. Physical Science

1. The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter and phases changes.
2. Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.
3. Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion.
4. Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object.
5. Kinetic energy can be distinguished from the various forms of potential energy.
6. Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states and amounts of matter.
7. When two objects interact, each one exerts a force on the other that can cause energy to be

transferred to and from the object.

8. A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound.
9. A wave model of light is useful to explain how light interacts with objects through a variety of properties.
10. Designed technologies can transmit digital information as wave pulses.

2. Life Science

1. All living things are made up of cells, which is the smallest unit that can be said to be alive.
2. Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.
3. Sustaining life requires substantial energy and matter inputs.
4. Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain.
5. Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving.
6. Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and

the recycling of matter and nutrients within the system.

7. Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem.
8. Heredity explains why offspring resemble, but are not identical to, their parents and is a unifying biological principle. Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes.
9. Fossils are mineral replacements, preserved remains, or traces of organisms that lived in the past.
10. Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment.
11. Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions.
12. Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems.

3. Earth and Space Science

1. Motion is predictable in both solar systems and galaxies.
2. The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
3. Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.
4. Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.
5. Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history.
6. Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.
7. Complex interactions determine local weather patterns and influence climate, including the role of the ocean.
8. Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the

planet as a result of past geologic processes.

9. Mapping the history of natural hazards in a region and understanding related geological forces.
10. Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things.
11. Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.

High School

1. Physical Science

1. The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter. Sunlight affects the Earth's surface.
2. Chemical processes, their rates, their outcomes, and whether or not energy is stored or released can be understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.
3. The strong nuclear interaction provides the primary force that holds nuclei together. Nuclear processes including fusion, fission, and radioactive decays of unstable nuclei involve changes in nuclear binding energies.
4. Newton's second law and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.
5. Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them.
6. Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.
7. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
8. Force fields (gravitational, electric, and magnetic) contain energy and can transmit energy across space from one object to another.
9. Although energy cannot be destroyed, it can be converted to less useful forms as it is captured, stored and transferred.
10. Waves have characteristic properties and behaviors.
11. Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common

applications of electromagnetic radiation.

12. Multiple technologies that are part of everyday experiences are based on waves and their interactions with matter.

2. Life Science

1. DNA codes for the complex hierarchical organization of systems that enable life's functions.
2. Growth and division of cells in complex organisms occurs by mitosis, which differentiates specific cell types.
3. Organisms use matter and energy to live and grow.
4. Organisms interact with the living and nonliving components of the environment to obtain matter and energy.
5. Matter and energy necessary for life are conserved as they move through ecosystems.
6. A complex set of interactions determine how ecosystems respond to disturbances.
7. Organisms interact in groups to benefit the species.
8. The characteristics of one generation are dependent upon the genetic information inherited from previous generations.
9. Variation between individuals results from genetic and environmental factors.
10. Evidence of common ancestry and diversity between species can be determined by examining variations including genetic, anatomical and physiological differences.
11. Genetic variation among organisms affects survival and reproduction.
12. The environment influences survival and reproduction of organisms over multiple generations.
13. Humans have complex interactions with ecosystems and have the ability to influence biodiversity on the planet.

3. Earth and Space Science

1. All stars, including the sun, undergo stellar evolution, and the study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.
2. Explanations of and predictions about the motions of orbiting objects are described by the laws of physics.
3. The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.
4. Earth's systems, being dynamic and interacting,

cause feedback effects that can increase or decrease the original changes, and these effects occur on different time scales, from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.

5. Plate tectonics can be viewed as the surface expression of mantle convection, which is driven by heat from radioactive decay within Earth's crust and mantle.
6. The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
7. The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.
8. The biosphere and Earth's other systems have many interconnections that cause a continual co-evolution of Earth's surface and life on it.
9. Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.
10. Natural hazards and other geological events have shaped the course of human history at local, regional, and global scales.
11. Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
12. Global climate models used to predict future climate change continue to improve our understanding of the impact of human activities on the global climate system.



