Utah State Board of Education

EXTENDED CORE SCIENCE WITH ENGINEERING EDUCATION (EXTENDED CORE SEED) STANDARDS FOR STUDENTS WITH SIGNIFICANT COGNITIVE DISABILITIES

Utah State Board of Education
250 East 500 South
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State Superintendent of Public Instruction

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In January 1984, the Utah State Board of Education established policy requiring the identification of specific core standards to be met by all K–12 students in order to graduate from Utah's secondary schools. The Utah State Board of Education regularly updates the Utah Core Standards, while parents, teachers, and local school boards continue to control the curriculum choices that reflect local values.

The Utah Core Standards are aligned to scientifically based content standards. They drive high quality instruction through statewide comprehensive expectations for all students. The standards outline essential knowledge, concepts, and skills to be mastered at each grade level or within a critical content area. The standards provide a foundation for ensuring learning within the classroom.

The Extended Core Science with Engineering Education Standards are aligned to the Utah Core Science with Engineering Education (SEEd) Standards. These alternate achievement standards are for students with significant cognitive disabilities to access the core curriculum.

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Development of the Extended Core SEEd Standards

The Extended Core SEEd Standards for grades 6 through 8 have been developed by numerous local experts in curriculum and special education including, special educators, general education teachers, university educators, and curriculum and assessment professionals at the Utah State Board of Education (USBE).

In developing the Extended Core SEEd Standards, it was identified that some SEEd standards are not developmentally applicable or not extendable to students with significant cognitive disabilities. The following SEEd standards have been omitted from the Extended Core SEEd Standards: 7.1.5, 7.5.4., 8.1.1., 8.2.3., and 8.2.6. SEEd Standards 7.5.2 and 7.5.3 have been combined into Extended Core SEEd Standard 7.5.2-3.

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INTRODUCTION TO THE EXTENDED CORE SEED STANDARDS

The school-age population in Utah is made up of students with a variety of unique abilities and diverse needs, including students who are gifted and talented and students with disabilities who may require specialized instruction or accommodations to achieve educational success. While many students with disabilities participate in regular instruction and assessment programs with varying degrees of accommodations, students with significant cognitive disabilities may require instruction in alternate achievement standards in order to make measurable gains in their grade-and-age-appropriate curriculum. This instructional decision is made by the Individualized Education Program (IEP) Team.

The U.S. Department of Education has regulations that provided guidance on the expectations for a State's Alternate Achievement (AA) Standards for students with the most significant cognitive disabilities as designated by the IEP team. The new Every Student Succeeds Act (ESSA) outlines that Alternate Achievement Standards must be:

(I) Aligned with the challenging State academic content Standards);
(II) Promote access to the general education curriculum, consistent with the Individuals with Disabilities Education Act (IDEA);
(III) Reflect professional judgment as to the highest possible Standards achievable by the affected students;
(IV) Designated in the individualized education program developed for each such student as the academic achievement Standards that will be used for the student; and
(V) Aligned to ensure that a student who meets the alternate academic achievement Standards is on track to pursue postsecondary education or employment. (Section 1111(b)(1)(E) of the ESEA, as amended by the ESSA)

AA Standards are the essential components of the Core Standards; the ideas, concepts, and skills that provide a foundation on which subsequent learning may be built only the AA standards are reduced in breadth, depth, and complexity to meet the expectations for students with the most significant cognitive disabilities. The Utah Core Curriculum, derived from the Utah Core Standards, are the driving force for instruction and assessment in the State of Utah. In order for students who have significant cognitive disabilities to access the Core Curriculum, the Extended Core Science with Engineering Education (SEEd) Standards for grades 6–8 have been developed in alignment of the Utah Core SEEd Standards.

If the student's IEP team decides a student will receive instruction in the AA Standards, the student will still have high academic expectations through the AA Standards to keep the student on track to successfully carryout postsecondary education, employment, and/or independent living.

Access Points for the Extended Core SEEd Standards

Every alternate achievement standard in the Extended Core SEEd standards is comprised of various levels for instruction and assessment called Access Points: proficient, developing, approaching, and emerging. These access points are helpful to guide instruction as they outline the different knowledge, skills, and understandings that students need to master to be proficient in the Extended Core SEEd standards.

Each Extended Core SEEd standard's ***proficient*** access point is most closely aligned with the knowledge, skills, and understandings described by that standard. Therefore the proficient level is the desired access point for instruction and assessment.

However, students who have not yet reached the proficient access point may instead be instructed or assessed at other various precursor access points to acquire the necessary skills to show proficiency in the standard. Those precursor access points are: ***developing***, ***approaching, and emerging***.

- **Proficient** – Most closely aligned with the knowledge, skills, and understanding described by the Extended Core SEEd Standard.
- **Developing** – Knowledge, skills, and understanding that are the final skills necessary to acquire before entering the proficient level.
- **Approaching** – Knowledge, skills, and understanding that move the student beyond the emerging access point toward the proficient level.
- **Emerging** – Entrance point to the standard, the most basic knowledge, skills, and understanding necessary to access the given standard.

INTRODUCTION | GRADE 6

SCIENCE LITERACY FOR ALL STUDENTS

Science is a way of knowing, a process for gaining knowledge and understanding of the natural world. Engineering combines the fields of science, technology, and mathematics to provide solutions to real-world problems. The nature and process of developing scientific knowledge and understanding includes constant questioning, testing, and refinement, which must be supported by evidence and has little to do with popular consensus. Since progress in the modern world is tied so closely to this way of knowing, scientific literacy is essential for a society to be competitively engaged in a global economy. Students should be active learners who demonstrate their scientific understanding by using it. It is not enough for students to read about science; they must participate in the three dimensions of science. They should observe, inquire, question, formulate and test hypotheses, analyze data, report, and evaluate findings. The students, as scientists, should have hands-on, active experiences throughout the instruction of the science curriculum. These standards help students find value in developing novel solutions as they engage with complex problems.

THREE DIMENSIONS OF SCIENCE[1]

Science education includes three dimensions of science understanding: science and engineering practices, crosscutting concepts, and disciplinary core ideas. Every standard includes each of the three dimensions; **Science and Engineering Practices are bolded**, <u>Crosscutting Concepts</u> are underlined, and Disciplinary Core Ideas are in normal font. Standards with *specific engineering expectations are italicized.*

Scientific and Engineering Practices	<u>Crosscutting Concepts</u>	Disciplinary Core Ideas
▶ Asking questions or defining problems ▶ Developing and using models ▶ Planning and carrying out investigations ▶ Analyzing and interpreting data ▶ Using mathematics and computational thinking ▶ Constructing explanations and designing solutions ▶ Engaging in argument from evidence ▶ Obtaining, evaluating, and communicating information	▶ Patterns ▶ Cause and effect: mechanism and explanation ▶ Scale, proportion, and quantity ▶ Systems and system models ▶ Energy and matter: flows, cycles, and conservation ▶ Structure and function ▶ Stability and change	▶ Earth and Space Science ▶ Life Science ▶ Physical Science ▶ Engineering

[1] NRC Framework K-12 Science Education: http://www.nap.edu/catalog.php?record_id=13165

ORGANIZATION OF STANDARDS

The Utah SEEd standards[2] are organized into **strands**, which represent significant areas of learning within content areas. Within each strand are **standards**. A standard is an articulation of the demonstrated proficiency to be obtained. A standard represents an essential element of the learning that is expected. While some standards within a strand may be more comprehensive than others, all standards are essential for mastery.

GRADE SIX UTAH SCIENCE WITH ENGINEERING EDUCATION (SEED) STANDARDS

The sixth grade SEEd standards provide a framework for student understanding of the cycling of matter and the flow of energy through the study of observable phenomena on Earth. Students will explore the role of energy and gravity in the solar system as they compare the scale and properties of objects in the solar system and model the Sun-Earth-Moon system. These strands also emphasize heat energy as it affects some properties of matter, including states of matter and density. The relationship between heat energy and matter is observable in many phenomena on Earth, such as seasons, the water cycle, weather, and climates. Types of ecosystems on Earth are dependent upon the interaction of organisms with each other and with the physical environment. By researching interactions between the living and nonliving components of ecosystems, students will understand how the flow of energy and cycling of matter affects stability and change within their environment.

[2] Most SEEd Standards are based on the Next Generation Science Standards: http://www.nextgenscience.org

Extended SEEd Strand 6.1: Structure and Motion Within the Solar System

The solar system consists of the Sun, planets, and other objects within the Sun's gravitational influence. Gravity is the force of attraction between masses. The Sun-Earth-Moon system provides an opportunity to study interactions between objects in the solar system that influence phenomena observed from Earth. Scientists use data from many sources to determine the scale and properties of objects in our solar system.

Standard 6.1.1

Develop and use a model of the Sun-Earth-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons. Examples of models could be physical, graphical, or conceptual.

Extended SEEd Standard 6.1.1

Use a model to show how the patterns of the motions of the Sun-Earth-Moon system cause the phases of the moon and the seasons.

Big Idea:

The Earth moves around the Sun and causes changes in seasons, phases in the Moon, and other repeating patterns. Recognizing patterns is important because they can be used to identify cause-and-effect relationships.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to show how the patterns of the motions of the Sun, Earth, and Moon cause the phases of the Moon and the seasons.
- **Approaching**
  - **Identify parts of a model** of the Sun-Earth-Moon system and patterns of a model of the phases of the Moon and seasons.
- **Developing**
  - **Identify the parts of a model** of the Sun-Earth-Moon system and the patterns of the motions of the Sun-Earth-Moon system that cause the seasons.
- **Emerging**
  - Identify the parts of a model of the Sun-Earth-Moon system (Sun, Earth, and Moon).

Standard 6.1.2

Develop and use a model to describe the role of gravity and inertia in orbital motions of objects in our solar system.

Extended SEEd Standard 6.1.2

Use a model to show how the balance of gravity and motion in the solar system keeps planets in their place as they orbit around the Sun.

Big Idea:

Objects in our solar system are held in place by a balance between motion and gravity.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to show how the balance of gravity and motion in the solar system keeps planets in their place as they orbit around the Sun.
- **Approaching**
  - **Use a simple model** representing the Sun and a planet that can be manipulated to keep the planet in an orbit.
- **Developing**
  - Identify that the planets in the solar system orbit the Sun.
- **Emerging**
  - Identify the different parts of the solar system (planets, moons, and Sun).

Standard 6.1.3

Use computational thinking to **analyze data** and determine the scale and properties of objects in the solar system. Examples of scale could include size and distance. Examples of properties could include layers, temperature, surface features, and orbital radius. Data sources could include Earth and space-based instruments such as telescopes and satellites. Types of data could include graphs, data tables, drawings, photographs, and models.

Extended SEEd Standard 6.1.3

Analyze and interpret data to determine that objects in our solar system are massively different in scale (i.e., size and distance from the Sun) and properties (e.g., mass, layers, temperature, orbital radius, and surface features).

Big Idea:

Objects in our solar system differ from one another because of their individual characteristics including mass, density, distance, temperature, orbital radius, surface features, and layers. The solar system consists of planets, moons, asteroids, and comets orbiting the Sun.

Access Points (levels of complexity)

- **Proficient**
  - **Analyze and interpret data** to determine that objects in our solar system are massively different in scale (i.e., size and distance from the Sun) and properties (e.g., mass, layers, temperature, orbital radius, and surface features).
- **Approaching**
  - **Analyze** data to classify planetary differences (either properties or scale).
- **Developing**
  - Classify objects in the solar system (e.g., hot and cold planets, big and small planets, and distance from the Sun).
- **Emerging**
  - Identify a difference between any two objects in the solar system (e.g., size, color, or temperature of Jupiter vs. Mars).

Extended SEEd Strand 6.2: Energy Affects Matter

Matter and energy are fundamental components of the universe. Matter is anything that has mass and takes up space. Transfer of energy creates change in matter. Changes between general states of matter can occur through the transfer of energy. Density describes how closely matter is packed together. Substances with a higher density have more matter in a given space than substances with a lower density. Changes in heat energy can alter the density of a material. Insulators resist the transfer of heat energy, while conductors easily transfer heat energy. These differences in energy flow can be used to design products to meet the needs of society.

Standard 6.2.1

Develop models to show that molecules are made of different kinds, proportions, and quantities of atoms. Emphasize understanding that there are differences between atoms and molecules, and that certain combinations of atoms form specific molecules. Examples of simple molecules could include water (H_2O), atmospheric oxygen (O_2), and carbon dioxide (CO_2).

Extended SEEd Standard 6.2.1

Develop models of simple molecules when given the proportions and quantities of their structure (e.g., Water: one Hydrogen and two Oxygen (H_2O), Carbon Dioxide: one Carbon, and two Oxygen (CO_2), atmospheric Oxygen: two Oxygen (O_2)).

Big Idea:

Atoms (the smallest building blocks that cannot be seen by the eye) combine to form specific molecules and makeup all matter (what we see around us).

Access Points (levels of complexity)

- **Proficient**
  - **Develop models** of simple molecules when given the proportions and quantities of their structure (e.g., Water: one Hydrogen and two Oxygen (H_2O), Carbon Dioxide: one Carbon and two Oxygen (CO_2), atmospheric Oxygen: two Oxygen (O_2)).
- **Approaching**
  - Understand that when combining different kinds and quantities of atoms they form different molecules (e.g., CO is carbon monoxide and CO_2 is carbon dioxide; H_2O is water and $C_6H_{12}O_6$ is sugar).
- **Developing**
  - Using a model of a simple molecule, identify that the individual components that make up the molecule are atoms.
- **Emerging**
  - Recognize that when combining individual parts together these parts are able to form larger whole structures (e.g., interlocking blocks, playdough balls).

STANDARD 6.2.2

Develop a model to predict the effect of heat energy on states of matter and density. Emphasize the arrangement of particles in states of matter (solid, liquid, or gas) and during phase changes (melting, freezing, condensing, and evaporating).

EXTENDED SEEd STANDARD 6.2.2

Develop a model to show the effect of heat energy on states of matter, and explain the relationship between the motion of the molecules in a system and a change in the state of matter.

Big Idea:

There are three states of matter: solid, liquid, gas. Addition or removal of heat energy (hot or cold) causes matter to change state. The object heats up as molecules move more rapidly; the object grows colder as molecules slow down.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to show the effect of heat energy on states of matter, and explain the relationship between the motion of the molecules in a system and a change in the state of matter.
- **Approaching**
  - **Use a model** to show the effect (addition or removal) of heat energy on states of matter (e.g., water bottle removed from freezer/put back in freezer).
- **Developing**
  - Recognize a change in state from solid to liquid or liquid to solid.
- **Emerging**
  - Recognize that matter has three different states: liquid, gas, and solid.

Standard 6.2.3

Plan and carry out an investigation to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data, and communicating the results of the investigation.

Extended SEEd Standard 6.2.3

Plan and carry out an investigation of the relationship between temperature and the amount of heat transferred. This investigation includes predicting, performing, evaluating the data, and communicating the results.

Big Idea:

Plan and carry out an experiment (investigation) to answer the question: What is the relationship between temperature and heat transferred (i.e., the hotter the temperature, the faster the molecules move/spread apart; the colder the temperature, the slower the molecules move and the matter changes state)?

Access Points (levels of complexity)

- **Proficient**
    - **Plan and carry** out an investigation of the relationship between temperature and the amount of heat transferred. This investigation includes predicting, performing, evaluating the data, and communicating the results.
- **Approaching**
    - When given an investigation to perform on the relationship between temperature and heat transfer, collect and use data to communicate results.
- **Developing**
    - Make a prediction for an investigation on the relationship between temperature and heat transfer (e.g., putting an item in the freezer that is 32 degrees makes it cold because it takes away heat).
- **Emerging**
    - Recognize the difference between hot temperatures and cold temperatures.

Standard 6.2.4

Design *an object, tool, or process* that minimizes or maximizes heat energy transfer. *Identify criteria and constraints, develop a prototype for iterative testing, analyze data from testing, and propose modifications for optimizing the* ***design solution.*** Emphasize demonstrating how the structure of differing materials allows them to function as either conductors or insulators.

Extended SEEd Standard 6.2.4

Design an object to function as a conductor or as an insulator and explain how the structure of the materials would allow it to minimize or maximize heat energy transfer.

Big Idea:

Heat transfer can be maximized or minimized by different types of materials. The structure of materials can make them more of a conductor (maximizing heat transfer) or an insulator (minimizing heat transfer).

Access Points (levels of complexity)

- **Proficient**
    - **Design** an object to function as a conductor or as an insulator and explain how the structure of the materials would allow it to minimize or maximize heat energy transfer.
- **Approaching**
    - Compare the structure of different materials and communicate how an object minimizes or maximizes heat energy transfer (e.g., Styrofoam cup (thick) versus plastic cup (thin)).
- **Developing**
    - Identify objects used to minimize and maximize heat energy transfer (insulators and conductors).
- **Emerging**
    - Recognize materials that are conductors and insulators (e.g., cotton batting from a potholder is an insulator; metal is a conductor).

EXTENDED SEEd STRAND 6.3: EARTH'S WEATHER PATTERNS AND CLIMATES

All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. Heat energy from the Sun, transmitted by radiation, is the primary source of energy that affects Earth's weather and drives the water cycle. Uneven heating across Earth's surface causes changes in density, which results in convection currents in water and air, creating patterns of atmospheric and oceanic circulation that determine regional and global climates.

STANDARD 6.3.1

Develop a model to describe how the cycling of water through Earth's systems is driven by energy from the Sun, gravitational forces, and density.

EXTENDED SEEd STANDARD 6.3.1

Use a model to describe how the cycling of water in the Earth is driven by energy from the Sun and gravity.

Big Idea:

Water cycles constantly between land, water (oceans, lakes, rivers), and the atmosphere. This cycle is propelled by the Sun and gravity. The heat energy from the Sun and gravitational forces push the cycle to continue in a never-ending pattern.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to describe how the cycling of water in the Earth is driven by energy from the Sun and gravity.
- **Approaching**
  - Identify the role of energy from the Sun and gravity in the cycling of water on the Earth.
- **Developing**
  - Recognize the water cycle is continuous.
- **Emerging**
  - Identify the components of the water cycle (body of water, land, atmosphere/sky).

STANDARD 6.3.2

Investigate the interactions between air masses that cause changes in weather conditions. Collect and analyze weather data to provide evidence for how air masses flow from regions of high pressure to low pressure causing a change in weather. Examples of data collection could include field observations, laboratory experiments, weather maps, or diagrams.

EXTENDED SEED STANDARD 6.3.2

Investigate the interactions between air masses that cause changes in weather conditions.

Big Idea:

The interactions between air masses cause changes in weather. High pressure and low pressure are always trying to balance each other. Air masses will flow from regions of high pressure to low pressure which causes a change in weather.

Access Points (levels of complexity)

- **Proficient**
  - **Investigate** the interactions between air masses that cause changes in weather conditions.
- **Approaching**
  - Identify how changes in weather conditions are influenced by low pressure or high pressure air masses to cause changes in weather conditions.
- **Developing**
  - Match air pressure with weather conditions (i.e., low pressure = clouds/rain, high pressure = clear/mild).
- **Emerging**
  - Observe and identify weather conditions (rainy, cloudy, sunny, and windy).

STANDARD 6.3.3

Develop and use a model to show how unequal heating of the Earth's systems causes patterns of atmospheric and oceanic circulation that determine regional climates. Emphasize how warm water and air move from the equator toward the poles. Examples of models could include Utah regional weather patterns such as lake-effect snow and wintertime temperature inversions.

EXTENDED SEED STANDARD 6.3.3

Use a model to show how unequal heating of the Earth causes patterns of circulation that determine regional climates.

Big Idea:

Unequal heating causes the different weather patterns on Earth. As the Sun's energy warms the air, the air rises and allows cooler air to come in and take its place. Water and land heat at different rates; land heats more quickly. Air heats over the land and rises, then air cools in the atmosphere and falls back to land creating a cyclic pattern. In the previous standard, the focus was on weather (what is happening now) which over time has an impact on climate.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to show how unequal heating of the Earth causes patterns of circulation that determine regional climates.
- **Approaching**
  - Identify that land heats up faster than water, resulting in circulation of air.
- **Developing**
  - Recognize that generally warm air and warm water rises and cool air and cool water sinks.
- **Emerging**
  - Identify that different regions have different temperatures (e.g., St. George as compared to Logan).

Standard 6.3.4

Construct an explanation supported by evidence for the role of the natural greenhouse effect in Earth's energy balance and how it enables life to exist on Earth. Examples could include comparisons between Earth and other planets such as Venus and Mars.

Extended SEEd Standard 6.3.4

Construct an explanation for the role of the natural greenhouse effect in Earth's energy balance and how it enables life to exist on Earth.

Big Idea:

The atmosphere covers the Earth like a blanket. It helps keep the temperature of the Earth balanced. It both absorbs and reflects the Sun's energy. The natural greenhouse effect impacts Earth's energy balance. Greenhouse gases both absorb and reflect heat in the atmosphere. Main greenhouse gases include Carbon Dioxide (CO_2), Water (H_2O), and Methane (CH_4). Like a greenhouse, the atmosphere traps some of the heat that radiates from the Sun and keeps the Earth at the correct temperature to sustain life.

Access Points (levels of complexity)

- **Proficient**
  - **Construct an explanation** for the role of the natural greenhouse effect in Earth's energy balance and how it enables life to exist on Earth.
- **Approaching**
  - Understand that greenhouse gases both absorb and reflect heat (energy) in the atmosphere.
- **Developing**
  - Identify that the atmosphere is made up of gases that determine the Earth's temperature.
- **Emerging**
  - Recognize that temperature on Earth affects living things (e.g., areas on Earth with the same amount of water but different temperatures have different types and amounts of life).

Extended SEEd Strand 6.4: Stability and Change in Ecosystems

The study of ecosystems includes the interaction of organisms with each other and with the physical environment. Consistent interactions occur within and between species in various ecosystems as organisms obtain resources, change the environment, and are affected by the environment. This influences the flow of energy through an ecosystem, resulting in system variations. Additionally, ecosystems benefit humans through processes and resources, such as the production of food, water and air purification, and recreation opportunities. Scientists and engineers investigate interactions among organisms and evaluate design solutions to preserve biodiversity and ecosystem resources.

Standard 6.4.1

Analyze data to provide evidence for the effects of resources availability on organisms and populations in an ecosystem. **Ask questions** to predict how changes in resource availability affect organisms in those ecosystems. Examples could include water, food, and living space in Utah environments.

Extended SEEd Standard 6.4.1

Analyze data to make a prediction based on evidence for the effects of resource availability on organisms and populations in an ecosystem.

Big Idea:

The availability of resources such as water, food, and living space affect living organisms and their populations. Organisms, and populations of organisms, are dependent on their environmental interactions, both with other living things and with nonliving factors. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Growth of organisms and population increases are limited by access to resources.

Access Points (levels of complexity)

- **Proficient**
  - **Analyze data** to make a prediction based on evidence for the effects of resource availability on organisms and populations in an ecosystem.
- **Approaching**
  - Predict how changes in resource availability affect organisms in those ecosystems.
- **Developing**
  - Identify that resources in an ecosystem have an effect on the growth or decline in populations (i.e., fewer resources = fewer organisms).
- **Emerging**
  - Identify one or more items needed to help organisms live (food, water, or living space).

Standard 6.4.2

Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments, such as competition, predation, and mutualism.

Extended SEEd Standard 6.4.2

Construct an explanation, based on identified patterns (competition and predation), of how organisms interact in an ecosystem.

Big Idea:

Organisms interact with each other in different ways, such as competition and predation. There are patterns of interactions among organisms in different ecosystems.

Access Points (levels of complexity)

- **Proficient**
  - **Construct an explanation,** based on identified patterns (competition and predation), of how organisms interact in an ecosystem.
- **Approaching**
  - Identify the different ways organisms interact in an ecosystem. (Competition and predation.)
- **Developing**
  - Identify predatory relationships in different ecosystems.
- **Emerging**
  - Recognize that animals compete for food.

STANDARD 6.4.3

Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts.

EXTENDED SEEd STANDARD 6.4.3

Use a model to identify the cycling of energy between producers and consumers in an ecosystem. Emphasis on food webs and the role of producers and consumers.

Big Idea:

Energy and matter flow in a predictable pattern within the ecosystem to remain stable. Ecosystems depend on cycles of the food web, including the roles of consumers, producers, and decomposers. A food web shows the feeding relationships between many organisms in an ecosystem. Producers (plants) get energy from the Sun and provide energy for consumers.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to identify the cycling of energy between producers and consumers in an ecosystem. Emphasis on food webs and the role of producers and consumers.
- **Approaching**
  - **Develop a model** of a simple food chain to show the flow of energy between producers and consumers in an ecosystem (e.g., producers get their energy from the Sun and consumers eat plants and/or animals for their energy).
- **Developing**
  - Recognize that when people or animals eat they are taking energy into their bodies.
- **Emerging**
  - Recognize animals must eat other plants and animals.

Standard 6.4.4

Construct an argument supported by evidence that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, and deserts.

Extended SEEd Standard 6.4.4

Construct an argument supported by evidence about how changes to components of an ecosystem affect the stability of populations.

Big Idea:

Changes to living and nonliving components in an ecosystem affect populations. Some survive and reproduce, some relocate, some die, and some change.

Access Points (levels of complexity)

- **Proficient**
  - **Construct an argument supported by evidence** about how changes to components of an ecosystem affect the stability of populations.
- **Approaching**
  - **Construct an argument** about how changes to an ecosystem affect populations.
- **Developing**
  - Communicate the effects of changes in an ecosystem on an organism (e.g., some survive and reproduce, some move to new locations, some remain in the transformed environment, and some die).
- **Emerging**
  - Identify things that can change in the environment (e.g., drought, flood, and temperature change).

Standard 6.4.5

Evaluate competing design solutions for preserving ecosystem services that protect resources and biodiversity based on how well the solutions maintain stability within the ecosystem. Emphasize **obtaining, evaluating, and communicating** information on differing design solutions. Examples could include policies affecting ecosystems, responding to invasive species or solutions for the preservation of ecosystem resources specific to Utah, such as air and water and quality and prevention of soil erosion.

Extended SEEd Standard 6.4.5

Using competing design solutions for preserving ecosystems, **evaluate and communicate** information about how well the solutions maintain stability of the ecosystem.

Big Idea:

Humans can provide solutions for preserving ecosystems. Ecosystems benefit humans through processes and resources, such as production of food, water and air purification, and recreation opportunities. Scientists and engineers investigate interactions among organisms and evaluate design solutions to preserve biodiversity and ecosystem resources.

Access Points (levels of complexity)

- **Proficient**
  - Using competing design solutions for preserving ecosystems, **evaluate and communicate** information about how well the solutions maintain stability of the ecosystem.
- **Approaching**
  - **Evaluate** a design solution for preserving ecosystems and **communicate** information about how well the solution maintains stability.
- **Developing**
  - Identify ways people can protect habitats to maintain stability in an ecosystem.
- **Emerging**
  - Identify different habitats.

INTRODUCTION | GRADE 7

SCIENCE LITERACY FOR ALL STUDENTS

Science is a way of knowing, a process for gaining knowledge and understanding of the natural world. Engineering combines the fields of science, technology, and mathematics to provide solutions to real-world problems. The nature and process of developing scientific knowledge and understanding includes constant questioning, testing, and refinement, which must be supported by evidence and has little to do with popular consensus. Since progress in the modern world is tied so closely to this way of knowing, scientific literacy is essential for a society to be competitively engaged in a global economy. Students should be active learners who demonstrate their scientific understanding by using it. It is not enough for students to read about science; they must participate in the three dimensions of science. They should observe, inquire, question, formulate and test hypotheses, analyze data, report, and evaluate findings. The students, as scientists, should have hands-on, active experiences throughout the instruction of the science curriculum. These standards help students find value in developing novel solutions as they engage with complex problems.

THREE DIMENSIONS OF SCIENCE[1]

Science education includes three dimensions of science understanding: science and engineering practices, crosscutting concepts, and disciplinary core ideas. Every standard includes each of the three dimensions; **Science and Engineering Practices are bolded**, <u>Crosscutting Concepts</u> are underlined, and Disciplinary Core Ideas are in normal font. Standards with *specific engineering expectations are italicized.*

Scientific and Engineering Practices	<u>Crosscutting Concepts</u>	Disciplinary Core Ideas
▶ Asking questions or defining problems ▶ Developing and using models ▶ Planning and carrying out investigations ▶ Analyzing and interpreting data ▶ Using mathematics and computational thinking ▶ Constructing explanations and designing solutions ▶ Engaging in argument from evidence ▶ Obtaining, evaluating, and communicating information	▶ Patterns ▶ Cause and effect: mechanism and explanation ▶ Scale, proportion, and quantity ▶ Systems and system models ▶ Energy and matter: flows, cycles, and conservation ▶ Structure and function ▶ Stability and change	▶ Earth and Space Science ▶ Life Science ▶ Physical Science ▶ Engineering

NRC Framework K-12 Science Education: http://www.nap.edu/catalog.php?record_id=13165

ORGANIZATION OF STANDARDS

The Utah SEEd standards[2] are organized into **strands**, which represent significant areas of learning within content areas. Within each strand are **standards**. A standard is an articulation of the demonstrated proficiency to be obtained. A standard represents an essential element of the learning that is expected. While some standards within a strand may be more comprehensive than others, all standards are essential for mastery.

GRADE SEVEN UTAH SCIENCE WITH ENGINEERING EDUCATION (SEED) STANDARDS

The seventh grade SEEd standards look for relationships of cause and effect, which enable students to pinpoint mechanisms of nature and allow them to make predictions. Students will explore how forces can cause changes in motion and are responsible for the transfer of energy and the cycling of matter. This takes place within and between a wide variety of systems, from simple, short-term forces on individual objects to the deep, long- term forces that shape our planet. In turn, Earth's environments provide the conditions for life as we know it. Organisms survive and reproduce only to the extent that their own mechanisms and adaptations allow. Evidence for the evolutionary histories of life on Earth is provided through the fossil record, similarities in the various structures among species, organism development, and genetic similarities across all organisms. Additionally, mechanisms shaping Earth are understood as forces affecting the cycling of Earth's materials. Questions about cause and effect and the ongoing search for evidence in science, or science's ongoing search for evidence, drive this storyline.

[2] Most SEEd Standards are based on the Next Generation Science Standards: http://www.nextgenscience.org

Extended SEEd Strand 7.1: Forces are Interactions Between Matter

Forces are push or pull interactions between two objects. Changes in motion, balance and stability, and transfers of energy are all facilitated by forces on matter. Forces, including electric, magnetic, and gravitational forces, can act on objects that are not in contact with each other. Scientists use data from many sources to examine the cause and effect of relationships determined by different forces.

Standard 7.1.1

Carry out an investigation that provides evidence that a change in an object's motion is dependent on the mass of the object and the sum of the forces acting on it. *Various experimental designs should be evaluated to determine how well the investigation measures an object's motion.* Emphasize conceptual understanding of Newton's First and Second Laws. Calculations will only focus on one-dimensional movement; the use of vectors will be introduced in high school.

Extended SEEd Standard 7.1.1

Carry out a simple investigation that demonstrates a change in an object's motion is dependent on the mass of the object and the sum of the forces acting on it.

Big Idea:

The change in motion of an object depends on its mass and forces acting on it.

Access Points (levels of complexity)

- **Proficient**
  - **Carry out a simple investigation** that demonstrates a change in an object's motion is dependent on the mass of the object and the sum of the forces acting on it.
- **Approaching**
  - **Participate in a simple investigation** that demonstrates a change in an object's motion is dependent on the forces acting on it.
- **Developing**
  - **Participate in a simple investigation** and predict change in an object's motion when a force acts or does not act on it.
- **Emerging**
  - Identify when an object is at rest or in motion.

Standard 7.1.2

Apply Newton's Third Law to ***design a solution*** *to a problem involving the motion of two colliding objects in a system*. Examples could include collisions between two moving objects or between a moving object and a stationary object.

Extended SEEd Standard 7.1.2

Design a solution *to a problem involving the motion of two colliding objects* (e.g., keep a dropping egg from breaking) *in a system* (e.g., tile floor, dropped from 3 feet, etc.).

Big Idea:

For every force between colliding objects, there is an equal and opposite force, related to mass.

Access Points (levels of complexity)

- **Proficient**
    - ***Design a solution*** *to a problem involving the motion of two colliding objects* (e.g., keep a dropping egg from breaking) *in a system* (e.g., tile floor, dropped from 3 feet, etc.).
- **Approaching**
    - Identify a **solution** to a problem involving the motion of two colliding objects in a system.
- **Developing**
    - Predict the effect of two objects colliding in a system.
- **Emerging**
    - Identify when two objects collide there is a result.

STANDARD 7.1.3

Construct a model using observational evidence to describe the nature of fields existing between objects that exert forces on each other even though the objects are not in contact. Emphasize the cause and effect relationship between properties of objects (such as magnets or electrically charged objects) and the forces they exert.

EXTENDED SEEd STANDARD 7.1.3

Construct a model to demonstrate understanding of the fields and the cause and effect relationship that exist between objects that are not in contact (e.g., magnetic or electrically charged objects).

Big Idea:

There are forces between objects that can affect them, even if they are not touching.

Access Points (levels of complexity)

- **Proficient**
  - **Construct a model** to demonstrate understanding of the fields and the cause and effect relationship that exist between objects that are not in contact (e.g., magnetic or electrically charged objects).
- **Approaching**
  - Use **a model** that demonstrates understanding of the fields and the cause and effect relationship that exist between objects that are not in contact (magnetic or electrically charged objects).
- **Developing**
  - Identify the cause and effect relationship that exist between objects that are not in contact (magnetic or electrically charged objects).
- **Emerging**
  - Given various objects, identify which sets of objects have magnetic and electrical forces.

STANDARD 7.1.4

Collect and analyze data to determine the factors that affect the strength of electric and magnetic forces. Examples could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or of increasing the number or strength of magnets on the speed of an electric motor.

EXTENDED SEED STANDARD 7.1.4

Collect and analyze data to determine the factors that affect the strength of electric and magnetic forces.

Big Idea:

The strength of electric or magnetic forces can be changed.

Access Points (levels of complexity)

- **Proficient**
  - **Collect and analyze data** to determine the factors that affect the strength of electric and magnetic forces.
- **Approaching**
  - **Analyze data** to determine the factors that affect the strength of electric and magnetic forces.
- **Developing**
  - Given two objects, identify which has a stronger electric or magnetic force. (e.g., balloons rubbed on different surfaces to create static electricity, two magnets attracting paper clips, etc.)
- **Emerging**
  - Identify that electric and magnetic forces push and pull other objects (e.g., static electric forces in clothes/balloons, using a magnet to move another magnet, etc.).

STANDARD 7.1.5 HAS BEEN OMITTED. SEE PAGE 4 FOR DETAILS.

EXTENDED SEEd STRAND 7.2: CHANGES TO EARTH OVER TIME

Earth's processes are dynamic and interactive, and are the result of energy flowing and matter cycling within and among Earth's systems. Energy from the Sun and Earth's internal heat are the main sources driving these processes. Plate tectonics is a unifying theory that explains crustal movements of Earth's surfaces, how and where different rocks form, the occurrence of earthquakes and volcanoes, and the distribution of fossil plants and animals.

STANDARD 7.2.1

Develop a model of the rock cycle to describe the relationship between energy flow and matter cycling that creates igneous, sedimentary, and metamorphic rocks. Emphasize the processes of melting, crystallization, weathering, deposition, sedimentation, and deformation, which act together to form mineral and rocks.

EXTENDED SEEd STANDARD 7.2.1

Develop a model of the rock cycle to describe the relationship between the energy flow and matter cycling that form igneous, sedimentary, and metamorphic rocks (e.g., volcanoes melt rocks, erosion breaks down rocks and new rocks are made of layers of broken down eroded rocks).

Big Idea:

Rocks change from one form to another through the rock cycle.

Access Points (levels of complexity)

- **Proficient**
  - **Develop a model** of the rock cycle to describe the relationship between the energy flow and matter cycling that form igneous, sedimentary, and metamorphic rocks (e.g., volcanoes melt rocks, erosion breaks down rocks and new rocks are made of layers of broken down eroded rocks).
- **Approaching**
  - **Use a model** of the rock cycle to describe the relationship between the energy flow and matter cycling that form igneous, sedimentary, and metamorphic rocks.
- **Developing**
  - Identify a model that describes the changes from one type of rock to another.
- **Emerging**
  - Recognize that the Earth is made up of rock (e.g., rock vs. non-rock).

STANDARD 7.2.2

Construct an explanation based on evidence for how processes have changed Earth's surface at varying time and spatial scales. Examples of processes that occur at varying time scales could include slow plate motions or rapid landslides. Examples of processes that occur at varying spatial scales could include uplift of a mountain range, or deposition of fine sediments.

EXTENDED SEED STANDARD 7.2.2

Construct an explanation based on evidence for how processes have changed Earth's surface at varying time and spatial scales.

Big Idea:

The processes that change Earth's surface can vary.

Access Points (levels of complexity)

- **Proficient**
  - **Construct an explanation** based on evidence for how processes have changed Earth's surface at varying time and spatial scales.
- **Approaching**
  - Identify evidence to support **an explanation** for how processes have changed Earth's surface at varying time and spatial scales (ex: given a photo of a canyon with a river running through it, the student will identify evidence that they see that the river caused changes to the canyon).
- **Developing**
  - Identify the processes that change Earth's surface (e.g., volcanoes, earthquakes, weathering, and erosion).
- **Emerging**
  - Identify various Earth surfaces (e.g., mountain, valley, river, and canyon).

Standard 7.2.3

Ask questions to *identify constraints* of specific geological hazards and *evaluate competing design solutions* for maintaining the stability of human-engineered structures, such as homes, roads, and bridges. Examples of geologic hazards could include earthquakes, landslides, or floods.

Extended SEEd Standard 7.2.3

Ask questions and *evaluate competing design solutions* of structures that can maintain stability and withstand specific geological hazards.

Big Idea:

Structures are engineered to withstand geologic hazards.

Access Points (levels of complexity)

- **Proficient**
  - **Ask questions** and *evaluate competing design solutions* of structures that can maintain stability and withstand specific geological hazards.
- **Approaching**
  - Build a structure that can maintain stability and withstand specific geological hazards.
- **Developing**
  - Identify possible solutions to maintain the stability of homes to withstand geological hazards.
- **Emerging**
  - Identify geological hazards that can affect homes in Utah.

STANDARD 7.2.4

Develop and use a scale model of the matter in the Earth's interior to demonstrate how differences in density and chemical composition (silicon, oxygen, iron, and magnesium) cause the formation of the crust, mantle, and core.

EXTENDED SEED STANDARD 7.2.4

Develop and use a scale model of the matter in the Earth's interior to demonstrate how differences in density cause the formation of the crust, mantle, and core.

Big Idea:

The interior of the Earth has layers.

Access Points (levels of complexity)

- **Proficient**
  - **Develop and use a scale model** of the matter in the Earth's interior to demonstrate how differences in density cause the formation of the crust, mantle, and core.
- **Approaching**
  - **Use a scale model** of the matter in the Earth's interior to demonstrate how differences in density cause the formation of the crust, mantle, and core.
- **Developing**
  - **Use a scale model** of the matter in the Earth's interior to identify the crust, mantle, and core.
- **Emerging**
  - **Use a scale model** of the Earth to recognize part and whole by identifying a layer of the Earth (e.g., crust).

STANDARD 7.2.5

Ask questions and analyze and interpret data about the patterns between plate tectonics and:

1. The occurrence of earthquakes and volcanoes.
2. Continental and ocean floor features.
3. The distribution of rocks and fossils.

Examples could include identifying patterns on maps of earthquakes and volcanoes relative to plate boundaries, the shapes of the continents, the locations of the ocean structures (including mountains, volcanoes, faults, and trenches), and similarities of rock and fossil types on different continents.

EXTENDED SEED STANDARD 7.2.5

Analyze data about the patterns between plate tectonics and the occurrence of earthquakes and volcanoes.

Big Idea:

Patterns found on Earth are evidence of plate tectonics.

Access Points (levels of complexity)

- **Proficient**
  - **Analyze data** about the patterns between plate tectonics and the occurrence of earthquakes and volcanoes.
- **Approaching**
  - Identify that the movement of tectonic plates can create earthquakes and volcanoes.
- **Developing**
  - Demonstrate understanding that the Earth's crust is made up of plates and that they move independently.
- **Emerging**
  - Identify that the Earth's crust is made of pieces.

Standard 7.2.6

Make an argument from evidence for how the geologic time scale shows the age and history of Earth. Emphasize scientific evidence from rock strata, the fossil record, and the principles of relative dating, such as superposition, uniformitarianism, and recognizing unconformities.

Extended SEEd Standard 7.2.6

Make an **argument from evidence** for how the geologic time scale shows the age and history of Earth.

Big Idea:

Layers of rock provide evidence of Earth's history.

Access Points (levels of complexity)

- **Proficient**
    - Make an **argument from evidence** for how the geologic time scale shows the age and history of Earth.
- **Approaching**
    - Identify **evidence** that supports how the geologic time scale shows the age and history of Earth.
- **Developing**
    - Identify that the oldest layers in rocks are usually at the bottom and the newest layers of rock are usually at the top.
- **Emerging**
    - Identify that most mountains are made of separate layers of rock that are visible on the exposed surfaces.

EXTENDED SEEd STRAND 7.3: STRUCTURE AND FUNCTION OF LIFE

Living things are made of smaller structures, which function to meet the needs of survival. The basic structural unit of all living things is the cell. Parts of a cell work together to function as a system. Cells work together and form tissues, organs, and organ systems. Organ systems interact to meet the needs of the organism.

STANDARD 7.3.1

Plan and carry out an investigation that provides evidence that the basic structures of living things are cells. Emphasize that cells can form single-celled or multicellular organisms, and the multicellular organisms are made of different types of cells.

EXTENDED SEEd STANDARD 7.3.1

Carry out an investigation that provides evidence that the basic structures of living things are cells.

Big Idea:

All living things are made of cells.

Access Points (levels of complexity)

- **Proficient**
  - **Carry out an investigation** that provides evidence that the basic structures of living things are cells.
- **Approaching**
  - **Carry out an investigation** that identifies differences in basic cell structures of living things.
- **Developing**
  - Identify living and nonliving things based on the presence of cell structures.
    - (e.g., onion cells are living, while plastic is not; students could compare microscope pictures of these things.)
- **Emerging**
  - Distinguish between living and nonliving organisms.

Standard 7.3.2

Develop and use a model to describe the function of a cell in living systems and the way parts of cells contribute to cell function. Emphasize the cell as a system, including the interrelating roles of the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.

Extended SEEd Standard 7.3.2

Use a model to describe how tissues are made up of parts called cells and that cells contribute to the functions of tissue (e.g., inside skin layer has cells that sense touch, cells that make sweat, cells that make hair).

Big Idea:

Body parts are made of organs, tissues, and cells that help give them their functions. This standard starts at organs and moves in complexity towards tissues and cells.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to describe how tissues are made up of parts called cells and that cells contribute to the functions of tissue (e.g., inside skin layer has cells that sense touch, cells that make sweat, cells that make hair).
- **Approaching**
  - **Use a model** to describe how organs are made up of parts called tissues and that tissues contribute to the functions of organs (e.g., skin tissues: outside layer to keep water in and germs out, inside layer to sense touch and hot/cold; muscles tissues: hold muscle to bone and flex and stretch).
- **Developing**
  - Identify the functions of organs (skin: senses and protects; muscles: move body parts; bone: provides structure and shape; heart: pumps blood; stomach: breaks down food).
- **Emerging**
  - Identify body parts (e.g., head, arm, chest, abdomen, leg, etc.) and the organs they are made of (e.g., head: bone, brain, skin; arm: bone, muscle, skin; etc.).

STANDARD 7.3.3

Construct an explanation using evidence to explain how body systems have various levels of organization. Emphasize understanding that cells form tissues, tissues form organs, organs form systems specialized for particular body functions. Examples could include relationships between the circulatory, excretory, digestive, respiratory, muscular, skeletal, and nervous systems. Specific organ functions will be taught at the high school level.

EXTENDED SEED STANDARD 7.3.3

Construct an explanation using evidence to explain how the functions of body systems (e.g., respiratory: take oxygen to blood and remove carbon dioxide; circulatory: transport oxygen and food energy to body and remove cell waste; digestive: breaks down food, absorbs energy, and removes food waste) are based on their organs and tissues.

Big Idea:

Body systems complete the functions necessary for life. This standard starts at organs and moves in complexity towards body systems.

Access Points (levels of complexity)

- **Proficient**
  - **Construct an explanation** using evidence to explain how the functions of body systems (e.g., respiratory: take oxygen to blood and remove carbon dioxide; circulatory: transport oxygen and food energy to body and remove cell waste; digestive: breaks down food, absorbs energy, and removes food waste) are based on their organs and tissues.
- **Approaching**
  - **Construct an explanation** for how multiple organs work together to make up the different body systems. (e.g., respiratory system: made of lungs, nose, etc.; circulatory system: made of heart, veins, etc.; digestive system: made of mouth, stomach, etc.)
- **Developing**
  - Identify the functions of organs (e.g., skin: senses and protects; muscles: move body parts; bone: provides structure and shape; heart: pumps blood; stomach: breaks down food).
- **Emerging**
  - Identify body parts (e.g., head, arm, chest, abdomen, leg, etc.) and the organs they are made of (e.g., head: bone, brain, skin; arm: bone, muscle, skin; etc.)

EXTENDED SEEd STRAND 7.4: REPRODUCTION AND INHERITANCE

The great diversity of species on Earth is a result of genetic variation. Genetic traits are passed from parent to offspring. These traits affect the structure and behavior of organisms, which affect the organism's ability to survive and reproduce. Mutations can cause changes in traits that may affect an organism. As technology has developed, humans have been able to change the inherited traits in organisms, which may have an impact on society.

STANDARD 7.4.1

Develop and use a model to explain the effects that different types of reproduction have on genetic variation, including asexual and sexual reproduction.

EXTENDED SEEd STANDARD 7.4.1

Use a model to explain the effects that different types of reproduction have on genetic variation, including asexual and sexual reproduction.

Big Idea:

Sexual reproduction produces genetic variation.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to explain the effects that different types of reproduction have on genetic variation, including asexual and sexual reproduction.
- **Approaching**
  - Recognize that asexual reproduction causes identical offspring and sexual reproduction causes diverse offspring.
- **Developing**
  - Identify similarities and differences between plant and animal parents and their offspring (e.g., eye color, hair/fur color, height, leaf shape, and/or markings).
- **Emerging**
  - Recognize that organisms differ within same species (e.g., dogs, chickens, oaks that differ in color and size, etc.).

Standard 7.4.2

Obtain, evaluate, and communicate information about specific animal and plant adaptations and structures that affect the probability of successful reproduction. Examples of adaptations could include nest building to protect young from the cold, herding of animals to protect young from predators, vocalization of animals and colorful plumage to attract mates for breeding, bright flowers attracting butterflies that transfer pollen, flower nectar and odor that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.

Extended SEEd Standard 7.4.2

Obtain and communicate information about specific animal and/or plant structures that affect the probability of successful reproduction (e.g., colorful plumage to attract mates for breeding, bright flowers attracting butterflies that transfer pollen, flower nectar and odor that attract insects that transfer pollen, and hard shells on nuts that squirrels bury).

Big Idea:

Specific adaptations and structures affect the probability of survival to reproduction.

Access Points (levels of complexity)

- **Proficient**
    - **Obtain and communicate** information about specific animal and/or plant structures that affect the probability of successful reproduction (e.g., colorful plumage to attract mates for breeding, bright flowers attracting butterflies that transfer pollen, flower nectar and odor that attract insects that transfer pollen, and hard shells on nuts that squirrels bury).
- **Approaching**
    - **Communicate** information about specific animal and/or plant structures that affect the probability of successful reproduction.
- **Developing**
    - Describe how access to things animals and plants need to survive increases the likelihood of reproduction.
- **Emerging**
    - Identify things that plants and animals need to survive (e.g., food, water, and shelter/space).

Standard 7.4.3

Develop and use a model to describe why genetic mutations may result in harmful, beneficial, or neutral effects to the structure and function of the organism. Emphasize the conceptual idea that changes to traits can happen because of genetic mutations. Specific changes of genes at molecular level, mechanisms for protein synthesis, and specific types of mutations will be introduced at the high school level.

Extended SEEd Standard 7.4.3

Use a model to describe why genetic mutations may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

Big Idea:

Mutations can be harmful, neutral, or beneficial.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to describe why genetic mutations may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- **Approaching**
  - **Use a model** to describe how genetic mutations may result in changes to the structure and function of the organism.
- **Developing**
  - Identify that a genetic mutation can cause variation to inherited traits (e.g., the reason for different inherited traits are due to a genetic mutation).
- **Emerging**
  - Distinguish between examples of inherited traits (e.g., hair color, height, eye color, skin color).

STANDARD 7.4.4

Obtain, evaluate, and communicate information about the technologies that have changed the way humans affect the inheritance of desired traits in organisms. *Analyze data from tests or simulations to determine the best solution to achieve success* in cultivating selected desired traits in organisms. Examples could include artificial selection, genetic modification, animal husbandry, and gene therapy.

EXTENDED SEED STANDARD 7.4.4

Obtain and communicate information about how humans have caused change in desired traits of a specific organism (e.g., humans breed small dogs, cross-pollinate trees to produce seedless fruits, breed larger livestock, etc.).

Big Idea:

Humans use technologies to select desired traits in organisms.

Access Points (levels of complexity)

- **Proficient**
  - **Obtain and communicate** information about how humans have caused change in desired traits of a specific organism (e.g., humans breed small dogs, cross-pollinate trees to produce seedless fruits, breed larger livestock, etc.).
- **Approaching**
  - **Communicate** information about how humans can cause change in desired traits in organisms (e.g., humans breed small dogs, cross-pollinate trees to produce seedless fruits, breed larger livestock, etc.).
- **Developing**
  - Identify the traits in organisms that would be different (e.g., drought-resistant crops, fast-running dogs, chickens that produce large eggs, etc.).
- **Emerging**
  - Recognize that organisms differ within same species (e.g., dogs, chickens, oak trees that differ in color and size, etc.).

Extended SEEd Strand 7.5: Changes in Species Over Time

Genetic variations and the proportion of traits within a population can change over time. These changes can result in evolution through natural selection. Additional evidence of change over time can be found in the fossil record, anatomical similarities and differences between modern and ancient organisms, and embryological development.

Standard 7.5.1

Construct an explanation that describes how the genetic variation of traits in a population can affect some individuals' probability of surviving and reproducing in a specific environment. Over time, specific traits may increase or decrease in populations. Emphasize the use of proportional reasoning to support explanations of trends in changes to populations over time. Examples could include camouflage, variation or body shape, speed and agility, or drought tolerance.

Extended SEEd Standard 7.5.1

Given an example, **construct an explanation** that describes how a specific trait can affect some individuals' ability to survive a change in their environment compared to others in the same population (e.g., faster snowshoe hares would be better able to survive a new predator in their environment).

Big Idea:

Certain traits can affect an organism's probability of survival.

Access Points (levels of complexity)

- **Proficient**
  - Given an example, **construct an explanation** that describes a specific trait can affect some individuals' ability to survive a change in their environment compared to others in the same population (e.g., faster snowshoe hares would be better able to survive a new predator in their environment).
- **Approaching**
  - Given an example, **construct an explanation** that describes how a species has adapted traits to allow them to survive and reproduce in a specific environment (e.g., snowshoe hares turn white in winter to camouflage them from predators).
- **Developing**
  - Identify traits that increase a species' ability to survive and reproduce (e.g., camouflage, speed, and drought tolerance) in a specific environment.
- **Emerging**
  - Identify things that plants and animals need to survive and reproduce (e.g., food, water, and shelter/space) in a specific environment.

Standards 7.5.2 & 7.5.3

Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth, under the assumption that natural laws operate today as in the past.

Construct explanations that describe the patterns of body structure similarities and differences between modern organisms, and between ancient and modern organisms, to infer possible evolutionary relationships.

Extended SEEd Standard 7.5.2-3

Construct explanations that describe the patterns of body structure similarities between ancient and modern animals, to infer possible evolutionary relationships.

Big Idea:

Modern and ancient body structures give evidence of evolutionary relationships.

Access Points (levels of complexity)

- **Proficient**
  - **Construct explanations** that describe the patterns of body structure similarities between ancient and modern animals, to infer possible evolutionary relationships.
- **Approaching**
  - **Construct explanations** that describe the patterns of body structure similarities between ancient and modern animals.
- **Developing**
  - Match modern animals with representations of a related organism from a fossil record, based on patterns of body structure.
- **Emerging**
  - Identify body structure similarities between animals.

Standard 7.4.4 has been omitted. See page 4 for details.

Introduction | Grade 8

Science Literacy for All Students

Science is a way of knowing, a process for gaining knowledge and understanding of the natural world. Engineering combines the fields of science, technology, and mathematics to provide solutions to real-world problems. The nature and process of developing scientific knowledge and understanding includes constant questioning, testing, and refinement, which must be supported by evidence and has little to do with popular consensus. Since progress in the modern world is tied so closely to this way of knowing, scientific literacy is essential for a society to be competitively engaged in a global economy. Students should be active learners who demonstrate their scientific understanding by using it. It is not enough for students to read about science; they must participate in the three dimensions of science. They should observe, inquire, question, formulate and test hypotheses, analyze data, report, and evaluate findings. The students, as scientists, should have hands-on, active experiences throughout the instruction of the science curriculum. These standards help students find value in developing novel solutions as they engage with complex problems.

Three Dimensions of Science[1]

Science education includes three dimensions of science understanding: science and engineering practices, crosscutting concepts, and disciplinary core ideas. Every standard includes each of the three dimensions; **Science and Engineering Practices are bolded**, <u>Crosscutting Concepts</u> are underlined, and Disciplinary Core Ideas are in normal font. Standards with *specific engineering expectations are italicized.*

Scientific and Engineering Practices	<u>Crosscutting Concepts</u>	Disciplinary Core Ideas
▶ Asking questions or defining problems ▶ Developing and using models ▶ Planning and carrying out investigations ▶ Analyzing and interpreting data ▶ Using mathematics and computational thinking ▶ Constructing explanations and designing solutions ▶ Engaging in argument from evidence ▶ Obtaining, evaluating, and communicating information	▶ Patterns ▶ Cause and effect: mechanism and explanation ▶ Scale, proportion, and quantity ▶ Systems and system models ▶ Energy and matter: flows, cycles, and conservation ▶ Structure and function ▶ Stability and change	▶ Earth and Space Science ▶ Life Science ▶ Physical Science ▶ Engineering

[1] NRC Framework K-12 Science Education: http://www.nap.edu/catalog.php?record_id=13165

ORGANIZATION OF STANDARDS

The Utah SEEd standards[2] are organized into **strands**, which represent significant areas of learning within content areas. Within each strand are **standards**. A standard is an articulation of the demonstrated proficiency to be obtained. A standard represents an essential element of the learning that is expected. While some standards within a strand may be more comprehensive than others, all standards are essential for mastery.

GRADE EIGHT UTAH SCIENCE WITH ENGINEERING EDUCATION (SEED) STANDARDS

The eighth grade SEEd standards describe the constant interaction of matter and energy in nature. Students will explore how matter is arranged into either simple or complex substances. The strands emphasize how substances store and transfer energy, which can cause them to interact physically and chemically, provide energy to living organisms, or be harnessed and used by humans. Matter and energy cycle and change in ecosystems through processes that occur during photosynthesis and cellular respiration. Additionally, substances that provide a benefit to organisms, including humans, are unevenly distributed on Earth due to geologic and atmospheric systems. Some resources form quickly, allowing them to be renewable, while other resources are nonrenewable. Evidence reveals that Earth systems change and affect ecosystems and organisms in positive and negative ways.

[2] Most SEEd Standards are based on the Next Generation Science Standards: http://www.nextgenscience.org

EXTENDED SEEd STRAND 8.1: MATTER AND ENERGY INTERACT IN THE PHYSICAL WORLD

The physical world is made of atoms and molecules. Even large objects can be viewed as a combination of small particles. Energy causes particles to move and interact physically or chemically. Those interactions create a variety of substances. As molecules undergo a chemical or physical change, the number of atoms in that system remains constant. Humans use energy to refine natural resources into synthetic materials.

STANDARD 8.1.1 HAS BEEN OMITTED. SEE PAGE 4 FOR DETAILS.

STANDARD 8.1.2

Obtain information about various properties of matter, **evaluate** how different materials' properties allow them to be used for particular functions in society, and **communicate** your findings. Emphasize general properties of matter. Examples could include color, density, flammability, hardness, malleability, odor, ability to rust, solubility, state, or the ability to react with water.

EXTENDED SEEd STANDARD 8.1.2

Evaluate the property of materials and match the materials to a function (ex. hardwood may be used for a shelf and paper towels may be used to absorb water).

Big Idea:

Different materials have different properties and the properties of a material determine its functions.

Access Points (levels of complexity)

- **Proficient**
  - **Evaluate** the property of materials and match the materials to a function (ex. hardwood may be used for a shelf and paper towels may be used to absorb water).
- **Approaching**
  - Identify a possible function for the observable properties of a material (e.g., something soft can be used to make clothing or something hard can be used to make a table).
- **Developing**
  - Sort materials by their observable properties (e.g., color and texture).
- **Emerging**
  - Identify the properties of a substance (e.g. hard, soft, rough, or smooth).

STANDARD 8.1.3

Plan and conduct an investigation and then **analyze and interpret the data** to identify patterns in changes in a substance's properties to determine whether a chemical reaction has occurred. Examples could include changes in properties such as color, density, flammability, odor, solubility, or state.

EXTENDED SEED STANDARD 8.1.3

Conduct an investigation and then **analyze and interpret data** to identify a pattern in changes in a substance's properties to determine whether a chemical reaction has occurred (e.g., when the Alka-Seltzer® tablet is dropped into a glass of water, the hard tablet dissolves and changes the color of the water and lets off a gas).

Big Idea:

A substance's properties change during chemical reactions.

Access Points (levels of complexity)

- **Proficient**
  - **Conduct an investigation** and then **analyze and interpret data** to identify a pattern in changes in a substance's properties to determine whether a chemical reaction has occurred (e.g., when the Alka-Seltzer® tablet is dropped into a glass of water, the hard tablet dissolves and changes the color of the water and lets off a gas).
- **Approaching**
  - **Conduct an investigation** with support**,** to identify patterns in chemical changes in a substance's properties (e.g., color changes, temperature changes, or production of gas).
- **Developing**
  - During an investigation, determine whether a chemical change has occurred (e.g., color change, temperature change, or production of gas).
- **Emerging**
  - Identify examples of change (e.g., matter, color, and temperature).

Standard 8.1.4

Obtain and evaluate information to describe how synthetic materials come from natural resources, what their functions are, and how society uses these new materials. Examples of synthetic materials could include medicine, foods, building materials, plastics, and alternative fuels.

Extended SEEd Standard 8.1.4

Obtain and evaluate information to describe a synthetic material, which natural materials it is made of, and its possible functions (e.g., flour is made from wheat and can make breads, cookies, and other baked goods).

Big Idea:

Synthetic (man-made) materials are made from natural resources.

Access Points (levels of complexity)

- **Proficient**
  - **Obtain and evaluate information** to describe a synthetic material, which natural materials it is made of, and its possible functions (e.g., flour is made from wheat and can make breads, cookies, and other baked goods).
- **Approaching**
  - **Obtain information** to identify the natural material(s) needed to create a specific synthetic (man-made) material (e.g., lined writing paper is made of wood pulp and plastic is made of crude oil).
- **Developing:**
  - Identify possible functions of natural materials (e.g., sponges to absorb water and wood to build houses).
- **Emerging**
  - Classify different materials that are natural or synthetic (man-made) material (e.g., rock, twig, dirt, plastic cup, sponge, and book).

STANDARD 8.1.5

Develop a model that uses **computational thinking** to illustrate cause and effect relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. Emphasize molecular-level models of solids, liquids, and gases to show how adding or removing heat energy can result in phase changes and focus on calculating the density of a substance's state.

EXTENDED SEED STANDARD 8.1.5

Use a model to illustrate cause and effect relationships in particle motion, temperature, and state of a pure substance when heat energy is added or removed. Emphasize solids, liquids, and gases to show how adding or removing heat energy can result in phase changes.

Big Idea:

Heat energy changes the state of a substance.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to illustrate cause and effect relationships in particle motion, temperature, and state of matter when heat energy is added or removed. Emphasize solids, liquids, and gases to show how adding or removing heat energy can result in phase changes.
- **Approaching**
  - **Use a model** to show the effect of the particle motion in different phases of matter (solids, liquids, and gases).
- **Developing**
  - Identify the effects on particle motion when heat energy is added or removed to solids, liquids, and gases (e.g., freezing and boiling of water).
- **Emerging**
  - Recognize that matter has three different states determined by particle motion: solids, liquids, and gases.

Standard 8.1.6

Develop a model to describe how the total number of atoms does not change in a chemical reaction, indicating that matter is conserved. Emphasize demonstrations of an understanding of the law of conservation of matter. Balancing equations and stoichiometry will be learned at the high school level.

Extended SEEd Standard 8.1.6

Using a model, describe how the amount of matter does not change in a chemical reaction, indicating that matter is conserved.

Big Idea:

In a chemical reaction, the mass of the reactant(s) is equal to the mass of the product(s).

Access Points (levels of complexity)

- **Proficient**
  - **Using a model**, describe how the amount of matter does not change in a chemical reaction, indicating that matter is conserved.
- **Approaching**
  - **Using a model**, describe how matter changes form through a chemical reaction (e.g., raw egg that is cooked or vinegar and baking soda combined).
- **Developing**
  - **Using a model**, describe how matter changes form physically (e.g., breaking a glass, water evaporation, etc.).
- **Emerging**
  - **Identify** examples of matter that has changed (e.g. melting ice, breaking a pencil, writing on paper, etc.).

Standard 8.1.7

Design, construct, and **test** a device that can affect the rate of phase change. *Compare and identify the best characteristics of competing devices and modify them based on* ***data analysis*** *to improve the device to better meet the criteria for success*.

Extended SEEd Standard 8.1.7

Design and **test** a device that can affect phase change by *identifying the best characteristics of competing devices and modify them based on* ***data analysis***.

Big Idea:

Engineering a device affects phase change.

Access Points (levels of complexity)

- **Proficient**
  - **Design** and **test** a device that can affect phase change by *identifying the best characteristics of competing devices and modify them based on* ***data analysis***.
- **Approaching**
  - **Analyze** a device that affects phase change. *Identify the best characteristics of the device and modify it to better meet the criteria for success*.
- **Developing**
  - **Analyze** how the function of a given device affects phase change (e.g., metal pans heat up faster than clay pots and freezers are able to make ice).
- **Emerging**
  - **Identify** that a device can affect a phase change (e.g., water boiling inside a pot on a stove can lead to vaporization of water).

Extended SEEd Strand 8.2: Energy is Stored and Transferred in Physical Systems

Objects can store and transfer energy within systems. Energy can be transferred between objects, which involves changes in the object's energy. There is a direct relationship between an object's energy, mass, and velocity. Energy can travel in waves and may be harnessed to transmit information.

Standard 8.2.1

Use computational thinking to **analyze data** about the relationship between the mass and speed of objects and the relative amount of kinetic energy of the objects. Emphasis should be on the quantity of mass and relative speed to the observable effects of the kinetic energy. Examples could include a full cart vs.an empty cart or rolling spheres with different masses down a ramp to measure the effects on stationary masses. Calculations of kinetic and potential energy will be learned at the high school level.

Extended SEEd Standard 8.2.1

Use computational thinking (e.g., identify quantitative attributes of objects, measure objects, and make graphs) to **analyze data** about how the quantity of mass and speed of objects (e.g., heavy or light ball, or one object pushed fast or slow) affects the amount of kinetic energy transferred to a stationary object (e.g., how far the moving object pushes it).

Big Idea:

Speed and mass affect the amount of kinetic energy an object has.

Access Points (levels of complexity)

- **Proficient**
  - **Use computational thinking** (e.g., identify quantitative attributes of objects, measure objects, and make graphs) to **analyze data** about how the quantity of mass and speed of objects (e.g., heavy or light ball, or one object pushed fast or slow) affects the amount of energy transferred to a stationary object (e.g., how far the moving object pushes it).
- **Approaching**
  - **Analyze data** about how the quantity of mass and speed of objects (e.g., heavy or light ball, or one object pushed fast or slow) affects the amount of energy transferred to a stationary object (e.g., how far the moving object pushes it).
- **Developing**
  - Identify that moving objects with different masses have different amounts energy.
- **Emerging**
  - Distinguish between light/heavy and fast/slow.

Standard 8.2.2

Ask questions about how the amount of potential energy varies as distance within the system changes. **Plan and conduct an investigation** to answer a question about potential energy. Emphasize comparing relative amounts of energy. Examples could include a cart at varying positions on a hill or an object being dropped from different heights. Calculations of kinetic and potential energy will be learned at the high school level.

Extended SEEd Standard 8.2.2

Plan and conduct an investigation to find how varying heights within a system affects the amount of potential energy of an object (e.g., objects dropped at varying heights will have varying potential energies).

Big Idea:

The height a ball is dropped from determines the height it will bounce back up to.

Access Points (levels of complexity)

- **Proficient**
  - **Plan and conduct an investigation** to find how varying heights within a system affects the amount of potential energy of an object (e.g., objects dropped at varying heights will have varying potential energies).
- **Approaching**
  - **Conduct an investigation** to find how varying heights within a system affects the amount of potential energy of an object (e.g., objects dropped at varying heights will have varying potential energies).
- **Developing**
  - Identify that an increase in height causes an increase in potential energy.
- **Emerging**
  - Distinguish between measures of height (e.g., high and low).

Standard 8.2.3 has been omitted. See page 4 for details.

STANDARD 8.2.4

Use computational thinking to describe a simple model for waves that shows the pattern of wave amplitude being related to wave energy. Emphasize describing waves with both quantitative and qualitative thinking. Examples could include using graphs, charts, computer simulations, or physical models to demonstrate amplitude and energy correlation.

EXTENDED SEED STANDARD 8.2.4

Use computational thinking to describe the pattern that the larger the wave's amplitude is, the more energy it has (e.g. if it is louder, brighter, or hotter, it has a bigger wave or bigger amplitude).

Big Idea:

The amplitude of a wave is related to the wave energy.

Access Points (levels of complexity)

- **Proficient**
  - **Use computational thinking** to describe the pattern that the larger the wave's amplitude, the more energy it has (e.g. if it is louder, brighter, or hotter, it has a bigger wave or bigger amplitude).
- **Approaching**
  - Recognize that energy travels through waves to produce various outcomes (e.g. sound, light, heat).
- **Developing**
  - Identify that there is energy required to make a wave.
- **Emerging**
  - Identify that a wave has a repeating pattern.

STANDARD 8.2.5

Develop and use a model to describe the structure of waves and how they are reflected, absorbed, or transmitted through various materials. Emphasize both light and mechanical waves. Examples could include drawings, simulations, and written descriptions of light waves through a prism; mechanical waves through gas vs. liquids vs. solids; or sound waves through different mediums.

EXTENDED SEED STANDARD 8.2.5

Develop and use a model to describe the structure of sound waves and how they are reflected or transmitted through various materials (e.g. water, air, table, etc.).

Big Idea:

The structure of a wave affects its ability to be reflected, absorbed, or transmitted through mediums.

Access Points (levels of complexity)

- **Proficient**
  - **Develop and use a model** to describe the structure of sound waves and how they are reflected or transmitted through various materials (e.g. water, air, table, etc.).
- **Approaching**
  - **Use a model** to show how sound waves are reflected or transmitted through various materials (e.g. water, air, table, etc.).
- **Developing**
  - Identify sources of sound waves (e.g., voices, speakers, instrument, banging, etc.).
- **Emerging**
  - Identify that a wave has a repeating pattern.

STANDARD 8.2.6 HAS BEEN OMITTED. PLEASE SEE PAGE 4 FOR DETAILS.

Extended SEEd Strand 8.3: Life Systems Store and Transfer Matter and Energy

Living things use energy from their environment to rearrange matter to sustain life. Photosynthetic organisms are able to transfer light energy to chemical energy. Consumers can break down complex food molecules to utilize the stored energy and use the particles to form new, life-sustaining molecules. Ecosystems are examples of how energy can flow while matter cycles through the living and nonliving components of systems.

Standard 8.3.1

Plan and conduct an investigation and **use the evidence to construct an explanation** of how photosynthetic organisms use energy to transform matter. Emphasize molecular and energy transformations during photosynthesis.

Extended SEEd Standard 8.3.1

Conduct an investigation and **use the evidence to construct an explanation** that describes the role of light energy to produce food in plants to sustain life (e.g., grow plants in the light and in the dark and have students explain why the plants in the dark did not grow as well).

Big Idea:

When given the right resources, plants grow.

Access Points (levels of complexity)

- **Proficient**
    - **Conduct an investigation** and **use the evidence to construct an explanation** that describes the role of light energy to produce food in plants to sustain life (e.g., grow plants in the light and in the dark and have students explain why the plant in the dark did not grow as well).
- **Approaching**
    - **Conduct an investigation** to gather evidence of the role of light energy to produce food in plants (e.g. grow plants in the light and in the dark).
- **Developing**
    - Explain that plants use water, air, and sunlight to make their food in the form of sugar.
- **Emerging**
    - Identify that plants need water, air, and sunlight to grow.

STANDARD 8.3.2

Develop a model to describe how food is changed through chemical reactions to form new molecules that support growth and/or release energy as matter cycles through an organism. Emphasis is on describing that during cellular respiration, molecules are broken apart and rearranged into new molecules, and that this process releases energy.

EXTENDED SEEd STANDARD 8.3.2

Use a model to describe how living organisms have the ability to break down food (matter) to produce energy to perform essential life functions.

Big Idea:

The food (matter) organisms consume is changed through chemical reactions to release energy and support growth.

Access Points (levels of complexity)

- **Proficient**
  - **Use a model** to describe how living organisms have the ability to break down food (matter) to produce energy to perform essential life functions.
- **Approaching**
  - Explain how living organisms get energy to carry out life functions (e.g., plants make energy from the Sun and animals consume other organisms to get energy).
- **Developing**
  - Identify the essential life functions that animals can do or perform because of the energy they obtain from food (e.g., their hearts beat, they can run, etc.).
- **Emerging**
  - Identify possible effects animals experience when they don’t have enough food.

STANDARD 8.3.3

Ask questions to **obtain, evaluate, and communicate information** about how changes to an ecosystem affect the stability of cycling matter and the flow of energy among living and nonliving parts of an ecosystem. Emphasize describing the cycling of matter and flow of energy through the carbon cycle.

EXTENDED SEEd STANDARD 8.3.3

Obtain, evaluate, and communicate information about how a change to an ecosystem affects the flow of energy among living organisms (e.g., if the producers die, if a predator is added to the system, or if disease kills an animal).

Big Idea:

Changes in any physical or biological component of an ecosystem will affect the stability of the cycling of matter and flow of energy through an ecosystem.

Access Points (levels of complexity)

- **Proficient**
  - **Obtain, evaluate, and communicate information** about how a change to an ecosystem affects the flow of energy among living organisms (e.g., if the producers die, if a predator is added to the system, or if disease kills an animal).
- **Approaching**
  - **Obtain and communicate information** about how energy transfer between producers and consumers occurs in an ecosystem (e.g., students are able to explain a food web).
- **Developing**
  - Identify energy transfer between producers and consumers in an ecosystem (e.g., producers get energy from sunlight and consumers receive energy from producers and/or consumers).
- **Emerging**
  - Identify examples of producers and consumers (plants are producers; animals are consumers).

Extended SEEd Strand 8.4: Interactions with Natural Systems and Resources

Interactions of matter and energy through geologic processes have led to the uneven distribution of natural resources. Many of these resources are nonrenewable and per-capita use can cause positive or negative consequences. As energy flows through the physical world, natural disasters can occur which affect human life. Humans can study patterns in natural systems to anticipate and forecast future disasters and work to mitigate the outcomes.

Standard 8.4.1

Construct a scientific explanation based on evidence that shows that the uneven distribution of Earth's mineral, energy, and groundwater resources is caused by geological processes. Examples of uneven distribution of resources could include Utah's unique geologic history that led to the formation and irregular distribution of natural resources like copper, gold, natural gas, oil shale, silver, and uranium.

Extended SEEd Standard 8.4.1

Construct a scientific explanation based on evidence that shows the cause of uneven distribution of Earth's resources (e.g., oil, copper, and ground water in Utah are only found in some counties).

Big Idea:

Geological processes affect the uneven distribution of resources.

Access Points (levels of complexity)

- **Proficient**
    - **Construct a scientific explanation** based on evidence that shows the cause of uneven distribution of Earth's resources (e.g., oil, copper, and ground water in Utah are only found in some counties).
- **Approaching**
    - Identify the distribution of Earth's mineral and energy resources (e.g., identify that copper sources are not all together on a map of Utah).
- **Developing**
    - Recognize the source where natural resources are found in nature (e.g., coal is mined from the ground and lumber is cut from trees).
- **Emerging**
    - Identify examples of natural resources (things found in nature that are useful to humans).

Standard 8.4.2

Engage in argument supported by evidence about the effect of per capita consumption of natural resources on Earth's systems. Emphasize that these resources are limited and may be non-renewable. Examples of evidence include rates of consumption of food and natural resources such as freshwater, minerals, and energy sources.

Extended SEEd Standard 8.4.2

Select an **argument supported by evidence** describing the effect of per capita consumption of natural resources on Earth's systems.

Big Idea:

Per capita consumption affects the availability of natural resources.

Access Points (levels of complexity)

- **Proficient**
  - Select an **argument supported by evidence** describing the effect of per capita consumption of natural resources on Earth's systems.
- **Approaching**
  - Summarize the effects of per capita consumption of natural resources on Earth's systems.
- **Developing**
  - Describe how natural resources (e.g., coal, gold, silver, oil, and water) are used by humans.
- **Emerging**
  - Identify examples of natural resources (things found in nature that are useful to humans).

STANDARD 8.4.3

Design a solution to monitor or mitigate the potential effects of the use of natural resources. **Evaluate** competing design solutions *using a systematic process to determine how well each solution meets the criteria and constraints of the problem.* Examples of uses of the natural environment could include agriculture, conservation efforts, recreation, solar energy, and water management.

EXTENDED SEED STANDARD 8.4.3

Design a solution to mitigate (reduce and control) the potential effects of the use of natural resources (e.g., install low flow shower heads to prevent running out of water or require emission checks for automobiles to reduce pollution).

Big Idea:

There are consequences for using natural resources.

Access Points (levels of complexity)

- **Proficient**
  - **Design a solution** to mitigate (reduce and control) the potential effects of the use of natural resources (e.g., install low flow shower heads to prevent running out of water or require emission checks for automobiles to reduce pollution).
- **Approaching**
  - Identify a way to mitigate (reduce and control) the potential effects of the use of natural resources (e.g., water is necessary for life; watering a lawn on a rainy day can waste water).
- **Developing**
  - Describe the potential effects of using natural resources (e.g., pollution).
- **Emerging**
  - Recognize natural resources (e.g., food, water, shelter, and air) in the environment that are important for human survival.

STANDARD 8.4.4

Analyze and interpret data on the factors that change global temperatures and their effects on regional climates. Examples of factors could include agricultural activity, changes in solar radiation, fossil fuel use, and volcanic activity. Examples of data could include graphs of the atmospheric levels of gases, seawater levels, ice cap coverage, human activities, and maps of global and regional temperatures.

EXTENDED SEEd STANDARD 8.4.4

Analyze data on factors that change global temperatures and their effects on regional climates.

Big Idea:

There are factors that affect regional climates and global temperatures.

Access Points (levels of complexity)

- **Proficient**
  - **Analyze data** on factors that change global temperatures and their effects on regional climates.
- **Approaching**
  - **Analyze data** to determine if climates have changed in the last century.
- **Developing**
  - Identify that climates are based on average seasonal temperatures and average seasonal rainfall.
- **Emerging**
  - Identify different types of weather (e.g., hot, cold, or rainy).

STANDARD 8.4.5

Analyze and interpret patterns of the occurrence of natural hazards to forecast future catastrophic events and investigate how data are used to develop technologies to mitigate their effects. Emphasize how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow prediction, but others, such as earthquakes, may occur without warning.

EXTENDED SEED STANDARD 8.4.5

Analyze and interpret patterns of the occurrence of natural hazards to forecast future catastrophic events.

Big Idea:

There are patterns in the occurrences of natural hazards and these patterns can be used to predict future catastrophic events.

Access Points (levels of complexity)

- **Proficient**
    - **Analyze and interpret** patterns of the occurrence of natural hazards to forecast future catastrophic events.
- **Approaching**
    - Identify patterns in occurrences of natural hazards to forecast future catastrophic events.
- **Developing**
    - Recognize that some natural hazards can be accurately predicted while others are not (e.g., hurricanes can be fairly accurately predicted, but earthquakes cannot be accurately predicted).
- **Emerging**
    - Identify a natural hazard that occurs on Earth (e.g., hurricanes, tornadoes, volcanoes, earthquakes, and avalanches).