A Model of the Three Dimensions of Science Learning

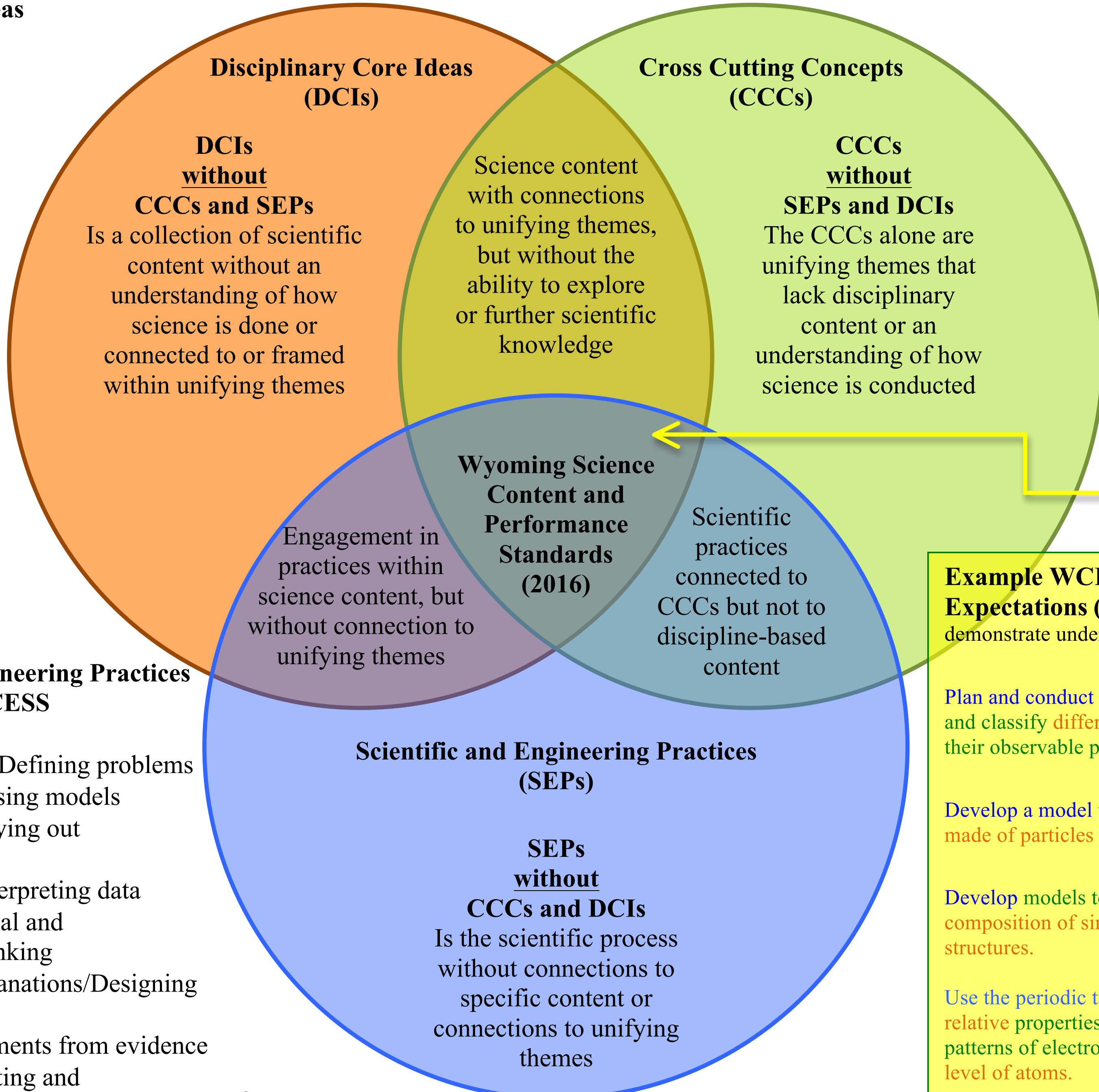
Adapted from: Houseal, A. (2015). A visual representation of three-dimensional learning: A tool for evaluating curriculum. Science Scope 39 (1): 58-62.

Disciplinary Core Ideas
CONTENT

- Life Sciences
- Physical Sciences
- Earth Systems Sciences
- Engineering, Technology, and Applications of Science

Cross Cutting Concepts
BIG IDEAS

- Patterns
- Cause & effect
- Scale, proportion, and quantity
- Systems & systems models
- Energy & matter
- Structure & function
- Stability & change



THIS IS WHERE WE WANT TO BE!

Scientific and Engineering Practices
PROCESS

- Asking questions/Defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematical and computational thinking
- Constructing explanations/Designing solutions
- Engaging in arguments from evidence
- Obtaining, evaluating and communicating information

Example WCPS Performance Expectations (PEs): Students who demonstrate understanding can:

2-PS1-1.
Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

5-PS1-1.
Develop a model to describe that matter is made of particles too small to be seen.

MS-PS1-1.
Develop models to describe the atomic composition of simple molecules and extended structures.

HS-PS1-1
Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

References:
National Research Council [NRC]. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.*. Washington, DC: The National Academies Press.
NRC. (2013). *Next Generation Science Standards: For States, By States.* Washington, DC: The National Academies Press.

Wyoming Science Content and Performance Standards

K-12 **2016**

Eight
Scientific and Engineering Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Forty-Four
DCI Components

Physical Sciences

PS1.A: Structure and Properties of Matter
B: Chemical Reactions
C: Nuclear Processes
PS2.A: Forces and Motion
B: Types of Interactions
C: Stability and Instability in Physical Systems
PS3.A: Definitions of Energy
B: Conservation of Energy and Energy Transfer
C: Relationship Between Energy and Forces
D: Energy in Chemical Processes and Everyday Life
PS4.A: Wave Properties
B: Electromagnetic Radiation
C: Information Technologies and Instrumentation

Life Sciences

LS1.A: Structure and Function
B: Growth and Development of Organisms
C: Organization for Matter and Energy Flow in Organisms
D: Information Processing
LS2.A: Interdependent Relationships in Ecosystems
B: Cycles of Matter and Energy Transfer in Ecosystems
C: Ecosystem Dynamics, Functioning, and Resilience
D: Social Interactions and Group Behavior
LS3.A: Inheritance of Traits
B: Variation of Traits
LS4.A: Evidence of Common Ancestry and Diversity
B: Natural Selection
C: Adaptation
D: Biodiversity and Humans

Earth and Space Sciences

ESS1.A: The Universe and its Stars
B: Earth and the Solar System
C: The History of Planet Earth
ESS2.A: Earth Materials and Systems
B: Plate Tectonics and Large-Scale System Interactions
C: The Roles of Water in Earth's Surface Processes
D: Weather and Climate
E: Biogeology
ESS3.A: Natural Resources
B: Natural Hazards
C: Human Impacts on Earth Systems
D: Global Climate Change

Engineering, Technology, and Applications of Science

ETS1.A: Defining and Delimiting an Engineering Problem
B: Developing Possible Solutions
C: Optimizing the Design Solution
ETS2.A: Interdependence of Sci, Eng, and Tech
B: Influence of Sci, Eng, and Tech, on Society and the Natural World

Seven
Crosscutting Concepts

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: Flows, cycles, and conservation
6. Structure and function
7. Stability and change

Three Dimensions of Learning

ISTE

National Educational Technology Standards for Students

1. **Creativity and Innovation**
   Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
   - **A.** Apply existing knowledge to generate new ideas, products, or processes.
   - **B.** Create original works as a means of personal or group expression.
   - **C.** Use models and simulations to explore complex systems and issues.
   - **D.** Identify trends and forecast possibilities.

2. **Communication and Collaboration**
   Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:
   - **A.** Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
   - **B.** Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
   - **C.** Develop cultural understanding and global awareness by engaging with learners of other cultures.
   - **D.** Contribute to project teams to produce original works or solve problems.

3. **Research and Information Fluency**
   Students apply digital tools to gather, evaluate, and use information. Students:
   - **A.** Plan strategies to guide inquiry.
   - **B.** Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
   - **C.** Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
   - **D.** Process data and report results.

4. **Critical Thinking, Problem Solving, and Decision Making**
   Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students:
   - **A.** Identify and define authentic problems and significant questions for investigation.
   - **B.** Plan and manage activities to develop a solution or complete a project.
   - **C.** Collect and analyze data to identify solutions and/or make informed decisions.
   - **D.** Use multiple processes and diverse perspectives to explore alternative solutions.

5. **Digital Citizenship**
   Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students:
   - **A.** Advocate and practice safe, legal, and responsible use of information and technology.
   - **B.** Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
   - **C.** Demonstrate personal responsibility for lifelong learning.
   - **D.** Exhibit leadership for digital citizenship.

6. **Technology Operations and Concepts**
   Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
   - **A.** Understand and use technology systems.
   - **B.** Select and use applications effectively and productively.
   - **C.** Troubleshoot systems and applications.
   - **D.** Transfer current knowledge to learning of new technologies.

Connections to the Common Core State Standards (CCSS) for Literacy in History, Social Studies, Science, and Technical Subjects: Standards Coding for Language Arts (ELA) & Math

Content Standard	**CCSS Coding**	**Stands for**	**Where You'll Find It**
ELA	R.CCR.9 W.CCR.1	Reading / Writing College- and Career-Ready Anchor Standard **Example:** R.CCR.9 = Reading, Individual College and Career Readiness (CCR) Anchor Standard, Standard 9	Language Arts Standards - CCSS ELA pages, after the introduction (Reading - CCR, K-5 pg. 10; Gr. 6-12 pg. 35) (Writing - CCR, K-5 pg. 18; Gr. 6-12 pg. 41)
Reading	RL.3.2 RI.4.3	Reading of Literature, Gr. 3 Reading for Information, Gr. 4 **Example:** RI.4.3 = Reading, Informational Text, Grade 4, Standard 3	Language Arts Standards - CCSS ELA pages, after the introduction (K-5 pp. 11-12; Gr. 6-12 pp. 36-38) (K-5 pp.13-14; Gr. 6-12 pp. 39-40)
Writing	W.5.1a	Writing, Gr. 5 **Example:** W.5.1a Writing, Grade 5, Standard 1a	Language Arts Standards - CCSS ELA pages, after the introduction (K-5 pp. 19-21; Gr. 6-12 pp. 42-47)
Literacy Standards for History, Science, & Technical Subjects	RHST.CCR.2 RH.9-10.3 RST.11-12.3 WHST.CCR.2 WHST.9-10.3	Reading for History/S.S., Science, & Technical Subjects), CCR Anchor Standard #2 Reading Lit. in History, Gr. 9-10 Reading Lit. in Science & Technical Subjects, Gr. 11-12 **Example:** RST.6-8.3 = Reading, Science and Technical Text, Grade 6-8, Standard 3	Language Arts Standards - CCSS ELA pages, after the introduction (Gr. 6-12) (Reading - CCR pg. 60) (Reading - History pg. 61) (Reading - Science & Technical Subjects (RST) pg. 62) (Writing - CCR pg. 63) (Writing for Literacy in History, Science, & Technical Subjects (WHST) pp. 64-66)
Math	MP.2 7.G.A.2	Math Practice #2 7th Grade Geometry **Example:** 4.MD.A.2 = 4th Grade Math, Measurement & Data Domain, 1st Cluster Heading, Standard 2	Mathematics Standards – CCSS Math pages, after the introduction (K-12 pp. 10-83)

All standards documents can be found on the Wyoming Department of Education Standards Page at http://edu.wyoming.gov/educators/standards/.

Wyoming Disciplinary Core Idea Progressions

Physical Science Progression

	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
PS1.A Structure of Matter (Includes PS1.C Nuclear Processes)	Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.	Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.	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, phase changes, and conservation of matter.	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, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.
PS1.B Chemical Reactions	Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	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.	Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.	Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.
PS2.A Forces and Motion	Pushes and pulls can have different strengths and directions, and can change the speed or direction of its motion or start or stop it.	The effect of unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion. Some forces act through contact, some forces act even when the objects are not in contact. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	The role of the mass of an object must be qualitatively accounted for in any change of motion due to the application of a force.	Newton's 2nd law (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.
PS2.B Types of Interactions			Forces that act at a distance involve fields that can be mapped by their relative strength and effect on an object.	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. These forces can be used to describe the relationship between electrical and magnetic fields.
PS2.C Stability & Instability in Physical Systems	N/A	N/A	N/A	N/A

Wyoming Disciplinary Core Idea Progressions

Physical Science Progression (cont.)

	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
PS3.A Definitions of Energy	N/A	Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.	Kinetic energy can be distinguished from the various forms of potential energy. 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.	The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects).
PS3.B Conservation of Energy and Energy Transfer	[Content found in PS3.D]			Systems move toward stable states.
PS3.C Relationship Between Energy and Forces	Bigger pushes and pulls cause bigger changes in an object's motion or shape.	When objects collide, contact forces transfer energy so as to change the objects' motions.	When two objects interact, each one exerts a force on the other, and these forces can transfer energy between them.	Fields contain energy that depends on the arrangement of the objects in the field.
PS3.D Energy in Chemical Processes and Everyday Life	Sunlight warms Earth's surface.	Energy can be "produced," "used," or "released" by converting stored energy. Plants capture energy from sunlight, which can later be used as fuel or food.	Sunlight is captured by plants and used in a reaction to produce sugar molecules, which can be reversed by burning those molecules to release energy.	Photosynthesis is the primary biological means of capturing radiation from the sun; energy cannot be destroyed, it can be converted to less useful forms.

Wyoming Disciplinary Core Idea Progressions

Physical Science Progression (cont.)				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
PS4.A Wave Properties	Sound can make matter vibrate, and vibrating matter can make sound.	Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength. Waves can make objects move.	A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy.	The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.
PS4.B Electromagnetic Radiation	Objects can be seen only when light is available to illuminate them.	Objects can be seen when light reflected from their surface enters our eyes.	The construct of a wave is used to model how light interacts with objects.	Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation.
PS4.C Information Technologies and Instrumentation	People use devices to send and receive information.	Patterns can encode, send, receive and decode information.	Waves can be used to transmit digital information. Digitized information is comprised of a pattern of 1s and 0s.	Large amounts of information can be stored and shipped around as a result of being digitized.

Wyoming Disciplinary Core Idea Progressions

Life Science Progression				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
LS1.A Structure and Function	All organisms have external parts that they use to perform daily functions.	Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.	Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.
LS1.B Growth and Development of Organisms	Parents and offspring often engage in behaviors that help the offspring survive.	Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles.	Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors.	Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.
LS1.C Organization for Matter and Energy Flow in Organisms	Animals obtain food they need from plants or other animals. Plants need water and light.	Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter and obtain energy from sunlight, which is used to maintain conditions necessary for survival.	Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.	The hydrocarbon backbones of sugars produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.
LS1.D Information Processing	Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.	Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.	Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain; The signals are then processed in the brain, resulting in immediate behavior or memories.	N/A

Wyoming Disciplinary Core Idea Progressions

Life Science Progression (cont.)				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
LS2.A Interdependent Relationships in Ecosystems	Plants depend on water and light to grow, and also depend on animals for pollination or to move their seeds around.	The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil.	Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.	Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem.
LS2.B Cycles of Matter and Energy Transfer in Ecosystems	[Content found in LS1.C and ESS3.A]	Matter cycles between the air and soil and among organisms as they live and die.	The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem elements are combined in different ways and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.
LS2.C Ecosystem Dynamics, Functioning, and Resilience	N/A	When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.	Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.
LS2.D Social Interactions and Group Behavior	N/A	Being part of a group helps animals obtain food, defend themselves, and cope with changes.	N/A	Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.

Wyoming Disciplinary Core Idea Progressions

Life Science Progression (cont.)				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
LS3.A Inheritance of Traits	Young organisms are very much, but not exactly, like their parents and also resemble other organisms of the same kind.	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.	Genes chiefly regulate a specific protein, which affect an individual's traits.	DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ.
LS3.B Variation of Traits			In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.	The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.
LS4.A Evidence of Common Ancestry and Diversity	N/A	Some living organisms resemble organisms that once lived on Earth. Fossils provide evidence about the types of organisms and environments that existed long ago.	The fossil record documents the existence, diversity, extinction, and change of many life forms and their environments through Earth's history. The fossil record and comparisons of anatomical similarities between organisms enables the inference of lines of evolutionary descent.	The ongoing branching that produces multiple lines of descent can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms.
LS4.B Natural Selection	N/A	Differences in characteristics between individuals of the same species provide advantages in surviving and reproducing.	Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population.	Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.

Wyoming Disciplinary Core Idea Progressions

Life Science Progression (cont.)				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
LS4.C Adaptation	N/A	Particular organisms can only survive in particular environments.	Species can change over time in response to changes in environmental conditions through adaptation by natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common.	Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence or extinction, can change when conditions change.
LS4.D Biodiversity and Humans	A range of different organisms lives in different places.	Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.	Changes in biodiversity can influence humans' resources and ecosystem services they rely on.	Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.

Wyoming Disciplinary Core Idea Progressions

Earth & Space Science Progression				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
ESS1.A The Universe and its Stars	Patterns of movement of the sun, moon, and stars as seen from Earth can be observed, described, and predicted.	Stars range greatly in size and distance from Earth and this can explain their relative brightness.	The solar system is part of the Milky Way, which is one of many billions of galaxies.	Light spectra from stars are used to determine their characteristics, processes, and lifecycles. Solar activity creates the elements through nuclear fusion. The development of technologies has provided the astronomical data that provide the empirical evidence for the Big Bang theory.
ESS1.B Earth and the Solar System		The Earth's orbit and rotation, and the orbit of the moon around the Earth cause observable patterns.	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.	Kepler's laws describe common features of the motions of orbiting objects. Observations from astronomy and space probes provide evidence for explanations of solar system formation. Changes in Earth's tilt and orbit cause climate changes such as Ice Ages.
ESS1.C The History of Planet Earth	Some events on Earth occur very quickly; others can occur very slowly.	Certain features on Earth can be used to order events that have occurred in a landscape.	Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.	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.
ESS2.A Earth Materials and Systems	Wind and water change the shape of the land.	Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around.	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.	Feedback effects exist within and among Earth's systems.

Wyoming Disciplinary Core Idea Progressions

Earth & Space Science Progression (cont.)				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
ESS2.B Plate Tectonics and Large-Scale System Interactions	Maps show where things are located. One can map the shapes and kinds of land and water in any area.	Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.	Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.	Radioactive decay within Earth's interior contributes to thermal convection in the mantle.
ESS2.C The Roles of Water in Earth's Surface Processes	Water is found in many types of places and in different forms on Earth.	Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground.	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.	The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
ESS2.D Weather and Climate	Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.	Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.	Complex interactions determine local weather patterns and influence climate, including the role of the ocean.	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.
ESS2.E Biogeology	Plants and animals can change their local environment.	Living things can affect the physical characteristics of their environment.	[Content found in LS4.A and LS4.D]	The biosphere and Earth's other systems have many interconnections that cause a continual co-evolution of Earth's surface and life on it.

Wyoming Disciplinary Core Idea Progressions

Earth & Space Science Progression (cont.)				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
ESS3.A Natural Resources	Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not.	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.	Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.
ESS3.B Natural Hazards	In a region, some kinds of severe weather are more likely than others. Forecasts allow communities to prepare for severe weather.	A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts.	Mapping the history of natural hazards in a region and understanding related geological forces.	Natural hazards and other geological events have shaped the course of human history at local, regional, and global scales.
ESS3.C Human Impacts on Earth Systems	Things people do can affect the environment but they can make choices to reduce their impacts.	Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.	Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
ESS3.D Global Climate Change	N/A	N/A	Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.	Global climate models used to predict changes continue to be improved, although discoveries about the global climate system are ongoing and continually needed.

Wyoming Disciplinary Core Idea Progressions

Engineering, Technology, and the Application of Science				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
EST1.A Defining and Delimiting an Engineering Problem	Asking questions, making observations, and gathering information are helpful in thinking about problems	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria).	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Humanity faces major global challenges today. These global challenges also may have manifestations in local communities.
ETS1.B Developing Possible Solutions	Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Testing a solution involves investigating how well it performs under a range of likely conditions.	A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions.	When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.

Engineering, Technology, and the Application of Science (cont.)				
	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
ETS1.C Optimizing the Design Solution	Because there is always more than one possible solution to a problem, it is useful to compare and test designs	Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints	Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.
ETS2.A Interdependence of Science, Engineering, and Technology	Science and engineering involve the use of tools to observe and measure things	Science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies.	Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. Science and technology drive each other forward.	Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.
ETS2.B Influence of Engineering, Technology, and Science on Society and the natural World	Very human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Taking natural materials to make things impacts the environment.	People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.	All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. The uses of technologies are driven by people's needs, desires, and values; Technology use varies over time and from region to region.	Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications. Engineers continuously modify these systems to increase benefits while decreasing costs and risks were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

National Research Council (NRC). (2012). A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press. Yaeger, R. (1996). Science-Technology-Society: As Reform in Science Education. Albany, NY: State University of New York Press.

Wyoming Science and Engineering Practices

1. Asking Questions & Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world(s) works and which can be empirically tested.

Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world.
Both scientists and engineers also ask questions to clarify ideas.

Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	**K-2**	• Ask questions based on observations to find more information about the natural and/or designed world(s).	• Ask and/or identify questions that can be answered by an investigation.	• Define a simple problem that can be solved through the development of a new or improved object or tool.	
Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.	**3-5**	• Ask questions about what would happen if a variable is changed.	• Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.	• Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	
Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.	**6-8**	Ask questions • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • to identify and/or clarify evidence and/or the premise(s) of an argument. • to determine relationships between independent and dependent variables and relationships in models.. • to clarify and/or refine a model, an explanation, or an engineering problem.	• Ask questions that require sufficient and appropriate empirical evidence to answer. • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.	• Ask questions that challenge the premise(s) of an argument or the interpretation of a data set.	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.	**9-12**	Ask questions • that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. • that arise from examining models or a theory, to clarify and/or seek additional information and relationships. • to determine relationships, including quantitative relationships, between independent and dependent variables. • to clarify and refine a model, an explanation, or an engineering problem.	• Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.	• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.	• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations.

Wyoming Science and Engineering Practices

2. Developing and Using Models				
A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.				
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.	**K-2**	• Distinguish between a model and the actual object, process, and/or events the model represents. • Compare models to identify common features and differences.	• Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	• Develop a simple model based on evidence to represent a proposed object or tool.
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.	**3-5**	• Identify limitations of models.	• Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena.	• Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	**6-8**	• Evaluate limitations of a model for a proposed object or tool.	• Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena.	• Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).	**9-12**	• Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability.	• Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.	• Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

Wyoming Science and Engineering Practices

3. Planning and Carrying Out Investigations				
Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.				
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.	**K-2**	• With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.	• Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question.	• Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. • Make predictions based on prior experiences.
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.	**3-5**	• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	• Evaluate appropriate methods and/or tools for collecting data.	• Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.
Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.	**6-8**	• Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.	• Evaluate the accuracy of various methods for collecting data.	• Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. • Collect data about the performance of a proposed object, tool, process, or system under a range of conditions.

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Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.				
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.	**9-12**	• Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.	• Select appropriate tools to collect, record, analyze, and evaluate data.	• Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables.

<table>
<tr><th colspan="6">4. Analyzing and Interpreting Data</th></tr>
<tr><td colspan="6">Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.</td></tr>
<tr><td>Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</td><td>K-2</td><td colspan="3">• Record information (observations, thoughts, and ideas).
• Use and share pictures, drawings, and/or writings of observations.
• Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
• Compare predictions (based on prior experiences) to what occurred (observable events).</td><td>• Analyze data from tests of an object or tool to determine if it works as intended.</td></tr>
<tr><td>Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</td><td>3-5</td><td>• Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.</td><td>• Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.</td><td>• Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.</td><td>• Analyze data to refine a problem statement or the design of a proposed object, tool, or process.
• Use data to evaluate and refine design solutions.</td></tr>
<tr><td>Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</td><td>6-8</td><td>• Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
• Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
• Distinguish between causal and correlational relationships in data.
• Analyze and interpret data to provide evidence for phenomena.</td><td>• Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible.</td><td>• Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).
• Analyze and interpret data to determine similarities and differences in findings.</td><td>• Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.</td></tr>
</table>

4. Analyzing and Interpreting Data					
Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis. Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.					
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.	**9-12**	• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	• Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	• Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations	• Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

Wyoming Science and Engineering Practices

5. Using Mathematical and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships.

Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions.

Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s).	**K-2**	• Decide when to use qualitative vs. quantitative data.	• Use counting and numbers to identify and describe patterns in the natural and designed world(s).	• Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.	• Use quantitative data to compare two alternative solutions to a problem.
Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.	**3-5**	• Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success.	• Organize simple data sets to reveal patterns that suggest relationships.	• Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.	• Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.
Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.	**6-8**	• Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends.	• Use mathematical representations to describe and/or support scientific conclusions and design solutions.	• Create algorithms (a series of ordered steps) to solve a problem. • Apply mathematical concepts and/or processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems. • Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem.	
Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.	**9-12**	• Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.	• Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	• Apply techniques of algebra and functions to represent and solve scientific and engineering problems. • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m^3, acre-feet, etc.).	

Wyoming Science and Engineering Practices

6. Constructing Explanations and Designing Solutions

The end-products of science are explanations and the end-products of engineering are solutions.

The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories.

The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

<table>
<tr><td>Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</td><td>K-2</td><td colspan="2">• Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.</td><td colspan="2">• Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.
• Generate and/or compare multiple solutions to a problem.</td></tr>
<tr><td>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</td><td>3-5</td><td>• Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).</td><td>• Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.</td><td>• Identify the evidence that supports particular points in an explanation.</td><td>• Apply scientific ideas to solve design problems.
• Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.</td></tr>
<tr><td>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</td><td>6-8</td><td>• Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.
• Construct an explanation using models or representations.</td><td>• Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
• Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.</td><td>• Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.</td><td>• Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
• Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.
• Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.</td></tr>
</table>

6. Constructing Explanations and Designing Solutions					
The end-products of science are explanations and the end-products of engineering are solutions. The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.					
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.	**9-12**	• Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.	• Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	• Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.	• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

7. Engaging in Argument from Evidence

Argumentation is the process by which evidence-based conclusions and solutions are reached.

In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem.

Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits.

Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.

Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).	**K-2**	• Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations.	• Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.	• Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.	• Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).	**3-5**	• Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.	• Respectfully provide and receive critiques from peers about a proposed procedure, explanation or model.by citing relevant evidence and posing specific questions.	• Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.	• Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).	**6-8**	• Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.	• Respectfully provide and receive critiques about one's explanations, procedures, models and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.	• Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	• Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system, based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Wyoming Science and Engineering Practices

7. Engaging in Argument from Evidence					
Argumentation is the process by which evidence-based conclusions and solutions are reached. In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.					
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.	**9-12**	• Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	• Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining what additional information is required to resolve contradictions.	• Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.	• Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

8. Obtaining, Evaluating, and Communicating Information					
Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.					
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.	**K-2**	• Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).	• Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea.	• Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim.	• Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.	**3-5**	• Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	• Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices.	• Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	• Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.
Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.	**6-8**	• Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).	• Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.	• Gather, read, synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. • Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts.	• Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

8. Obtaining, Evaluating, and Communicating Information					
Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.					
Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.	**9-12**	• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.	• Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.	• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

References

Lee, O., Quinn, H., & Valdés, G. (2013). Science and language for English language learners in relation to Next Generation Science Standards and with implications for Common Core State Standards for English language arts and mathematics. *Educational Researcher*.

Wyoming Crosscutting Concepts

		Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
1	Patterns	K-LS1-1, K-ESS2-1, 1-LS1-2, 1-LS3-1, 1-ESS1-1, 1-ESS1-2, 2-PS1-1, 2-ESS2-2, 2-ESS2-3	3-PS2-2, 3-LS1-1, 3-LS3-1, 3-ESS2-1, 3-ESS2-2, 4-PS4-1, 4-PS4-3, 4-ESS1-1, 4-ESS2-2, 5-ESS1-2	MS-PS1-2, MS-PS1-5,MS-PS4-1, MS-LS2-2, MS-LS4-1, MS-LS4-2, MS-LS4-3, MS-ESS1-1, MS-ESS2-3, MS-ESS3-2	HS-PS1-1, HS-PS1-2, HS-PS1-3, HS-PS1-5, HS-PS2-4, HS-LS4-1, HS-LS4-3, HS-ESS1-5
2	Cause and Effect	K-PS2-1, K-PS2-2, K-PS3-1, K-PS3-2, K-ESS3-2, K-ESS3-3, 1-PS4-1, 1-PS4-2, 1-PS4-3, 2-PS1-1, 2-PS1-2, 2-qPS1-4 2-LS2-1	3-PS2-1, 3-PS2-3, 3-LS2-1, 3-LS3-2, 3-LS4-2, 3-LS4-3, 3-ESS3-1, 4-PS4-2, 4-ESS2-1, 4-ESS3-1, 4-ESS3-2, 5-PS1-4, 5-PS2-1	MS-PS1-4, MS-PS2-3, MS-PS2-5, MS-LS1-4, MS-LS1-5, MS-LS1-8, MS-LS2-1, MS-LS3-2, MS-LS4-4, MS-LS4-5, MS-LS4-6, MS-ESS2-5, MS-ESS3-1, MS-ESS3-3, MS-ESS3-4	HS-PS2-1, HS-PS2-3,HS-PS2-4, HS-PS2-5, HS-PS3-5, HS-PS4-1, HS-PS4-5, HS-LS2-8, HS-LS3-1, HS-LS3-2, HS-LS4-2, HS-LS4-4, HS-LS4-5, HS-LS4-6, HS-ESS2-4, HS-ESS3-5 HS-ESS3-1 HS-ETS1-5
3	Scale, Proportion, and Quantity		3-LS4-1, 5-PS1-1, 5-PS1-2, 5-PS1-3, 5-ESS1-1, 5-ESS2-2	MS-PS1-1, MS-PS3-1, MS-PS3-4, MS-LS1-1, MS-ESS1-3, MS-ESS1-4, MS-ESS2-2	HS-LS2-1, HS-LS2-2, HS-LS3-3, HS-ESS1-1, HS-ESS1-2, HS-ESS1-4
4	Systems and System Models	K-ESS3-1, K-ESS2-2	3-LS4-4, 4-LS1-1, 4-LS1-2, 5-LS2-1 5-ESS2-1, 5-ESS3-1	MS-PS2-1, MS-PS2-4, MS-PS3-2, MS-LS1-3, MS-ESS1-2, MS-ESS2-6	HS-PS2-2, HS-PS3-1, HS-PS3-4, HS-PS4-3, HS-LS1-2, HS-LS1-4, HS-LS2-5, HS-ESS3-6, HS-ETS1-2, HS-ETS1-4
5	Energy and Matter	2-PS1-3	4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4, 5-PS3-1, 5-LS1-1	MS-PS3-3, MS-PS3-5, MS-LS1-6, MS-LS1-7, MS-LS2-3, MS-ESS2-4	HS-PS1-4, HS-PS1-7, HS-PS1-8, HS-PS3-2, HS-PS3-3, HS-LS1-5, HS-LS1-6, HS-LS1-7, HS-LS2-3, HS-LS2-4, HS-ESS1-2, HS-ESS1-3, HS-ESS2-3, HS-ESS2-6
6	Structure and Function	1-LS1-1, 2-LS2-2, K-2-ETS1-2		MS-PS4-2, MS-PS4-3, MS-LS1-2, MS-LS1-6, MS-LS1-7, MS-LS3-1	HS-PS2-6, HS-LS1-1, HS-ESS2-5
7	Stability and Change	1-PS4-4, 2-ESS1-1, 2-ESS2-1, 3-PS2-4, 3-5- ETS1-1, 3-5- ETS1-2		MS-PS1-6, MS-PS2-2, MS-LS2-4, MS-LS2-5, MS-ESS2-1, MS-ESS3-5 MS-ETS1-1, MS-ETS 1-2	HS-PS1-6, HS-PS4-2, HS-LS1-3, HS-LS2-6, HS-LS2-7, HS-ESS1-6, HS-ESS2-1, HS-ESS2-2, HS-ESS2-7, HS-ESS3-2, HS-ESS3-3, HS-ESS3-4, HS-ETS1-1, HS-ETS1-3

Wyoming Crosscutting Concepts

	1. Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.				
K-2	Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.				
3-5	Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.		Patterns of change can be used to make predictions.	Patterns can be used as evidence to support an explanation.	
6-8	Macroscopic patterns are related to the nature of microscopic and atomic-level structure.	Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.		Patterns can be used to identify cause and effect relationships.	Graphs, charts, and images can be used to identify patterns in data.
9-12	Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.	Classifications or explanations used at one scale may fail or need revision when information from smaller or larger scales is introduced; thus requiring improved investigations and experiments.	Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.	Mathematical representations are needed to identify some patterns.	Empirical evidence is needed to identify patterns.

	2. Cause and Effect: Mechanism and Explanation – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.			
K-2	Events have causes that generate observable patterns.		Simple tests can be designed to gather evidence to support or refute student ideas about causes.	
3-5	Cause and effect relationships are routinely identified, tested, and used to explain change.		Events that occur together with regularity might or might not be a cause and effect relationship.	
6-8	Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.	Cause and effect relationships may be used to predict phenomena in natural or designed systems.	Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	
9-12	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.	Systems can be designed to cause a desired effect.	Changes in systems may have various causes that may not have equal effects.

	3. Scale, Proportion, and Quantity – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.				
K-2	Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower).		Standard units are used to measure length.		
3-5	Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods.		Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.		
6-8	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	The observed function of natural and designed systems may change with scale.	Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.	Scientific relationships can be represented through the use of algebraic expressions and equations.	Phenomena that can be observed at one scale may not be observable at another scale.
9-12	The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.	Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly.	Patterns observable at one scale may not be observable or exist at other scales.	Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.	Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Wyoming Crosscutting Concepts

<table>
<tr><td colspan="5">4. Systems and System Models – A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.</td></tr>
<tr><td>K-2</td><td colspan="2">Objects and organisms can be described in terms of their parts.</td><td colspan="2">Systems in the natural and designed world have parts that work together.</td></tr>
<tr><td>3-5</td><td colspan="2">A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.</td><td colspan="2">A system can be described in terms of its components and their interactions.</td></tr>
<tr><td>6-8</td><td>Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.</td><td colspan="2">Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.</td><td>Models are limited in that they only represent certain aspects of the system under study.</td></tr>
<tr><td>9-12</td><td>Systems can be designed to do specific tasks.</td><td>When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.</td><td>Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.</td><td>Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.</td></tr>
</table>

<table>
<tr><td colspan="6">5. Energy and Matter: Flows, Cycles, and Conservation – Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.</td></tr>
<tr><td>K-2</td><td colspan="5">Objects may break into smaller pieces, be put together into larger pieces, or change shapes.</td></tr>
<tr><td>3-5</td><td>Matter is made of particles.</td><td colspan="3">Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.</td><td>Energy can be transferred in various ways and between objects.</td></tr>
<tr><td>6-8</td><td>Matter is conserved because atoms are conserved in physical and chemical processes.</td><td>Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.</td><td colspan="2">Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).</td><td>The transfer of energy can be tracked as energy flows through a designed or natural system.</td></tr>
<tr><td>9-12</td><td>The total amount of energy and matter in closed systems is conserved.</td><td>Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.</td><td>Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.</td><td>Energy drives the cycling of matter within and between systems.</td><td>In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.</td></tr>
</table>

Wyoming Crosscutting Concepts

	6. Structure and Function – The way an object is shaped or structured determines many of its properties and functions.	
K-2	The shape and stability of structures of natural and designed objects are related to their function(s).	
3-5	Different materials have different substructures, which can sometimes be observed.	Substructures have shapes and parts that serve functions.
6-8	Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
9-12	Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.	The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

	7. Stability and Change – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.			
K-2	Some things stay the same while other things change.		Things may change slowly or rapidly.	
3-5	Change is measured in terms of differences over time and may occur at different rates.		Some systems appear stable, but over long periods of time will eventually change.	
6-8	Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.	Small changes in one part of a system might cause large changes in another part.	Stability might be disturbed either by sudden events or gradual changes that accumulate over time.	Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms.
9-12	Much of science deals with constructing explanations of how things change and how they remain stable.	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.	Feedback (negative or positive) can stabilize or destabilize a system.	Systems can be designed for greater or lesser stability.

National Research Council (NRC). (2012). A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Understandings about the Nature of Science

Understandings about the Nature of Science Associated with the Scientific & Engineering Practices				
Categories	**Scientific Investigations Use a Variety of Methods**	**Scientific Knowledge is Based on Empirical Evidence**	**Scientific Knowledge is Open to Revision in Light of New Evidence**	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**
K-2	• Science investigations begin with a question. • Scientist use different ways to study the world.	• Scientists look for patterns and order when making observations about the world.	• Science knowledge can change when new information is found.	• Scientists use drawings, sketches, and models as a way to communicate ideas. • Scientists search for cause and effect relationships to explain natural events.
3-5	• Science methods are determined by questions. • Science investigations use a variety of methods, tools, and techniques.	• Science findings are based on recognizing patterns. • Scientists use tools and technologies to make accurate measurements and observations.	• Science explanations can change based on new evidence.	• Science theories are based on a body of evidence and many tests. • Science explanations describe the mechanisms for natural events.
MS	• Science investigations use a variety of methods and tools to make measurements and observations. • Science investigations are guided by a set of values to ensure accuracy of measurements, observations, and objectivity of findings. • Science depends on evaluating proposed explanations. • Scientific values function as criteria in distinguishing between science and non-science.	• Science knowledge is based upon logical and conceptual connections between evidence and explanations. • Science disciplines share common rules of obtaining and evaluating empirical evidence.	• Scientific explanations are subject to revision and improvement in light of new evidence. • The certainty and durability of science findings varies. • Science findings are frequently revised and/or reinterpreted based on new evidence.	• Theories are explanations for observable phenomena. • Science theories are based on a body of evidence developed over time. • Laws are regularities or mathematical descriptions of natural phenomena. • A hypothesis is used by scientists as an idea that may contribute important new knowledge for the evaluation of a scientific theory. • The term "theory" as used in science is very different from the common use outside of science.

Understandings about the Nature of Science

Understandings about the Nature of Science Associated with the Scientific & Engineering Practices				
Categories	**Scientific Investigations Use a Variety of Methods**	**Scientific Knowledge is Based on Empirical Evidence**	**Scientific Knowledge is Open to Revision in Light of New Evidence**	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**
HS	• Science investigations use diverse methods and do not always use the same set of procedures to obtain data. • New technologies advance scientific knowledge. • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. • The discourse practices of science are organized around disciplinary domains that share exemplars for making decisions regarding the values, instruments, methods, models, and evidence to adopt and use. • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.	• Science knowledge is based on empirical evidence. • Science disciplines share common rules of evidence used to evaluate explanations about natural systems. • Science includes the process of coordinating patterns of evidence with current theory. • Science arguments are strengthened by multiple lines of evidence supporting a single explanation.	• Scientific explanations can be probabilistic. • Most scientific knowledge is quite durable but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. • Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.	• Theories and laws provide explanations in science, but theories do not with time become laws or facts. • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that has been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. • Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. • Laws are statements or descriptions of the relationships among observable phenomena. • Scientists often use hypotheses to develop and test theories and explanations.

Understandings about the Nature of Science

Understandings about the Nature of Science Associated with the Crosscutting Concepts				
Categories	**Science is a Way of Knowing**	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**	**Science is a Human Endeavor**	**Science Addresses Questions About the Natural and Material World**
K-2	• Science knowledge helps us know about the world.	• Science assumes natural events happen today as they happened in the past. • Many events are repeated.	• People have practiced science for a long time. • Men and women of diverse backgrounds are scientists and engineers.	• Scientists study the natural and material world.
3-5	• Science is both a body of knowledge and processes that add new knowledge. • Science is a way of knowing that is used by many people.	• Science assumes consistent patterns in natural systems. • Basic laws of nature are the same everywhere in the universe.	• Men and women from all cultures and backgrounds choose careers as scientists and engineers. • Most scientists and engineers work in teams. • Science affects everyday life. • Creativity and imagination are important to science.	• Science findings are limited to what can be answered with empirical evidence.
MS	• Science is both a body of knowledge and the processes and practices used to add to that body of knowledge. • Science knowledge is cumulative and many people, from many generations and nations, have contributed to science knowledge. • Science is a way of knowing used by many people, not just scientists.	• Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. • Science carefully considers and evaluates anomalies in data and evidence.	• Men and women from different social, cultural, and ethnic backgrounds work as scientists and engineers. • Scientists and engineers rely on human qualities such as persistence, precision, reasoning, logic, imagination and creativity. • Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism and openness to new ideas. • Advances in technology influence the progress of science and science has influenced advances in technology.	• Scientific knowledge is constrained by human capacity, technology, and materials. • Science limits its explanations to systems that lend themselves to observation and empirical evidence. • Science knowledge can describe consequences of actions but is not responsible for society's decisions.

Understandings about the Nature of Science

Understandings about the Nature of Science Associated with the Crosscutting Concepts				
Categories	**Science is a Way of Knowing**	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**	**Science is a Human Endeavor**	**Science Addresses Questions About the Natural and Material World**
HS	• Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge. • Science is a unique way of knowing and there are other ways of knowing. • Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review. • Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time.	• Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. • Science assumes the universe is a vast single system in which basic laws are consistent.	• Scientific knowledge is a result of human endeavor, imagination, and creativity. • Individuals and teams from many nations and cultures have contributed to science and to advances in engineering. • Scientists' backgrounds, theoretical commitments, and fields of endeavor influence the nature of their findings. • Technological advances have influenced the progress of science and science has influenced advances in technology. • Science and engineering are influenced by society and society is influenced by science and engineering.	• Not all questions can be answered by science. • Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. • Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. • Many decisions are **not** made using science alone, but rely on social and cultural contexts to resolve issues.

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Performance Expectations That Incorporate Engineering Practices

	Engineering	Physical Science	Life Science	Earth and Space Science
K	K-2-ETS1-1	K-PS2-2 K-PS3-2		K-ESS3-2
	K-2-ETS1-2	K-PS3-2		K-ESS3-3
1	K-2-ETS1-1 K-2-ETS1-2	1-PS4-4	1-LS1-1	
2	K-2-ETS1-1	2-PS1-3		
	K-2-ETS1-2		2-LS2-2	
	K-2-ETS1-3	2-PS1-2		2-ESS2-1
3	3-5-ETS1-1 3-5-ETS1-2	3-PS2-4	3-LS4-4	3-ESS3-1
4	3-5-ETS1-1	4-PS3-4		
	3-5-ETS1-2	4-PS3-4 4-PS4-3		4-ESS3-2
	3-5-ETS1-3	4-PS3-4		
5	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	5-PS2-1		5-ESS2-1 5-ESS3-1
6-8	MS-ETS1-1	MS-PS1-6 MS-PS2-1 MS-PS3-3		MS-ESS3-3
	MS-ETS1-2		MS-LS2-5	MS-ESS3-3 MS-ESS3-5
	MS-ETS1-3			MS-ESS3-3
	MS-ETS1-4	MS-PS1-6 MS-PS2-1		
	MS-ETS2-1	MS-PS1-3	MS-LS4-5	MS-ESS1-3
	MS-ETS2-2		MS-LS2-5 MS-LS4-5	MS-ESS3-3
9-12	HS-ETS1-1	HS-PS2-6 HS-PS4-2 HS-PS4-5	HS-LS2-7 HS-LS4-6	HS-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4
	HS-ETS1-2	HS-PS2-3 HS-PS3-3 HS-PS4-1	HS-LS2-7 HS-LS4-6	HS-ESS3-3
	HS-ETS1-3	HS-PS2-3 HS-PS4-2 HS-PS4-5		HS-ESS3-2 HS-ESS3-3 HS-ESS3-4
	HS-ETS1-4	HS-PS2-3 HS-PS2-6 HS-PS3-1 HS-PS3-3 HS-PS4-1	HS-LS2-1 HS-LS2-2 HS-LS2-7 HS-LS4-6	HS-ESS3-3 HS-ESS3-4 HS-ESS2-4 HS-ESS2-6
	HS-ETS-1-5	HS-PS2-6 HS-PS4-1 HS-PS4-2	HS-LS2-6 HS-LS3-2 HS-LS4-5	HS-ESS2-2 HS-ESS2-4 HS-ESS2-7 HS-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4

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2016 Wyoming Science Standards Glossary

These definitions were compiled by the Standards Review Committee to help readers understand the terminology.

Abiotic:
1. not associated with or derived from living organisms
2. a term that refers to nonliving factors in the environment such as light and temperature

Absorption:
1. Biology: uptake of substances by a tissue
2. Chemistry: taking in or reception by molecular or chemical action, as of gases or liquids
3. Physics: removal of energy or particles from a beam by the medium through which the beam propagates

Acceleration: rate of change of the velocity of a moving body; an increase in the magnitude of the velocity of a moving body (an increase in speed) is called a positive acceleration; a decrease in speed is called a negative acceleration

Adaptation: process in which a species becomes better suited to survive in an environment

Aerobic: requiring the presence of air or free oxygen for life

Age: a subdivision of geologic time that divides an epoch into smaller parts

Allele: any of several forms of a gene, usually arising through mutation that are responsible for hereditary variation

Amino Acid: building blocks from which proteins are constructed

Amplitude: a measure of change in signal/wave height over a single period (such as time or spatial period)

Anaerobic: living in the absence of air or free oxygen

Application of Science: any use of scientific knowledge for a specific purpose, whether to do more science; to design a product, process or medical treatment; to develop a new technology; or to predict the impacts of human actions

Analyze: to separate (a material or abstract entity) into constituent parts or elements; determine the elements or essential features of (opposed to synthesize)

Anatomy: science dealing with the structure of animals and plants

Animal: living thig that can move independently and uses senses to reach the environment around it

Anthropogenic: relating to, or resulting from the influence of human beings on nature

Asteroid: small rocky body orbiting the sun

Atmosphere: layers of gases surrounding a planet or other celestial body

Atmospheric Pressure: the force exerted by air on a unit area

Atom:
1. the basic unit of a chemical element
2. An atom is the smallest particle of an element that retains all the properties of that element

Beam: a ray of shaft of light coming from a source (sun, flashlight)

Behavior: response of an individual, group, or species to its environment: anything that an organism does involving action and response to stimulation

Big Bang Theory: the rapid expansion of matter from a state of extremely high density and temperature that according to current cosmological theories marked the origin of the universe

Biochemistry: the chemical characteristics and reactions of a particular living organism or biological substance

Biodiversity:
1. the variety of life in the world or in a particular habitat or ecosystem
2. the innumerable genetic combinations of organisms that results in a great variety within a species

Bio Geology: study of the interactions between the Earth's biosphere and the lithosphere

Biological Adaptations: the changes an organism makes in order to become better suited to survive in its environment

Biological Evolution: any genetic change in a population that is inherited over several generations; changes have to occur on the genetic level of a population

Biomass: organic matter derived from living, or recently living organisms; can be used as a source of energy; most often refers to plants or plant-based materials which are not used for food or feed

Bioremediation: waste management technique that involves the use of organisms to remove or neutralize pollutants from a contaminated site

Biosphere:
1. the area in which life is possible on our planet
2. the entire portion of Earth that is inhabited by life; the sum of all the planet's communities and ecosystems

Biotic:
1. living organisms or to something that is produced or caused by living organisms
2. pertaining to the living organisms in the environment

Carbohydrate: molecular compounds made from just three elements: carbon, hydrogen and oxygen; often called sugars

Carrying Capacity: number of people, other living organisms, or crops that a region can support without environmental degradation

Causality: the relationship between causes and effects; it is considered to be fundamental to all natural science, especially physics

Cell Cycle: series of events that take place in a cell leading to its division and duplication (replication) that produces two daughter cells

Cellular Respiration: oxidation (breakdown) of organic compounds that occurs within cells, producing energy for cellular processes

Chemical Change: a change resulting from a chemical reaction in which bonds are broken and new bonds are formed between different atoms in a substance; a chemical change produces one or more new substances with different chemical properties

Chemical Weathering: erosion or disintegration of rocks, building materials, etc., caused by chemical reactions (chiefly with water and substances dissolved in it) rather than by mechanical processes

Chromosome: any of several threadlike bodies, consisting of chromatin, that carry the genes in a linear order; the human species has 23 pairs, designated 1 to 22 in order of decreasing size and X and Y for the female and male sex chromosomes respectively

Classification: specific scientific nomenclature that describes natural relationships that exist between living things: also known as taxonomy

Climate: composite or generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the year, averaged over a series of years

Co-evolution: change in the genetic composition of one species (or group) in response to a genetic change in another

Communicate: to give information be speaking, vocalization, writing, movement, etc.

Communication Technology: any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications

Competition: contest between two or more organisms, animals, individuals, groups, etc., for territory, a niche, for a location of resources, for resources and goods, for mates

Compound:
1. a thing that is composed of two or more separate elements; a mixture
2. substance made of two or more types of atoms

Condensation: process of forming a liquid from a gas

Conduction: process by which heat energy is transmitted through collisions between neighboring molecules

Conductivity: the degree to which a specified material conducts electricity

Conservation: act of preserving, guarding or protecting biodiversity, environment, and natural resources, including protection and management

Constraint: a limitation or restriction

Consumer: organism on the food chain that depends on autotrophs (producers) or other consumers for food, nutrition, and energy

Consumers: those organisms within an environment that are nutritionally dependent upon other organisms or their products

Control: standard against which experimental observations may be evaluated; procedure identical to the experimental procedure except for the one factor being studied

Convection: heat transfer by mass motion of a fluid such as air or water when the heated fluid is caused to move away from the source of heat, carrying energy with it

Convection Current: transfer of heat by the mass movement of heated particles into an area of cooler fluid; when in reference to plate tectonics, currents in the Earth's mantle that are a driving force in lithospheric motion

Core Ideas: ideas in science that have broad importance and explanatory power in a discipline or across disciplines of science, and which are teachable and learnable at increasing levels of depth over multiple years; core ideas are grouped into four major domains: physical sciences; life sciences; earth and space sciences; and engineering, technology and applications of science; each broad core idea is described and then broken down into more focused component ideas

Correlation: a mutual relationship or connection between two or more things

Cosmic Background Radiation: electromagnetic radiation coming from every direction in the universe; considered the remnant of the big bang

Cost Benefit Analysis: relating to or denoting a process that assesses the relation between the cost of an undertaking and the value of the resulting benefits

Coulomb's Law: law of physics describing the electrostatic interaction between electrically charged particles

Cryosphere: frozen water; part of the earth's system

Data: individual facts, statistics, or items of information

Decomposer: organism that breaks down dead organic material

Decomposers:
1. organisms that break down dead or decaying organisms, and in doing so they carry out the natural process of decomposition
2. organisms that break down the tissues and excretions of other organisms into simpler substances through the process of decay

Delta: a nearly flat plain of alluvial deposit between diverging branches of the mouth of a river

Density:
1. the degree of compactness of a substance
2. the amount of mass per unit volume; something that is more tightly packed is denser than something that has more space between the molecules

Dependent Variable: a factor that is measured to learn the effect of one or more independent variables; it is what happens as a result of the independent variable

Deposition: geological process in which sediments, soil and rocks are added to a landform or land mass

Design: a plan or drawing used to show the look, function, or workings of an object

Designed Systems: systems design is the process of defining the architecture, components, modules, interfaces, and dada for a system, to satisfy specified requirements

Designed World: parts of the world that have been shaped, controlled largely through the use of technology by human action

Differentiation: process by which cells or arts of an organism change during development to serve a specific function

Diffraction: bending of waves, especially sound and light waves, around obstacles in their path

Digital Transmission: physical transfer of data (a digital bit stream or a digitized analog signal) over a point-to-point or point-to-multipoint communication channel

Digitized: convert (pictures or sound) into a digital form that can be processed by a computer

Deoxyribonucleic Acid (DNA): an extremely long, double-stranded nucleic acid molecule arranged as a double helix that is the main constituent of the chromosome and that carries the genes as segments along its strands

Dynamic: of or relating to energy or to objects in motion; characterized by continuous change, activity, or progress

Earth: the planet on which we live, also called the world

Ecosystem: a unit of the biosphere in which living and nonliving things interact, and in which materials are used over and over again

Effect: cause, result, consequences as the result of an agent, power to reduce results

Electric Field: region around a charged particle or object within which a force would be exerted on other charged particles or objects

Electrical Force: attractive or repulsive interaction between any two charged objects

Electric Field: region around a charged particle or object within which a force would be exerted on other charged particles or objects

Electromagnetic Radiation: kind of radiation including visible light, radio waves, gamma rays, and X-rays, in which electric and magnetic fields vary simultaneously

Electromagnetic Wave: waves that contain an electric field and a magnetic field and carry energy; travel at the speed of light

Ellipse (elliptical orbit): "flattened" circle (oval); revolving of one object around another in an oval-shaped path called an ellipse

Electrostatic force: attraction or repulsion of particles or objects because of their electric charge

Embryology: branch of biology and medicine concerned with the study of embryos and their development

Emission Control System: means employed to limit the discharge of noxious gases from combustion systems

Empirical Evidence:

1. is information acquired by observation of experimentation; data is recorded and analyzed by scientists and is central process as part of the scientific method
2. is derived from or guided by experience or experiment

Endangered Species: species of animal or plant that is seriously at risk of extinction

Endothermic: a reaction that requires energy in order to be completed

Energy (Energy Transformation): property of objects which can be transferred to other objects or converted into different forms, but cannot be created or destroyed

Engineering: a systematic and often iterative approach to designing objects processes, and systems to meet human needs and wants

Environment: the whole of all surrounding, natural and man-made, of a living organism

Epoch: a subdivision of the geologic timescale that is longer than an age and shorter than a period

Equilibrium: the state of balance that all things, living and nonliving, seek to attain

Era:
1. subdivision of geologic time that divides an eon into smaller units of time
2. epic period

Erosion: is the action of surface processes (such as water flow or wind) that removes soil, rock, or dissolved material from one location on the Earth's crust, then transported away to another location

Evaporation: a type of vaporization of a liquid that occurs from the surface of a liquid into a gaseous phase that is not saturated with the evaporating substance

Evidence Based: refers to any concept or strategy that is derived from or informed by objective evidence

Exothermic: a reaction that gives off heat as a by-product

Experiment: a scientific procedure undertaken to make a discovery, teat a hypothesis, or demonstrate a known fact

Experimental Design: a method or process of designing an experimental investigation used to test cause-and effect relationships between variables; a classic experimental design specifies an experimental group and a control group; the independent variable is administered to the experimental group and not to the control group, and both groups are measured on the same dependent variable

Exponential: an increase or decrease which becomes more and more rapid

External: outside or surface of an object

Extinct (Extinction):
1. Biology: (of a species, family, or other larger group) having no living members
2. Earth Science: (of a volcano) not having erupted in recorded history

Fact: a confirmed or, at least, agreed-upon empirical observation (or conclusion if referring to an "inferred" fact); scientific facts, even what appear to be simple observations, are themselves embedded in or rooted in the theories the observer holds

Feedback Mechanism: a loop system in which the system responds to perturbation either in the same direction (positive feedback) or in the opposite direction (negative feedback); process in which the level of one substance influences the level of another substance; mechanism or a signal that tends to initiate (or accelerate) or to inhibit (or slow down) a process

Fission:
1. Physics: the splitting of the nucleus of an atom into nuclei of lighter atoms, accompanied by the release of energy
2. Biology: the division of an organism into new organisms as a process of reproduction

Food Web: (or food cycle) is the natural interconnection of food chains and generally a graphical representation (usually an image) of what-eats-what in an ecological community; another name for food web is a consumer-resource system

Force: a push or a pull that gives energy to an object, sometimes causing a change in the motion of the object

Forest: large area covered with trees and undergrowth

Form: the structure of a substance or organism

Fossil Fuel: any combustible organic material, as oil, coal, or natural gas, derived from the remains of former life

Frame of Reference: a framework that is used for the observation and mathematical description of physical phenomena and the formulation of physical laws, usually consisting of an observer, a coordinate system, and a clock or clocks assigning times at positions with respect to the coordinate system

Frequency: the number of periods or regularly occurring events of any given kind in unit of time, usually in one second

Frost Wedging: a form of mechanical weathering (that is, weathering that involves physical, rather than chemical change); is caused by the repeated freeze-thaw cycle of water in extreme climates

Fusion: the combining of the nuclei of two atoms to form another, heavier atom; nuclear fusion in the sun, releases large amounts of energy

Gene: discrete unit of hereditary information consisting of a specific nucleotide sequence in DNA (or RNA, in some viruses)

Gene Control Mechanism: biological agents such as proteins or hormones that serve to control gene expressions

Gene Expression: a process by which information from a gene is used in the synthesis of a functional gene product; products are often proteins, but in non-protein coding genes such as transfer RNA (tRNA) or small nuclear RNA (snRNA) genes, the product is a functional RNA; used by all known life - eukaryotes (including multicellular organisms), prokaryotes (bacteria and archaea), and utilized by viruses - to generate the macromolecular machinery for life

Gene Frequency: occurrence or proportions of different alleles of a particular gene in a given population

Genetic Drift: process by which gene frequencies are changed by the chances of random sampling in small populations

Genetic Flow: loss or gain of alleles from a population due to the emigration or immigration of fertile individuals, or the transfer of gametes, between populations

Geochemical Cycle: a cycle that Earth materials move through such as the water cycle or rock cycle

Geographic Barrier: a naturally occurring formation or body of water that segregates and isolates an area; common geographic barriers are mountains, glaciers, islands, lakes, rivers, oceans, and canyons
Geoscience: an all-encompassing term that refers to the fields of science dealing with planet Earth

Geothermal: relating to, or produced by the internal heat of the Earth

Geographic Information System (GIS): a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data

Glacier: an extended mass of ice formed from snow falling and accumulating over the years and moving very slowly, either descending from high mountains, as in valley glaciers, or moving outward from centers of accumulation, as in continental glaciers

Glucose: a sugar with the molecular formula $C_6H_{12}O_6$

Gravitational Field: the force field that exists in the space around every mass or group of masses; a field that extends out in all directions, but the magnitude of the gravitational force decreases as the distance from the object increases

Gravitational Potential Energy: energy an object possesses because of its position in a gravitational field; use is for an object near the surface of the Earth where the gravitational acceleration can be assumed to be constant at about 9.8 m/s^2

Gravity: natural force of attraction exerted by a celestial body, such as Earth, upon objects at or near its surface, tending to draw them toward the center of the body

Greenhouse Gases: any of the atmospheric gases that contribute to the greenhouse effect by absorbing infrared radiation produced by solar warming of the Earth's surface; includes carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), and water vapor

Groundwater: water in the soil and beneath the Earth' surface (snow cover, ice, and water in the atmosphere, including water vapor)

Groundwater Recharge: a hydrologic process where water moves downward from surface water to groundwater; recharge is the primary method that water enters an aquifer

Habitat: an ecological or environmental area that is inhabited by a particular species of animal, plant, or other type of organism

Hardy Weinberg Calculations: a mathematical equation that can be used to calculate the genetic variation of a population at equilibrium; the amount of genetic variation in a population will remain constant from one generation to the next in the absence of disturbing factors

Heritable Genetic Variation: differences among individuals in morphology, behavior, and reproductive performance that have a genetic basis

Histogram: display of statistical information that uses rectangles to show the frequency of data items in successive numerical intervals of equal size; in the most common form of histogram, the independent variable is plotted along the horizontal axis and the dependent variable is plotted along the vertical axis

Homeostasis: a property of cells, tissues, and organisms that allows the maintenance and regulation of the stability and constancy needed to function properly

Human: of or relating to people (Homo sapiens)

Hydrocarbons: a compound of hydrogen and carbon, such as any of those that are the chief components of petroleum and natural gas

Hydrologic Cycle: the sequence of conditions through which water passes from vapor in the atmosphere through precipitation upon land or water surfaces and ultimately back into the atmosphere as a result of evaporation and transpiration

Hydrosphere:

1. all of the Earth's water including surface water (water in oceans, lakes and rivers) and all water systems of the Earth, including atmospheric water, oceans, rivers, and lakes
2. gradual wearing away of rocks from weather; first stage in erosion

Hypothesis: a proposed explanation of certain "facts" that must be empirically testable in some conceivable fashion; not proven true or correct; rather, it is either rejected (or "falsified") because it is determined to be inconsistent with the data, or, if not rejected, regarded as being "provisionally true" and kept as a working hypothesis to be used until found to be faulty in light of new evidence or further testing; hypotheses that have withstood numerous, rigorous tests and not found to be "false" are often regarded as "facts" since they are effectively beyond rational dispute

Ice age: a period of long-term reduction in the temperature of Earth's climate, resulting in an expansion of the continental ice sheets, polar ice sheets and mountain glaciers

Illuminate: to supply or brighten with light; light up

Illumination: intensity of light falling at a given place on a lighted surface; the luminous flux incident per unit area, expressed in lumens per unit of area

Independent Variable: a variable that is manipulated (controlled) by the researcher and evaluated by its measurable effect on the dependent variable or variables; purposely changed so that the effect can be tested

Inertia:

1. tendency of an object to resist a change in motion; an object at rest will remain at rest unless a force acts on it; an object in motion will continue in the same direction, at the same speed, unless an outside force acts on it
2. Newton’s First Law of Motion
3. tendency of an object to resist a change in its movement, whether the object is moving or is at rest

Inference: is an idea or conclusion that's drawn from evidence and reasoning; an educated guess

Inquiry: systematic investigation or to seek truth, information or knowledge

Interference: phenomenon in which two waves superpose to form a resultant wave of greater, lower, or the same amplitude; usually refers to the interaction of waves that are correlated or coherent with each other, either because they come from the same source or because they have the same or nearly the same frequency

Invasive Species: organism that causes ecological or economic harm in a new environment where it is not native

Investigate: to carry out research or study into (a subject, typically one in a scientific or academic field) so as to discover facts or information

Investigation: a systematic, minute, and thorough attempt to learn the facts about something complex or hidden

Isotope: each of two or more forms of the same element that contain equal numbers of protons but different numbers of neutrons in their nuclei, and hence differ in relative atomic mass but not in chemical properties; in particular, a radioactive form of an element

Iterative: repeating; making repetitions; repetitious

Kepler's Laws: 1) path of the planets about the sun is elliptical in shape, with the center of the sun being located at one focus (The Law of Ellipses); 2) imaginary line drawn from the center of the sun to the center of the planet will sweep out equal areas in equal intervals of time (The Law of Equal Areas); and 3) ratio of the squares of the periods of any two planets is equal to the ratio of the cubes of their average distances from the sun (The Law of Harmonies)

Kinetic Energy: the energy of motion, observable as the movement of an object, particle, or set of particles

Land: solid surface of earth; surface of Earth not covered by water

Law: a statement based on repeated experimental observations that describes some aspects of the universe; always applies under the same conditions, and implies that there is a causal relationship involving its elements

Law of Conservation of Energy: states that the total energy in a system does not change (can be neither created nor destroyed) but transfers from one form to another

Law of Conservation of Mass: states that mass cannot be created or destroyed in a chemical reaction; also called the Law of Conservation of Matter

Le Chatelier's Principle: states when a stress is applied to a chemical system at equilibrium, the equilibrium will shift to relieve the stress; examples: changes in concentration, changes in temperature, or changes in pressure

Light: source of illumination; agent that makes things visible; can be natural or artificial

Linear Function: where increasing or decreasing one variable (n) times will cause a corresponding increase or decrease of n times in the other variable too

Line of Descent: in legal usage, is a blood relative in the direct line of descent - the children, grandchildren, great-grandchildren, etc. of a person

Lipid: any of a class of organic compounds that are fatty acids or their derivatives and are insoluble in water but soluble in organic solvents; include many natural oils, waxes, and steroids

Lithosphere: the solid outer section of the earth, which includes the earth's crust as well as the underlying cool, dense and rigid upper part of the upper mantle

Logarithmic Scale: nonlinear scale used when there is a large range of quantities; common uses include the earthquake strength, sound loudness, light intensity, and pH of solutions

Luster (or Lustre): the way light interacts with the surface of a crystal, rock, or mineral

Macroinvertebrates: organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate)

Macroscopic: of or relating to large-scale or general analysis, visible to the naked eye; not microscopic

Magnetic Field: a place in space near a magnet or an electric current where a physical field is created from a moving electric charge that creates force on another moving electric charge

Magnets: material (such as iron or steel) that attracts certain metals

Magnify: to enlarge in actuality or appearance of an object

Mantle: the region of the interior of the Earth between the core (on its inner surface) and the crust (on its outer)

Map: visual representation of an area highlighting relationships between elements, such as objects, regions, and theme

Mass: a measure of the number of atoms in an object combined with the density of those atoms

Mass Wasting: (slope movement or mass movement) is the geomorphic process by which soil, sand, regolith, and rock move downslope typically as a mass, largely under the force of gravity, but frequently affected by water and water content as in submarine environments and mudflows

Material: substance or substances from which a thing is made or constructed

Mechanical Wave: waves which propagate through a material medium (solid, liquid, or gas) at a wave speed which depends on the elastic and inertial properties of that medium; two basic types of wave motion for mechanical waves: longitudinal waves and transverse waves

Mechanical Weathering: breaks down rocks and minerals without changing their chemical composition; for example, by ice wedging

Mechanisms: a device designed to transform input forces and movement into a desired set of output forces and movement

Medical Imaging: the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology)

Media:

1. a substance, such as agar, in which bacteria or other microorganisms are grown for scientific purposes
2. a substance that makes possible the transfer of energy from one location to another, especially through waves

Meiosis: a form of cell division happening in sexually reproducing organisms by which two consecutive nuclear divisions (meiosis I and meiosis II) occur without the chromosomal replication in between, leading to the production of four haploid gametes (sex cells), each containing one of every pair of homologous chromosomes (that is, with the maternal and paternal chromosomes being distributed randomly between the cells)

Meteorite: a piece of rock or metal that has fallen to the ground from outer space; a meteor that reaches the surface of the Earth without burning up entirely

Microbe: any of the microorganisms, especially those causing diseases or infections; was coined to refer collectively to the microscopic organisms, including bacteria, fungi, protozoa, and viruses

Microscopic: the scale of objects and events smaller than those that can easily be seen by the naked eye, requiring a lens or microscope to see them clearly

Migration: movement to another place, often of a large group of people or animals

Mimic/Mimicking: one species adopts the color, habits, sounds, or structure of another species; usually for protection

Mineral: a mineral is a naturally occurring inorganic substance with a definite chemical composition and a regular internal structure

Mitigation: involves steps taken to avoid or minimize negative environmental impacts

Mitosis: a part of the cell cycle process by which chromosomes in a cell nucleus are separated into two identical sets of chromosomes, each in its own nucleus

Mixture: a material system made up of two or more different substances which are mixed but are not combined chemically

Model:

1. a small copy or representation (sometimes in miniature) to show the construction or appearance of something
2. a systematic description of an object or phenomenon that shares important characteristics with the object or phenomenon
3. scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories

Molecule: smallest particle in a chemical element or compound that has the chemical properties of that element or compound consisting of one or more atoms

Molecular Structure: describes the type, arrangement, position, and direction of the bonds linking atoms within a molecule

Momentum: is the property or tendency of a moving object to continue moving; an object moving in a line, the momentum is the mass of the object multiplied by its velocity (linear momentum); thus, a slowly moving, very massive body and a rapidly moving, light body can have the same momentum

Moon: a celestial body that makes an orbit around a planet, including the eight major planets, dwarf planets, and minor planets

Morse Code: a type of character encoding that transmits telegraphic information using rhythm

Motion:

1. one dimensional motion is motion along a straight line; line used for this motion is often the familiar x-axis, or x number line; an object may move forward or backward along this line; forward is usually considered positive movement, and this movement is usually considered to be to the right.
2. since acceleration is a vector quantity, it has a direction associated with it; direction of the acceleration vector depends on two things: whether the object is speeding up or slowing down whether the object is moving in the + or – direction

Mutation (deletion, insertion, substitution): changing of the structure of a gene, resulting in a variant form that may be transmitted to subsequent generations, caused by the alteration of single base units in DNA, or the deletion, insertion, substitution, or rearrangement of larger sections of genes or chromosomes

Natural Gas: a mixture of hydrocarbon gases that occurs naturally beneath the Earth's surface, often with or near petroleum deposits; natural gas contains mostly of methane but also has varying amounts of ethane, propane, butane, and nitrogen; used as a fuel and in making organic compounds

Natural Hazard: severe and extreme weather and climate events that occur naturally in all parts of the world, although some regions are more vulnerable to certain hazards than others

Natural Laws: in philosophy, a system of right or justice held to be common to all humans and derived from nature rather than from the rules of society, or positive law

Natural Resources all that exists without the actions of humankind; includes all natural characteristics such as magnetic, gravitational, and electrical properties and forces; on Earth includes sunlight, atmosphere, water, land (includes all minerals) along with all vegetation and animal life that naturally subsists upon or within the heretofore identified characteristics and substances

Natural Selection: the process in nature by which, according to Darwin's theory of evolution, organisms that are better adapted to their environment tend to survive longer and transmit more of their genetic characteristics to succeeding generations than do those that are less well adapted

Natural Systems: in the field of ecology, one that exists in nature independent of any human involvement

Natural World: the physical world including all living things as well as the land and the oceans

Negative Feedback Loop: a type of self-regulating system. In this type of feedback loop, increased output from the system inhibits future production by the system

Neural Stimuli: hormones are released directly due to stimulation of the endocrine gland by nerves

Net Force: overall force acting on an object; to calculate the net force, the body is isolated and interactions with the environment or other constraints are represented as forces and torques in a free-body diagram

Newton's Law of Gravitation: any two bodies in the universe attract each other with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them

Newton's First Law of Motion: An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force. (Law of Inertia)

Newton's Second Law of Motion: the relationship between the acceleration of an object to its mass and the force applied to it ($F = m \times a$)

Newton's Third Law of Motion: for every action force there is an equal and opposite reaction force

Nonlinear Relationship: a relationship in which is extremely hard (or impossible) to calculate or predict because there is not a proportional increase and/or decrease between the independent and dependent variables

Non-Relativistic: of, relating to, or being a body moving at less than a relativistic (near the speed of light) velocity

Non-Renewable Resource: a resource that does not renew itself within a human time-frame

Nucleus: Physics: nucleus is the positively charged central core of an atom, consisting of protons and neutrons and containing nearly all its mass; Biology: nucleus is a dense organelle present in most eukaryotic cells, typically a single rounded structure bounded by a double membrane, containing the genetic material

Nucleosynthesis: process that creates new atomic nuclei from pre-existing nucleons, primarily protons and neutrons

Observations:

1. active acquisition of information from a primary source; in living beings, observation employs the senses
2. can involve the recording of data via the use of instruments; any data collected during the scientific activity
3. can be qualitative, that is, only the absence or presence of a property is noted, or quantitative if a numerical value is attached to the observed phenomenon by counting or measuring

Offspring: organism or organism as a result of sexual or asexual reproduction

Oil: a hydrocarbon liquid substance that is greasy to the touch and is formed by natural resources or the breakdown of fats; oil comes in many forms as diverse as crude oil and vegetable oil, which serve very different purposes

Oil Shale: also known as kerogen shale, is an organic-rich fine-grained sedimentary rock containing kerogen (a solid mixture of organic chemical compounds) from which liquid hydrocarbons called shale oil (not to be confused with tight oil—crude oil occurring naturally in shales) can be produced

Opaque: light cannot penetrate; not transparent or translucent

Organ: a group of tissues in a living organism that have been adapted to perform a specific function

Organism: living or once-living thing

Orogeny: process of mountain formation, especially by folding and faulting of the Earth's crust and by plastic folding, metamorphism, and the intrusion of magmas in the lower parts of the lithosphere

Particle: a minute fragment or quantity of matter

Particle Model: light or matter

Patterns: arrangements following repeated designs or sequences

Patterns of Inheritance: patterns related to the transmission of genetic information

Peer Review: the evaluation of scientific, academic, or professional work by others working in the same field

Period: subdivision of geologic time that is smaller than eons and eras, but larger than epochs and ages

Petroleum: a liquid mixture of hydrocarbons that is present in certain rock strata and can be extracted and refined to produce fuels including gasoline, kerosene, and diesel oil; oil

Phases or States of Matter: distinct forms in which material can exist; solid is the state in which intermolecular attractions keep the molecules in fixed spatial relationships (fixed volume and shape); liquid is the state in which intermolecular attractions keep molecules in proximity but do not keep the molecules in fixed relationships (fixed volume but no fixed shape, assuming the shape of its container); gas is that state in which the molecules are comparatively separated; plasma hot ionized gas consisting of approximately equal numbers of positively charged ions and negatively charged electrons

Phenomena:

1. observed or detected fact or event or an object known through senses rather than by thought or intuition; fact or event of scientific interest susceptible of scientific description and explanation
2. a fact or situation that is observed to exist or happen, especially one whose cause or explanation is in question

Photoelectric Effect: occurs when matter emits electrons upon exposure to electromagnetic radiation, such as photons of light

Photosynthesis: a natural chemical-process by which chlorophyll (magnesium-containing pigment in green plants, blue-green algae, phytoplankton, and green and purple bacteria) uses sunlight (radiation) energy to convert (synthesize) water and atmospheric carbon dioxide into life sustaining organic compounds such as glucose; responsible for almost all the oxygen in atmosphere, photosynthesis is the basis of all life on earth

Physical Change: a change in physical properties that does not affect the chemical nature of a substance. Examples include changes in texture, shape, size, color, odor, volume, mass, weight, and density

Physical Phenomena: relating to, or according with material things or natural laws as opposed to things mental, moral, spiritual, or imaginary; of or relating to natural science

Physiology: a branch of biology that deals with the functions and activities of life or of living matter (as organs, tissues, or cells) and of the physical and chemical phenomena involved

Plants: living things that use sunlight to make food for survival and growth

Plate Tectonics: a theory explaining the structure of the earth's crust and many associated phenomena as resulting from the interaction of rigid lithospheric plates that move slowly over the underlying mantle

Polarity: two opposite tendencies or opposite electrical charges

Pollinate: to transfer or carry pollen from a stamen to a pistil of a flower or from a male cone to a female cone

Pollination: transfer of pollen from the male part of a plant to the female part of a plant

Population: groups of individuals belonging to the same species that live in the same region at the same time

Positive Feedback Loop: enhance or amplify changes; this tends to move a system away from its equilibrium state and make it more unstable

Prairie: large expanse of level or rolling grassland; from the French word for meadow

Predator: animal that hunts other animals for food

Predation: a form of symbiotic relationship between two organisms of unlike species in which one of them acts as predator that captures and feeds on the other organism that serves as the prey

Predict: to say or tell something will happen in the future

Probe: spacecraft designed for exploring space beyond the gravitational and magnetic fields of the earth

Producer: organism on the food chain that can produce its own energy and nutrients; also called an autotroph

Producers: organisms (typically green plants) that produce their own food

Properties: an intensive, often quantitative, property of some material; quantitative properties may be used as a metric by which the benefits of one material versus another can be assessed, thereby aiding in materials selection

Protein: any of a class of nitrogenous organic compounds that consist of large molecules composed of one or more long chains of amino acids and are an essential part of all living organisms, especially as structural components of body tissues such as muscle, hair, collagen, etc., and as enzymes and antibodies

Protein Synthesis: the process by which amino acids are linearly arranged into proteins through the involvement of ribosomal RNA, transfer RNA, messenger RNA, and various enzymes

Pull: a force that acts in the direction of the origin of the force

Push: an applied force typically intended to drive or impel. In contrast to a pull it acts in a direction away from person or thing causing the force

Qualitative:
1. describing the quality of something in size, appearance, value, etc. as opposed to a quantitative description or analysis
2. term that refers to the nature—the characteristics and attributes—of a substance, object, or event rather than the amount

Quantitative:
1. to measurement or amount rather than to characteristics or attributes
2. relating to, measuring, or measured by the quantity of something rather than its quality

Quantum Theory: is based on the principle that matter and energy have the properties of both particles and waves, created to explain the radiation of energy from a blackbody, the photoelectric effect, and the Bohr theory, and now used to account for a wide range of physical phenomena, including the existence of discrete packets of energy and matter, the uncertainty principle, and the exclusion principle

Radiation: emission and propagation of energy in the form of rays or waves; energy radiated or transmitted in the form of rays, waves, or particles; a stream of particles or electromagnetic waves that is emitted by the atoms and molecules of a radioactive substance as a result of nuclear decay

Radioactive Decay: the spontaneous transformation of an unstable atomic nucleus into a lighter one, in which radiation is released in the form of alpha particles, beta particles, gamma rays, and other particles

Radiometric Dating: a method for determining the age of an object based on the concentration of a particular radioactive isotope contained within it and the half-life of that isotope

Rangeland: land suitable for grazing animals; rain is too low and unpredictable growing crops

Receptor:
1. specialized cell or group of nerve endings that responds to sensory stimuli
2. a molecular structure or site on the surface or interior of a cell that binds with substances such as hormones, antigens, drugs, or neurotransmitters

Reclamation: restoration, as to productivity, usefulness, or morality

Recycle: the process of collecting and reprocessing materials that would typically be considered waste

Red Shift: the reddening of light sent out by an object that is moving away from an observer

Refraction: the change in direction of propagation of any wave as a result of its traveling at different speeds at different points along the wave front

Reflective: causing light, sound, heat, etc. to move away

Refraction: the change in direction of propagation of any wave as a result of its traveling at different speeds at different points along the wave front

Relative Time:
1. theory, formulated essentially by Albert Einstein, that all motion must be defined relative to a frame of reference and that space and time are relative, rather than absolute concepts: it consists of two principal parts
2. geologic time determined by the placing of events in a chronologic order of occurrence, especially time as determined by organic evolution or superposition

Relationship: a connection between two numbers or other variables where an increase or decrease in one variable causes the same change to occur in the second variable

Reliable Resources: has competence in the field of interest, without any biases or conflicts of interest related to the topic

Renewable Resource: an organic natural resource which can replenish to overcome usage and consumption, either through biological reproduction or other naturally recurring processes; part of Earth's natural environment and the largest components of its ecosphere

Replication: double helix is unwound and each strand acts as a template for the next strand; bases are matched to synthesize the new partner strands; DNA replication is the process of producing two identical replicas from one original DNA molecule

Reproduction: the sexual or asexual process by which organisms generate new individuals of the same kind; procreation

Resiliency: the power or ability to return to the original form, position, etc., after being bent, compressed, or stretched; elasticity

Resonance: the reinforcement or prolongation of sound by reflection from a surface or by the synchronous vibration of a neighboring object

Retina: the innermost coat of the posterior part of the eyeball that receives the image produced by the lens; is continuous with the optic nerve, and consists of several layers, one of which contains the rods and cones that are sensitive to light

Rock Cycle: idealized cycle of processes undergone by rocks in the earth's crust, involving igneous intrusion, uplift, erosion, transportation, deposition as sedimentary rock, metamorphism, re-melting, and further igneous intrusion

Rocks:
1. hard material consisting of one mineral or several minerals compacted together
2. naturally occurring solid aggregate of one or more minerals or mineraloids

Rube Goldberg Device: a contraption, invention, device or apparatus that is deliberately over-engineered to perform a simple task in a complicated fashion, generally including a chain reaction

Sand:
1. small, loose debris of rocks
2. particulate matter that's larger than silt and smaller than gravel

Satellite (both natural and man-made definitions)
1. an artificial body placed in orbit around the earth or moon or another planet in order to collect information or for communication
2. celestial body orbiting the earth or another planet

Scientific Law: a statement based on repeated experimental observations that describes some aspects of the universe

Scientific Model: “testable idea… created by the human mind that tells a story about what happens in nature”

Scientific Notation: shorthand way to write numbers that are either very large or very small by using powers of ten

Scientific Principles:

A. Basic Principles
    1. Respect for the integrity of knowledge
    2. Collegiality – involving shared responsibility, as among a group of colleagues
    3. Honesty
    4. Objectivity
    5. Openness

B. Particular principles characteristic of specific scientific disciplines
    1. Methods of observation
    2. Acquisition, storage, management, and sharing of data
    3. Communication of scientific knowledge and information
    4. Training of younger scientists

Note: the basic and particular principles that guide scientific research practices exist primarily in an unwritten code of ethics

Sea Level Change: changes according to the tide but the sea level also changes on a much grander time scale; changes in sea level are normally caused by ice ages or other major global events; sea level changes for a variety of reasons; two categories, eustatic and isostatic change, depending on if they have a global effect on sea level or a local effect on the sea level

Seismic Wave: wave of energy that is generated by an earthquake or other earth vibration and that travels within the earth or along its surface

Sensory Receptor: nerve ending that responds to a stimulus in the internal or external environment of an organism

Simulation: the imitation of the operation of a real-world process or system over time

Soil: top layer of the Earth's surface, consisting of rock and mineral particles mixed with decayed organic matter

Soil Moisture: soil moisture sensor measures the quantity of water contained in a material, such as soil on a volumetric or gravimetric basis

Solar Flare: brief eruption of intense high-energy radiation from the sun's surface, associated with sunspots and causing electromagnetic disturbances on the earth, as with radio frequency communications and power line transmissions

Solubility:
1. the property of a solid, liquid, or gaseous chemical substance called solute to dissolve in a solid, liquid, or gaseous solvent to form a solution of the solute in the solvent
2. the ability of a substance to dissolve into another substance

Solution: method used for solving a problem; homogeneous mixture of two or more substances

Sound: traveling through the atmosphere; something that can be heard

Sound Wave: pattern of disturbance caused by the movement of energy traveling through a medium (such as air, water, or any other liquid or solid matter) as it propagates away from the source of the sound; source is some object that causes a vibration, such as a ringing telephone, or a person's vocal chords

Spatial Scale: used for describing or classifying with large approximation the extent or size of a length, distance, or area studied or described

Species Diversity: the number of species and abundance of each species that live in a particular location

Spectra: an array of entities, as light waves or particles, ordered in accordance with the magnitudes of a common physical property, as wavelength or mass: often the band of colors produced when sunlight is passed through a prism, comprising red, orange, yellow, green, blue, indigo, and violet

Star: a huge ball of gas held together with gravity; release visible light, which can be seen as a glow

States of Matter: one of the four principal conditions in which matter exists—solid, liquid, gas, and plasma

Statistical Analysis: the science of collecting, exploring and presenting large amounts of data to discover underlying patterns and trends

Stellar Masses: a phrase that is used by astronomers to describe the mass of a star. It is usually enumerated in terms of the Sun's mass as a proportion of a solar mass ($M_\odot$). Hence, the bright star Sirius has around 2.02 $M_\odot$

Stomata: minute aperture structures on plants found typically on the outer leaf skin layer, also known as the epidermis consisting of two specialized cells, called guard cells that surround a tiny pore called a stoma

Structural Homologies: similar structures found in different species such as the bone structure of the human hand and the bone structure in a bat's wing

Substances: material with specific properties

Sunspot Cycle: averaging in duration slightly more than 11 years, in which the frequency of sunspots varies from a maximum to a minimum and back to a maximum again

Supernova: a star that suddenly increases greatly in brightness because of a catastrophic explosion that ejects most of its mass

Surface: the upper or outermost boundary of an object

Sun: the star in our solar system; the planets rotate around the sun

Sunlight: the light of the sun

Survive: continue to live or exist

Sustainability: the capacity to endure; how biological systems remain diverse and productive indefinitely; long-lived and healthy wetlands and forests are examples of sustainable biological systems; endurance of systems and processes

System: a group of individual parts and/or processes that function together

Table: An arrangement of words, numbers, or signs, or combinations of them (as in parallel columns), to exhibit a set of facts or relations in a definite, compact, and comprehensive form; a synopsis or scheme

Technological System: a set of interconnected components that serve to transform, store, transport, or control materials, energy, and/or information

Technology: any modification of the natural world made to fulfill human needs or desires

Tectonic Plate Activity: the movement of the rocky plates that compose the earth's crust

Tectonic Uplift:
1. the portion of the total geologic uplift of the mean Earth surface that is not attributable to an isostatic response to unloading
2. the raising of a geographical area as a consequence of plate tectonics

Telescope: instrument used to view distant objects

Temperature: a measure of average kinetic energy of matter

Temporal Scale: habitat lifespan relative to the generation, time of the organism, and spatial scale is the distance between habitat patches, relative to the dispersal distance of the organism

Theory: an integrated, comprehensive explanation of many "facts" and an explanation capable of generating additional hypotheses and testable predictions about the way the natural world looks and works; scientific theories represent our best efforts to understand and explain a variety of what appear to be interrelated natural phenomena

Thermal Energy: the internal energy of an object due to the kinetic energy of its atoms and/or molecules

Threatened Species: any species (including animals, plants, fungi, etc.) which are vulnerable to endangerment in the near future

Tissue: consists of groups of cells with a similar structure working together for a specific function

Topographic: having to do with maps based on natural and human-made features of the land, and marked by contour lines showing elevation

Trait: characteristic or aspect

Transcription: the process by which the information in a strand of DNA is copied into a new molecule of messenger RNA (mRNA)

Translation: process in which cellular ribosomes create proteins; proceeds in four phases
1) Initiation: the ribosome assembles around the target mRNA. The first tRNA is attached at the start codon; 2) Elongation: The tRNA transfers an amino acid to the tRNA corresponding to the next codon. 3) Translocation: ribosome then moves (translocates) to the next mRNA codon to continue the process, creating an amino acid chain; 4) Termination: When a stop codon is reached, the ribosome releases the polypeptide

Translucent: permitting light to pass through but diffusing it so that persons, objects, etc., on the opposite side are not clearly visible

Transparent: material that allows light to pass through so that objects behind can be seen
Trend: general course or prevailing tendency of a line of data; if one variable increases as the other increases, the trend is said to be positive; if one variable decreases as the other increases, the trend is said to be negative

Trophic Level: the position of a particular organism in the food chain; examples: green plants are in a trophic level at the beginning of the food chain or web and are known as producers, and those in succeeding levels are known as consumers

Tsunami: a large wave on the ocean, usually caused by an undersea earthquake, a volcanic eruption, or coastal landslide

Universe: the whole of all matter, energy, planets, galaxies and space

Vibrating: moving to and fro continuously

Vacuum: space entirely devoid of matter

Viscosity: resistance of a fluid (liquid or gas) to a change in shape, or movement of neighboring portions relative to one another; denotes opposition to flow

Vocalization: utter a sound or word

Volume: amount of space an object occupies

Warranted Inferences: when one infers from the premise that a given hypothesis would provide a "better" explanation for the evidence than would any other hypothesis, leading to the conclusion that the given hypothesis is true

Water: odorless, tasteless, clear liquid that falls from clouds (rain), water makes up the oceans, rivers, lakes, etc.

Wavelength: distance between one peak of a wave to the next corresponding peak, or between any two adjacent corresponding points, defined as the speed of a wave divided by its frequency

Wave Model: an equation used in wave mechanics to describe a physical system. For a particle of mass (m) and potential energy (V) it is written $(ih/2\pi).(\partial\psi/\partial t) = (-h2/8\pi 2m)\nabla 2\psi + V\psi$, where $i = \sqrt{-1}$, (h) is the Planck constant, (t) is time, $\nabla 2$ the Laplace operator, and ψ the wave function

Weather: condition of the air (atmosphere) above the Earth involving wind, temperature and moisture

Weathering: gradual wearing-away of rocks from weather; first stage in erosion

Weight: measure of the pull of gravity on an object or substance; proportional to the mass; the greater the mass, the greater the weight

Wyoming Science Standards Acronyms

A-CED: Algebra- Creating Equations (Math Connection)

A-SSE: Algebra- Seeing Structure and Expressions (Math Connection)

CCSS: Common Core State Standards

CC: Counting and Cardinality (Math Connection)

CV: Career Vocational

CCC: Crosscutting Concepts

DCI: Disciplinary Core Ideas

ELL: English Language Learner

EE: Expressions & Equations (Math Connection)

ELA: English Language Arts

ED: Engineering Design

ESS: Earth and Space Science

ETS: Engineering, Technology, and Applications of Science

F-BF: Functions-Building Functions (Math Connection)

F-IF: Functions-Interpreting Functions (Math Connection)

FPA: Fine and Performing Arts

G: Geometry (Math Connection)

HE: Health

HS: High School

N-Q: Numbers and Quantities (Math Connection)

ISTE: International Society for Technology in Education

K: Kindergarten

LS: Life Science

MD: Measurement Data (Math Connection)

MS: Middle School

MP: Mathematical Practices (Math Connection)

NGSS: Next Generation Science Standards

NBT: Number and Operations Base Ten (Math Connection)

NSTA: National Science Teachers Association

OA: Operations & Algebraic Thinking (Math Connection)

PE: Physical Education

PS: Physical Sciences

RI: Reading Informational Text (ELA Connection)

Wyoming Science Standards Acronyms

RL: Reading Literature (ELA Connection)

RP: Ratios and Proportional Relationships (Math Connection)

RST: Reading Standards for Literacy in Science & Technical Subjects 6-12 (ELA Connection)

SEP: Scientific and Engineering Practices

SL: Speaking & Listening (ELA Connection)

S- IC: Statistics- Interpreting Categorical and Quantitative Data (Math Connection)

SP: Statistics & Probability (Math Connection)

SS: Social Studies

SSRC: Science Standards Review Committee

STEM: Science, Technology, Engineering, and Mathematics

W: Writing (ELA Connection)

WHST: Writing Standards for Literacy in History/Social Studies, Science and Technical Subjects 6-12 (ELA Connection)

WyCPS: Wyoming Content and Performance Standards