

2016 WYOMING SCIENCE

CONTENT AND PERFORMANCE STANDARDS

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2016 WYOMING SCIENCE CONTENT AND PERFORMANCE STANDARDS

INTRODUCTION

The Wyoming Science Content and Performance Standards (WyCPS) were last reviewed and approved in 2008 in accordance with Wyoming state statute W.S. 21-2-304(c). The 2016 Wyoming Content and Performance Standards were developed collaboratively through the contributions of Science Standard Review Committee (SSRC) members from across the state. The committee's work was informed and guided by initial public input through community forums, as well as input solicited from specific stakeholder groups.

INTRODUCTION TO STANDARDS

Content Standards: Content standards define what students are expected to know and be able to do by the time they graduate. They do not dictate what methodology or instructional materials should be used, nor how the material is delivered.

Benchmarks: Benchmarks (also called performance expectations in this document) specify what students are expected to know and be able to do at the end of each of the benchmark grade levels. These benchmarks specify the skills and content students must master along the way in order to demonstrate proficiency of the content standard by the time they graduate. In this standards document, you will find these are broken out into individual grades for Kindergarten through 5th grade and then banded by grade bands for middle school/junior high school and high school grade levels (6-8 and 9-12).

RATIONALE

Today, quality science education enables students to learn science by being actively involved with scientific and engineering practices as they progress from kindergarten through 12th grade. They are encouraged to be inquisitive, to actively explore their environment, and become productive, scientifically literate citizens. The standards we present here provide the necessary foundation for local school district decisions about curriculum, assessments, and instruction. Implementation of the new standards will better prepare Wyoming high school graduates for the rigors of college and/or careers. In turn, Wyoming employers will be able to hire workers with a strong science and engineering base — both in specific content areas and in critical thinking and inquiry-based problem solving.

The Wyoming Science Content and Performance Standards support that:

- all students can engage in sophisticated science and engineering practices.
- students must have the opportunity to conduct investigations, solve problems, and engage in discussions.
- students learn through relevant context and use modeling to explain observed phenomena.
- students move beyond facts and terminology to develop explanations and design solutions supported by evidence-based arguments and reasoning.
- students discuss open-ended questions that focus on the strength of the evidence used to generate claims.
- students develop summaries of information through multiple sources, including science-related magazine and journal articles and web-based resources.
- students develop questions that drive multiple investigations with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas.
- students write reports, create posters, and design media presentations that explain and add credibility to their argument.
- students develop a better understanding of the science they are researching by accessing professional scientists and engineers through various means.
- students communicate and defend their research to an authentic audience such as at colloquiums with secondary students.

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ORGANIZATION OF STANDARDS

These standards were informed by *A Framework for K-12 Science Education* (National Research Council, 2012), the Next Generation Science Standards (National Academies Press, 2013), and the unique needs of Wyoming. They are distinct from prior science standards in that they integrate three dimensions of learning within each standard and have intentional connections across standards, grade bands, and subjects. The three dimensions are crosscutting concepts, disciplinary core ideas, and science and engineering practices.

Dimension 1: Crosscutting Concepts (CCC)

The seven crosscutting concepts have application across all domains of science. As such, they provide one way of linking across the domains of the Disciplinary Core Ideas.

Dimension 2: Disciplinary Core Ideas (DCI)

The continuing expansion of scientific knowledge makes it impossible to teach all of the ideas related to a given discipline in exhaustive detail during the K-12 years. But given the cornucopia of information available today, virtually at a touch, an important role of science education is not to teach “all the facts” but rather to prepare students in the four domains of science with sufficient core knowledge so that they can later acquire additional information on their own. The four domains referenced are: 1) physical science, 2) life science, 3) earth and space science, and 4) engineering, technology and applications of science.

Dimension 3: Science and Engineering Practices (SEP)

The SEPs describe (a) the major practices that scientists employ as they investigate and build models and theories about the world, and (b) a key

set of engineering practices that engineers use as they design and build systems. We use the term “practices” instead of skills to emphasize that engaging in a scientific investigation requires not only skill but also knowledge that is specific to each practice.

Cross-curricular connections to Wyoming Content and Performance Standards in English Language Arts (ELA), Mathematics, Social Studies (S.S.), Physical Education (P.E.), Health, Fine and Performing Arts (FPA), and Career and Vocational Education (CVE) are identified and referenced within the science standards. These are intended as suggestions for areas where other content standards can be integrated in the teacher’s instruction and lessons. The connection would be dependent on the curricula.

2016 Wyoming Science Standards

Physical Science	PS1 - Matter and Its Interactions							
	K	1	2	3	4	5	6-8	9-12
	PS2 - Motion and Stability: Forces and Interactions							
	K	1	2	3	4	5	6-8	9-12
	PS3 - Energy							
Life Science	K	1	2	3	4	5	6-8	9-12
	PS4 - Waves and Their Applications in Technologies for Information Transfer							
	K	1	2	3	4	5	6-8	9-12
	ETS - Engineering, Technology, and Applications of Science							
Earth & Space	LS1 - From Molecules to Organisms: Structure and Processes							
	K	1	2	3	4	5	6-8	9-12
	LS2 - Ecology: Interactions, Energy, and Dynamics							
	K	1	2	3	4	5	6-8	9-12
ETS	LS3 - Heredity: Inheritance and Variation of Traits							
	K	1	2	3	4	5	6-8	9-12
	LS4 - Biological Evolution: Unity and Diversity							
ETS	ESS1 - Earth's Place in the Universe							
	K	1	2	3	4	5	6-8	9-12
	ESS2 - Earth's Systems							
ETS	K	1	2	3	4	5	6-8	9-12
	ESS3 - Earth and Human Activity							
ETS	ETS - Engineering, Technology, and Applications of Science							
	K	1	2	3	4	5	6-8	9-12

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On the next page you will find how to read this document and understand its many components.

WYOMING CROSS-CURRICULAR CONNECTIONS

At the bottom of each standards page, you will find where these science standards tie in with other content areas, such as the following:

- ELA
- Mathematics
- Social Studies
- Health
- Physical Education
- Career & Vocational Education
- Fine & Performing Arts

These standards can be found on the WDE website at
<http://edu.wyoming.gov/educators/standards>

INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION (ISTE) CONNECTIONS

The Committee suggests educators use the following ISTE standards in their science curriculum, instruction, and activities, where appropriate. Standard 3 has been identified throughout the document, however others may apply depending on the curriculum used.

[2007 ISTE Standards for Students](#)

1. Creativity and innovation
2. Communication and collaboration
3. Research and information fluency
4. Critical thinking, problem solving, and decision making
5. Digital citizenship
6. Technology operations and concepts

RESOURCES / REFERENCES

National Research Council [NRC]. (2012). [A Framework for K-12 Science Education](#): Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press.

NGSS Lead States (2013). [Next Generation Science Standards: For States, By States](#). Washington, DC: National Academies Press.

National Research Council. (2015). [Guide to Implementing the Next Generation Science Standards](#) (pp. 8-9). Washington, DC: National Academies Press.

How to Read This Document

Earth's Place in the Universe [4-ESS1-1]

Grade Level

Performance Expectations (PE) are the benchmarks; the skills and content students should master.

Clarification Statements provide further explanation or examples to support educators.

The State Assessment Boundary is to be considered when developing classroom and district assessments and gives limitations to the state assessment.

Symbol denotes WY examples are given or can be considered in instruction



Performance Expectations (Benchmark)

4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

Clarification Statement: Examples of evidence from patterns (may include, but not limited to, Wyoming specific examples) could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom indicating that over time a river cut through the rock.

State Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.



Three Dimensions of Learning

Crosscutting Concepts

Patterns can be used as evidence to support an explanation.

Disciplinary Core Ideas

The History of Planet Earth:

- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes.
- The presence and location of certain fossil types indicate the order in which rock layers were formed.

Science & Engineering Practices

Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Identify the evidence that supports particular points in an explanation.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.</p> <p>W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.</p> <p>W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>	<p>SS5.5.2 Explain how physical features, patterns, and systems impact different regions and how these features may help us generalize and compare areas within the state, nation, or world.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.</p>

Science Standard Code [4.ESS1-1] means Grade 4, Earth & Space Science, Standard 1, Benchmark 1

Crosscutting Concepts (CCC) represent themes that span across engineering and science disciplines.

Disciplinary Core Ideas (DCI) represent a set of ideas for K-12 science education.

Science & Engineering Practices (SEP) will help students develop problem solving skills and understand their world through investigation.

Wyoming Cross-Curricular Connections identify possible connections to other WY Content & Performance Standards. These are intended to be suggestions and may be relevant depending on curriculum and instruction.

2016 WYOMING SCIENCE CONTENT AND PERFORMANCE STANDARDS

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Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four **disciplinary core ideas**: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain increasingly complex phenomena in the four disciplines as they progress to middle school and high school. The performance expectations shown in kindergarten through fifth grade couple particular practices and **crosscutting concepts** with specific **disciplinary core ideas**. However, instructional decisions should include use of additional practices and **crosscutting concepts** that lead to the performance expectations.

Kindergarten



Kindergarten performance expectations include **PS2, PS3, LS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas** adapted from the NRC Framework. The performance expectations in kindergarten help students formulate answers to questions such as: “What happens if you push or pull an object harder? Where do animals live and why do they live there? What is the weather like today and how is it different from yesterday?” Students are expected

to develop understanding of patterns and variations in local weather and the purpose of weather forecasting to prepare for, and respond to, severe weather. Students are able to apply an understanding of the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze a design solution. Students are also expected to develop understanding of what plants and animals (including humans) need to survive and the relationship between their needs and where they live.

The **Crosscutting Concepts** and Connections to Engineering, Technology, and Applications of Science, listed below, are the organizing concepts for these **Disciplinary Core Ideas**.

Crosscutting Concepts

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

Connections to Engineering, Technology, and Applications of Science

- Interdependence of science, engineering, and technology
- Influence of science, engineering, and technology on society and the natural world

In the kindergarten performance expectations, students are expected to demonstrate understanding of the **core ideas** and grade appropriate proficiency in using the **Science and Engineering Practices** below:

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



Motion and Stability: Forces and Interactions [K-PS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.</p> <p>Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.</p> <p>State Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.</p>	Crosscutting Concepts	Simple tests can be designed to gather evidence to support or refute student ideas about causes.
	Disciplinary Core Ideas	<p>Forces and Motion:</p> <ul style="list-style-type: none"> Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. <p>Types of Interactions:</p> <ul style="list-style-type: none"> When objects touch or collide, they push on one another and can change motion. <p>Relationship Between Energy and Forces:</p> <ul style="list-style-type: none"> A bigger push or pull makes things speed up or slow down more quickly.
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> With guidance, plan and conduct an investigation in collaboration with peers.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them).</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.</p> <p>K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/”less of” the attribute, and describe the difference.</p>



Motion and Stability: Forces and Interactions [K-PS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.</p> <p><i>Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.</i></p> <p><i>State Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.</i></p> <p>Engineering, Technology & Application of Science Connections K-2-ETS1-1 (pg. 19)</p>	<p>Crosscutting Concepts</p>	<p>Simple tests can be designed to gather evidence to support or refute student ideas about causes.</p>
	<p>Disciplinary Core Ideas</p>	<p>Forces and Motion:</p> <ul style="list-style-type: none"> Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. <p>Defining Engineering Problems:</p> <ul style="list-style-type: none"> A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.
	<p>Science & Engineering Practices</p>	<p>Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> Analyze data from tests of an object or tool to determine if it works as intended.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RI.K.1 With prompting and support, ask and answer questions about key details in a text.</p> <p>SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood.</p>	<p>K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.</p> <p>K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.</p> <p>K.CC.C.6 Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies.</p> <p>K.CC.C.7 Compare two numbers between 1 and 10 presented as written numerals.</p>

Energy [K-PS3-1]



Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-PS3-1. Make observations to determine the effect of sunlight on Earth’s surface.</p> <p><i>Clarification Statement: Examples of Earth’s surface could include sand, soil, rocks, and water.</i></p> <p><i>State Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.</i></p>	Crosscutting Concepts	Events have causes that generate observable patterns.
	Disciplinary Core Ideas	Conservation of Energy and Energy Transfer: <ul style="list-style-type: none"> • Sunlight warms Earth’s surface.
	Science & Engineering Practices	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. <ul style="list-style-type: none"> • Make observations (firsthand or from media) to collect data that can be used to make comparisons.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
<p>W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them).</p>		<p>K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference.</p>

Energy [K-PS3-2]



Performance Expectations (Benchmark)

K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.

Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.

Engineering, Technology & Application of Science
Connections

K-2-ETS1-1 (pg. 19)

K-2-ETS1-2 (pg. 20)

Three Dimensions of Learning

Crosscutting Concepts

Events have causes that generate observable patterns.

Disciplinary Core Ideas

Conservation of Energy and Energy Transfer:

- Sunlight warms Earth’s surface.

Defining and Delimiting Engineering Problems:

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be prepared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

Developing Possible Solutions:

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

Science & Engineering Practices

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them).

Fine & Performing Arts Connections

FPA4.1.A.1 Students create and revise original art to express ideas, experiences, and stories.
FPA4.1.A.3 Students apply the elements and principles of design to their artwork.
FPA4.1.A.5 Students use art materials and tools in a safe and responsible manner.
FPA4.1.A.6 Students complete and exhibit their artwork.

Mathematics Connections

K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference.



From Molecules to Organisms: Structures & Processes [K-LS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.</p> <p><i>Clarification Statement: Examples of patterns could include that animals need to take in food but plants make their own food; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.</i></p> <p>Engineering, Technology, & Applications of Science Connections K-2-ETS1-1 (pg. 19) K-2-ETS1-2 (pg. 20)</p> <p>ISTE-3 Students apply digital tools to gather, evaluate, and use information.</p>	Crosscutting Concepts	Matter is transported into, out of, and within systems.
	Disciplinary Core Ideas	<p>Organization of Matter and Energy Flow in Organisms:</p> <ul style="list-style-type: none"> Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.
	Science & Engineering Practices	<p>Analyzing and Interpreting Data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Health Connections	Fine & Performing Arts Connections	Mathematics Connections
<p>W.K. 7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them).</p>	<p>HE2.3.4 Identify characteristics of effective listening skills to enhance or reduce/avoid health risks (e.g., eyes on speaker, etc.). PCD, IP/S, FA.</p>	<p>FPA4.1.A.2 Students investigate and apply a variety of materials, resources, technologies and processes to communicate experiences and ideas through art. FPA4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p>	<p>K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/”less of” the attribute, and describe the difference.</p>



Earth's Systems [K-ESS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.</p> <p>Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.</p> <p>State Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.</p>	<p>Crosscutting Concepts</p>	<p>Patterns in the natural and human designed world can be observed and used as evidence.</p>
	<p>Disciplinary Core Ideas</p>	<p>Weather and Climate:</p> <ul style="list-style-type: none"> Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.
	<p>Science & Engineering Practices</p>	<p>Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them).</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>K.CC.A Know number names and the count sequence.</p> <p>K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.</p> <p>K.MD.B.3 Classify objects into given categories; count the number of objects in each category and sort the categories by count.</p>



Earth's Systems [K-ESS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.</p> <p><i>Clarification Statement: Examples of plants and animals changing their environment could include: a squirrel digs in the ground to hide its food and tree roots can break concrete.</i></p>	<p>Crosscutting Concepts</p>	<p>Systems in the natural and designed world have parts that work together.</p>
	<p>Disciplinary Core Ideas</p>	<p>Biogeology:</p> <ul style="list-style-type: none"> Plants and animals can change their environment. <p>Human Impacts on Earth Systems:</p> <ul style="list-style-type: none"> Things that people do to live comfortably can affect the world around them.
	<p>Science & Engineering Practices</p>	<p>Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).</p> <ul style="list-style-type: none"> Construct an argument with evidence to support a claim.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.K.1 With prompting and support, ask and answer questions about key details in a text.</p> <p>W.K.1 Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book.</p> <p>W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.</p>		<p>K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.</p>



Earth and Human Activity [K-ESS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.</p> <p>Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested and rangeland areas; and, grasses need sunlight so they often grow in meadows and prairies. Plants, animals, and their surroundings make up a system.</p> 	<p>Crosscutting Concepts</p>	<p>Systems in the natural and designed world have parts that work together.</p>
	<p>Disciplinary Core Ideas</p>	<p>Natural Resources:</p> <ul style="list-style-type: none"> • Living things need water, air, and resources from the land, and they live in places that have the things they need. • Humans use natural resources for everything they do.
	<p>Science & Engineering Practices</p>	<p>Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> • Use a model to represent relationships in the natural world.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Fine & Performing Arts Connections	Mathematics Connections
<p>SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail.</p>	<p>FPA 4.1.A.4 Students collaborate with others in creative artistic processes.</p> <p>FPA 4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p> <p>FPA 4.1.A.6 Students complete and exhibit their artwork.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>K.CC Counting and Cardinality</p>



Earth and Human Activity [K-ESS3-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.</p> <p>Clarification Statement: Emphasis is on local forms of severe weather.</p> <p>Engineering, Technology & Application of Science Connections K-2-ETS1-1 (pg. 19)</p>	Crosscutting Concepts	Events have causes that generate observable patterns.
	Disciplinary Core Ideas	<p>Natural Hazards:</p> <ul style="list-style-type: none"> Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. <p>Defining and Delimiting an Engineering Problem:</p> <ul style="list-style-type: none"> Asking questions, making observations, and gathering information are helpful in thinking about problems.
	Science & Engineering Practices	<p>Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.</p> <ul style="list-style-type: none"> Ask questions based on observations to find more information about the designed world. <p>Obtaining, Evaluating, and Communicating Information in K-2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections	Health Connections	Mathematics Connections
<p>RI.K.1 With prompting and support, ask and answer questions about key details in a text.</p> <p>SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood.</p>	<p>HE2.1.4 Identify ways to contact or find help for health and safety emergencies (e.g., call 911, find playground monitor). VP/B, IP/S, FA.</p> <p>HE2.3.3 Identify appropriate ways to respond to/in unwanted, threatening or dangerous situations. IP/S., PH, VP/B.</p>	<p>MP.4 Model with mathematics.</p> <p>K.CC Counting and Cardinality</p>



Earth and Human Activity [K-ESS3-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-ESS3-3. Communicate solutions that will manage the impact of humans on the land, water, air, and/or other living things in the local environment.</p> <p><i>Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.</i></p> <p>Engineering, Technology & Application of Science Connections K-2-ETS1-2 (pg. 20)</p>	<p>Crosscutting Concepts</p>	<p>Events have causes that generate observable patterns.</p>
	<p>Disciplinary Core Ideas</p>	<p>Human Impacts on Earth Systems:</p> <ul style="list-style-type: none"> • Things that people do to live comfortably can affect the world around them. But they can make choices that manage their impacts on the land, water, air, and other living things. <p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people.
	<p>Science & Engineering Practices</p>	<p>Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> • Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Health Connections	Mathematics Connections
<p>W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.</p>	<p>HE2.3.4 Identify characteristics of effective listening skills to enhance or reduce/avoid health risks (e.g., eyes on speaker, etc.). PCD, IP/S, FA.</p> <p>HE2.4.2 Identify behaviors that help avoid or reduce health risks. IP/S, VP/B, ATOD.</p> <p>HE2.4.3 Identify behaviors that prevent the spread of disease. CEH, PH, PCD.</p>	<p>N/A</p>



Engineering, Technology, & Applications of Science [K-2-ETS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.</p> <p>Science Standards Connections K-PS2-2 (pg. 10) K-PS3-2 (pg. 12) K-LS1-1 (pg. 13) K-ESS3-2 (pg. 17)</p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution, it is important to clearly understand the problem.
	Science & Engineering Practices	<p>Asking Questions and Defining Problems in K-2 builds on prior experiences and progresses to simple descriptive questions.</p> <ul style="list-style-type: none"> • Ask questions based on observations to find more information about the natural and/or designed world. • Define a simple problem that can be solved through the development of a new or improved object or tool.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.2.1 Ask and answer such questions as <i>who, what, where, when, why, and how</i> to demonstrate understanding of key details in a text.</p> <p>W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>	<p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p> <p>SS2.5.3 Use the human features of a community to describe what makes that community special (e.g., cultural, language, religion, food, clothing, political, economic, population, and types of jobs in the area) and why others want to move there or move away from there.</p> <p>SS2.5.4 Identify how people may adjust to and/or change their environment in order to survive (e.g., clothing, houses, foods, and natural resources).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.</p>



Engineering, Technology, & Applications of Science [K-2-ETS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.</p> <p>Science Standards Connections K-PS3-2 (pg. 12) K-LS1-1 pg. 13) K-ESS3-3 (pg. 18)</p>	Crosscutting Concepts	The shape and stability of structures of natural and designed objects are related to their function(s).
	Disciplinary Core Ideas	Developing Possible Solutions: <ul style="list-style-type: none"> • Designs can be conveyed through sketches, drawings, or physical models. The representations are useful in communicating ideas for a problem’s solutions to other people.
	Science & Engineering Practices	Developing and Using Models in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. <ul style="list-style-type: none"> • Develop a simple model based on evidence to represent a proposed object or tool.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Fine & Performing Arts Connections
<p>SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings.</p>	<p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p>	<p>FPA4.1.A.4 Students collaborate with others in creative artistic processes.</p> <p>FPA4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p> <p>FPA4.1.A.6 Students complete and exhibit their artwork.</p>



Engineering, Technology, & Applications of Science [K-2-ETS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	Optimizing the Design Solution: <ul style="list-style-type: none"> Because there is always more than one possible solution to a problem, it is useful to compare the test designs.
	Science & Engineering Practices	Analyzing and Interpreting Data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. <ul style="list-style-type: none"> Analyze data from tests of an object or tool to determine if it works as intended.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>	<p>SS2.3.3 Identify how science or technology affects production (e.g., assembly line, robots, and video streaming).</p> <p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.</p>

Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four **disciplinary core ideas**: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain increasingly complex phenomena in the four disciplines as they progress to middle school and high school. The performance expectations shown in kindergarten through fifth grade couple particular practices and **crosscutting concepts** with specific **disciplinary core ideas**. However, instructional decisions should include use of additional practices and **crosscutting concepts** that lead to the performance expectations.

First Grade



First grade performance expectations include **PS4, LS1, LS3, and ESS1 Disciplinary Core Ideas** adapted from the NRC Framework. The performance expectations in first grade help students formulate answers to questions such as: “What happens when materials vibrate? What happens when there is no light? What are some ways plants and animals meet their needs so that they can survive and grow? How are parents and their children similar and different? What objects are in the sky and how do they seem to move?” The idea that light travels from place to place can be understood by students at this level through determining the effect of placing objects made with different materials in the path of a beam of light. Students are expected to develop understanding of the relationship between sound and vibrating materials as well as between the availability of light and ability to see objects. Students are also expected to develop understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs as well as how behaviors of parents and offspring help the offspring survive. The understanding is developed that young plants and animals are like, but not exactly the same as, their parents. Students are able to observe, describe, and predict some patterns of the movement of objects in the sky.

The **Crosscutting Concepts** and Connections to Engineering, Technology, and Applications of Science, listed below, are the organizing concepts for these **Disciplinary Core Ideas**.

Crosscutting Concepts

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

Connections to Engineering, Technology, and Applications of Science

- Interdependence of science, engineering, and technology
- Influence of science, engineering, and technology on society and the natural world

In the first grade performance expectations, students are expected to demonstrate understanding of the **core ideas** and grade appropriate proficiency in using the **Science and Engineering Practices** below:

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

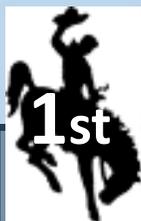


Waves & Their Application in Technologies for Information Transfer [1-PS4-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.</p> <p><i>Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.</i></p>	Crosscutting Concepts	Simple tests can be designed to gather evidence to support or refute student ideas about causes.
	Disciplinary Core Ideas	Wave Properties: <ul style="list-style-type: none"> • Sound can make matter vibrate, and vibrating matter can make sound.
	Science & Engineering Practices	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. <ul style="list-style-type: none"> • Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Fine & Performing Arts Connections	Mathematics Connections
<p>W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions).</p> <p>W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.</p> <p>SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.</p>	<p>FPA4.1.M.4 Students create music using a variety of traditional and nontraditional sound sources.</p>	<p>N/A</p>



Waves & Their Application in Technologies for Information Transfer [1-PS4-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-PS4-2. Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.</p> <p><i>Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.</i></p>	Crosscutting Concepts	Simple tests can be designed to gather evidence to support or refute student ideas about causes.
	Disciplinary Core Ideas	Electromagnetic Radiation: <ul style="list-style-type: none"> • Objects can be seen if light is available to illuminate them or if they give off their own light.
	Science & Engineering Practices	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. <ul style="list-style-type: none"> • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.1.2 Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.</p> <p>W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions).</p> <p>W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.</p> <p>SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.</p>		<p>N/A</p>

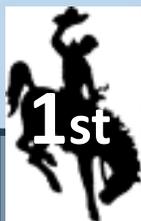


Waves & Their Application in Technologies for Information Transfer [1-PS4-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-PS4-3. Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.</p> <p><i>Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).</i></p> <p><i>State Assessment Boundary: Assessment does not include the speed of light.</i></p>	Crosscutting Concepts	Simple tests can be designed to gather evidence to support or refute student ideas about causes.
	Disciplinary Core Ideas	<p>Electromagnetic Radiation:</p> <ul style="list-style-type: none"> Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.)
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions).</p> <p>W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.</p> <p>SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.</p>		N/A



Waves & Their Application in Technologies for Information Transfer [1-PS4-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.</p> <p>Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string “telephones”, and a pattern of drum beats.</p> <p>State Assessment Boundary: Assessment does not include technological details for how communication devices work.</p> <p>Engineering, Technology & Application of Science Connections K-2-ETS1-1 (pg. 32) K-2-ETS1-2 (pg. 33)</p>	Crosscutting Concepts	<p>People depend on various technologies in their lives; human life would be very different without technology.</p>
	Disciplinary Core Ideas	<p>Information Technologies and Instrumentation:</p> <ul style="list-style-type: none"> • People also use a variety of devices to communicate (send and receive information) over long distances. <p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be prepared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. <p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> • Use tools and materials provided to design a device that solves a specific problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Fine & Performing Arts Connections	Mathematics Connections
<p>W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions).</p>	<p>FPA4.1.A.2 Students investigate and apply a variety of materials, resources, technologies and processes to communicate experiences and ideas through art.</p> <p>FPA4.1.A.4 Students collaborate with others in creative artistic processes.</p> <p>FPA.4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p> <p>FPA4.1.T.1 Students create and perform to express ideas through the use of movement, sound and language.</p>	<p>MP.5 Use appropriate tools strategically.</p> <p>1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object.</p> <p>1.MD.A.2 Express the length of an object as a whole number of length units, by layering multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps.</p>



From Molecules to Organisms: Structures & Processes [1-LS1-1]

1st Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.</p> <p><i>Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, pine cone scales, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.</i></p> <p>Engineering, Technology & Application of Science Connections K-2-ETS1-1 (pg. 32) K-2-ETS1-2 (pg. 33)</p> <p>ISTE-3. Students apply digital tools to gather, evaluate, and use information.</p>	Crosscutting Concepts	The shape and stability of structures of natural and designed objects are related to their function(s).
	Disciplinary Core Ideas	<p>Structure and Function:</p> <ul style="list-style-type: none"> All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. <p>Information Processing:</p> <ul style="list-style-type: none"> Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. <p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be prepared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. <p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Fine & Performing Arts Connections	Health Connections
<p>W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how to” books on a given topic and use them to write a sequence of instructions).</p>	<p>FPA4.1.A.2 Students investigate and apply a variety of materials, resources, technologies and processes to communicate experiences and ideas through art.</p> <p>FPA4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p>	<p>HE2.3.4 Identify characteristics of effective listening skills to enhance health or reduce/avoid health risks (e.g., eyes on speaker, etc.). PCD, IP/S, FA.</p>



From Molecules to Organisms: Structures & Processes [1-LS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.</p> <p>Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).</p> 	Crosscutting Concepts	Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.
	Disciplinary Core Ideas	<p>Growth and Development of Organisms:</p> <ul style="list-style-type: none"> • Adult plants and animals can have young. • In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.
	Science & Engineering Practices	<p>Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> • Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Health Connections	Mathematics Connections
<p>RI.1.1 Ask and answer questions about key details in a text.</p> <p>RI.1.2 Identify the main topic and retell key details of a text.</p> <p>RI.1.10 With prompting and support read informational texts appropriately complex for grade.</p>	<p>HE2.3.1 Identify various methods to express individual health needs, wants, and feelings (e.g., visual, verbal, physical). PH, ME, FAM.</p> <p>HE2.3.4 Identify characteristics of effective listening skills to enhance health or reduce/avoid health risks (e.g., eyes on speaker, etc.). PCD, IP/S, FA</p>	<p>1.NBT.B.3 Compare two two-digit numbers based on the meanings of the tens and one digits, recording the results of comparisons with the symbols $>$, $=$, and $<$.</p> <p>1.NBT.C.4 Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning uses. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.</p> <p>1.NBT.C.5 Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used.</p> <p>1.NBT.C.6 Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.</p>

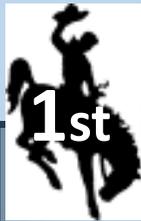


Heredity: Inheritance and Variation of Traits [1-LS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.</p> <p><i>Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.</i></p> <p><i>State Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.</i></p>	Crosscutting Concepts	<p>Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.</p>
	Disciplinary Core Ideas	<p>Inheritance of Traits:</p> <ul style="list-style-type: none"> • Young animals are very much, but not exactly like, their parents. • Plants also are very much, but not exactly, like their parents. <p>Variation of Traits:</p> <ul style="list-style-type: none"> • Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.1.1 Ask and answer questions about key details in a text.</p> <p>W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions).</p> <p>W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object.</p>



Earth's Place in the Universe [1-ESS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.</p> <p>Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.</p> <p>State Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.</p>	Crosscutting Concepts	Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.
	Disciplinary Core Ideas	The Universe and its Stars: <ul style="list-style-type: none"> Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.
	Science & Engineering Practices	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. <ul style="list-style-type: none"> Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions).</p> <p>W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.</p>		<p>N/A</p>



Earth's Place in the Universe [1-ESS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.</p> <p><i>Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.</i></p> <p><i>State Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.</i></p>	Crosscutting Concepts	Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.
	Disciplinary Core Ideas	Earth and the Solar System: <ul style="list-style-type: none"> Seasonal patterns of sunrise and sunset can be observed, described, and predicted.
	Science & Engineering Practices	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, which provide data to support explanations or design solutions. <ul style="list-style-type: none"> Make observations (firsthand or from media) to collect data that can be used to make comparisons.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions).</p> <p>W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>1.OA.A.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations to represent the problem.</p> <p>1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.</p>

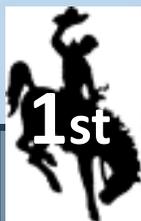


Engineering, Technology, & Applications of Science [K-2-ETS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.</p> <p>Science Standards Connections 1-PS4-4 (pg. 26) 1-LS1-1 (pg. 27)</p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution, it is important to clearly understand the problem.
	Science & Engineering Practices	<p>Asking Questions and Defining Problems in K-2 builds on prior experiences and progresses to simple descriptive questions.</p> <ul style="list-style-type: none"> • Ask questions based on observations to find more information about the natural and/or designed world. • Define a simple problem that can be solved through the development of a new or improved object or tool.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.2.1 Ask and answer such questions as <i>who, what, where, when, why, and how</i> to demonstrate understanding of key details in a text.</p> <p>W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>	<p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p> <p>SS2.5.3 Use the human features of a community to describe what makes that community special (e.g., cultural, language, religion, food, clothing, political, economic, population, and types of jobs in the area) and why others want to move there or move away from there.</p> <p>SS2.5.4 Identify how people may adjust to and/or change their environment in order to survive (e.g., clothing, houses, foods, and natural resources).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.</p>

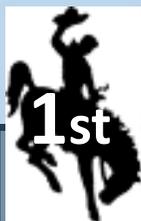


Engineering, Technology, & Applications of Science [K-2-ETS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.</p> <p>Science Standards Connections 1-PS4-4 (pg. 26) 1-LS1-1 (pg. 27)</p>	<p>Crosscutting Concepts</p>	<p>Structure and Function:</p> <ul style="list-style-type: none"> The shape and stability of structures of natural and designed objects are related to their function(s).
	<p>Disciplinary Core Ideas</p>	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> Designs can be conveyed through sketches, drawings, or physical models. The representations are useful in communicating ideas for a problem’s solutions to other people.
	<p>Science & Engineering Practices</p>	<p>Developing and Using Models in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> Develop a simple model based on evidence to represent a proposed object or tool.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Fine & Performing Arts Connections
<p>SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings.</p>	<p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p>	<p>FPA4.1.A.4 Students collaborate with others in creative artistic processes.</p> <p>FPA4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p> <p>FPA4.1.A.6 Students complete and exhibit their artwork.</p>



Engineering, Technology, & Applications of Science [K-2-ETS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	Optimizing the Design Solution <ul style="list-style-type: none"> Because there is always more than one possible solution to a problem, it is useful to compare the test designs.
	Science & Engineering Practices	Analyzing and Interpreting Data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. <ul style="list-style-type: none"> Analyze data from tests of an object or tool to determine if it works as intended.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>	<p>SS2.3.3 Identify how science or technology affects production (e.g., assembly line, robots, and video streaming).</p> <p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.</p>

Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four **disciplinary core ideas**: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain increasingly complex phenomena in the four disciplines as they progress to middle school and high school. The performance expectations shown in kindergarten through fifth grade couple particular practices and **crosscutting concepts** with specific **disciplinary core ideas**. However, instructional decisions should include use of additional practices and **crosscutting concepts** that lead to the performance expectations.

Second Grade



Second grade performance expectations include **PS1, LS2, LS4, ESS1, ESS2, and ETS1 Disciplinary Core Ideas** adapted from NRC Framework. The performance expectations in second grade help students formulate answers to questions such as: “How does land change and what are some things that cause it to change? What are the different kinds of land and bodies of water? How

are materials similar and different from one another, and how do the properties of the materials relate to their use? What do plants need to grow? How many types of living things live in a place?” Students are expected to develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination. Students are also expected to compare the diversity of life in different habitats. An understanding of observable properties of materials is developed by students at this level through analysis and classification of different materials. Students are able to apply their understanding of the idea that wind and water can change the shape of the land to compare design solutions to slow or prevent such change. Students are able to use information and models to identify and represent the shapes and kinds of land and bodies of water in an area and where water is found on Earth.

The **Crosscutting Concepts** and Connections to Engineering, Technology, and Applications of Science, listed below, are the organizing concepts for these **Disciplinary Core Ideas**.

Crosscutting Concepts

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

Connections to Engineering, Technology, and Applications of Science

- Interdependence of science, engineering, and technology
- Influence of science, engineering, and technology on society and the natural world

In the second grade performance expectations, students are expected to demonstrate understanding of the **core ideas** and grade appropriate proficiency in using the **Science and Engineering Practices** below:

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



Matter and Its Interactions [2-PS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.</p> <p><i>Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.</i></p>	Crosscutting Concepts	Patterns in the natural and human designed world can be observed.
	Disciplinary Core Ideas	Structure and Properties of Matter: <ul style="list-style-type: none"> Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. Different properties are suited to different purposes.
	Science & Engineering Practices	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, which provide data to support explanations or design solutions. <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>		<p>MP.4 Model with mathematics.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.</p>



Matter and Its Interactions [2-PS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.</p> <p><i>Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.</i></p> <p><i>State Assessment Boundary: Assessment of quantitative measurements is limited to length.</i></p> <p>Engineering, Technology & Application of Science Connections—K-2-ETS1-3 (pg. 49)</p>	Crosscutting Concepts	Simple tests can be designed to gather evidence to support or refute student ideas about causes.
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Different properties are suited to different purposes. <p>Optimizing the design Solution:</p> <ul style="list-style-type: none"> Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
	Science & Engineering Practices	<p>Analyzing and interpreting data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> Analyze data from tests of an object or tool to determine if it works as intended.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.2.8 Describe how reasons support specific points the author makes in a text.</p> <p>W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.</p>



Matter and Its Interactions [2-PS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.</p> <p><i>Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.</i></p> <p>Engineering, Technology & Application of Science Connections K-2-ETS1-1 (pg. 47)</p>	Crosscutting Concepts	Objects may break into smaller pieces and be put together into larger pieces, or change shapes.
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces. <p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be prepared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>		<p>N/A</p>



Matter and Its Interactions [2-PS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.</p> <p><i>Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.</i></p>	Crosscutting Concepts	Events have causes that generate observable patterns.
	Disciplinary Core Ideas	Chemical Reactions: <ul style="list-style-type: none"> • Heating or cooling a substance may cause changes that can be observed. • Sometimes these changes are reversible, and sometimes they are not.
	Science & Engineering Practices	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). <ul style="list-style-type: none"> • Construct an argument with evidence to support a claim.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.2.1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.</p> <p>RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.</p> <p>RI.2.8 Describe how reasons support specific points the author makes in a text.</p> <p>W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., because, and, also) to connect opinion and reasons, and provide a concluding statement or section.</p>	<p>SS2.6.1 Identify what kinds of information can be found in different resources (e.g., library, computer, atlas, and dictionary).</p>	<p>N/A</p>



Ecosystems: Interactions, Energy, and Dynamics [2-LS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.</p> <p>State Assessment Boundary: Assessment is limited to testing one variable at a time.</p>	Crosscutting Concepts	Events have causes that generate observable patterns.
	Disciplinary Core Ideas	Interdependent Relationships in Ecosystems: <ul style="list-style-type: none"> Plants depend on water and light to grow.
	Science & Engineering Practices	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, which provide data to support explanations or design solutions. <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p>



Ecosystems: Interactions, Energy, and Dynamics [2-LS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.</p> <p><i>Clarification Statement: Examples could include the natural structure of an animal that helps it disperse seeds (e.g., hair that snares seeds, squirrel cheek pouches that transport seeds) or that helps it pollinate plants (e.g., bees have fuzzy bodies to which pollen sticks, hummingbirds' bodies transport pollen).</i></p> <p>Engineering, Technology & Application of Science Connections K-2 ETS1-2 (pg. 48)</p>	<p>Crosscutting Concepts</p>	<p>The shape and stability of structures of natural and designed objects are related to their function(s).</p>
	<p>Disciplinary Core Ideas</p>	<p>Interdependent Relationships in Ecosystems:</p> <ul style="list-style-type: none"> Plants depend on animals for pollination or to move their seeds around. <p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.
	<p>Science & Engineering Practices</p>	<p>Developing and using models in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> Develop a simple model based on evidence to represent a proposed object or tool.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Fine & Performing Arts Connections	Mathematics Connections
<p>SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings.</p>	<p>FPA4.1.A.4 Students collaborate with others in creative artistic processes.</p> <p>FPA.4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p> <p>FPA4.1.A.6 Students complete and exhibit their artwork.</p>	<p>MP.4 Model with mathematics.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems.</p>



Biological Unity and Diversity [2-LS4-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.</p> <p><i>Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.</i></p> <p><i>State Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.</i></p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Biodiversity and Humans:</p> <ul style="list-style-type: none"> There are many different kinds of living things in any area, and they exist in different places on land and in water.
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, which provide data to support explanations or design solutions.</p> <ul style="list-style-type: none"> Make observations (firsthand or from media) to collect data which can be used to make comparisons.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
<p>W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems.</p>



Earth's Place in the Universe [2-ESS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.</p> <p>Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.</p> <p>State Assessment Boundary: Assessment does not include quantitative measurements of timescales.</p> <p>ISTE-3. Students apply digital tools to gather, evaluate, and use information.</p>	Crosscutting Concepts	Things may change slowly or rapidly.
	Disciplinary Core Ideas	<p>The History of Planet Earth:</p> <ul style="list-style-type: none"> Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> Make observations from several sources to construct an evidence-based account for natural phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.2.1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.</p> <p>RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.</p> <p>W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.</p> <p>W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p> <p>SL.2.2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.</p>	<p>SS2.6.1 Identify what kinds of information can be found in different resources (e.g., library, computer, atlas, and dictionary).</p>	<p>MP.4 Model with mathematics.</p> <p>2.NBT.A Understand place value</p>



Earth's Systems [2-ESS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.</p> <p><i>Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.</i></p> <p>Engineering, Technology & Application of Science Connections—K-2-ETS1-3 (pg. 49)</p> <p>ISTE-3. Students apply digital tools to gather, evaluate, and use information.</p>	Crosscutting Concepts	<p>Things may change slowly or rapidly.</p>
	Disciplinary Core Ideas	<p>Earth Materials and Systems:</p> <ul style="list-style-type: none"> • Wind and water can change the shape of the land. <p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> • Compare multiple solutions to a problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.</p> <p>RI.2.9 Compare and contrast the most important points presented by two texts on the same topic.</p>	<p>SS2.5.4 Identify how people may adjust to and/or change their environment in order to survive (e.g., clothing, houses, foods, and natural resources).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>2.MD.B.5 Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.</p>



Earth's Systems [2-ESS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.</p> <p>State Assessment Boundary: Assessment does not include quantitative scaling in models.</p>	Crosscutting Concepts	Patterns in the natural world can be observed.
	Disciplinary Core Ideas	Plate Tectonics and Large-Scale System Interactions: <ul style="list-style-type: none"> • Maps show where things are located. One can map the shapes and kinds of land and water in any area.
	Science & Engineering Practices	Developing and using models in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions. <ul style="list-style-type: none"> • Develop a model to represent patterns in the natural world.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Fine & Performing Arts Connections	Mathematics Connections
<p>SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings.</p>	<p>SS2.5.1 Use a map, globe, and mental mapping to identify familiar areas and simple patterns and create maps using various media.</p>	<p>FPA4.1.A.4 Students collaborate with others in creative artistic processes.</p> <p>FPA.4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p> <p>FPA4.1.A.6 Students complete and exhibit their artwork.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>2.NBT.A.3 Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.</p>



Earth's Systems [2-ESS2-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid, liquid, or gas.</p> <p>ISTE-3. Students apply digital tools to gather, evaluate, and use information.</p>	Crosscutting Concepts	Patterns in the natural world can be observed.
	Disciplinary Core Ideas	<p>The Roles of Water in Earth's Surface Processes:</p> <ul style="list-style-type: none"> Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice, liquid form, or as a gas.
	Science & Engineering Practices	<p>Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> Obtain information using various texts, text features (e.g., headings, tables, contents, glossaries, electronic menus, icons, and other media that will be useful in answering scientific questions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer questions.</p>	<p>SS2.6.1 Identify what kinds of information can be found in different resources (e.g., library, computer, atlas, and dictionary).</p> <p>SS2.5.1 Use a map, globe, and mental mapping to identify familiar areas and simple patterns and create maps using various media.</p>	N/A



Engineering, Technology, & Applications of Science [K-2-ETS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.</p> <p>Science Standards Connections 2-PS1-3 (pg. 38)</p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> A situation that people want to change or create can be approached as a problem to be solved through engineering. Asking questions, making observations, and gathering information are helpful in thinking about problems. Before beginning to design a solution, it is important to clearly understand the problem.
	Science & Engineering Practices	<p>Asking Questions and Defining Problems in K-2 builds on prior experiences and progresses to simple descriptive questions.</p> <ul style="list-style-type: none"> Ask questions based on observations to find more information about the natural and/or designed world. Define a simple problem that can be solved through the development of a new or improved object or tool.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.2.1 Ask and answer such questions as <i>who</i>, <i>what</i>, <i>where</i>, <i>when</i>, <i>why</i>, and <i>how</i> to demonstrate understanding of key details in a text.</p> <p>W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>	<p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p> <p>SS2.5.3 Use the human features of a community to describe what makes that community special (e.g., cultural, language, religion, food, clothing, political, economic, population, and types of jobs in the area) and why others want to move there or move away from there.</p> <p>SS2.5.4 Identify how people may adjust to and/or change their environment in order to survive (e.g., clothing, houses, foods, and natural resources).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.</p>



Engineering, Technology, & Applications of Science [K-2-ETS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.</p> <p>Science Standards Connections 2-LS2-2 (pg. 41)</p>	<p>Crosscutting Concepts</p>	<p>Structure and Function:</p> <ul style="list-style-type: none"> The shape and stability of structures of natural and designed objects are related to their function(s).
	<p>Disciplinary Core Ideas</p>	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> Designs can be conveyed through sketches, drawings, or physical models. The representations are useful in communicating ideas for a problem's solutions to other people.
	<p>Science & Engineering Practices</p>	<p>Developing and Using Models in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> Develop a simple model based on evidence to represent a proposed object or tool.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Fine & Performing Arts Connections
<p>SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings.</p>	<p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p>	<p>FPA4.1.A.4 Students collaborate with others in creative artistic processes.</p> <p>FPA4.1.A.5 Students use art materials and tools in a safe and responsible manner.</p> <p>FPA4.1.A.6 Students complete and exhibit their artwork.</p>



Engineering, Technology, & Applications of Science [K-2-ETS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.</p> <p>Science Standards Connections 2-PS1-2 (pg. 37) 2-ESS2-1 (pg. 44)</p>	<p>Crosscutting Concepts</p>	<p><i>Intentionally Left Blank</i></p>
	<p>Disciplinary Core Ideas</p>	<p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> Because there is always more than one possible solution to a problem, it is useful to compare the test designs.
	<p>Science & Engineering Practices</p>	<p>Analyzing and Interpreting Data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> Analyze data from tests of an object or tool to determine if it works as intended.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.</p> <p>W.2.8 Recall information from experiences or gather information from provided sources to answer a question.</p>	<p>SS2.3.3 Identify how science or technology affects production (e.g., assembly line, robots, and video streaming).</p> <p>SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.</p>

Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four **disciplinary core ideas**: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain increasingly complex phenomena in the four disciplines as they progress to middle school and high school. The performance expectations shown in kindergarten through fifth grade couple particular practices and **crosscutting concepts** with specific **disciplinary core ideas**. However, instructional decisions should include use of additional practices and **crosscutting concepts** that lead to the performance expectations.

Third Grade

Third grade performance expectations include **PS2, LS1, LS2, LS3, LS4, ESS2, and ESS3 Disciplinary Core Ideas** adapted from the



NRC Framework. The performance expectations in third grade help students formulate answers to questions such as: “What is typical weather in different parts of the world and during different times of the year? How can the impact of weather-related hazards be reduced? How do organisms vary in their traits? How are plants, animals, and environments of the past similar or different from current

plants, animals, and environments? What happens to organisms when their environment changes? How do equal and unequal forces on an object affect the object? How can magnets be used?” Students are able to organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students are able to make a claim about the merit of a design solution that reduces the impacts of such hazards. Students are expected to develop an understanding of the similarities and differences of organisms’ life cycles. An understanding that organisms have different inherited traits, and that the environment can also affect the traits that an organism develops, is acquired by students at this level. In addition, students are able to construct an explanation using evidence for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Students are expected to develop an understanding of types of organisms that lived long ago and also about the nature of their environments. Third graders are expected to develop an understanding of the idea that when the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Students are able to determine the effects of balanced and unbalanced forces on the motion of an object and the cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. They are then able to apply their understanding of magnetic interactions to define a simple design problem that can be solved with magnets.

The **Crosscutting Concepts** and Connections to Engineering, Technology, and Applications of Science, listed below, are the organizing concepts for these **Disciplinary Core Ideas**.

Crosscutting Concepts

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

Connections to Engineering, Technology, and Applications of Science

- Interdependence of science, engineering, and technology
- Influence of science, engineering, and technology on society and the natural world

In the third grade performance expectations, students are expected to demonstrate understanding of the **core ideas** and grade appropriate proficiency in using the **Science and Engineering Practices** below:

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



Motion and Stability: Forces and Interactions [3-PS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.</p> <p>Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.</p> <p>State Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.</p>	Crosscutting Concepts	Cause and effect relationships are routinely identified.
	Disciplinary Core Ideas	<p>Forces and Motion:</p> <ul style="list-style-type: none"> Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) <p>Types of Interactions:</p> <ul style="list-style-type: none"> Objects in contact exert forces on each other.
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>W.3.7 Conduct short research projects that build knowledge about a topic.</p> <p>W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.</p>



Motion and Stability: Forces and Interactions [3-PS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-PS2-2. Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.</p> <p><i>Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.</i></p> <p><i>State Assessment Boundary: Assessment does not include technical terms such as period and frequency.</i></p>	Crosscutting Concepts	Patterns of change can be used to make predictions.
	Disciplinary Core Ideas	<p>Forces and Motion:</p> <ul style="list-style-type: none"> The patterns of an object’s motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.3.7 Conduct short research projects that build knowledge about a topic.</p> <p>W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.</p>		N/A



Motion and Stability: Forces and Interactions [3-PS2-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.</p> <p><i>Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.</i></p> <p><i>State Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.</i></p>	Crosscutting Concepts	Cause and effect relationships are routinely identified, tested, and used to explain change.
	Disciplinary Core Ideas	<p>Types of Interactions:</p> <ul style="list-style-type: none"> Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.
	Science & Engineering Practices	<p>Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> Ask questions that can be investigated based on patterns such as cause and effect relationships.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.</p> <p>RI.3.8 Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence).</p> <p>SL.3.3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.</p>		N/A



Motion and Stability: Forces and Interactions [3-PS2-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.</p> <p><i>Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.</i></p> <p>Engineering, Technology & Application of Science Connections 3-5-ETS1-1 (pg. 66) 3-5-ETS1-2 (pg. 67)</p>	Crosscutting Concepts	<p>Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.</p>
	Disciplinary Core Ideas	<p>Types of Interactions:</p> <ul style="list-style-type: none"> Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. <p>Interdependence of Science, Engineering, and Technology:</p> <ul style="list-style-type: none"> Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.
	Science & Engineering Practices	<p>Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> Define a simple problem that can be solved through the development of a new or improved object or tool.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		N/A



From Molecules to Organisms: Structures & Processes [3-LS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.</p> <p><i>Clarification Statement: Changes organisms go through during their life form a pattern.</i></p> <p><i>State Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.</i></p>	Crosscutting Concepts	Patterns of change can be used to make predictions.
	Disciplinary Core Ideas	<p>Growth and Development of Organisms:</p> <ul style="list-style-type: none"> • Reproduction is essential to the continued existence of every kind of organism. • Plants and animals have unique and diverse life cycles.
	Science & Engineering Practices	<p>Developing and using models in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> • Develop models to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.3.7 Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).</p> <p>SL.3.5 Create engaging audio recordings of stories or poems that demonstrate fluid reading at an understandable pace; add visual displays when appropriate to emphasize or enhance certain facts or details.</p>		<p>MP.4 Model with mathematics.</p> <p>3.NBT Number and Operations in Base Ten</p> <p>3.NF Number and Operations—Fractions</p>



Ecosystems: Interactions, Energy, and Dynamics [3-LS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-LS2-1. Construct an argument that some animals form groups that help members survive.</p> <p>State Assessment Boundary: Use WY animals as examples.</p> 	Crosscutting Concepts	Cause and effect relationships are routinely identified and used to explain change.
	Disciplinary Core Ideas	Social Interactions and Group Behavior: <ul style="list-style-type: none"> Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.
	Science & Engineering Practices	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). <ul style="list-style-type: none"> Construct an argument with evidence, data, and/or a model.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.</p> <p>W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons.</p>		<p>MP.4 Model with mathematics.</p> <p>3.NBT Number and Operations in Base Ten</p>



Heredity: Inheritance and Variation of Traits [3-LS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.</p> <p><i>Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.</i></p> <p><i>State Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.</i></p>	Crosscutting Concepts	Similarities and differences in patterns can be used to sort and classify natural phenomena.
	Disciplinary Core Ideas	<p>Inheritance of Traits:</p> <ul style="list-style-type: none"> Many characteristics of organisms are inherited from their parents. <p>Variation of Traits:</p> <ul style="list-style-type: none"> Different organisms vary in how they look and function because they have different inherited information.
	Science & Engineering Practices	<p>Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> Analyze and interpret data to make sense of phenomena using logical reasoning.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.</p> <p>RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.</p> <p>W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <p>SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.</p>



Heredity: Inheritance and Variation of Traits [3-LS3-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-LS3-2. Use evidence to support the explanation that observable traits can be influenced by the environment.</p> <p><i>Clarification Statement: Environmental factors that vary for organisms of the same type (e.g., amount of food, amount of water, and amount of exercise an animal gets, chemicals in the water) may influence organisms' observable traits.</i></p>	Crosscutting Concepts	Cause and effect relationships are routinely identified and used to explain change.
	Disciplinary Core Ideas	<p>Inheritance of Traits:</p> <ul style="list-style-type: none"> Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. <p>Variation of Traits:</p> <ul style="list-style-type: none"> The environment also affects the traits that an organism develops.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> Use evidence (e.g., observations, patterns) to support an explanation.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.</p> <p>RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.</p> <p>W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <p>SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.</p>



Biological Evolution: Unity and Diversity [3-LS4-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.</p> <p><i>Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.</i></p> <p><i>State Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.</i></p>	Crosscutting Concepts	Observable phenomena exist from very short to very long time periods.
	Disciplinary Core Ideas	Evidence of Common Ancestry and Diversity: <ul style="list-style-type: none"> Some kinds of plants and animals that once lived on Earth are no longer found anywhere. Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.
	Science & Engineering Practices	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. <ul style="list-style-type: none"> Analyze and interpret data to make sense of phenomena using logical reasoning.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.</p> <p>RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.</p> <p>W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons.</p> <p>W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <p>W.3.9 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.</p>



Biological Evolution: Unity and Diversity [3-LS4-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.</p> <p><i>Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.</i></p>	Crosscutting Concepts	Observable phenomena exist from very short to very long time periods.
	Disciplinary Core Ideas	<p>Natural Selection:</p> <ul style="list-style-type: none"> Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> Use evidence (e.g., observations, patterns) to construct an explanation.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.</p> <p>RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.</p> <p>W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <p>SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs.</p>



Biological Evolution: Unity and Diversity [3-LS4-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.</p> <p><i>Clarification Statement: Examples of evidence could include needs and traits of the organisms and characteristics of the habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.</i></p>	Crosscutting Concepts	Cause and effect relationships are routinely identified and used to explain change.
	Disciplinary Core Ideas	<p>Adaptation:</p> <ul style="list-style-type: none"> For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> Construct an argument with evidence.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.</p> <p>RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.</p> <p>W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons.</p> <p>W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <p>SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.</p>	<p>SS5.5.4 Describe how the environment influences people in Wyoming and how we adjust to and/or change our environment in order to survive (e.g., natural resources, housing, and food).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and twostep “how many more” and “how many less” problems using information presented in scaled bar graphs.</p>



Biological Evolution: Unity and Diversity [3-LS4-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.</p> <p>Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.</p> <p>State Assessment Boundary: Assessment is limited to a single environmental change.</p> <p>Engineering, Technology & Application of Science Connections 3-5-ETS1-1 (pg. 66) 3-5-ETS1-2 (pg. 67)</p>	Crosscutting Concepts	<p>A system can be described in terms of its components and their interactions.</p>
	Disciplinary Core Ideas	<p>Ecosystem Dynamics, Functioning, and Resilience:</p> <ul style="list-style-type: none"> When the environment changes in ways that affect a place’s physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. <p>Biodiversity and Humans:</p> <ul style="list-style-type: none"> Populations live in a variety of habitats, and change in those habitats affects the organisms living there.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.</p> <p>RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.</p> <p>W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons.</p> <p>W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <p>SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.</p>	<p>SS5.5.4 Describe how the environment influences people in Wyoming and how we adjust to and/or change our environment in order to survive (e.g., natural resources, housing, and food).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Earth's Systems [3-ESS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.</p> <p>Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.</p> <p>State Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.</p>	Crosscutting Concepts	Patterns of change can be used to make predictions.
	Disciplinary Core Ideas	Weather and Climate: <ul style="list-style-type: none"> Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
	Science & Engineering Practices	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. <ul style="list-style-type: none"> Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
N/A	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.</p> <p>3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in bar graphs.</p>



Earth's Systems [3-ESS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.</p>	<p>Crosscutting Concepts</p>	<p>Patterns of change can be used to make predictions.</p>
	<p>Disciplinary Core Ideas</p>	<p>Weather and Climate:</p> <ul style="list-style-type: none"> Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.
	<p>Science & Engineering Practices</p>	<p>Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> Obtain and combine information from books and other reliable media to explain phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>RI.3.9 Compare and contrast the most important points and key details presented in two texts on the same topic.</p> <p>W.3.9 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Earth and Human Activity [3-ESS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.</p> <p>Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.</p> <p>Engineering, Technology & Application of Science Connections 3-5-ETS1-1 (pg. 66) 3-5-ETS1-2 (pg. 67)</p>	Crosscutting Concepts	Cause and effect relationships are routinely identified, tested, and used to explain change.
	Disciplinary Core Ideas	<p>Natural Hazards:</p> <ul style="list-style-type: none"> A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. <p>Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.</p> <p>Influence of Engineering, Technology, and Science on Society and the Natural World:</p> <p>Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones).</p>
	Science & Engineering Practices	<p>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons.</p> <p>W.3.7 Conduct short research projects that build knowledge about a topic.</p>	<p>SS.6.2 Identify validity of information (e.g., accuracy, relevancy, fact, or fiction).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Engineering, Technology, & Applications of Science [3-5-ETS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</p> <p>Science Standards Connections 3-PS2-4 (pg. 54) 3-LS4-4 (pg. 62) 3-ESS3-1 (pg.65)</p>	<p>Crosscutting Concepts</p>	<p>People’s needs and wants change over time, as do their demands for new and improved technologies.</p>
	<p>Disciplinary Core Ideas</p>	<p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be prepared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
	<p>Science & Engineering Practices</p>	<p>Asking questions and Defining Problems in 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>N/A</p>	<p>SS.5.4.2 Describe how tools and technology makes life easier; describe how one tool or technology evolves into another (e.g., telegraph to telephone to cell phone or horse-drawn wagon to railroad to car); identify a tool or technology that impacted history (e.g., ships allowed for discovery of new lands or boiling water prevented spread of disease).</p> <p>SS5.6.2 Distinguish between fiction and non-fiction.</p>	<p>N/A</p>



Engineering, Technology, & Applications of Science [3-5-ETS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</p> <p>Science Standards Connections 3-PS2-4 (pg. 54) 3-LS4-4 (pg. 62) 3-ESS3-1 (pg. 65)</p>	Crosscutting Concepts	<p>Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.</p>
	Disciplinary Core Ideas	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
	Science & Engineering Practices	<p>Constructing Explanations and Designing Solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
N/A	SS5.6.2 Distinguish between fiction and non-fiction.	N/A



Engineering, Technology, & Applications of Science [3-5-ETS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p>	<p>Crosscutting Concepts</p>	<p><i>Intentionally Left Blank</i></p>
	<p>Disciplinary Core Ideas</p>	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. <p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
	<p>Science & Engineering Practices</p>	<p>Planning and Carrying Out Investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
N/A	SS5.6.2 Distinguish between fiction and non-fiction.	N/A

Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four **disciplinary core ideas**: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain increasingly complex phenomena in the four disciplines as they progress to middle school and high school. The performance expectations shown in kindergarten through fifth grade couple particular practices and **crosscutting concepts** with specific **disciplinary core ideas**. However, instructional decisions should include use of additional practices and **crosscutting concepts** that lead to the performance expectations.

Fourth Grade



Fourth grade performance expectations include **PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas** adapted from the NRC Framework. The performance expectations in fourth grade help students formulate answers to questions such as: “What are waves and what are some things they can do? How can water, ice, wind, and vegetation change the land? What patterns of

Earth’s features can be determined with the use of maps? How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals? What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem?” Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth’s features, students analyze and interpret data from maps. Fourth graders are expected to develop an understanding that plants and animals have internal and external

structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The **Crosscutting Concepts** and Connections to Engineering, Technology, and Applications of Science, listed below, are called out as organizing concepts for these **Disciplinary Core Ideas**.

Crosscutting Concepts

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

Connections to Engineering, Technology, and Applications of Science

- Interdependence of science, engineering, and technology
- Influence of science, engineering, and technology on society and the natural world

In the fourth grade performance expectations, students are expected to demonstrate understanding of the **core ideas** and grade appropriate proficiency in using the **Science and Engineering Practices** below:

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

Energy [4-PS3-1]



Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.</p> <p>State Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.</p>	Crosscutting Concepts	Energy can be transferred in various ways and between objects.
	Disciplinary Core Ideas	<p>Definitions of Energy:</p> <ul style="list-style-type: none"> The faster a given object is moving, the more energy it possesses.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> Use evidence (e.g., measurements, observations, patterns) to construct an explanation.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.</p> <p>RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.</p> <p>RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.</p> <p>W.4.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <p>W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.</p> <p>W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>		N/A

Energy [4-PS3-2]



Performance Expectations (Benchmark)

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

State Assessment Boundary: Assessment does not include quantitative measurements of energy.

Three Dimensions of Learning

Crosscutting Concepts

Energy can be transferred in various ways and between objects.

Disciplinary Core Ideas

Definitions of Energy:

- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

Conservation of Energy and Energy Transfer:

- Energy is present whenever there are moving objects, sound, light, or heat.
- When objects collide, energy can be transferred from one object to another, thereby changing their motion.
- In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- Light also transfers energy from place to place.
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light.
- The currents may have been produced to begin with by transforming the energy of motion into electrical energy.

Science & Engineering Practices

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

- W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic.
- W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Mathematics Connections

N/A

Energy [4-PS3-3]



Performance Expectations (Benchmark)

4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.

Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.

State Assessment Boundary: Assessment does not include quantitative measurements of energy.

Three Dimensions of Learning

Crosscutting Concepts

Energy can be transferred in various ways and between objects.

Disciplinary Core Ideas

Definitions of Energy:

- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

Conservation of Energy and Energy Transfer:

- Energy is present whenever there are moving objects, sound, light, or heat.
- When objects collide, energy can be transferred from one object to another, thereby changing their motion.
- In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.

Relationship Between Energy and Forces:

- When objects collide, the contact forces transfer energy so as to change the objects' motions.

Science & Engineering Practices

Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

Wyoming Cross-Curricular Connections

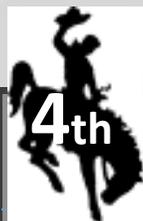
ELA / Literacy Connections

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.
W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Mathematics Connections

N/A

Energy [4-PS3-4]



4th

Performance Expectations (Benchmark)

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.

State Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.

Engineering, Technology & Application of Science
Connections

3-5-ETS1-1 (pg. 84)

3-5-ETS1-2 (pg. 85)

3-5-ETS1-3 (pg. 86)

Three Dimensions of Learning

Crosscutting Concepts

Energy can be transferred in various ways and between objects.

Disciplinary Core Ideas

Conservation of Energy and Energy Transfer:

- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.

Energy in Chemical Processes and Everyday Life:

- The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.

Defining Engineering Problems:

(Possible solutions to a problem are limited by available materials and resources (constraints).

- The success of a designed solution is determined by considering the desired features of a solution (criteria).
- Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

Influence of Engineering, Technology, and Science on Society and the Natural World:

- Engineers improve existing technologies or develop new ones.

Science & Engineering Practices

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Apply scientific ideas to solve design problems.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Mathematics Connections

4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.



Waves and Their Applications in Technology for Information Transfer [4-PS4-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.</p> <p><i>Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.</i></p> <p><i>State Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.</i></p>	Crosscutting Concepts	Similarities and differences in patterns can be used to sort and classify natural phenomena.
	Disciplinary Core Ideas	Wave Properties: <ul style="list-style-type: none"> Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).
	Science & Engineering Practices	Developing and using models in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. <ul style="list-style-type: none"> Develop a model using an analogy, example, or abstract representation to describe a scientific principle.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.</p>		<p>MP.4 Model with mathematics.</p> <p>4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.</p>



Waves and Their Applications in Technology for Information Transfer [4-PS4-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.</p> <p>State Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.</p>	Crosscutting Concepts	Cause and effect relationships are routinely identified.
	Disciplinary Core Ideas	Electromagnetic Radiation: <ul style="list-style-type: none"> An object can be seen when light reflected from its surface enters the eyes.
	Science & Engineering Practices	Developing and using models in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. <ul style="list-style-type: none"> Develop a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.</p>		<p>MP.4 Model with mathematics.</p> <p>4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.</p>



Waves and Their Applications in Technology for Information Transfer [4-PS4-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.</p> <p><i>Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse Code to send text.</i></p> <p>Engineering, Technology & Application of Science Connections—3-5-ETS1-2 (pg. 85)</p>	<p>Crosscutting Concepts</p>	<p>Similarities and differences in patterns can be used to sort and classify designed products.</p>
	<p>Disciplinary Core Ideas</p>	<p>Information Technologies and Instrumentation:</p> <ul style="list-style-type: none"> Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. <p>Optimizing The Design Solution</p> <ul style="list-style-type: none"> Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
	<p>Science & Engineering Practices</p>	<p>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.</p> <p>RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.</p>		<p>MP.2 Reason abstractly and quantitatively.</p>



From Molecules to Organisms: Structure and Processes [4-LS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.</p> <p><i>Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.</i></p> <p><i>State Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.</i></p>	Crosscutting Concepts	A system can be described in terms of its components and their interactions.
	Disciplinary Core Ideas	Structure and Function: <ul style="list-style-type: none"> Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
	Science & Engineering Practices	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). <ul style="list-style-type: none"> Construct an argument with evidence, data, and/or a model.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.</p>		<p>4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.</p>



From Molecules to Organisms: Structure and Processes [4-LS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.</p> <p><i>Clarification Statement: Emphasis is on systems of information transfer.</i></p> <p><i>State Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.</i></p>	<p>Crosscutting Concepts</p>	<p>A system can be described in terms of its components and their interactions.</p>
	<p>Disciplinary Core Ideas</p>	<p>Information Processing:</p> <ul style="list-style-type: none"> • Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal’s brain. • Animals are able to use their perceptions and memories to guide their actions.
	<p>Science & Engineering Practices</p>	<p>Developing and using models in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> • Use a model to test interactions concerning the functioning of a natural system.
Wyoming Cross-Curricular Connections		
<p>ELA / Literacy Connections</p>		<p>Mathematics Connections</p>
<p>SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.</p>		<p>N/A</p>



Earth's Place in the Universe [4-ESS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.</p> <p>Clarification Statement: Examples of evidence from patterns (may include, but not limited to, Wyoming specific examples) could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.</p> <p>State Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.</p>	<p>Crosscutting Concepts</p>	<p>Patterns can be used as evidence to support an explanation.</p>
	<p>Disciplinary Core Ideas</p>	<p>The History of Planet Earth:</p> <ul style="list-style-type: none"> Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.
	<p>Science & Engineering Practices</p>	<p>Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> Identify the evidence that supports particular points in an explanation.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.</p> <p>W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.</p> <p>W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>	<p>SS5.5.2 Explain how physical features, patterns, and systems impact different regions and how these features may help us generalize and compare areas within the state, nation, or world.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.</p>



Earth's Systems [4-ESS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.</p> <p><i>Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.</i></p> <p><i>State Assessment Boundary: Assessment is limited to a single form of weathering or erosion.</i></p>	Crosscutting Concepts	Cause and effect relationships are routinely identified, tested, and used to explain change.
	Disciplinary Core Ideas	Earth Materials and Systems: <ul style="list-style-type: none"> Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
	Science & Engineering Practices	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. <ul style="list-style-type: none"> With guidance, plan and conduct an investigation with peers.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.</p> <p>W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.</p> <p>4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.</p>



Earth's Systems [4-ESS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.</p> <p><i>Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.</i></p>	Crosscutting Concepts	Patterns can be used as evidence to support an explanation.
	Disciplinary Core Ideas	<p>Plate Tectonics and Large-Scale System Interactions:</p> <ul style="list-style-type: none"> The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.
	Science & Engineering Practices	<p>Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> Analyze and interpret data to make sense of phenomena using logical reasoning.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.</p>		<p>4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.</p>



Earth and Human Activity [4-ESS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from renewable and non-renewable resources and how their uses affect the environment.</p> <p><i>Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials.</i></p>	<p>Crosscutting Concepts</p>	<p>Cause and effect relationships are routinely identified and used to explain change.</p>
	<p>Disciplinary Core Ideas</p>	<p>Natural Resources:</p> <ul style="list-style-type: none"> • Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. • Some resources are renewable over time, and others are not.
	<p>Science & Engineering Practices</p>	<p>Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> • Obtain and combine information from books and other reliable media to explain phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.</p> <p>W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.</p> <p>W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>4.OA.A.1 Interpret a multiplication equation as a comparison, e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.</p>



Earth and Human Activity [4-ESS3-2]

4th Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.</p> <p>Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.</p> <p>State Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, landslides, or volcanic eruptions.</p> <p>Engineering, Technology & Application of Science Connections—3-5-ETS1-2 (pg. 85)</p>	Crosscutting Concepts	Cause and effect relationships are routinely identified and used to explain change.
	Disciplinary Core Ideas	<p>Natural Hazards:</p> <ul style="list-style-type: none"> A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. <p>Designing Solutions to Engineering Problems:</p> <ul style="list-style-type: none"> Testing a solution involves investigating how well it performs under a range of likely conditions. <p>Influence of Engineering, Technology, and Science on Society and the Natural World:</p> <ul style="list-style-type: none"> Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.4.1 Refer to details and examples in a text when explain what the text says explicitly and when drawing inferences from the text.</p> <p>RI.4.7 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.</p>	<p>SS.5.4.2 Describe how tools and technology make life easier; describe how one tool or technology evolves into another (e.g., telegraph to telephone to cell phone or horse-drawn wagon to railroad to car); identify a tool or technology that impacted history (e.g., ships allowed for discovery of new lands or boiling water prevented spread of disease).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>4.OA.A.1 Interpret a multiplication equation as a comparison, e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.</p>



Engineering, Technology, & Applications of Science [3-5-ETS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</p> <p>Science Standards Connections 4-PS3-4 (pg. 73) 4-PS4-3 (pg. 76) 4-ESS3-2 (pg. 83)</p>	Crosscutting Concepts	<p>People’s needs and wants change over time, as do their demands for new and improved technologies.</p>
	Disciplinary Core Ideas	<p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be prepared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
	Science & Engineering Practices	<p>Asking questions and Defining Problems in 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
N/A	<p>SS.5.4.2 Describe how tools and technology makes life easier; describe how one tool or technology evolves into another (e.g., telegraph to telephone to cell phone or horse-drawn wagon to railroad to car); identify a tool or technology that impacted history (e.g., ships allowed for discovery of new lands or boiling water prevented spread of disease).</p> <p>SS5.6.2 Distinguish between fiction and non-fiction.</p>	N/A



Engineering, Technology, & Applications of Science [3-5-ETS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</p> <p>Science Standards Connections 4-PS3-4 (pg. 73) 4-PS4-3 (pg. 76) 4-ESS3-2 (pg. 83)</p>	Crosscutting Concepts	<p>Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.</p>
	Disciplinary Core Ideas	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
	Science & Engineering Practices	<p>Constructing Explanations and Designing Solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
N/A	SS5.6.2 Distinguish between fiction and non-fiction.	N/A



Engineering, Technology, & Applications of Science [3-5-ETS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p> <p>Science Standards Connections 4-PS3-4 (pg.73)</p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. <p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
	Science & Engineering Practices	<p>Planning and Carrying Out Investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
N/A	SS5.6.2 Distinguish between fiction and non-fiction.	N/A

Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four **disciplinary core ideas**: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain increasingly complex phenomena in the four disciplines as they progress to middle school and high school. The performance expectations shown in kindergarten through fifth grade couple particular practices and **crosscutting concepts** with specific disciplinary core ideas. However, instructional decisions should include use of additional practices and **crosscutting concepts** that lead to the performance expectations.

Fifth Grade



Fifth grade performance expectations include **PS1, PS2, PS3, LS1, LS2, ESS1, ESS2, and ESS3 Disciplinary Core Ideas** adapted from the NRC Framework. The performance expectations in fifth grade help students formulate answers to questions such as: “When matter changes, does its weight change? How much water can be found in different places on Earth? Can new substances be created by combining other substances? How does matter cycle through ecosystems? Where does the energy in food come from and what is it used for? How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?” Students are able to describe that matter is made of particles too small to be seen through the development of a model. Students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. Through the development of a model using an example, students are able to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. They describe and graph data to provide evidence about the

distribution of water on Earth. Students develop an understanding of the idea that plants get the materials they need for growth primarily from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals’ food was once energy from the sun. Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

The **Crosscutting Concepts** and Connections to Engineering, Technology, and Applications of Science, listed below, are the organizing concepts for these **Disciplinary Core Ideas**.

Crosscutting Concepts

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

Connections to Engineering, Technology, and Applications of Science

- Interdependence of science, engineering, and technology
- Influence of science, engineering, and technology on society and the natural world

In the fifth grade performance expectations, students are expected to demonstrate understanding of the **core ideas** and grade appropriate proficiency in using the **Science and Engineering Practices** below:

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



Matter and Its Interactions [5-PS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.</p> <p><i>Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.</i></p> <p><i>State Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.</i></p>	Crosscutting Concepts	Natural objects exist from the very small to the immensely large.
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects.
	Science & Engineering Practices	<p>Developing and using models in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> Develop a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>5.NBT.A.1 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.</p> <p>10. 5.NF.B.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.</p> <p>5.MD.C.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement.</p> <p>5.MD.C.4 Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft., and improvised units.</p>



Matter and Its Interactions [5-PS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.</p> <p><i>Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.</i></p> <p><i>State Assessment Boundary: Assessment does not include distinguishing mass and weight.</i></p>	Crosscutting Concepts	Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. <p>Chemical Reactions:</p> <ul style="list-style-type: none"> No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)
	Science & Engineering Practices	<p>Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.</p> <ul style="list-style-type: none"> Measure and graph quantities such as weight to address scientific and engineering questions and problems.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.</p> <p>W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.</p> <p>W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems.</p>



Matter and Its Interactions [5-PS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-PS1-3. Make observations and measurements to identify materials based on their properties.</p> <p><i>Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, luster, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.</i></p> <p><i>State Assessment Boundary: Assessment does not include density or distinguishing mass and weight.</i></p>	<p>Crosscutting Concepts</p>	<p>Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.</p>
	<p>Disciplinary Core Ideas</p>	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)
	<p>Science & Engineering Practices</p>	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.</p> <p>W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.</p> <p>W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p>



Matter and Its Interactions [5-PS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.</p> <p><i>Clarification Statement: Determination of the new substance is based on the properties of the resulting substance, which could include quantitative (e.g. weight) and qualitative properties (e.g. state of matter, color, texture, and odor).</i></p> <p><i>State Assessment Boundary: Assessment does not include identification of the new substance.</i></p>	Crosscutting Concepts	Cause and effect relationships are routinely identified, tested, and used to explain change.
	Disciplinary Core Ideas	Chemical Reactions: <ul style="list-style-type: none"> When two or more different substances are mixed, a new substance with different properties may be formed.
	Science & Engineering Practices	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. <ul style="list-style-type: none"> Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.</p> <p>W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.</p> <p>W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>		<p>N/A</p>



Motion and Stability: Forces and Interactions [5-PS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.</p> <p>Clarification Statement: “Down” is a local description of the direction that points toward the center of the spherical Earth.</p> <p>State Assessment Boundary: Assessment does not include mathematical representation of gravitational force.</p> <p>Engineering, Technology & Application of Science Connections 3-5-ETS1-1 (pg. 101) 3-5-ETS1-2 (pg. 102) 3-5-ETS1-3 (pg. 103)</p>	<p>Crosscutting Concepts</p>	<p>Cause and effect relationships are routinely identified, tested, and used to explain change.</p>
	<p>Disciplinary Core Ideas</p>	<p>Types of Interactions:</p> <ul style="list-style-type: none"> The gravitational force of Earth acting on an object near Earth’s surface pulls that object toward the planet’s center.
	<p>Science & Engineering Practices</p>	<p>Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> Support an argument with evidence, data, or a model.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
<p>RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.</p> <p>RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.</p> <p>W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.</p>		<p>N/A</p>

Energy [5-PS3-1]



Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.</p> <p><i>Clarification Statement: Examples of models could include diagrams, and flow charts.</i></p>	Crosscutting Concepts	Energy can be transferred in various ways and between objects.
	Disciplinary Core Ideas	<p>Energy in Chemical Processes and Everyday Life:</p> <ul style="list-style-type: none"> The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). <p>Organization of Matter and Energy Flow in Organisms:</p> <ul style="list-style-type: none"> Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.
	Science & Engineering Practices	<p>Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> Use models to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.</p> <p>SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.</p>		<p>N/A</p>



From Molecules to Organisms: Structure and Processes [5-LS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-LS1-1. Support an argument that plants get the materials they need for growth primarily from air and water.</p> <p><i>Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.</i></p>	Crosscutting Concepts	Matter is transported into, out of, and within systems.
	Disciplinary Core Ideas	Organization for Matter and Energy Flow in Organisms: <ul style="list-style-type: none"> Plants acquire their material for growth chiefly from air and water.
	Science & Engineering Practices	Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world. <ul style="list-style-type: none"> Support an argument with evidence, data, or a model.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.</p> <p>RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.</p> <p>W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>MP.5 Use appropriate tools strategically.</p> <p>5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.</p>



Ecosystems: Interactions, Energy, and Dynamics [5-LS2-1]

5th Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.</p> <p><i>Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.</i></p> <p><i>State Assessment Boundary: Assessment does not include molecular explanations.</i></p>	Crosscutting Concepts	A system can be described in terms of its components and their interactions.
	Disciplinary Core Ideas	<p>Interdependent Relationships in Ecosystems:</p> <ul style="list-style-type: none"> The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. <p>Cycles of Matter and Energy Transfer in Ecosystems:</p> <ul style="list-style-type: none"> Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment.
	Science & Engineering Practices	<p>Developing and using models in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> Develop a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.</p> <p>SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Earth's Place in the Universe [5-ESS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.</p> <p><i>State Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).</i></p>	Crosscutting Concepts	Natural objects exist from the very small to the immensely large.
	Disciplinary Core Ideas	<p>The Universe and Its Stars:</p> <ul style="list-style-type: none"> The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world.</p> <ul style="list-style-type: none"> Support an argument with evidence, data, or a model.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.</p> <p>RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.</p> <p>RI.5.8 Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).</p> <p>RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.</p> <p>W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>5.NBT.A.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.</p>



Earth's Place in the Universe [5-ESS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.</p> <p><i>Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.</i></p> <p><i>State Assessment Boundary: Assessment does not include causes of seasons.</i></p>	<p>Crosscutting Concepts</p>	<p>Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.</p>
	<p>Disciplinary Core Ideas</p>	<p>Earth and the Solar System:</p> <ul style="list-style-type: none"> The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.
	<p>Science & Engineering Practices</p>	<p>Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.</p>



Earth's Systems [5-ESS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.</p> <p><i>Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.</i></p> <p><i>State Assessment Boundary: Assessment is limited to the interactions of two systems at a time.</i></p> <p>Engineering, Technology & Application of Science Connections 3-5-ETS1-1 (pg. 101) 3-5-ETS1-2 (pg. 102) 3-5-ETS1-3 (pg. 103)</p>	Crosscutting Concepts	A system can be described in terms of its components and their interactions.
	Disciplinary Core Ideas	Earth Materials and System: <ul style="list-style-type: none"> Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.
	Science & Engineering Practices	Developing and using models in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. <ul style="list-style-type: none"> Develop a model using an example to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.</p> <p>SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.</p>



Earth's Systems [5-ESS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.</p> <p>State Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.</p>	Crosscutting Concepts	Standard units are used to measure and describe physical quantities such as weight and volume.
	Disciplinary Core Ideas	The Roles of Water in Earth's Surface Processes: <ul style="list-style-type: none"> Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
	Science & Engineering Practices	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. <ul style="list-style-type: none"> Describe and graph quantities such as area and volume to address scientific questions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.</p> <p>W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.</p> <p>SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Earth and Human Activity [5-ESS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to conserve Earth’s resources and environment.</p> <p>Engineering, Technology & Application of Science Connections</p> <p>3-5-ETS1-1 (pg. 101) 3-5-ETS1-2 (pg. 102) 3-5-ETS1-3 (pg. 103)</p>	Crosscutting Concepts	A system can be described in terms of its components and their interactions.
	Disciplinary Core Ideas	<p>Human Impacts on Earth Systems:</p> <ul style="list-style-type: none"> Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. However, individuals and communities are doing things to help protect Earth’s resources and environments.
	Science & Engineering Practices	<p>Obtaining, evaluating, and communicating information in 3– 5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.</p> <p>RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.</p> <p>RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.</p> <p>W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.</p> <p>W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>	<p>SS5.3.3 Identify and describe how science and technology have affected production and distribution locally, nationally, and globally (e.g., trains and natural resources).</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Engineering, Technology, & Applications of Science [3-5-ETS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</p> <p>Science Standards Connections 5-PS2-1 (pg. 92) 5-ESS2-1 (pg. 98) 5-ESS3-1 (pg. 100)</p>	Crosscutting Concepts	People’s needs and wants change over time, as do their demands for new and improved technologies.
	Disciplinary Core Ideas	<p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be prepared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
	Science & Engineering Practices	<p>Asking questions and Defining Problems in 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"> Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	<p>SS.5.4.2 Describe how tools and technology makes life easier; describe how one tool or technology evolves into another (e.g., telegraph to telephone to cell phone or horse-drawn wagon to railroad to car); identify a tool or technology that impacted history (e.g., ships allowed for discovery of new lands or boiling water prevented spread of disease).</p> <p>SS5.6.2 Distinguish between fiction and non-fiction.</p>	<p>CV5.5.1.4 Students complete tasks within an allotted time acquiring, storing, organizing, and using materials and space efficiently.</p>	N/A



Engineering, Technology, & Applications of Science [3-5-ETS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</p> <p>Science Standards Connections 5-PS2-1 (pg. 92) 5-ESS2-1 (pg. 98) 5-ESS3-1 (pg. 100)</p>	Crosscutting Concepts	<p>Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.</p>
	Disciplinary Core Ideas	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
	Science & Engineering Practices	<p>Constructing Explanations and Designing Solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	SS5.6.2 Distinguish between fiction and non-fiction.	CV5.5.1.4 Students complete tasks within an allotted time acquiring, storing, organizing, and using materials and space efficiently.	N/A



Engineering, Technology, & Applications of Science [3-5-ETS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p> <p>Science Standards Connections 5-PS2-1 (pg. 92) 5-ESS2-1 (pg. 98) 5-ESS3-1 (pg. 100)</p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. <p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
	Science & Engineering Practices	<p>Planning and Carrying Out Investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	SS5.6.2 Distinguish between fiction and non-fiction.	CV5.5.1.4 Students complete tasks within an allotted time acquiring, storing, organizing, and using materials and space efficiently.	N/A

Middle School



Students in middle school continue their learning from the K-5 grades to develop more complete understanding of the Framework **core ideas** in the four areas: Physical Sciences, Life Sciences, Earth and Space Sciences, and finally, Engineering, Technology, and Applications of Science.

The **Science and Engineering Practices** students will be expected to perform are :

1. ask relevant questions and define problems
2. develop and use models
3. plan and carry out investigations
4. analyze and interpret data
5. use mathematics and computational thinking
6. construct explanations and design solutions
7. engage in argument from evidence
8. obtain, evaluate, and communicate information

The **Crosscutting Concepts** that help students deepen their understanding of the **disciplinary core ideas** and develop a coherent and scientifically-based view of the world are:

1. patterns
2. cause and effect: mechanisms, and explanation
3. scale, proportion, and quality
4. systems and system models
5. energy and matter: flows, cycles, and conservation
6. structure and function
7. stability and change

Physical Sciences

The middle school performance expectations in the Physical Sciences build on K-5 experiences, ideas, and capabilities encouraging students to explain phenomena central to the physical sciences, but also to the life sciences and earth and space sciences. The performance expectations in the physical sciences blend the **core ideas** with **scientific and engineering practices** and **crosscutting concepts** to support students in developing useable knowledge with which they can explain real-world phenomena in all areas of science. Active learning at the middle school level focuses on

students developing their skills and knowledge of the Physical Science **core ideas**, as well as their abilities in the use of **scientific and engineering practices** and **crosscutting concepts** in order to meet performance expectations.

Middle School performance expectations for **Core Idea PS1: Matter and it's Interactions** are encompassed in **three** component ideas: **(A) Structure and Properties of Matter, (B) Chemical Reactions, and (C) Nuclear Processes.**

Students will be able to formulate an answer to questions such as: "How can particles too small to be seen combine to form the variety of matter one observes? How do particles produce a substance with different properties? How does thermal energy affect particles? What is the primary force that holds nuclei together and determines their nuclear binding energies?" By searching for answers, students will build understanding of what occurs at the atomic and molecular scale and learn that, despite the immense variation and number of substances, there are only about one hundred different stable elements. These elements, with their characteristic chemical properties, make up the Periodic Table, a systematic representation of known elements, organized horizontally by increasing atomic number and vertically by families of elements with related chemical properties.

By the end of Middle School, students will be able to apply an understanding that pure substances have characteristic properties and are made from a single type of atom or molecule. They will be able to provide molecular level accounts to explain states of matter and changes between states. They will apply their knowledge of the structure of atoms to explain electrical attractions and repulsions between charged particles (e.g., atomic nuclei and electrons) and to explain how atoms use their forces to form molecules (via chemical bonds), which range in size from two to thousands of atoms. They will be able to describe how gases and liquids are made of molecules or inert atoms that are moving about, while in a solid, atoms are closely spaced and vibrate in position, but do not change relative positions. Connections to Engineering, Technology, and Applications of Science, along with **Crosscutting Concepts 2, 3, 6** and **Scientific and Engineering Practices 2 and 8**, will be applied in students learning about **Core Idea PS1** and its three component ideas.

Middle School performance expectations for **Core Idea PS2:**



Middle School Physical Sciences (continued)

Motion and Stability: Forces and Interactions are encompassed in three component ideas: **(A) Forces and Motion, (B) Types of Interactions, and (C) Stability and Instability in Physical Systems.**

Students will be able to formulate answers to questions such as: “What happens when new materials are formed?” “What stays the same and what changes?” by building understanding of what occurs at the atomic and molecular scale during chemical reactions. By the end of middle school, students will be able to provide molecular level accounts to explain that chemical reactions involve regrouping of atoms to form new substances, and that atoms rearrange during chemical reactions. Students are also able to apply an understanding of the design and the process of optimization in engineering to chemical reaction systems. The **Crosscutting Concepts 1 and 5** are called out as guiding principles for these **disciplinary core ideas**. In these performance expectations, students will demonstrate proficiency in **Scientific and Engineering Practices 2, 4, and 6** to show their understanding of the **core ideas**. The students must also focus on understanding ideas related to why some objects will keep moving, why objects fall to the ground and why some materials are attracted to each other while others are not. Students answer the question, “How can one describe physical interactions between objects and within systems of objects?”

By the end of Middle School, students will be able to apply Newton’s Third Law of Motion to relate forces and explain the motion of objects. Students also apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while other repel. In particular, students will develop understanding that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Connections to Engineering, Technology and Applications of Science, along with **Crosscutting Concepts 2, 3, 6** and **Scientific and Engineering Practices 2 and 8**, will be applied in students learning

about the **Core Idea PS2** and its component ideas.

Middle School performance expectations for **Core Idea PS3: Energy** are encompassed in four component ideas: **(A) Definitions of Energy, (B) Conservation of Energy and Energy Transfer, (C) Relationships Between Energy and Forces, and (D) Energy in Chemical Processes and Everyday Life.**

Students will actively learn to formulate an answer to questions such as: “How can energy be transferred from one object or system to another?” Students will also develop their understanding of important qualitative ideas about energy including that the interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another, and that the total change of energy in any system is always equal to the total energy transferred into or out of the system.

By the end of Middle School, students will be able to describe how objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students will also be able to explain the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy. In addition, students will be able to apply an understanding of design to the process of energy transfer. **Crosscutting Concepts 3, 4 and 5** and **Scientific and Engineering Practices 2, 3, 4, 6 and 7**, will be applied in students learning about the **Core Idea in PS3** and its component ideas.

Middle School performance expectations for **Core Idea PS4: Waves and Their Applications in Technologies for Information** are encompassed in three component ideas: **(A) Wave Properties, (B) Electromagnetic Radiation, and (C) Information Technologies and Instrumentation.**

Students will actively learn to formulate an answer to the question, “What are the characteristic properties of waves and how can they be used?”

By the end of Middle School, students are able to describe and predict characteristic properties and behaviors of waves when the waves interact with matter. Students can apply an understanding of waves as a means to send digital information. **Crosscutting Concepts of 1 and 6** and **Scientific and Engineering Practices 2, 5 and 8** will be applied in students learning about the **Core Idea PS4** and its component ideas.



Matter and Its Interactions [MS-PS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.</p> <p><i>Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.</i></p> <p><i>State Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.</i></p>	<p>Crosscutting Concepts</p>	<p>Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.</p>
	<p>Disciplinary Core Ideas</p>	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
	<p>Science & Engineering Practices</p>	<p>Developing and using models in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop a model to predict and/or describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.</p>



Matter and Its Interactions [MS-PS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.</p> <p><i>Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.</i></p> <p><i>State Assessment boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.</i></p>	Crosscutting Concepts	Macroscopic patterns are related to the nature of microscopic and atomic-level structure.
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. <p>Chemical Reactions:</p> <ul style="list-style-type: none"> Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
	Science & Engineering Practices	<p>Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</p> <ul style="list-style-type: none"> Analyze and interpret data to determine similarities and differences in findings.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>8.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.</p> <p>8.SP.B.5 Summarize numerical data sets in relation to their context.</p>



Matter and Its Interactions [MS-PS1-3]

MS Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.</p> <p>Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels. Wyoming examples could include, but are not limited to, changing oil into plastic or fibers, trona into synthetic rubber, etc.</p> <p>State Assessment Boundary: Assessment is limited to qualitative information.</p> <p>Engineering, Technology & Application of Science Connections MS-ETS2-1 (pg. 170) MS-ETS2-2 (pg. 171)</p>	Crosscutting Concepts	Macroscopic patterns are related to the nature of microscopic and atomic-level structure.
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. <p>Chemical Reactions:</p> <ul style="list-style-type: none"> Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
	Science & Engineering Practices	<p>Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.</p> <ul style="list-style-type: none"> Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.4.2 Career-aware students demonstrate an ability to identify sources from which they locate, interpret, extract and summarize data in an ethical and appropriate manner.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media, including visually and quantitatively, as well as in words.</p>	<p>N/A</p>



Matter and Its Interactions [MS-PS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p> <p><i>Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.</i></p>	Crosscutting Concepts	<p>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p>
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. <p>Definitions of Energy: The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.</p> <ul style="list-style-type: none"> The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system’s total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop a model to predict and/or describe phenomena

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>WHST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>	<p>6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.</p>



Matter and Its Interactions [MS-PS1-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.</p> <p><i>Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.</i></p> <p><i>State Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.</i></p>	Crosscutting Concepts	<p>Matter is conserved because atoms are conserved in physical and chemical processes.</p>
	Disciplinary Core Ideas	<p>Chemical Reactions:</p> <ul style="list-style-type: none"> • Substances react chemically in characteristic ways. • In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. • The total number of each type of atom is conserved, and thus the mass does not change.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> • Develop a model to describe unobservable mechanisms.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
<p>WHST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.</p>



Matter and Its Interactions [MS-PS1-6]

MS Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.</p> <p>Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.</p> <p>State Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.</p> <p>Engineering, Technology & Application of Science Connections</p> <p>MS-ETS1-1 (pg. 166) MS-ETS1-2 (pg. 167) MS-ETS1-3 (pg. 168) MS-ETS1-4 (pg. 169)</p>	Crosscutting Concepts	<p>The transfer of energy can be tracked as energy flows through a designed or natural system.</p>
	Disciplinary Core Ideas	<p>Chemical Reactions:</p> <ul style="list-style-type: none"> Some chemical reactions release energy, others store energy. <p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. <p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.</p> <ul style="list-style-type: none"> Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<p>8.SP Investigate patterns of association in bivariate data.</p>



Motion and Stability: Forces and Interactions [MS-PS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS2-1. Apply Newton’s third law to design a solution to a problem involving the motion of two colliding objects.</p> <p>Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.</p> <p>State Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.</p> <p>Engineering, Technology & Application of Science Connections—MS-ETS1-1 (pg. 166); MS-ETS1-2 (pg. 167); MS-ETS1-3 (pg. 168); MS-ETS1-4 (pg. 169); MS-ETS2-2 (pg. 171)</p>	Crosscutting Concepts	Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.
	Disciplinary Core Ideas	<p>Forces and Motion:</p> <ul style="list-style-type: none"> For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s third law).
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Apply scientific ideas or principles to design an object, tool, process or system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Voc. Ed. Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media, including visually and quantitatively, as well as in words.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.</p> <p>6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers.</p> <p>7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Motion and Stability: Forces and Interactions [MS-PS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS2-2. Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.</p> <p><i>Clarification Statement: Emphasis is on balanced (Newton’s first law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton’s second law), frame of reference, and specification of units.</i></p> <p><i>State Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.</i></p>	Crosscutting Concepts	<p>Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.</p>
	Disciplinary Core Ideas	<p>Forces and Motion:</p> <ul style="list-style-type: none"> The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> Plan an investigation individually and collaboratively: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers.</p> <p>7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Motion and Stability: Forces and Interactions [MS-PS2-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p><i>Clarification Statement: Examples of devices that use electric and magnetic forces 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 the effect of increasing the number or strength of magnets on the speed of an electric motor.</i></p> <p><i>State Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.</i></p>	Crosscutting Concepts	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
	Disciplinary Core Ideas	<p>Types of Interactions:</p> <ul style="list-style-type: none"> Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
	Science & Engineering Practices	<p>Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.</p> <ul style="list-style-type: none"> Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media, including visually and quantitatively, as well as in words.</p>	<p>MP.2 Reason abstractly and quantitatively.</p>



Motion and Stability: Forces and Interactions [MS-PS2-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.</p> <p><i>Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.</i></p> <p><i>State Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.</i></p>	Crosscutting Concepts	<p>Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.</p>
	Disciplinary Core Ideas	<p>Types of Interactions:</p> <ul style="list-style-type: none"> Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have a large mass—e.g., Earth and the sun.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.</p> <ul style="list-style-type: none"> Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>WHST.6-8.1 Write arguments focused on discipline-specific content.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.2 Career-aware students demonstrate an ability to identify sources from which they locate, interpret, extract and summarize data in an ethical and appropriate manner.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p>	<p>MP.2 Reason abstractly and quantitatively.</p>



Motion and Stability: Forces and Interactions [MS-PS2-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.</p> <p><i>Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.</i></p> <p><i>State Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.</i></p>	Crosscutting Concepts	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
	Disciplinary Core Ideas	<p>Types of Interactions:</p> <ul style="list-style-type: none"> Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>		N/A

Energy [MS-PS3-1]



Performance Expectations (Benchmark)

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a whiffle ball versus a tennis ball.

Three Dimensions of Learning

Crosscutting Concepts

Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

Disciplinary Core Ideas

Definitions of Energy:

- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.

Science & Engineering Practices

Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Construct and interpret graphical displays of data to identify linear and nonlinear relationships.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Career & Vocational Ed. Connections

CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.

CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.

CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.

CV8.5.3 Career-aware students demonstrate technical knowledge and skills by safely, ethically and appropriately acquiring, storing, organizing and using materials, tools, and workspace.

Mathematics Connections

MP.2 Reason abstractly and quantitatively.

6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.

6.RP.A.2 Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.

7.RP.A.2 Recognize and represent proportional relationships between quantities.

8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.

8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

Energy [MS-PS3-2]



Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</p> <p>Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate’s hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.</p> <p>State Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.</p>	<p>Crosscutting Concepts</p>	<p>Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.</p>
	<p>Disciplinary Core Ideas</p>	<p>Definitions of Energy:</p> <ul style="list-style-type: none"> • A system of objects may also contain stored (potential) energy, depending on their relative positions. <p>Relationship Between Energy and Forces:</p> <ul style="list-style-type: none"> • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.
	<p>Science & Engineering Practices</p>	<p>Developing and using models in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> • Develop a model to predict and/or describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p>CV8.5.3 Career-aware students demonstrate technical knowledge and skills by safely, ethically and appropriately acquiring, storing, organizing and using materials, tools, and workspace.</p>	<p>N/A</p>

Energy [MS-PS3-3]



Performance Expectations	Three Dimensions of Learning	
<p>MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.</p> <p>Clarification Statement: Examples of devices could include an insulated box, a natural system (e.g., a compost bin), a solar cooker, and a Styrofoam cup.</p> <p>State Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.</p> <p>Engineering, Technology & Application of Science Connections—MS-ETS1-1 (pg. 166); MS-ETS1-2 (pg. 167); MS-ETS1-3 (pg. 168)</p>	Crosscutting Concepts	<p>The transfer of energy can be tracked as energy flows through a designed or natural system.</p>
	Disciplinary Core Ideas	<p>Definitions of Energy:</p> <ul style="list-style-type: none"> Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. <p>Conservation of Energy and Energy Transfer:</p> <ul style="list-style-type: none"> Energy is spontaneously transferred out of hotter regions or objects and into colder ones. <p>Defining and Delimiting an Engineering Problem:</p> <p>The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.</p> <p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.2 Career-aware students demonstrate an ability to identify sources from which they locate, interpret, extract and summarize data in an ethical and appropriate manner.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p>CV8.5.4 Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.</p> <p>6.G.G Understand congruence and similarity using physical models, transparencies, or geometry software.</p>

Energy [MS-PS3-4]



Performance Expectations (Benchmark)

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.

State Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.

Three Dimensions of Learning

Crosscutting Concepts

Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

Disciplinary Core Ideas

Definitions of Energy:

- Temperature is a measure of the average kinetic energy of particles of matter.
- The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.

Conservation of Energy and Energy Transfer:

- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

Science & Engineering Practices

Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>	<p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.2 Career-aware students demonstrate an ability to identify sources from which they locate, interpret, extract and summarize data in an ethical and appropriate manner.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p>CV8.5.4 Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.SP.B.5 Summarize numerical data sets in relation to their context.</p>

Energy [MS-PS3-5]



Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p> <p><i>Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.</i></p> <p><i>State Assessment Boundary: Assessment does not include calculations of energy.</i></p>	Crosscutting Concepts	Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
	Disciplinary Core Ideas	<p>Conservation of Energy and Energy Transfer:</p> <ul style="list-style-type: none"> When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds.</p> <ul style="list-style-type: none"> Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. <p>Scientific Knowledge is Based on Empirical Evidence.</p> <ul style="list-style-type: none"> Science knowledge is based upon logical and conceptual connections between evidence and explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.6-8.1 Write arguments focused on discipline-specific content.</p>	<p>CV.8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>7.RP.A.2 Recognize and represent proportional relationships between quantities.</p> <p>8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.</p>



Waves and their Applications in Technologies for Information Transfer [MS-PS4-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS4-1. Use mathematical representations to describe a simple model for waves, which includes how the amplitude of a wave is related to the energy in a wave.</p> <p>Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.</p> <p>State Assessment Boundary: Assessment is limited to standard repeating waves.</p>	Crosscutting Concepts	Graphs and charts can be used to identify patterns in data.
	Disciplinary Core Ideas	Waves Properties: <ul style="list-style-type: none"> A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
	Science & Engineering Practices	Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. <ul style="list-style-type: none"> Use mathematical representations to describe and/or support scientific conclusions and design solutions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Fine & Performing Arts Connections	Mathematics Connections
<p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>	<p>FPA8.4.M.2 Students describe ways in which other disciplines are interrelated with music.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>7.RP.A.2 Recognize and represent proportional relationships between quantities.</p> <p>8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.</p>



Waves and their Applications in Technologies for Information Transfer [MS-PS4-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <p>Clarification Statement: Emphasis is on both electromagnetic and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.</p> <p>State Assessment Boundary: Assessment is limited to qualitative applications pertaining to electromagnetic and mechanical waves.</p>	Crosscutting Concepts	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
	Disciplinary Core Ideas	<p>Waves Properties:</p> <ul style="list-style-type: none"> A sound wave needs a medium through which it is transmitted. <p>Electromagnetic Radiation:</p> <ul style="list-style-type: none"> When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>	<p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p>	<p>N/A</p>



Waves and their Applications in Technologies for Information Transfer [MS-PS4-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p> <p><i>Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen.</i></p> <p><i>State Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.</i></p>	Crosscutting Concepts	Structures can be designed to serve particular functions.
	Disciplinary Core Ideas	<p>Information Technologies and Instrumentation:</p> <ul style="list-style-type: none"> Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.
	Science & Engineering Practices	<p>Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.</p> <ul style="list-style-type: none"> Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p> <p>RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.3. Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p>CV8.5.4 Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	<p>MP.6 Attend to precision.</p>

Middle School



Students in middle school continue their learning from the K-5 grades to develop more complete understanding of the Framework **core ideas** in the four areas: Physical Sciences, Life Sciences, Earth and Space Sciences, and finally, Engineering, Technology, and Applications of Science.

The **Science and Engineering Practices** students will be expected to perform are :

1. ask relevant questions and define problems
2. develop and use models
3. plan and carry out investigations
4. analyze and interpret data
5. use mathematics and computational thinking
6. construct explanations and design solutions
7. engage in argument from evidence
8. obtain, evaluate, and communicate information

The **Crosscutting Concepts** that help students deepen their understanding of the **disciplinary core ideas** and develop a coherent and scientifically-based view of the world are:

1. patterns
2. cause and effect: mechanisms, and explanation
3. scale, proportion, and quality
4. systems and system models
5. energy and matter: flows, cycles, and conservation
6. structure and function
7. stability and change

Life Sciences

The middle school performance expectations in Life Sciences build on K-5 experiences and upon students' science understanding from earlier grades and from the **disciplinary core ideas**, **science and engineering practices**, and **crosscutting concepts** of other experiences with physical and earth sciences. The performance expectations in middle school blend the **core ideas** with **scientific and engineering practices** and **crosscutting concepts** to support students in developing useable knowledge across the science disciplines. While the performance expectations in middle school life science couple particular **practices** with specific **disciplinary core ideas**, instructional decisions should include use of many **science and engineering practices** integrated in the performance expectations.

Middle School performance expectations for **Core Idea LS1: From Molecules to Organisms: Structures and Processes** are encompassed in four component ideas: **(A) Structure and Function; (B) Growth and Development of Organisms; (C) Organization for Matter and Energy Flow in Organisms; and (D) Information Processing.**

Students will actively learn to formulate an answer to the question, "How can one explain the ways cells contribute to the function of living organisms."

By the end of Middle School, students can gather information and use this information to support explanations of the structure and function relationship of cells. They can communicate understanding of cell theory. They have a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. The understanding of cells provides a context for the plant process of photosynthesis and the movement of matter and energy needed for the cell. Students can construct an explanation for how environmental and genetic factors affect growth of organisms. They can connect this to the role of animal behaviors in reproduction of animals as well as the dependence of some plants on animal behaviors for their reproduction. **Crosscutting Concepts 2, 5, 6** will be applied in students learning about the **Core Idea LS1** and its component ideas.



Middle School Life Sciences (continued)

Middle School performance expectations for **Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics** are encapsulated in four component ideas: **(A) Interdependent Relationships in Ecosystems; (B) Cycles of Matter and Energy Transfer in Ecosystems; (C) Ecosystem Dynamics, Functioning, and Resilience; and (D) Social Interactions and Group Behavior.**

Students will formulate answers to the question, “How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem?”

By the end of Middle School, students can analyze and interpret data, develop models, and construct arguments and demonstrate a deeper understanding of resources and the cycling of matter and the flow of energy in ecosystems. They can also study patterns of the interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on population. They evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Middle School performance expectations for **Core Idea LS3: Heredity: Inheritance and Variation of Traits** are encompassed in two component ideas: **(A) Inheritance of Traits, and (B) Variation of Traits.**

Students will learn to formulate an answer to the question, “How do living organisms pass traits from one generation to the next?”

By the end of Middle School, students can use models to describe ways gene mutations and sexual reproduction contribute to genetic variation. **Crosscutting Concepts 2 and 6** provide students with a deeper understanding of how gene structure determines differences in the functioning of organisms.

Middle School performance expectations for **Core Idea LS4: Biological Evolution: Unity and Diversity** are encompassed in four component ideas: **(A) Evidence of Common Ancestry and Diversity, (B) Natural Selection, (C) Adaptation, and (D) Biodiversity and Humans.**

Students will learn to formulate an answer to the question, “How do organisms change over time in response to changes in the environment?”

By the end of Middle School, students can construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They can use ideas of genetic variation in a population to make sense of organisms surviving and reproducing, hence passing on the traits of the species. They are able to use fossil records and anatomical similarities of the relationships among organisms and species to support their understanding. **Crosscutting Concepts 1 and 6** contribute to the evidence students can use to show proficiency in describing biological evolution.

Note: MS-LS4-3 was removed, and the rationale can be found on page 143.



From Molecules to Organisms: Structure and Processes [MS-LS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.</p> <p>Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.</p>	Crosscutting Concepts	Phenomena that can be observed at one scale may not be observable at another scale.
	Disciplinary Core Ideas	Structure and Function: <ul style="list-style-type: none"> All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).
	Science & Engineering Practices	Planning and carrying out investigations in 6-8 builds on K- 5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. <ul style="list-style-type: none"> Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p>		<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.</p>



From Molecules to Organisms: Structure and Processes [MS-LS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS1-2. Develop and use models to describe the parts, functions, and basic processes of cells.</p> <p><i>Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. Basic processes of a cell should include, but are not limited to, cell growth and reproduction.</i></p> <p><i>State Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells, cell parts, or specific stages of the cell cycle.</i></p>	<p>Crosscutting Concepts</p>	<p>Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/ systems can be analyzed to determine how they function.</p>
	<p>Disciplinary Core Ideas</p>	<p>Structure and Function:</p> <ul style="list-style-type: none"> • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.
	<p>Science & Engineering Practices</p>	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> • Develop and use a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>		<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.</p>



From Molecules to Organisms: Structure and Processes [MS-LS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p> <p><i>Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.</i></p> <p><i>State Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.</i></p>	<p>Crosscutting Concepts</p>	<p>Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.</p>
	<p>Disciplinary Core Ideas</p>	<p>Structure and Function:</p> <ul style="list-style-type: none"> In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.
	<p>Science & Engineering Practices</p>	<p>Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.</p> <p>WHST.6-8.1 Write arguments focused on discipline content.</p>		<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.</p>



From Molecules to Organisms: Structure and Processes [MS-LS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.</p> <p><i>Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.</i></p>	Crosscutting Concepts	Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
	Disciplinary Core Ideas	<p>Growth and Development of Organisms:</p> <ul style="list-style-type: none"> Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.</p> <p>WHST.6-8.1 Write arguments focused on discipline content.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.5.4 Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p>	<p>6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution, which can be described by its center, spread, and overall shape.</p> <p>6.SP.B.4 Summarize numerical data sets in relation to their context.</p>



From Molecules to Organisms: Structure and Processes [MS-LS1-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.</p> <p><i>Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.</i></p> <p><i>State Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.</i></p>	Crosscutting Concepts	Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
	Disciplinary Core Ideas	<p>Growth and Development of Organisms:</p> <ul style="list-style-type: none"> Genetic factors as well as local conditions affect the growth of the adult plant.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.</p> <ul style="list-style-type: none"> Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p>	<p>6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.</p> <p>6.SP.B.4 Summarize numerical data sets in relation to their context.</p>



From Molecules to Organisms: Structure and Processes [MS-LS1-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.</p> <p><i>Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.</i></p> <p><i>State Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.</i></p>	Crosscutting Concepts	<p>Within a natural system, the transfer of energy drives the motion and/or cycling of matter.</p>
	Disciplinary Core Ideas	<p>Organization for Matter and Energy Flow in Organisms:</p> <ul style="list-style-type: none"> Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. <p>Energy in Chemical Processes and Everyday Life:</p> <p>The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur.</p> <ul style="list-style-type: none"> In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.</p> <ul style="list-style-type: none"> Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>		<p>6.EE.C.9 Use variables to represent two quantities in real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.</p>



From Molecules to Organisms: Structure and Processes [MS-LS1-7]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS1-7. Develop a model to describe how food molecules (sugar) are rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.</p> <p><i>Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.</i></p> <p><i>State Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.</i></p>	Crosscutting Concepts	<p>Matter is conserved because atoms are conserved in physical and chemical processes.</p>
	Disciplinary Core Ideas	<p>Organization for Matter and Energy Flow in Organisms:</p> <ul style="list-style-type: none"> • Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. <p>Energy in Chemical Processes and Everyday Life:</p> <ul style="list-style-type: none"> • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> • Develop a model to describe unobservable mechanisms.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
<p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>		N/A



From Molecules to Organisms: Structure and Processes [MS-LS1-8]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p> <p><i>State Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.</i></p>	<p>Crosscutting Concepts</p>	<p>Cause and effect relationships may be used to predict phenomena in natural systems.</p>
	<p>Disciplinary Core Ideas</p>	<p>Information Processing:</p> <ul style="list-style-type: none"> Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.
	<p>Science & Engineering Practices</p>	<p>Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.</p> <ul style="list-style-type: none"> Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.
Wyoming Cross-Curricular Connections		
<p>ELA / Literacy Connections</p>		<p>Mathematics Connections</p>
<p>WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.</p>		<p>N/A</p>



Ecosystems: Interactions, Energy, and Dynamics [MS-LS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.</p> <p><i>Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources. Emphasis should include, but is not limited to, Wyoming ecosystems and examples, such as native trout populations, deer and antelope populations, wolf populations, bitterroot, sagebrush, Indian Paintbrush, macroinvertebrates, etc.</i></p> 	<p>Crosscutting Concepts</p>	<p>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p>
	<p>Disciplinary Core Ideas</p>	<p>Interdependent Relationships in Ecosystems:</p> <ul style="list-style-type: none"> 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.
	<p>Science & Engineering Practices</p>	<p>Analyzing and interpreting data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</p> <ul style="list-style-type: none"> Analyze and interpret data to provide evidence for phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.7 Integrate quantitative technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.2 Career-aware students demonstrate an ability to identify sources from which they locate, interpret, extract and summarize data in an ethical and appropriate manner.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p>	<p>MP.4 Model with mathematics.</p>



Ecosystems: Interactions, Energy, and Dynamics [MS-LS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.</p> <p><i>Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems.</i></p> <p><i>Examples of types of interactions could include competitive, predatory, and mutually beneficial.</i></p>	Crosscutting Concepts	Patterns can be used to identify cause and effect relationships.
	Disciplinary Core Ideas	Interdependent Relationships in Ecosystems: <ul style="list-style-type: none"> Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.
	Science & Engineering Practices	Constructing explanations (for science) and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. <ul style="list-style-type: none"> Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p> <p>WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.</p> <p>SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.</p>	<p>SS8.5.1 Use and create models of the Earth to analyze the interactions of physical and human systems to demonstrate global interconnectedness.</p>	<p>6.SP.B.5 Summarize numerical data sets in relation to their context.</p>



Ecosystems: Interactions, Energy, and Dynamics [MS-LS2-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.</p> <p>Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.</p> <p>State Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.</p>	Crosscutting Concepts	<p>The transfer of energy can be tracked as energy flows through a natural system.</p>
	Disciplinary Core Ideas	<p>Cycle of Matter and Energy Transfer in Ecosystems:</p> <ul style="list-style-type: none"> • Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. • Transfers of matter into and out of the physical environment occur at every level. • Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. • The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> • Develop a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>	<p>SS8.5.1 Use and create models of the Earth to analyze the interactions of physical and human systems to demonstrate global interconnectedness.</p>	<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.</p>



Ecosystems: Interactions, Energy, and Dynamics [MS-LS2-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.</p> <p>Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems. Wyoming examples could include, but are not limited to, mountain pine beetles, excess precipitation, drought and fires, invasive species, Wyoming species, habitat change, etc.</p> 	Crosscutting Concepts	Small changes in one part a system might cause large changes in another part.
	Disciplinary Core Ideas	<p>Ecosystem Dynamics, Functioning, and Resilience:</p> <ul style="list-style-type: none"> Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.
	Science & Engineering Practices	<p>Engaging in argument from evidence in argument from evidence in 6–8 builds on K– 5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RI.8.8 Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.</p> <p>WHST.6-8.1 Write arguments to support claims with clear reasons and relevant evidence.</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>		<p>MP.7 Look for and make use of structures.</p>



Ecosystems: Interactions, Energy, and Dynamics [MS-LS2-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.</p> <p>Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and societal considerations.</p> <p>Engineering, Technology & Application of Science Connections MS-ETS1-2 (pg. 167) MS-ETS1-3 (pg. 168) MS-ETS1-4 (pg. 169) MS-ETS2-2 (pg. 171)</p>	Crosscutting Concepts	Small changes in one part of a system might cause large changes in another part.
	Disciplinary Core Ideas	<p>Ecosystem Dynamics, Functioning, and Resilience:</p> <ul style="list-style-type: none"> Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health. <p>Biodiversity and Humans:</p> <ul style="list-style-type: none"> Changes in biodiversity can influence humans’ resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. <p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 6–8 builds on K– 5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Social Studies Connections	Mathematics Connections
<p>RST.6-8.8 Distinguish among facts, reasoned judgement based on research findings, and speculation in a text.</p> <p>WHST.6-8.9 Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.5.2 Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p>SS8.3.3 Describe the impact of technological advancements on production, distribution, and consumption. (e.g., businesses and/or corporations in the United States and the world).</p> <p>SS8.3.5 Describe how values and beliefs influence individual, family, and business decisions (microeconomics).</p>	<p>MP.4 Model with mathematics.</p> <p>6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.</p>



Heredity: Inheritance and Variation of Traits [MS-LS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.</p> <p><i>Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.</i></p> <p><i>State Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.</i></p>	Crosscutting Concepts	<p>Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.</p>
	Disciplinary Core Ideas	<p>Inheritance of Traits:</p> <ul style="list-style-type: none"> Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. <p>Variation of Traits:</p> <ul style="list-style-type: none"> In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p> <p>SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>		<p>MP.2 Reason abstractly and quantitatively.</p>



Heredity: Inheritance and Variation of Traits [MS-LS3-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.</p> <p><i>Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.</i></p> <p><i>State Assessment Boundary: Assessment is limited to monohybrid crossing.</i></p>	Crosscutting Concepts	<p>Cause and effect relationships may be used to predict phenomena in natural systems.</p>
	Disciplinary Core Ideas	<p>Growth and Development of Organisms:</p> <ul style="list-style-type: none"> Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. <p>Inheritance of Traits:</p> <ul style="list-style-type: none"> Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. <p>Variation of Traits:</p> <ul style="list-style-type: none"> In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p> <p>SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>	<p>CV8.3.3 Describe the impact of technological advancements on production, distribution, and consumption. (e.g., businesses and/or corporations in the United States and the world).</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p>	<p>MP.4 Model with mathematics.</p> <p>6.SP.B.5 Summarize numerical data sets in relation to their context.</p>



Biological Evolution: Unity and Diversity [MS-LS4-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS4-1. 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.</p> <p><i>Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.</i></p> <p><i>State Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.</i></p>	Crosscutting Concepts	<p>Graphs, charts, and images can be used to identify patterns in data.</p>
	Disciplinary Core Ideas	<p>Evidence of Common Ancestry and Diversity:</p> <ul style="list-style-type: none"> The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.
	Science & Engineering Practices	<p>Analyzing and interpreting data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</p> <ul style="list-style-type: none"> Analyze and interpret data to determine similarities and differences in findings.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>		<p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p>



Biological Evolution: Unity and Diversity [MS-LS4-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.</p> <p><i>Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.</i></p>	Crosscutting Concepts	Patterns can be used to identify cause and effect relationships.
	Disciplinary Core Ideas	<p>Evidence of Common Ancestry and Diversity:</p> <ul style="list-style-type: none"> The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Apply scientific ideas to construct an explanation for real- world phenomena, examples, or events.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others’ ideas and expressing their own clearly.</p> <p>SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.</p>	<p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p>



Biological Evolution: Unity and Diversity

Rationale for Removal of MS-LS4-3:

- The Recapitulation Theory (Biogenetic Principle) is no longer scientifically valid.
http://evolution.berkeley.edu/evolibrary/article/history_15
- The standard was written in a way that overlapped with curricular decisions.
- Developmental appropriateness for younger middle-school students is questionable.
- Removal does not affect the learning progressions.



Biological Evolution: Unity and Diversity [MS-LS4-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population affects individuals' probability of surviving and reproducing in a specific environment.</p> <p><i>Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.</i></p>	Crosscutting Concepts	Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
	Disciplinary Core Ideas	<p>Natural Selection:</p> <ul style="list-style-type: none"> Natural selection leads to the predominance of certain traits in a population and the suppression of others.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Voc. Ed. Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions</p> <p>RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p>	<p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6.SP.B..5 Summarize numerical data sets in relation to their context.</p> <p>7.RP.A.2 Recognize and represent proportional relationships between quantities.</p>



Biological Evolution: Unity and Diversity [MS-LS4-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.</p> <p><i>Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the positive and negative impacts these technologies have on society as well as the technologies leading to these scientific discoveries.</i></p>	<p>Crosscutting Concepts</p>	<p>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</p>
	<p>Disciplinary Core Ideas</p>	<p>Natural Selection:</p> <ul style="list-style-type: none"> In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring.
<p>Engineering, Technology & Application of Science Connections MS-ETS2-1 (pg. 170) MS-ETS2-2 (pg. 171)</p>	<p>Science & Engineering Practices</p>	<p>Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.</p> <ul style="list-style-type: none"> Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p>	<p>N/A</p>



Biological Evolution: Unity and Diversity [MS-LS4-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.</p> <p><i>Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.</i></p> <p><i>State Assessment Boundary: Assessment does not include Hardy Weinberg calculations.</i></p>	Crosscutting Concepts	Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
	Disciplinary Core Ideas	<p>Adaptation:</p> <ul style="list-style-type: none"> Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not, become less common. Thus, the distribution of traits in a population changes.
	Science & Engineering Practices	<p>Using mathematics and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.</p> <ul style="list-style-type: none"> Use mathematical representations to support scientific conclusions and design solutions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		<p>MP.4 Model with mathematics.</p> <p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6.SP.B.5 Summarize numerical data sets in relation to their context.</p> <p>7.RP.A.2 Recognize and represent proportional relationships between quantities.</p>

Middle School



Students in middle school continue their learning from the K-5 grades to develop more complete understanding of the Framework **core ideas** in the four areas: Physical Sciences, Life Sciences, Earth and Space Sciences, and finally, Engineering, Technology, and Applications of Science.

The **Science and Engineering Practices** students will be expected to perform are :

1. ask relevant questions and define problems
2. develop and use models
3. plan and carry out investigations
4. analyze and interpret data
5. use mathematics and computational thinking
6. construct explanations and design solutions
7. engage in argument from evidence
8. obtain, evaluate, and communicate information

The **Crosscutting Concepts** that help students deepen their understanding of the **disciplinary core ideas** and develop a coherent and scientifically-based view of the world are:

1. patterns
2. cause and effect: mechanisms, and explanation
3. scale, proportion, and quality
4. systems and system models
5. energy and matter: flows, cycles, and conservation
6. structure and function
7. stability and change

Earth and Space Sciences

The middle school performance expectations in Life Sciences build on K – 5 experiences and upon students’ science understanding from earlier grades and from the **disciplinary core ideas**, **science and engineering practices**, and **crosscutting concepts** of other experiences with physical and earth sciences. Performance expectations in Earth and Space Science build on the elementary school ideas and skills and allow middle school students to explain more in-depth phenomena central not only to the earth and space sciences, but to life and physical sciences as well. These performance expectations blend the **core ideas** with **scientific and engineering practices** and **crosscutting concepts** to support students in developing useable knowledge to explain ideas across the science disciplines. While the performance expectations shown in middle school earth and space science couple particular practices with specific **disciplinary core ideas**, instructional decisions should include use of many **practices** that lead to the performance expectations.

Middle School performance expectations for **Core Idea ESS1: Earth’s Place in the Universe** are encompassed in three component ideas: **(A) the universe and its stars, (B) Earth and the solar system, and (C) The history of planet Earth.**

Students will formulate an answer to questions such as: “What is Earth’s place in the Universe”, “What makes up our solar system and how can the motion of Earth explain seasons and eclipses”, and “How do people figure out that the Earth and life on Earth have changed through time?” Students examine the Earth’s place in relation to the solar system, Milky Way galaxy, and universe. There is a strong emphasis on a systems approach, using models of the solar system to explain astronomical and other observations of the cyclic patterns of eclipses, tides, and seasons. There is also a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain the data that support the theories that explain the formation and evolution of the universe.



Middle School Earth and Space Sciences (continued)

By the end of Middle School, students can examine geoscience data in order to understand the processes and events in Earth's history. Students are expected to demonstrate proficiency in [developing and using models](#), [analyzing data](#), and [constructing explanations and designing solutions](#); and to use these [practices](#) to demonstrate understanding of the [core ideas](#). [Crosscutting Concepts 3 and 4](#) are used by students to define systems and construct models while demonstrating proficiency in recognizing what are relevant measures of size, time, and energy, and how changes in these measures affect a system's structure and performance. Students are also expected to demonstrate proficiency in [Scientific and Engineering Practices 1, 2, 4, and 7](#).

Middle School performance expectations for **Core Idea ESS2: Earth's Systems**, are encompassed in five component ideas: **(A) Earth materials and systems**, **(B) Plate Tectonics and Large-Scale System Interactions**, **(C) The Roles of Water in Earth's Surface Processes**, **(D) Weather and Climate**, and **(E) Biogeology**.

Students will formulate an answer to questions such as: "How do the materials in and on Earth's crust change over time?", "How does the movement of tectonic plates impact the surface of Earth?", "How does water influence weather, circulate in the oceans, and shape Earth's surface?", "What factors interact and influence weather?", and "How have living organisms changed the Earth and how have Earth's changing conditions impacted living organisms?"

By the end of Middle School, students will understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students will investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Of special importance in

both topics are the ways that geoscience processes provide resources needed by society but also cause natural hazards that present risks to society; both involve technological challenges, for the identification and development of resources. Students develop understanding of the factors that control weather. A systems approach is also important here, examining the feedbacks between systems as energy from the sun is transferred between systems and circulates through the ocean and atmosphere. [Crosscutting Concepts 1, 2, 3, 4, 5 and 7](#) are put to use and students are expected to demonstrate proficiency in [Scientific and Engineering Practices 2, 3, 4 and 6](#) to demonstrate understanding of the [core ideas](#).

Middle School performance expectations for **Core Idea ESS3: Earth and Human Activity** are encompassed in four component ideas: **(A) Natural Resources**, **(B) Natural Hazards**, **(C) Human Impact on Earth systems**, and **(D) Global Climate Change**.

Students will formulate answers to questions such as: "How is the availability of needed natural resources related to naturally occurring processes?", "How can natural hazards be predicted?", "How do human activities affect Earth systems?", and "How do we know our global climate is changing?"

By the end of Middle School, students will understand the ways that human activities impacts Earth's other systems. Students use many different [practices](#) to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of their development. [Crosscutting Concepts 1, 2, and 7](#) are put to use and students are expected to demonstrate proficiency in [Scientific and Engineering Practices 1, 2, 4, 6, and 7](#) to demonstrate understanding of the [core ideas](#).



Earth's Place in the Universe [MS-ESS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.</p> <p><i>Clarifying Statement: Examples of models can be physical, graphical, or conceptual.</i></p>	Crosscutting Concepts	Patterns can be used to identify cause-and-effect relationships.
	Disciplinary Core Ideas	<p>The Universe and Its Stars:</p> <ul style="list-style-type: none"> Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. <p>Earth and the Solar System:</p> <ul style="list-style-type: none"> The model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>		<p>MP.4 Model with mathematics.</p> <p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>7.RP.A.2 Recognize and represent relationships between quantities.</p>



Earth's Place in the Universe [MS-ESS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.</p> <p><i>Clarifying Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).</i></p> <p><i>State Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.</i></p>	Crosscutting Concepts	Models can be used to represent systems and their interactions.
	Disciplinary Core Ideas	<p>The Universe and Its Stars:</p> <ul style="list-style-type: none"> Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. <p>Earth and the Solar System:</p> <ul style="list-style-type: none"> The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>	<p>MP.4 Model with mathematics.</p> <p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or depending on the purpose at hand, any number in a specific set.</p> <p>7.RP.A.2 Recognize and represent relationships between quantities.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities</p>



Earth's Place in the Universe [MS-ESS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.</p> <p><i>Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.</i></p> <p><i>State Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.</i></p> <p>Engineering, Technology & Application of Science Connections MS-ETS2-1 (pg. 170)</p>	Crosscutting Concepts	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
	Disciplinary Core Ideas	<p>Earth and the Solar System:</p> <ul style="list-style-type: none"> The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.
	Science & Engineering Practices	<p>Analyzing and interpreting data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</p> <ul style="list-style-type: none"> Analyze and interpret data to determine similarities and differences in findings.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>7.RP.A.2 Recognize and represent proportional relationships between quantities.</p>



Earth's Place in the Universe [MS-ESS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS1-4. Construct a scientific explanation based on evidence from rocks and rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.</p> <p><i>Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.</i></p> <p><i>State Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.</i></p>	Crosscutting Concepts	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
	Disciplinary Core Ideas	<p>The History of Planet Earth:</p> <ul style="list-style-type: none"> The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 6– 8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p>		<p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Earth's Systems [MS-ESS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.</p> <p>Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.</p> <p>State Assessment Boundary: Assessment does not include the identification and naming of minerals.</p>	<p>Crosscutting Concepts</p>	<p>Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.</p>
	<p>Disciplinary Core Ideas</p>	<p>Earth's Materials and Systems:</p> <ul style="list-style-type: none"> All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.
	<p>Science & Engineering Practices</p>	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena.

Wyoming Cross-Curricular Connections		
ELA / Literacy Connections	Fine & Performing Arts Connections	Mathematics Connections
<p>SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>	<p>FPA8.4.A.1 Students describe ways in which the principles and subject matter of other disciplines taught in the school are interrelated with the visual arts.</p>	<p>MP.2 Reason abstractly and quantitatively.</p>



Earth's Systems [MS-ESS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.</p> <p><i>Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.</i></p>	Crosscutting Concepts	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
	Disciplinary Core Ideas	<p>Earth's Materials and Systems:</p> <ul style="list-style-type: none"> The planet's systems interact over scales that range from microscopic to global in size. These interactions have shaped Earth's history and will determine its future. <p>The Roles of Water in Earth's Surface Processes:</p> <ul style="list-style-type: none"> Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 6– 8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p> <p>SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>	<p>SS.8.5.4 Analyze the changes to and consequences of human, natural, and technological impacts on the physical environment.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Earth's Systems [MS-ESS2-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.</p> <p><i>Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).</i></p> <p><i>State Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.</i></p>	<p>Crosscutting Concepts</p>	<p>Patterns in rates of change and other numerical relationships can provide information about natural systems.</p>
	<p>Disciplinary Core Ideas</p>	<p>The History of Planet Earth: Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.</p> <p>Plate Tectonics and Large Scale System Interactions:</p> <ul style="list-style-type: none"> • Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.
	<p>Science & Engineering Practices</p>	<p>Analyzing and interpreting data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</p> <ul style="list-style-type: none"> • Analyze and interpret data to provide evidence for phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p> <p>RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Earth's Systems [MS-ESS2-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.</p> <p>Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.</p> <p>State Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.</p>	Crosscutting Concepts	<p>Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.</p>
	Disciplinary Core Ideas	<p>The Roles of Water in Earth's Surface Processes:</p> <ul style="list-style-type: none"> Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. Global movements of water and its changes in form are propelled by sunlight and gravity.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop a model to describe unobservable mechanisms.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
N/A		MP.2 Reason abstractly and quantitatively.



Earth's Systems [MS-ESS2-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p> <p>Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).</p> <p>State Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.</p>	Crosscutting Concepts	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
	Disciplinary Core Ideas	Weather and Climate: <ul style="list-style-type: none"> Because these patterns are so complex, weather can only be predicted probabilistically.
	Science & Engineering Practices	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. <ul style="list-style-type: none"> Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p> <p>WHST.6-8.8 Gather relevant information from multiple and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.2 Career-aware students demonstrate an ability to identify sources from which they locate, interpret, extract and summarize data in an ethical and appropriate manner.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p>CV8.5.4 Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.</p>



Earth's Systems [MS-ESS2-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.</p> <p><i>Clarifying Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.</i></p> <p><i>State Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.</i></p>	Crosscutting Concepts	<p>Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy, matter, and information flows within systems.</p>
	Disciplinary Core Ideas	<p>The Roles of Water in Earth's Surface Processes:</p> <ul style="list-style-type: none"> Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. <p>Weather and Climate:</p> <ul style="list-style-type: none"> Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.
	Science & Engineering Practices	<p>Developing and using models in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>		<p>MP.4 Model with mathematics.</p>



Earth and Human Activity [MS-ESS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth’s mineral, energy, and groundwater resources are the result of past and current geoscience processes.</p> <p>Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).</p>	Crosscutting Concepts	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
	Disciplinary Core Ideas	<p>Natural Resources:</p> <ul style="list-style-type: none"> • Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. • Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. • These resources are distributed unevenly around the planet as a result of past geologic processes.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 6– 8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Earth and Human Activity [MS-ESS3-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p> <p><i>Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).</i></p>	Crosscutting Concepts	Graphs, charts, and images can be used to identify patterns in data.
	Disciplinary Core Ideas	Natural Hazards: <ul style="list-style-type: none"> Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.
	Science & Engineering Practices	Analyzing and interpreting data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. <ul style="list-style-type: none"> Analyze and interpret data to provide evidence for phenomena.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.2 Career-aware students demonstrate an ability to identify sources from which they locate, interpret, extract and summarize data in an ethical and appropriate manner.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p>CV8.4.4 Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p>CV8.5.2 Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Earth and Human Activity [MS-ESS3-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS3-3. Apply scientific principles to design a method for monitoring, evaluating, and managing a human impact on the environment.</p> <p>Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could manage that impact. Examples of human impacts can include conservation techniques, water usage (such as municipal withdrawals, industrial applications, and irrigation), land usage (such as urban development, recreation, agriculture, or reclamation), and pollution.</p> <p>Engineering, Technology & Application of Science Connections MS-ETS1-1 (pg. 166) MS-ETS1-4 (pg. 169) MS-ETS1-2 (pg. 167) MS-ETS2-2 (pg. 171) MS-ETS1-3 (pg. 168)</p>	Crosscutting Concepts	Relationships can be classified as casual or correlational, and correlation does not necessarily imply causation.
	Disciplinary Core Ideas	<p>Human Impacts on Earth Systems:</p> <ul style="list-style-type: none"> Human activities have altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts for different living things. Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Apply scientific principles to design an object, tool, process or system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.</p> <p>WHST.6-8.8 Gather relevant information from multiple and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.5.1 Career-aware students identify technical and digital systems, how the are properly and ethically used and their relationship to other systems globally.</p> <p>CV8.5.2 Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio between two quantities.</p> <p>7.RP.A.2 Recognize and represent proportional relationships between quantities.</p> <p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Earth and Human Activity [MS-ESS3-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS3-4. Construct an argument supported by evidence for how changes in human population and per-capita consumption of natural resources impact Earth's systems.</p> <p><i>Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of changing human populations and the consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.</i></p>	Crosscutting Concepts	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
	Disciplinary Core Ideas	Human Impacts on Earth Systems: <ul style="list-style-type: none"> Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
	Science & Engineering Practices	Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). <ul style="list-style-type: none"> Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or solution to a problem.

Wyoming Cross-Curricular Connections

ELA / Literacy	Social Studies Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>WHST.6-8.1 Write arguments focused on discipline content.</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>SS8.3.1 Identify and apply basic economic concepts (e.g., supply, demand, production, exchange and consumption, labor, wages, scarcity, prices, incentives, competition, and profits).</p> <p>SS8.3.2 Compare and contrast how people organize for the production, distribution, and consumption of goods and services in various economic systems (e.g., characteristics of market, command, and mixed economies).</p> <p>SS8.3.3 Describe the impact of technological advancements on production, distribution, and consumption. (e.g., businesses and/or corporations in the United States and the world).</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision-making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.5.1 Career-aware students identify technical and digital systems, how they are properly and ethically used and their relationship to other systems globally.</p> <p>CV8.5.2 Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio between two quantities.</p> <p>7.RP.A.2 Recognize and represent proportional relationships between quantities.</p> <p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>



Earth and Human Activity [MS-ESS3-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused changes in global temperatures over time.</p> <p><i>Clarification Statement: Examples of factors include natural processes and human activities. Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases, and the frequency and rates of natural processes and human activities.</i></p> <p>Engineering, Technology & Application of Science Connections MS-ETS1-2 (pg. 167)</p>	Crosscutting Concepts	Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
	Disciplinary Core Ideas	<p>Global Climate Change:</p> <ul style="list-style-type: none"> Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.
	Science & Engineering Practices	<p>Asking Questions and Defining Problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.</p> <ul style="list-style-type: none"> Ask questions to identify and clarify evidence of an argument.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p>	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.5.1 Career-aware students identify technical and digital systems, how they are properly and ethically used and their relationship to other systems globally.</p> <p>CV8.5.2 Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p>

Middle School



Students in middle school continue their learning from the K-5 grades to develop more complete understanding of the Framework **core ideas** in the four areas: Physical Sciences, Life Sciences, Earth and Space Sciences, and finally, Engineering, Technology, and Applications of Science.

Engineering, Technology, and Applications of Science

By the time students reach middle school they should have had numerous experiences in engineering design. The goal for middle school students is to define problems more precisely, to conduct a more thorough process of choosing the best solution, and to optimize the final design.

Middle School performance expectations for **Core Idea ETS1: Engineering, Technology, and Applications of Science** are encompassed in three component ideas: **(A) Defining and Delimiting an Engineering Problem, (B) Developing Possible Solutions, and (C) Optimizing the Design Solution.**

Students will actively learn that defining and delimiting an engineering problem involves thinking more deeply about the needs a problem is intended to address or goals a design is intended to reach. Developing possible solutions does not explicitly address generating design ideas since students were expected to develop the capability in elementary school. The focus in middle school is on a two stage process of evaluating the different ideas that have been proposed: by using a systematic method, such as a tradeoff matrix, to determine which solutions are most promising, and by testing different solutions, and then combining the best ideas into new solution that may be better than any of the preliminary ideas. Improving designs at the middle school level involves an iterative process in which students test the best design, analyze the results, modify the design accordingly, and then re-test and modify the design again. Students may go through this cycle two, three, or

more times in order to reach the optimal (best possible) result.

By the end of Middle School, students are expected to achieve all four ETS1 performance expectations (MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, and MS-ETS1-4) related to a single problem in order to understand the interrelated processes of engineering design. In addition, students will be able to demonstrate their engineering design skills and use of all eight **Scientific and Engineering Practices**. **Crosscutting Concepts 4, 6 and 7** are used by students in demonstrating their skills and knowledge in Engineering Design.

Middle School performance expectations for **Core Idea ETS2: Links Among Engineering, Technology, Science, and Society** are encompassed in two component ideas: **(A) Interdependence of Science, Engineering and Technology, and (B) Influence of Engineering, Technology, and Science on Society and the Natural World.**

Students will describe how connections with other science disciplines help them develop skills in engineering. For example, in the life sciences students apply their engineering design capabilities to evaluate plans for maintaining biodiversity and ecosystem services (MS-LS2-5). In the physical sciences students define and solve problems involving a number of **core ideas** in physical science, including: chemical processes that release or absorb energy (MS-PS1-6), Newton's third law of motion (MS-PS2-1), and energy transfer (MS-PS3-3). In the Earth and space sciences students apply their engineering design capabilities to problems related the impacts of humans on Earth systems (MS-ESS3-3).

By the end of Middle School, students will be able to describe the connections between and the interdependencies of Science, Engineering and Technology. They will also be able to describe how Engineering, Science and Technology can influence and impact both society and the natural world in both the short and long term. Finally, the students will be able to explain the importance of ethics and integrity in science and engineering.

All **Crosscutting Concepts** and **Scientific and Engineering Practices** will be used by students in demonstrating their understanding of the links among Engineers, Scientists, Technologists and Society.



Engineering, Technology, and Applications of Science [MS-ETS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.</p> <p><i>Clarification Statement: Example problems could include citing and designing a retirement home, a hospice building, or a new Junior High School within the city.</i></p> <p><u>Science Standards Connections</u></p> <p>MS-PS1-6 (pg. 111) MS-PS2-1 (pg. 112) MS-PS3-3 (pg. 119) MS-ESS3-3 (pg. 162)</p>	<p>Crosscutting Concepts</p>	<ul style="list-style-type: none"> All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.
	<p>Disciplinary Core Ideas</p>	<p>Defining and Delimiting Engineering Problems: The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.</p>
	<p>Science & Engineering Practices</p>	<p>Asking questions and defining problems in grades 6-8 builds from grades K-5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.</p> <ul style="list-style-type: none"> Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	<p>CV8.3.1 Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.</p> <p>CV8.5.4 Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	N/A



Engineering, Technology, and Applications of Science [MS-ETS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p><i>Clarification Statement: Preliminary building designs could involve overall dimensions, number of rooms, entries & exits, orientation to permit solar energy collection. Criteria and constraints could include these design elements or those of another project.</i></p> <p><u>Science Standards Connections</u> MS-PS1-6 (pg. 111) MS-PS2-1 (pg. 112) MS-PS3-3 (pg. 119) MS-LS2-5 (pg. 139) MS-ESS3-3 (pg. 162) MS-ESS3-5 (pg. 164)</p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Developing Possible Solutions</p> <ul style="list-style-type: none"> There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
	Science & Engineering Practices	<p>Engaging in Argument from Evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.</p> <ul style="list-style-type: none"> Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	<p>CV8.5.2 Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	N/A



Engineering, Technology, and Applications of Science [MS-ETS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.</p> <p><i>Clarification Statement: Tests could include building capacity, heating efficiency, use of hazardous materials, meeting ADA requirements, or earthquake survival.</i></p> <p><u>Science Standards Connections</u> MS-PS1-6 (pg. 111) MS-PS2-1 (pg. 112) MS-PS3-3 (pg. 119) MS-LS2-5 (pg. 139) MS-ESS3-3 (pg. 162)</p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> • There are systematic processes for evaluating solutions with respect to how well they met the criteria and constraints of a problem. • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.
	Science & Engineering Practices	<p>Analyzing and Interpreting data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</p> <ul style="list-style-type: none"> • Analyze and interpret data to determine similarities and differences in findings.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	<p>CV8.3.3 Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.</p> <p>CV8.4.3 Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p>	N/A



Engineering, Technology, and Applications of Science [MS-ETS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ETS1-4. Develop a model for a proposed object, tool or process and then use an iterative process to test the model, collect data, and generate modification ideas trending toward an optimal design.</p> <p><i>Clarification Statement: The object, tool or process could include a bicycle, a bridge, a smart furnace, or an auto airbag system. Test data could be collected from tests of a model object, or from test data for a similar object, tools, or process found on the internet.</i></p> <p><u>Science Standards Connections</u> MS-PS1-6 (pg. 111) MS-PS2-1 (pg. 112) MS-LS2-5 (pg. 139) MS-ESS3-3 (pg. 162)</p>	Crosscutting Concepts	<i>Intentionally Left Blank</i>
	Disciplinary Core Ideas	<p>Developing Possible Solutions:</p> <ul style="list-style-type: none"> A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions. <p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.
	Science & Engineering Practices	<p>Developing and Using Models in data in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"> Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
N/A	SS8.4.2 Describe how tools and technology in different historical periods impacted the way people lived, made decisions, and saw the world.	N/A



Engineering, Technology, Science and Society [MS-ETS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ETS2-1. Ask questions about a common household appliance, collect data to reverse-engineer the appliance and learn how it's design has evolved, describe how scientific discoveries, technological advances, and engineering design played significant roles in its development, and explore how science, engineering and technology might be used together or individually in producing improved versions of the appliance.</p> <p><i>Clarification Statement: Examples of household appliances could include radios, heaters, food processors, refrigerators, and washing machines.</i></p> <p><u>Science Standards Connections</u> MS-PS1-3 (pg. 108) MS-LS4-5 (pg. 146) MS-ESS1-3 (pg. 152)</p>	Crosscutting Concepts	Define the system—specifying its boundaries and make an explicit model of that system.
	Disciplinary Core Ideas	Interdependence of Science, Engineering, and Technology <ul style="list-style-type: none"> Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineering systems.
	Science & Engineering Practices	Planning and carrying out investigations to answer questions or test solutions to problems in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. <ul style="list-style-type: none"> Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		N/A



Engineering, Technology, Science and Society [MS-ETS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>MS-ETS2-2. Develop a model defining and prioritizing the impacts of human activity on a particular aspect of the environment, identifying positive and negative consequences of the activity, both short and long-term, and investigate and explain how the ethics and integrity of scientists and engineers and respect for individual property rights might constrain future development.</p> <p><i>Clarification Statement: The model could be mathematical, tabular, or graphic. Examples of impacted activities could include agriculture, medicine, energy production and water resources. Constraints on human impacts could include balancing costs, benefits, and risks to society.</i></p> <p><u>Science Standards Connections</u> MS-PS1-3 (pg. 108) MS-PS2-1 (pg. 112) MS-LS2-5 (pg. 139) MS-LS4-5 (pg. 146) MS-ESS3-3 (pg. 162)</p>	Crosscutting Concepts	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
	Disciplinary Core Ideas	<p>Influence of Engineering, Technology, and Science on Society and the Natural World:</p> <ul style="list-style-type: none"> The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region over time.
	Science & Engineering Practices	<p>Developing and using models:</p> <ul style="list-style-type: none"> Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test and predict more abstract phenomena and design systems.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections	Mathematics Connections	
N/A	N/A	

High School



Students in high school continue their learning from the middle school grades to develop more complete understanding of these four areas: Physical Science, Life Science, Earth and Space Science, and Engineering, Technology, and Applications of Science.

These standards and benchmarks include the most fundamental concepts of science, but are intended to leave room for expanded study in upper-level high school courses. The high school performance expectations allow high school students to explain more in-depth phenomena across the science disciplines, **science and engineering practices** and **crosscutting concepts**.

The **Science and Engineering Practices** students will be expected to perform are :

1. ask relevant questions and define problems
2. develop and use models
3. plan and carry out investigations
4. analyze and interpret data
5. use mathematics and computational thinking
6. construct explanations and design solutions
7. engage in argument from evidence
8. obtain, evaluate, and communicate information

The **Crosscutting Concepts** that help students deepen their understanding of the **disciplinary core ideas** and develop a coherent and scientifically-based view of the world are:

1. patterns
2. cause and effect: mechanisms, and explanation
3. scale, proportion, and quality
4. systems and system models
5. energy and matter: flows, cycles, and conservation
6. structure and function
7. stability and change

Physical Sciences

Students in high school continue to develop their understanding of the four core ideas in the physical sciences. These ideas include the most fundamental concepts from chemistry and physics, but are intended to leave room for expanded study in upper-level high school courses. The high school performance expectations in Physical Science build on the middle school ideas and skills, and allow high school students to explain more in-depth phenomena central not only to the physical sciences, but across the science disciplines and engineering practices as well. The four physical science **disciplinary core ideas** in high school are: 1) *Matter and its Interactions*, 2) *Motion and Stability: Forces and Interactions*, 3) *Energy*, and 4) *Waves and Their Applications in Technologies for Information Transfer*. The PS performance expectations blend these **core ideas** with **scientific and engineering practices** and **crosscutting concepts** to support students in developing useable knowledge to explain ideas across the science disciplines.

The performance expectations in **PS1: Matter and its Interactions** help students formulate an answer to the question, “How can one explain the structure, properties, and interactions of matter?” The PS1 **Disciplinary Core Idea** is broken down into three component ideas: **The Structure and Properties of Matter**, **Chemical Reactions**, and **Nuclear Processes**. Students are expected to develop understanding of the substructure of atoms and to provide more mechanistic explanations of the properties of substances. Chemical reactions, including rates of reactions and energy changes, can be understood by students at this level in terms of the collisions of molecules and the rearrangements of atoms. Students are able to use the periodic table as a tool to explain and predict the properties of elements. Using this expanded knowledge of chemical reactions, students are able to explain important biological and geophysical phenomena. Phenomena involving nuclei are also important to understand, as they explain the formation and abundance of the elements, radioactivity, the release of energy from the sun and other stars, and the generation of nuclear power. Students are also able to apply an understanding of the process of optimization in engineering design to chemical reaction systems.



High School Physical Sciences (continued)

The Performance Expectations associated with **PS2: Motion and Stability: Forces and Interactions** support students' understanding of ideas related to why some objects will keep moving, why objects fall to the ground, and why some materials are attracted to each other while others are not. Students should be able to answer the question, "How can one explain and predict interactions between objects and within systems of objects?" The **Disciplinary Core Idea** for PS2 is broken down into the components of **Forces and Motion** and **Types of Interactions**. The performance expectations in PS2 focus on students building an understanding of forces and interactions and Newton's Second Law. Students also develop an understanding that the total momentum of a system of objects is conserved when there is no net force on the system. Students are able to use Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

The Performance Expectations associated with **PS3: Energy** help students formulate an answer to the question, "How is energy transferred and conserved?" The **Core Idea** expressed in PS3 is broken down into four component ideas: **Definitions of Energy, Conservation of Energy and Energy Transfer, the Relationship between Energy and Forces**, and **Energy in Chemical Process and Everyday Life**. Energy is understood as quantitative property of a system that depends on the motion and interactions of matter and radiation within that system, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students develop an understanding that energy at both the macroscopic and the atomic scale can be accounted for as either motions of particles or energy associated with the configuration (relative positions) of particles. In some cases, the energy associated with the configuration of particles can be thought of as stored in fields. Students also

demonstrate their understanding of engineering principles when they design, build, and refine devices associated with the conversion of energy.

The Performance Expectations associated with **PS4: Waves and Their Applications in Technologies for Information Transfer** are critical to understand how many new technologies work. As such, this core idea helps students answer the question, "How are waves used to transfer energy and send and store information?" The **Disciplinary Core Idea** in PS4 is broken down into **Wave Properties, Electromagnetic Radiation**, and **Information Technologies and Instrumentation**. Students are able to apply understanding of how wave properties and the interactions of electromagnetic radiation with matter can transfer information across long distances, store information, and investigate nature on many scales. Models of electromagnetic radiation as either a wave of changing electric and magnetic fields or as particles are developed and used. Students understand that combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information. Students also demonstrate their understanding of engineering ideas by presenting information about how technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Note: HS-PS4-4 was removed and incorporated into a new standard. See HS-ETS1-5 (pg. 250) [Evaluate the validity and reliability of claims in a variety of materials.]



Matter and Its Interactions [HS-PS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</p> <p>Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.</p> <p>State Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.</p>	Crosscutting Concepts	<p>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations or phenomena.</p>
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Use a model to predict the relationships between systems or between components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.9-10.7 Translate quantitative or technical information in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Matter and Its Interactions [HS-PS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS1-2. Construct an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties, and revise, as needed.</p> <p>Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.</p> <p>State Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.</p>	Crosscutting Concepts	<p>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations or phenomena.</p>
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. <p>Chemical Reactions:</p> <ul style="list-style-type: none"> The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.</p>	<p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Matter and Its Interactions [HS-PS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the macroscopic scale to infer the strength of electrical forces between particles.</p> <p><i>Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of macroscopic properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.</i></p> <p><i>State Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.</i></p>	Crosscutting Concepts	Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> The structure and interactions of matter at the macroscopic scale are determined by electrical forces within and between atoms.
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.</p> <ul style="list-style-type: none"> Plan and conduct an investigation individually or collaboratively to produce data to serve as the basis for evidence. In the design: decide on types, amounts, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time).

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11.12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively, assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Matter and Its Interactions [HS-PS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</p> <p>Clarification Statement: Emphasis is on the idea that a chemical reaction, as a system, affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.</p> <p>State Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.</p>	Crosscutting Concepts	Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
	Disciplinary Core Ideas	<p>Structure and Properties of Matter:</p> <ul style="list-style-type: none"> A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. <p>Chemical Reactions:</p> <ul style="list-style-type: none"> Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>	<p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Matter and Its Interactions [HS-PS1-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS1-5. Apply scientific principles and use evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p> <p>Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.</p> <p>State Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.</p>	Crosscutting Concepts	<p>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations or phenomena.</p>
	Disciplinary Core Ideas	<p>Chemical Reactions:</p> <ul style="list-style-type: none"> Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
<p>RST.11.12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Matter and Its Interactions [HS-PS1-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS1-6. Evaluate the design of a chemical system by changing conditions to produce increased amounts of products at equilibrium, and refine the design, as needed.</p> <p>Clarification Statement: Emphasis is on the application of Le Chatelier’s Principle by evaluating and refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.</p> <p>State Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.</p>	Crosscutting Concepts	Much of science deals with constructing explanations of how things change and how they remain stable.
	Disciplinary Core Ideas	<p>Chemical Reactions:</p> <ul style="list-style-type: none"> In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. <p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain over others (tradeoffs) may be needed.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student- generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Refine a solution to a complex real-world problem, based on scientific knowledge, student- generated sources of evidence, prioritized criteria, and tradeoff considerations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Matter and Its Interactions [HS-PS1-7]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</p> <p><i>Clarification Statement: Emphasis is on using mathematical ideas beyond memorization and rote application of problem solving techniques to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale.</i></p> <p><i>State Assessment Boundary: Assessment does not include complex chemical reactions.</i></p>	Crosscutting Concepts	The total amount of energy and matter in closed systems is conserved.
	Disciplinary Core Ideas	<p>Chemical Reactions:</p> <ul style="list-style-type: none"> The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use mathematical representations of phenomena to support claims.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Matter and Its Interactions [HS-PS1-8]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.</p> <p><i>Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.</i></p> <p><i>State Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.</i></p>	Crosscutting Concepts	<p>In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.</p>
	Disciplinary Core Ideas	<p>Nuclear Processes:</p> <ul style="list-style-type: none"> Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		<p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting</p>



Motion and Stability: Forces and Interactions [HS-PS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.</p> <p>Clarification Statement: Examples of data could come from lab experiments or include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.</p> <p>State Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.</p>	Crosscutting Concepts	<p>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p>
	Disciplinary Core Ideas	<p>Forces and Motion:</p> <ul style="list-style-type: none"> Newton’s second law accurately predicts changes in the motion of macroscopic objects.
	Science & Engineering Practices	<p>Analyzing and interpreting data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.</p> <ul style="list-style-type: none"> Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.</p> <p>HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p>HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems.</p> <p>HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p> <p>HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases.</p> <p>HSS-ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p>



Motion and Stability: Forces and Interactions [HS-PS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.</p> <p>Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.</p> <p>State Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.</p>	Crosscutting Concepts	<p>When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.</p>
	Disciplinary Core Ideas	<p>Forces and Motion:</p> <ul style="list-style-type: none"> Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use mathematical representations of phenomena to describe explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
N/A	<p>MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p>



Motion and Stability: Forces and Interactions [HS-PS2-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.</p> <p>Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.</p> <p>State Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.</p> <p>Engineering, Technology & Application of Science Connections HS-ETS1-2 (pg. 247) HS-ETS1-3 (pg. 248) HS-ETS1-4 (pg. 249)</p>	Crosscutting Concepts	Systems can be designed to cause a desired effect.
	Disciplinary Core Ideas	<p>Forces and Motion: If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.</p> <p>Defining and Delimiting Engineering Problems:</p> <ul style="list-style-type: none"> Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p>		<p>MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.</p>



Motion and Stability: Forces and Interactions [HS-PS2-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS2-4. Use mathematical representations to predict the gravitational and/or electrostatic forces between objects using Newton’s Law of Gravitation and/or Coulomb’s Law, respectively.</p> <p>Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and/or electric fields.</p> <p>State Assessment Boundary: Assessment is limited to systems with two objects.</p>	Crosscutting Concepts	<p>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</p>
	Disciplinary Core Ideas	<p>Types of Interactions:</p> <ul style="list-style-type: none"> • Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. • Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> • Use mathematical representations of phenomena to describe explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
N/A	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.</p> <p>HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p>



Motion and Stability: Forces and Interactions [HS-PS2-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.</p> <p>State Assessment Boundary: Assessment is limited to designing and conducting investigations with common materials and tools.</p>	Crosscutting Concepts	Systems can be designed to cause a desired effect.
	Disciplinary Core Ideas	<p>Types of Interactions:</p> <ul style="list-style-type: none"> Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.</p> <ul style="list-style-type: none"> Plan and conduct an investigation individually or collaboratively to produce data to serve as the basis for evidence. In the design process decide on types, amounts, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time).

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Motion and Stability: Forces and Interactions [HS-PS2-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of materials.</p> <p><i>Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include: why electrically conductive materials are often made of metal; flexible but durable materials are made up of long chained molecules; and pharmaceuticals are designed to interact with specific receptors.</i></p> <p>Engineering, Technology & Application of Science Connections HS-ETS1-1 (pg. 246) HS-ETS1-4 (pg. 249) HS-ETS1-5 (pg. 250)</p>	<p>Crosscutting Concepts</p>	<p>Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</p>
	<p>Disciplinary Core Ideas</p>	<p>Types of Interactions:</p> <ul style="list-style-type: none"> Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.
	<p>Science & Engineering Practices</p>	<p>Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.</p> <ul style="list-style-type: none"> Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p>		<p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>

Energy [HS-PS3-1]



Performance Expectations (Benchmark)

HS-PS3-1. Create or apply a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.

State Assessment Boundary: Assessment is limited to basic algebraic expressions or computations, to systems of two or three components, and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.

Engineering, Technology & Application of Science Connections
HS-ETS1-4 (pg. 249)

Three Dimensions of Learning

Crosscutting Concepts

Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

Disciplinary Core Ideas

Definitions of Energy:

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.

Conservation of Energy and Energy Transfer:

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.
- The availability of energy limits what can occur in any system.

Science & Engineering Practices

Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Mathematics Connections

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Energy [HS-PS3-2]



Performance Expectations (Benchmark)

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.

Three Dimensions of Learning

Crosscutting Concepts

Energy cannot be created nor destroyed it only moves between one place and another place, between objects and/or fields, or between systems.

Disciplinary Core Ideas

Definitions of Energy:

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Science & Engineering Practices

Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Mathematics Connections

MP.2 Reason abstractly and quantitatively.
MP.4 Model with mathematics.

Energy [HS-PS3-3]



Performance Expectations (Benchmark)

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of a variety of energy forms and efficiency.

State Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with common materials.

Engineering, Technology & Application of Science Connections
HS-ETS1-2 (pg. 247)
HS-ETS1-4 (pg. 249)

Three Dimensions of Learning

Crosscutting Concepts

Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Disciplinary Core Ideas

Definitions of Energy:

- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.

Defining and Delimiting Engineering Problems:

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

Interdependence of Science, Engineering, and Technology:

- Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Science & Engineering Practices

Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Social Studies Connections

SS12.3.3 Analyze and evaluate the impact of current and emerging technologies at the micro and macroeconomic levels (e.g., jobs, education, trade, and infrastructure) and their impact on global economic interdependence.

Mathematics Connections

MP.2 Reason abstractly and quantitatively.
MP.4 Model with mathematics.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Energy [HS-PS3-4]



Performance Expectations (Benchmark)

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system.

Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.

State Assessment Boundary: Assessment is limited to investigations based on common materials and tools.

Three Dimensions of Learning

Crosscutting Concepts

When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Disciplinary Core Ideas

Conservation of Energy and Energy Transfer:

- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill; objects hotter than their surrounding environment cool down).

Science & Engineering Practices

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.

- Plan and conduct an investigation individually or collaboratively to produce data to serve as the basis for evidence. In the design: decide on types, amounts, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time).

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Social Studies Connections

SS12.3.3 Analyze and evaluate the impact of current and emerging technologies at the micro and macroeconomic levels (e.g., jobs, education, trade, and infrastructure) and their impact on global economic interdependence.

Mathematics Connections

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

Energy [HS-PS3-5]



Performance Expectations (Benchmark)

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.

State Assessment Boundary: Assessment is limited to systems containing two objects.

Three Dimensions of Learning

Crosscutting Concepts

Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Disciplinary Core Ideas

Relationship Between Energy and Forces:

- When two objects interacting through a field change relative position, the energy stored in the field is changed.

Science & Engineering Practices

Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Mathematics Connections

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.



Waves and Their Applications in Technologies for Information Transfer [HS-PS4-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.</p> <p>Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum or glass, sound waves traveling through air or water, and seismic waves traveling through the Earth.</p> <p>State Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.</p> <p>Engineering, Technology & Application of Science Connections HS-ETS1-2 (pg. 247) HS-ETS1-4 (pg. 249) HS-ETS1-5 (pg. 250)</p>	Crosscutting Concepts	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
	Disciplinary Core Ideas	<p>Wave Properties:</p> <ul style="list-style-type: none"> The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p>		<p>MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. HSA-CED.A.4 Rearrange formulas to highlight a quantity in interest, using the same reasoning as in solving equations.</p>



Waves and Their Applications in Technologies for Information Transfer [HS-PS4-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS4-2. Evaluate the advantages and disadvantages of using digital transmission and storage of information.</p> <p><i>Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.</i></p> <p>Engineering, Technology & Application of Science Connections HS-ETS1-1 (pg. 246) HS-ETS1-3 (pg. 248) HS-ETS1-5 (pg. 250)</p>	Crosscutting Concepts	Systems can be designed for greater or lesser stability.
	Disciplinary Core Ideas	<p>Wave Properties:</p> <ul style="list-style-type: none"> Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. <p>Interdependence of Science, Engineering, and Technology:</p> <ul style="list-style-type: none"> Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
	Science & Engineering Practices	<p>Asking questions (for science) and defining problems (for engineering) in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.</p> <ul style="list-style-type: none"> Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.</p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusion in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p>	<p>SS12.3.2 Analyze and evaluate how people organize for the production, distribution, and consumption of goods and services in various economic systems (e.g., capitalism, communism, and socialism).</p> <p>SS12.3.3 Analyze and evaluate the impact of current and emerging technologies at the micro and macroeconomic levels (e.g., jobs, education, trade, and infrastructure) and their impact on global economic interdependence.</p> <p>SS12.6.1 Analyze, evaluate, and/or synthesize multiple sources of information in diverse formats and media in order to address a question or solve a problem.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p>



Waves and Their Applications in Technologies for Information Transfer [HS-PS4-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS4-3. Evaluate evidence behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.</p> <p>Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.</p> <p>State Assessment Boundary: Assessment does not include using quantum theory.</p>	Crosscutting Concepts	<p>Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.</p>
	Disciplinary Core Ideas	<p>Wave Properties:</p> <ul style="list-style-type: none"> Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up. <p>Electromagnetic Radiation:</p> <ul style="list-style-type: none"> Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.</p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusion in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.</p> <p>HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p>HSA-CED.A.4 Rearrange formulas to highlight a quantity in interest, using the same reasoning as in solving equations.</p>



Waves and Their Applications in Technologies for Information Transfer [HS-PS4-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</p> <p><i>Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.</i></p> <p><i>State Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.</i></p> <p>Engineering, Technology & Application of Science Connections HS-ETS1-1 (pg. 246) HS-ETS1-3 (pg. 248)</p>	Crosscutting Concepts	<p>Systems can be designed to cause a desired effect.</p>
	Disciplinary Core Ideas	<p>Energy in Chemical Processes:</p> <ul style="list-style-type: none"> Solar cells are human-made devices that likewise capture the sun’s energy and produce electrical energy. <p>Wave Properties:</p> <ul style="list-style-type: none"> Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. <p>Electromagnetic Radiation:</p> <ul style="list-style-type: none"> Photoelectric materials emit electrons when they absorb light of a high- enough frequency. <p>Information Technologies and Instrumentation:</p> <ul style="list-style-type: none"> Multiple technologies based on the understanding of waves and their interactions with matter are part of every day experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. <p>Interdependence of Science, Engineering, and Technology:</p> <ul style="list-style-type: none"> Modern civilization depends on major technological systems.
	Science & Engineering Practices	<p>Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.</p> <ul style="list-style-type: none"> Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p>	<p>SS12.6.2 Assess the extent to which the reasoning and evidence in a text supports the author's claims.</p>	<p>MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p>

High School



Students in high school continue their learning from the middle school grades to develop more complete understanding of these four areas: Physical Science, Life Science, Earth and Space Science, and Engineering, Technology, and Applications of Science.

These standards and benchmarks include the most fundamental concepts of science, but are intended to leave room for expanded study in upper-level high school courses. The high school performance expectations allow high school students to explain more in-depth phenomena across the science disciplines, **science and engineering practices**, and **crosscutting concepts**.

The **Science and Engineering Practices** students will be expected to perform are :

1. ask relevant questions and define problems
2. develop and use models
3. plan and carry out investigations
4. analyze and interpret data
5. use mathematics and computational thinking
6. construct explanations and design solutions
7. engage in argument from evidence
8. obtain, evaluate, and communicate information

The **Crosscutting Concepts** that help students deepen their understanding of the **disciplinary core ideas** and develop a coherent and scientifically-based view of the world are:

1. patterns
2. cause and effect: mechanisms, and explanation
3. scale, proportion, and quality
4. systems and system models
5. energy and matter: flows, cycles, and conservation
6. structure and function
7. stability and change

Life Sciences

Students in high school develop an understanding of key concepts that will help them make sense of life science. The ideas are built upon students' science understanding of **disciplinary core ideas**, **science and engineering practices**, and **crosscutting concepts** from earlier grades. There are four life science **Disciplinary Core Ideas** in high school: 1) *From Molecules to Organisms: Structures and Processes*, 2) *Ecosystems: Interactions, Energy, and Dynamics*, 3) *Heredity: Inheritance and Variation of Traits*, and 4) *Biological Evolution: Unity and Diversity*. The performance expectations for high school life science blend **core ideas** with **scientific and engineering practices** and **crosscutting concepts** to support students in developing useable knowledge that can be applied across the science disciplines. While the performance expectations in high school life science couple particular practices with specific **disciplinary core ideas**, instructional decisions should include use of many practices underlying the performance expectations.

The performance expectations in **LS1: From Molecules to Organisms: Structures and Processes** help students formulate an answer to the question, "How do organisms live and grow?" The LS1 **Disciplinary Core Idea** is presented as three components: **Structure and Function**, **Growth and Development of Organisms**, and **Organization for Matter and Energy Flow in Organisms**. In these performance expectations, students demonstrate that they can use investigations and gather evidence to support explanations of cell function and reproduction. They understand the role of proteins as essential to the work of the cell and living systems. Students can use models to explain photosynthesis, respiration, and the cycling of matter and flow of energy in living organisms. The cellular processes can be used as a model for understanding of the hierarchical organization of organism.

The performance expectations in **LS2: Ecosystems: Interactions, Energy, and Dynamics** help students formulate an answer to the question, "How and why do organisms interact with their environment, and what are the effects of these interactions?" The LS2 **Disciplinary Core Idea** includes four components: **Interdependent Relationships in Ecosystems**, **Cycles of Matter and Energy Transfer in Ecosystems**, **Ecosystem Dynamics, Functioning and Resilience**, and **Social**



High School Life Sciences (continued)

Interactions and Group Behavior. High school students can use mathematical reasoning to demonstrate understanding of fundamental concepts of carrying capacity, factors affecting biodiversity and populations, and the cycling of matter and flow of energy among organisms in an ecosystem. These mathematical models provide support of students' conceptual understanding of systems and their ability to develop design solutions for reducing the impact of human activities on the environment and maintaining biodiversity.

The performance expectations in **LS3: Heredity: Inheritance and Variation of Traits** help students formulate answers to the questions: "How are characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics?" The LS3 **Disciplinary Core Idea** includes two components: **Inheritance of Traits** and **Variation of Traits**. Students are able to ask questions, make and defend a claim, and use concepts of probability to explain the genetic variation in a population. Students demonstrate understanding of why individuals of the same species vary in how they look, function, and behave. Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expression.

The performance expectations in **LS4: Biological Evolution: Unity and Diversity** help students formulate an answer to the question, "What evidence shows that different species are related?" The LS4 **Disciplinary Core Idea** involves four components: **Evidence of Common Ancestry and Diversity**, **Natural Selection**, **Adaptation**, and **Biodiversity and Humans**. Students can construct explanations for the processes of natural selection and evolution and communicate how multiple lines of evidence support these explanations. Students can evaluate evidence of the conditions that may result in new

species and understand the role of genetic variation in natural selection. Additionally, students can apply concepts of probability to explain trends in populations as those trends relate to advantageous heritable traits in a specific environment.

The **crosscutting concepts** of **cause and effect** and **systems and system models** play an important role in students' understanding of the evolution of life on Earth.



From Molecules to Organisms: Structure and Processes [HS-LS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p> <p><i>Clarification Statement: Explanations emphasize basic DNA replication, transcription, and translation.</i></p> <p><i>State Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.</i></p>	Crosscutting Concepts	<p>Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</p>
	Disciplinary Core Ideas	<p>Structure and Function:</p> <ul style="list-style-type: none"> Systems of specialized cells within organisms help them perform the essential functions of life. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
	Science & Engineering Practices	<p>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



From Molecules to Organisms: Structure and Processes [HS-LS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multi-cellular organisms.</p> <p><i>Clarification Statement:</i> Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.</p> <p><i>State Assessment Boundary:</i> Assessment does not include interactions and functions at the molecular or chemical reaction level.</p>	<p>Crosscutting Concepts</p>	<p>Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.</p>
	<p>Disciplinary Core Ideas</p>	<p>Structure and Function:</p> <ul style="list-style-type: none"> Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
	<p>Science & Engineering Practices</p>	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
Wyoming Cross-Curricular Connections		
<p>ELA / Literacy Connections</p>		<p>Mathematics Connections</p>
<p>SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>		<p>MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.</p>



From Molecules to Organisms: Structure and Processes [HS-LS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</p> <p><i>Clarification Statement: Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.</i></p> <p><i>State Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.</i></p>	Crosscutting Concepts	Feedback (negative and positive) can stabilize or destabilize a system.
	Disciplinary Core Ideas	<p>Structure and Function:</p> <ul style="list-style-type: none"> Feedback mechanisms maintain a living system’s internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Outside that range (e.g., at a too high or too low external temperature, with too little food or water available) the organism cannot survive.
	Science & Engineering Practices	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.</p> <ul style="list-style-type: none"> Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSF-BF.A.1 Write a function that describes a relationship between two quantities.</p>



From Molecules to Organisms: Structure and Processes [HS-LS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.</p> <p>Clarification Statement: Cellular division should include a description of the entire cell cycle along with the phases of mitosis.</p> <p>State Assessment Boundary: Assessment does not include specific gene control mechanisms.</p>	Crosscutting Concepts	<p>Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.</p>
	Disciplinary Core Ideas	<p>Growth and Development of Organisms:</p> <ul style="list-style-type: none"> In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Use a model based on evidence to illustrate the relationships between systems or between components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>	<p>MP.4 Model with mathematics.</p> <p>HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.</p> <p>HSF-BF.A.1 Write a function that describes a relationship between two quantities.</p>



From Molecules to Organisms: Structure and Processes [HS-LS1-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.</p> <p><i>Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.</i></p> <p><i>State Assessment Boundary: Assessment does not include specific biochemical steps.</i></p>	<p>Crosscutting Concepts</p>	<p>Changes in energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.</p>
	<p>Disciplinary Core Ideas</p>	<p>Organization for Matter and Energy Flow in Organisms:</p> <ul style="list-style-type: none"> The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.
	<p>Science & Engineering Practices</p>	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Use a model based on evidence to illustrate the relationships between systems or between components of a system.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
<p>SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.</p>



From Molecules to Organisms: Structure and Processes [HS-LS1-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS1-6. Construct explanations and revise, as needed, based on evidence for: 1) how carbon, hydrogen, and oxygen may combine with other elements to form amino acids and/or other large carbon-based molecules, and 2) how other hydrocarbons may also combine to form large carbon-based molecules.</p> <p>Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations. Other hydrocarbons should include, but are not limited to: lipids, carbohydrates, and proteins.</p> <p>State Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecule subgroups, such as saturated vs. unsaturated fats or identification of specific amino acids.</p>	Crosscutting Concepts	<p>Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.</p>
	Disciplinary Core Ideas	<p>Organization for Matter and Energy Flow:</p> <ul style="list-style-type: none"> The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into large molecules that can be assembled into large molecules (such as proteins or DNA), used for example to form new cells. As matter and energy flow through different organization levels of living systems, chemical elements are recombined in different ways to form different products.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.</p>



From Molecules to Organisms: Structure and Processes [HS-LS1-7]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of sugar molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.</p> <p>Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration. The term “molecules” is synonymous with “food” in other grade level bands.</p> <p>State Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.</p>	Crosscutting Concepts	<p>Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.</p>
	Disciplinary Core Ideas	<p>Organization for Matter and Energy Flow in Organisms:</p> <ul style="list-style-type: none"> As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Use a model based on evidence to illustrate the relationships between systems or between components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>		<p>MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.</p>



Ecosystems: Interactions, Energy, and Dynamics [HS-LS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.</p> <p>Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among independent factors including boundaries, resources, climate, and competition in the Rocky Mountain region. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical, regional, or current data sets.</p> <p>State Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.</p> <p>Engineering , Technology & Application of Science Connections—HS-ETS1-4 (pg. 249)</p>	Crosscutting Concepts	The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
	Disciplinary Core Ideas	<p>Interdependent Relationships in Ecosystems:</p> <ul style="list-style-type: none"> Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use mathematical and/or computational representations of phenomena or design solutions to support explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Ecosystems: Interactions, Energy, and Dynamics [HS-LS2-2]

HS Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.</p> <p>Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. Revision refers to the scientific practice of modifying explanations using additional data analysis and/or research.</p> <p>State Assessment Boundary: Assessment is limited to provided data.</p> <p>Engineering, Technology, and Applications of Science Connections—HS-ETS1-4 (pg. 249)</p>	Crosscutting Concepts	Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.
	Disciplinary Core Ideas	<p>Interdependent Relationships in Ecosystems:</p> <ul style="list-style-type: none"> Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. <p>Ecosystem Dynamics, Functioning, and Resilience:</p> <ul style="list-style-type: none"> A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use mathematical representations of phenomena or design solutions to support and revise explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Ecosystems: Interactions, Energy, and Dynamics [HS-LS2-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS2-3. Construct an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions, and revise as needed.</p> <p><i>Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments. Examples could include bioremediation of hydrocarbons or other materials, sewage / waste treatment, or decomposition.</i></p> <p><i>State Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.</i></p> 	Crosscutting Concepts	Energy drives the cycling of matter within and between systems.
	Disciplinary Core Ideas	<p>Cycles of Matter and Energy Transfer in Ecosystems:</p> <ul style="list-style-type: none"> • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Ecosystems: Interactions, Energy, and Dynamics [HS-LS2-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p> <p>Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen, and nitrogen being conserved as they move through an ecosystem.</p> <p>State Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.</p>	Crosscutting Concepts	<p>Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.</p>
	Disciplinary Core Ideas	<p>Cycles of Matter and Energy Transfer in Ecosystems:</p> <ul style="list-style-type: none"> Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use mathematical representations of phenomena or design solutions to support claims.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
N/A	<p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Ecosystems: Interactions, Energy, and Dynamics [HS-LS2-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.</p> <p>State Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.</p>	Crosscutting Concepts	<p>Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.</p>
	Disciplinary Core Ideas	<p>Cycles of Matter and Energy Transfer in Ecosystems:</p> <ul style="list-style-type: none"> Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. <p>Energy in Chemical Processes:</p> <ul style="list-style-type: none"> The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop a model based on evidence to illustrate the relationships between systems or components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Ecosystems: Interactions, Energy, and Dynamics [HS-LS2-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex biotic and abiotic interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a modified ecosystem.</p> <p><i>Clarification statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.</i></p> <p>Engineering , Technology & Application of Science Connections—HS-ETS1-5 (pg. 250)</p>	Crosscutting Concepts	<p>Much of science deals with constructing explanations of how things change and how they remain stable.</p>
	Disciplinary Core Ideas	<p>Ecosystem Dynamics, Functioning, and Resilience:</p> <ul style="list-style-type: none"> • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. • If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. • Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.</p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSS-ID.A.1 Represent data with plots on the real number line.</p> <p>HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HSS-IC.B.6 Evaluate reports based on data.</p>



Ecosystems: Interactions, Energy, and Dynamics [HS-LS2-7]

Performance Expectations (Benchmark)

Three Dimensions of Learning

HS-LS2-7. Evaluate and assess impacts on the environment and biodiversity in order to refine or design a solution for detrimental impacts or enhancement for positive impacts.

Clarification Statement: Examples of impacts could include urbanization, reclamation projects, building dams, habitat restoration, and dissemination of invasive species.

Engineering , Technology & Application of

Science Connections

HS-ETS1-1 (pg. 246)

HS-ETS1-2 (pg. 247)

HS-ETS1-3 (pg. 248)

HS-ETS1-4 (pg. 249)

Crosscutting Concepts

Much of science deals with constructing explanations of how things change and how they remain stable.

Disciplinary Core Ideas

Ecosystem Dynamics, Functioning, and Resilience:

- Moreover, anthropogenic changes (included by human activity) in the environment-including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change-can disrupt an ecosystem and threaten the survival of some species.

Biodiversity and Humans:

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Developing Possible Solutions:

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Science & Engineering Practices

Constructing Explanations and Designing Solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

- RST.9-10.8** Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.
- RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- RST.11-12.8** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- WHST.9-12.7** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Mathematics Connections

- MP.2** Reason abstractly and quantitatively.
- HSN-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling.
- HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



Ecosystems: Interactions, Energy, and Dynamics [HS-LS2-8]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.</p> <p><i>Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.</i></p>	Crosscutting Concepts	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
	Disciplinary Core Ideas	<p>Social Interactions and Group Behavior:</p> <ul style="list-style-type: none"> Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.</p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Heredity: Inheritance and Variation of Traits [HS-LS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</p> <p>State Assessment Boundary: Assessment does not include the biochemical mechanism of specific steps in the process.</p>	Crosscutting Concepts	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
	Disciplinary Core Ideas	<p>Structure and Function:</p> <ul style="list-style-type: none"> All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. <p>Inheritance of Traits:</p> <ul style="list-style-type: none"> Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for protein, some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known functions.
	Science & Engineering Practices	<p>Asking questions (for science) and defining problems (for engineering) in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.</p> <ul style="list-style-type: none"> Ask question that arise from examining models or a theory to clarify relationships.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Heredity: Inheritance and Variation of Traits [HS-LS3-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</p> <p>Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.</p> <p>State Assessment Boundary: Assessment does not include the biochemical mechanism of specific steps in the process.</p> <p>Engineering , Technology & Application of Science Connections—HS-ETS1-5 (pg. 250)</p>	Crosscutting Concepts	<p>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p>
	Disciplinary Core Ideas	<p>Variation of Traits:</p> <ul style="list-style-type: none"> In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also cause mutations in genes, and variables mutations are inherited. Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in the population. Thus the variation and distribution of traits observe depends on both genetic and environmental factors.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.1 Write arguments focused on discipline-specific content.</p>		<p>MP.2 Reason abstractly and quantitatively.</p>



Heredity: Inheritance and Variation of Traits [HS-LS3-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</p> <p><i>Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.</i></p> <p><i>State Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.</i></p>	Crosscutting Concepts	<p>Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).</p>
	Disciplinary Core Ideas	<p>Variation of Traits:</p> <ul style="list-style-type: none"> Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in the population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.
	Science & Engineering Practices	<p>Analyzing and interpreting data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.</p> <ul style="list-style-type: none"> Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
N/A		MP.2 Reason abstractly and quantitatively.



Biological Evolution: Unity and Diversity [HS-LS4-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.</p> <p><i>Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, biochemical similarities, and order of appearance of structures in embryological development.</i></p>	Crosscutting Concepts	<p>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</p>
	Disciplinary Core Ideas	<p>Evidence of Common Ancestry and Diversity:</p> <ul style="list-style-type: none"> Genetic information provides evidence of common ancestry and diversity. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.
	Science & Engineering Practices	<p>Analyzing and interpreting data in 9-12 builds on K-8 experiences and progress to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.</p> <ul style="list-style-type: none"> Analyze and interpret data to determine similarities and differences in findings.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.</p>		<p>MP.2 Reason abstractly and quantitatively.</p>



Biological Evolution: Unity and Diversity [HS-LS4-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p> <p><i>Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.</i></p> <p><i>State Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.</i></p>	Crosscutting Concepts	<p>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p>
	Disciplinary Core Ideas	<p>Natural Selection: Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.</p>
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Biological Evolution: Unity and Diversity [HS-LS4-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.</p> <p>Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. Further development may include allele frequency calculations.</p> <p>State Assessment Boundary: Assessment is based on statistical and graphical analysis.</p>	<p>Crosscutting Concepts</p>	<p>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</p>
	<p>Disciplinary Core Ideas</p>	<p>Natural Selection:</p> <ul style="list-style-type: none"> Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. <p>Adaptation:</p> <ul style="list-style-type: none"> Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Adaptation also means that the distribution of traits in a population can change when conditions change.
	<p>Science & Engineering Practices</p>	<p>Analyzing and interpreting data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.</p> <ul style="list-style-type: none"> Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>		<p>MP.2 Reason abstractly and quantitatively.</p>



Biological Evolution: Unity and Diversity [HS-LS4-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.</p> <p><i>Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term change in climate, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.</i></p>	Crosscutting Concepts	<p>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p>
	Disciplinary Core Ideas	<p>Adaptation:</p> <ul style="list-style-type: none"> Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>		<p>MP.2 Reason abstractly and quantitatively.</p>



Biological Evolution: Unity and Diversity [HS-LS4-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.</p> <p><i>Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.</i></p> <p>Engineering , Technology & Application of Science Connections HS-ETS1-5 (pg. 250)</p>	Crosscutting Concepts	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
	Disciplinary Core Ideas	<p>Adaptation:</p> <ul style="list-style-type: none"> Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species. Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species’ adaptation over time is lost.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis , reflection, and research.</p>		<p>MP.2 Reason abstractly and quantitatively.</p>



Biological Evolution: Unity and Diversity [HS-LS4-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-LS4-6. Create and/or use a simulation to evaluate the impacts of human activity on biodiversity.</p> <p><i>Clarification Statement: Emphasis is on examining positive and negative impacts of human activity. Examples could include cost benefit analysis of proposed actions, protection for threatened or endangered species, reclamation projects and/or efforts to maintain biodiversity.</i></p>  <p>Engineering , Technology & Application of Science Connections HS-ETS1-1 (pg. 246) HS-ETS1-2 (pg. 247) HS-ETS1-3 (pg. 248) HS-ETS1-4 (pg. 249)</p>	Crosscutting Concepts	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
	Disciplinary Core Ideas	Adaptation: <ul style="list-style-type: none"> Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline and sometimes the extinction of some species.
	Science & Engineering Practices	Using Mathematics and Computational Thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, and range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. <ul style="list-style-type: none"> Create or revise a simulation of a phenomenon, designed device, process, or system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.</p> <p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>

High School



Students in high school continue their learning from the middle school grades to develop more complete understanding of these four areas: Physical Science, Life Science, Earth and Space Science, and Engineering, Technology, and Applications of Science.

These standards and benchmarks include the most fundamental concepts of science, but are intended to leave room for expanded study in upper-level high school courses. The high school performance expectations allow high school students to explain more in-depth phenomena across the science disciplines, **science and engineering practices**, and **crosscutting concepts**.

The **Science and Engineering Practices** students will be expected to perform are :

1. ask relevant questions and define problems
2. develop and use models
3. plan and carry out investigations
4. analyze and interpret data
5. use mathematics and computational thinking
6. construct explanations and design solutions
7. engage in argument from evidence
8. obtain, evaluate, and communicate information

The **Crosscutting Concepts** that help students deepen their understanding of the **disciplinary core ideas** and develop a coherent and scientifically-based view of the world are:

1. patterns
2. cause and effect: mechanisms, and explanation
3. scale, proportion, and quality
4. systems and system models
5. energy and matter: flows, cycles, and conservation
6. structure and function
7. stability and change

Earth & Space Sciences

Students in high school continue to develop their understanding of the three **disciplinary core ideas** in the Earth and Space Sciences. The high school performance expectations in Earth and Space Science build on the middle school ideas and skills and allow high school students to explain more in-depth phenomena central not only to the earth and space sciences, but to life and physical sciences as well. These performance expectations blend the **core ideas** with **scientific and engineering practices** and **crosscutting concepts** to support students in developing useable knowledge to explain ideas across the science disciplines. While the performance expectations shown in high school earth and space science couple particular practices with specific **disciplinary core ideas**, instructional decisions should include use of many **practices** that lead to the performance expectations.

The performance expectations in **ESS1: Earth's Place in the Universe**, help students formulate an answer to the question: "What is the universe, and what is Earth's place in it?" The ESS1 **Disciplinary Core Idea** is broken down into three components: **The Universe and Its Stars**, **Earth and the Solar System**, and **The History of Planet Earth**. Students examine the processes governing the formation, evolution, and workings of the solar system and universe. Some concepts studied are fundamental to science, such as understanding how the matter of our world formed during the Big Bang and within the cores of stars. Others concepts are practical, such as understanding how short-term changes in the behavior of our sun directly affect humans. Engineering and technology play a large role here in obtaining and analyzing the data that support the theories of the formation of the solar system and universe.

The performance expectations in **ESS2: Earth's Systems**, help students formulate an answer to the question: "How and why is Earth constantly changing?" The ESS2 **Disciplinary Core Idea** is broken down into five components: **Earth Materials and Systems**, **Plate Tectonics and Large-Scale System Interactions**, **The Roles of Water in Earth's Surface Processes, Weather and Climate**, and **Biogeology**. Students develop models and explanations for the ways that feedbacks between different Earth systems control the appearance of Earth's surface. Central



High School Earth & Space Sciences (continued)

to this is the tension between internal systems, which are largely responsible for creating land at Earth's surface, and the sun-driven surface systems that tear down the land through weathering and erosion. Students begin to examine the ways that human activities cause feedbacks that create changes to other systems. Students understand the system interactions that control weather and climate, with a major emphasis on the mechanisms and implications of climate change. Students model the flow of energy between different components of the weather system and how this affects chemical cycles such as the carbon cycle.

The performance expectations in **ESS3: Earth and Human Activity** help students formulate an answer to the question: "How do Earth's surface processes and human activities affect each other?" The ESS3 **Disciplinary Core Idea** is broken down into four components: **Natural Resources**, **Natural Hazards**, **Human Impact on Earth Systems**, and **Global Climate Change**. Students understand the complex and significant interdependencies between humans and the rest of Earth's systems through the impacts of natural hazards, our dependencies on natural resources, and the significant environmental impacts of human activities. Engineering and technology figure prominently here, as students use mathematical thinking and the analysis of geoscience data to examine and construct solutions to the many challenges facing long-term human sustainability on Earth.



Earth's Place in the Universe [HS-ESS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.</p> <p><i>Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11- year sunspot cycle, and non-cyclic variations over centuries.</i></p> <p><i>State Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.</i></p>	Crosscutting Concepts	<p>The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.</p>
	Disciplinary Core Ideas	<p>The Universe and Its Stars:</p> <ul style="list-style-type: none"> The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. <p>Energy in Chemical Processes and Everyday Life:</p> <p>Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.</p>
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop a model based on evidence to illustrate the relationships between systems or components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.</p> <p>HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p>



Earth's Place in the Universe [HS-ESS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.</p> <p><i>Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).</i></p>	<p>Crosscutting Concepts</p>	<p>The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.</p>
	<p>Disciplinary Core Ideas</p>	<p>Earth and the Solar System:</p> <ul style="list-style-type: none"> The solar system consists of the sun and a collection of objects of varying sizes and conditions – including planets and their moons – that are held in orbit around the sun by its gravitational pull on them.
	<p>Science & Engineering Practices</p>	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop a model based on evidence to illustrate the relationships between systems or components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.</p> <p>HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p>



Earth's Place in the Universe [HS-ESS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.</p> <p><i>Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.</i></p> <p><i>State Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.</i></p>	Crosscutting Concepts	In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
	Disciplinary Core Ideas	<p>The Universe and Its Stars:</p> <ul style="list-style-type: none"> The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. Other than the hydrogen and helium, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.
	Science & Engineering Practices	<p>Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.</p> <ul style="list-style-type: none"> Communicate scientific information (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p> <p>SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.</p>		<p>MP.2 Reason abstractly and quantitatively.</p>



Earth's Place in the Universe [HS-ESS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.</p> <p>Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as natural solar system objects.</p> <p>State Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.</p>	Crosscutting Concepts	<p>Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).</p>
	Disciplinary Core Ideas	<p>Earth and the Solar System:</p> <ul style="list-style-type: none"> Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. <p>Interdependence of Science, Engineering, and Technology:</p> <ul style="list-style-type: none"> Science and engineering compliment each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use mathematical representations of phenomena or design solutions to support and revise explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
N/A	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.</p> <p>HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p>



Earth's Place in the Universe [HS-ESS1-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.</p> <p><i>Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust decreasing with distance away from a central ancient core (a result of past plate interactions).</i></p>	Crosscutting Concepts	Much of science deals with constructing explanations of how things change and how they remain stable.
	Disciplinary Core Ideas	<p>Plate Tectonics and Large-Scale System Interactions:</p> <ul style="list-style-type: none"> Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a scientific or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth's Place in the Universe [HS-ESS1-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.</p> <p><i>Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest rocks), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.</i></p>	Crosscutting Concepts	<p>Much of science deals with constructing explanations of how things change and how they remain stable.</p>
	Disciplinary Core Ideas	<p>History of Planet Earth:</p> <ul style="list-style-type: none"> Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over years. Studying these objects can provide information about Earth's formation and early history.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>WHST.9-12.1 Write arguments focused on <i>discipline-specific content</i>.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.</p> <p>HSS-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how those variables are related.</p>



Earth's Systems [HS-ESS2-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.</p> <p><i>Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion). Focus on the varying rates of process.</i></p> <p><i>State Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.</i></p>	Crosscutting Concepts	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
	Disciplinary Core Ideas	<p>Earth Materials and Systems:</p> <ul style="list-style-type: none"> Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. <p>Plate Tectonics and Large-Scale System Interactions:</p> <ul style="list-style-type: none"> Plate tectonics is the unifying theory that explains the past and current movements of rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop a model based on evidence to illustrate the relationships between systems or components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>SL.11-12.5 Make strategic use of digital media (e.g., textual graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth's Systems [HS-ESS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.</p> <p>Clarification Statement: Examples of system interactions could include how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; how a decrease in greenhouse gases contributes to a decrease in global surface temperature which leads to an increase in glacial ice, or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.</p> <p>Engineering , Technology & Application of Science Connections HS-ETS1-5 (pg. 250)</p>	Crosscutting Concepts	Feedback (negative or positive) can stabilize or destabilize a system.
	Disciplinary Core Ideas	<p>Earth Materials and Systems:</p> <ul style="list-style-type: none"> Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. <p>Weather and Climate:</p> <ul style="list-style-type: none"> The foundation for Earth's global climate system is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.
	Science & Engineering Practices	<p>Analyzing and interpreting data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.</p> <ul style="list-style-type: none"> Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth's Systems [HS-ESS2-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.</p> <p><i>Clarification Statement: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.</i></p>	Crosscutting Concepts	Energy drives the cycling of matter within and between systems.
	Disciplinary Core Ideas	<p>Earth Materials and Systems:</p> <ul style="list-style-type: none"> Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface features, its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. <p>Plate Tectonics and Large-Scale System Interactions:</p> <ul style="list-style-type: none"> The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. <p>Waves Properties: (secondary to HS-ESS2-3)</p> <ul style="list-style-type: none"> Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop a model based on evidence to illustrate the relationships between systems or components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>SL.11-12.5 Make strategic use of digital media (e.g., textual graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth's Systems [HS-ESS2-4]

Performance Expectations (Benchmark)

Three Dimensions of Learning

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.

State Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.

Engineering , Technology & Application of Science Connections

HS-ETS1-4 (pg. 249)

HS-ETS1-5 (pg. 250)

Crosscutting Concepts

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Disciplinary Core Ideas

Earth and the Solar System:

- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the Earth. These phenomena cause a cycle of ice ages and other changes in climate.

Earth Materials and Systems:

- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.

Weather and Climate:

- The foundation for Earth's global climate system is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.

Science & Engineering Practices

Analyzing and interpreting data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using computational models in order to make valid and reliable scientific claims.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

SL.11-12.5 Make strategic use of digital media (e.g., textual graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Mathematics Connections

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



Earth's Systems [HS-ESS2-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</p> <p><i>Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids). Emphasis could be on local, regional and Wyoming state hydrological resources and features.</i></p> 	<p>Crosscutting Concepts</p>	<p>The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.</p>
	<p>Disciplinary Core Ideas</p>	<p>The Role of Water in Earth's Surface Processes:</p> <ul style="list-style-type: none"> The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.
	<p>Science & Engineering Practices</p>	<p>Planning and carrying out investigations in 9-12 builds on 6-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.</p> <ul style="list-style-type: none"> Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p>		<p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth's Systems [HS-ESS2-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</p> <p><i>Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.</i></p> <p>Engineering , Technology & Application of Science Connections HS-ETS1-4 (pg. 249)</p>	Crosscutting Concepts	The total amount of energy and matter in closed systems is conserved.
	Disciplinary Core Ideas	<p>Biogeology:</p> <ul style="list-style-type: none"> Organisms ranging from bacteria to human beings are a major driver of the global carbon and they influence global climate by modifying the chemical makeup of the atmosphere. The abundance of carbon in the atmosphere is reduced through the ocean floor accumulation of marine sediments and the accumulation of plant biomass.
	Science & Engineering Practices	<p>Developing and using models in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> Develop a model based on evidence to illustrate the relationships between systems or components of a system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth's Systems [HS-ESS2-7]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.</p> <p><i>Clarification Statement:</i> Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.</p> <p><i>State Assessment Boundary:</i> Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.</p> <p>Engineering , Technology & Application of Science Connections HS-ETS1-5 (pg. 250)</p>	<p>Crosscutting Concepts</p>	<p>Much of science deals with constructing explanations of how things change and how they remain stable.</p>
	<p>Disciplinary Core Ideas</p>	<p>Weather and Climate:</p> <ul style="list-style-type: none"> Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. <p>Biogeology:</p> <ul style="list-style-type: none"> The many dynamic and delicate feedback mechanisms between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it.
	<p>Science & Engineering Practices</p>	<p>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> Construct an oral and written argument or counter-arguments based on data and evidence.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p>WHST.9-12.1 Write arguments focused on <i>discipline-specific content</i>.</p>		<p>MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.</p>



Earth and Human Activity [HS-ESS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</p> <p>Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.</p> <p>Engineering , Technology & Application of Science Connections HS-ETS1-1 (pg. 246) HS-ETS1-5 (pg. 250)</p> 	Crosscutting Concepts	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
	Disciplinary Core Ideas	<p>Natural Resources:</p> <ul style="list-style-type: none"> Resource availability has guided the development of human society. <p>Natural Hazards:</p> <ul style="list-style-type: none"> Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth and Human Activity [HS-ESS3-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS3-2. Evaluate competing design solutions for developing, managing, and using energy and mineral resources based on cost-benefit ratios.</p> <p><i>Clarification Statement: Cost-benefit analysis should be based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, and ethical considerations). Emphasis needs to include the conservation, recycling, and reuse of resources (e.g., minerals, metals, and water) where possible, and on minimizing impacts where it is not. Examples include developing best practices for wind, hydroelectric, and solar energy, agricultural soil use, mining (for coal, and oil shales), and pumping (for petroleum and natural gas).</i></p> <p>Engineering , Technology & Application of Science Connections HS-ETS1-1 (pg. 246) HS-ETS1-3 (pg. 248) HS-ETS1-5 (pg. 250)</p> 	Crosscutting Concepts	<p>Engineers continuously modify these systems to increase benefits while decreasing costs and risks. Analysis of costs and benefits is a critical aspect of decisions about technology.</p>
	Disciplinary Core Ideas	<p>Natural Resources:</p> <ul style="list-style-type: none"> All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. Developing Possible Solutions: (secondary to HS-ESS3-2) When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
	Science & Engineering Practices	<p>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.</p> <ul style="list-style-type: none"> Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p>	<p>MP.2 Reason abstractly and quantitatively.</p>



Earth and Human Activity [HS-ESS3-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS3-3. Use computational tools to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</p> <p><i>Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.</i></p> <p>Engineering , Technology, & Application of Science Connections HS-ETS1-1 (pg. 246) HS-ETS1-2 (pg. 247) HS-ETS1-3 (pg. 248) HS-ETS1-4 (pg. 249) HS-ETS1-5 (pg. 250)</p>	Crosscutting Concepts	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
	Disciplinary Core Ideas	<p>Human Impacts on Earth Systems:</p> <ul style="list-style-type: none"> The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.
	Science & Engineering Practices	<p>Using mathematics and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Create a computational model or simulation of a phenomenon, design device, process or system.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Earth and Human Activity [HS-ESS3-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p><i>Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Technological solutions to evaluate could include landscape reclamation, reducing, reusing, and recycling resources, emission control systems, or evaporation control.</i></p> <p><i>Examples for limiting future impacts could range from local efforts to large-scale design solutions.</i></p> <p>Engineering , Technology & Application of Science Connections HS-ETS1-1 (pg. 246) HS-ETS1-3 (pg. 248) HS-ETS1-4 (pg. 249) HS-ETS1-5 (pg. 250)</p>	Crosscutting Concepts	Feedback (negative or positive) can stabilize or destabilize a system.
	Disciplinary Core Ideas	<p>Human Impacts on Earth Systems:</p> <ul style="list-style-type: none"> Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student- generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Design or refine a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoff considerations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth and Human Activity [HS-ESS3-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS3-5. Analyze data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.</p> <p><i>Clarification Statement: Examples of evidence, for both data and climate model outputs, are for changes in climate (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmospheric and oceanic composition).</i></p> <p><i>State Assessment Boundary: Assessment is limited to one example of a change in climate and its associated impacts.</i></p>	Crosscutting Concepts	<p>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p>
	Disciplinary Core Ideas	<p>Natural Resources:</p> <ul style="list-style-type: none"> Most elements exist in Earth’s crust at concentrations too low to be extracted, but in some locations where geological processes have concentrated them extraction is economically viable.
	Science & Engineering Practices	<p>Constructing explanations (for science) and designing solutions (for engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>



Earth and Human Activity [HS-ESS3-6]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ESS3-6. Use the results of a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.</p> <p><i>Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. Consideration should be given to both positive and negative modification results.</i></p> <p><i>State Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.</i></p>	Crosscutting Concepts	<p>When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.</p>
	Disciplinary Core Ideas	<p>Weather and Climate:</p> <ul style="list-style-type: none"> Current models predict that, though future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. <p>Global Climate Change:</p> <ul style="list-style-type: none"> Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.
	Science & Engineering Practices	<p>Using Mathematics and Computational Thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
N/A	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p> <p>HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose in interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>

High School



Students in high school continue their learning from the middle school grades to develop more complete understanding of these four areas: Physical Science, Life Science, Earth and Space Science, and Engineering, Technology, and Applications of Science.

These standards and benchmarks include the most fundamental concepts of science, but are intended to leave room for expanded study in upper-level high school courses. The high school performance expectations allow high school students to explain more in-depth phenomena across the science disciplines, [science and engineering practices](#), and [crosscutting concepts](#).

The [Science and Engineering Practices](#) students will be expected to perform are :

1. [ask relevant questions and define problems](#)
2. [develop and use models](#)
3. [plan and carry out investigations](#)
4. [analyze and interpret data](#)
5. [use mathematics and computational thinking](#)
6. [construct explanations and design solutions](#)
7. [engage in argument from evidence](#)
8. [obtain, evaluate, and communicate information](#)

The [Crosscutting Concepts](#) that help students deepen their understanding of the [disciplinary core ideas](#) and develop a coherent and scientifically-based view of the world are:

1. [patterns](#)
2. [cause and effect: mechanisms, and explanation](#)
3. [scale, proportion, and quality](#)
4. [systems and system models](#)
5. [energy and matter: flows, cycles, and conservation](#)
6. [structure and function](#)
7. [stability and change](#)

Engineering, Technology, and Applications of Sciences

At the high school level students are expected to engage with major global issues at the interface of science, technology, society and the environment, and to bring to bear the kinds of analytical and strategic thinking that prior training and increased maturity make possible. As in prior levels, these capabilities can be thought of in three stages—defining the problem, developing possible solutions, and improving designs.

Defining the problem at the high school level requires both qualitative and quantitative analysis. For example, the need to provide food and fresh water for future generations comes into sharp focus when considering the speed at which world population is growing, and conditions in countries that have experienced famine. While high school students are not expected to solve these challenges, they are expected to begin thinking about them as problems that can be addressed, at least in part, through engineering.

Developing possible solutions for major global problems begins by breaking them down into smaller problems that can be tackled with engineering methods. To evaluate potential solutions students are expected to not only consider a wide range of criteria, but to also recognize that criteria need to be prioritized. For example, public safety or environmental protection may be more important than cost or even functionality. Decisions on priorities can then guide tradeoff choices.

Improving designs at the high school level may involve sophisticated methods, such as using computer simulations to model proposed solutions. Students are expected to use such methods to take into account a range of criteria and constraints, to try and anticipate possible societal and environmental impacts, and to test the validity of their simulations by comparison to the real world.

Connections with other science disciplines help high school students develop these capabilities in various contexts. For example, in the life sciences students are expected to design, evaluate, and refine a solution for reducing human impact on the environment (HS-LS2-7) and to create or revise a simulation to test solutions for mitigating adverse impacts of human activity on biodiversity (HS-LS4-6). In the physical



High School Engineering, Technology, and Applications of Science (continued)

sciences, students solve problems by applying their engineering capabilities along with their knowledge of conditions for chemical reactions (HS-PS1-6), forces during collisions (HS-PS2-3), and conversion of energy from one form to another (HS-PS3-3). In the Earth and space sciences students apply their engineering capabilities to reduce human impacts on Earth systems, and improve social and environmental cost-benefit ratios (HS-ESS3-2, HS-ESS3-4).

By the end of 12th grade students are expected to achieve all five HS-ETS1 performance expectations (HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1-4, and HS-ETS1-5) related to a single problem in order to understand the interrelated processes of engineering design. These include **analyzing major global challenges, quantifying criteria and constraints for solutions; breaking down a complex problem into smaller, more manageable problems, evaluating alternative solutions based on prioritized criteria and trade-offs, evaluate the validity and reliability of claims in a variety of materials, and using a computer simulation to model the impact of proposed solutions.** While the performance expectations shown in High School **Engineering, Technology, and Applications of Science** couple particular practices with specific **disciplinary core ideas**, instructional decisions should include use of many practices that lead to the performance expectations.



Engineering, Technology, & Applications of Science [HS-ETS1-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><i>Clarification Statement: Examples of challenges could include rural cell phone coverage, geothermal energy use, and sage grouse population.</i></p> <p><u>Science Standards Connections</u></p> <p>HS-LS2-7 (pg. 212) HS-ESS3-1 (pg. 238) HS-LS4-6 (pg. 222) HS-ESS3-2 (pg. 239) HS-PS2-6 (pg. 187) HS-ESS3-3 (pg. 240) HS-PS4-2 (pg. 194) HS-ESS3-4 (pg. 241) HS-PS4-5 (pg. 196)</p>	Crosscutting Concepts	Influence of Science, Engineering, and Technology on Society and the Natural World <ul style="list-style-type: none"> New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
	Disciplinary Core Ideas	Defining and Delimiting Engineering Problems: <ul style="list-style-type: none"> Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
	Science & Engineering Practices	Asking Questions and Defining Problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. <ul style="list-style-type: none"> Analyze complex real-world problems by specifying criteria and constraints for successful solutions.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Engineering, Technology, & Applications of Science [HS-ETS1-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>Clarification Statement: Emphasis is on creativity, innovation, and inquiry.</p> <p>Science Standards Connections</p> <p>HS-PS2-3 (pg. 184)</p> <p>HS-PS3-3 (pg. 190)</p> <p>HS-PS4-1 (pg. 193)</p> <p>HS-LS2-7 (pg. 212)</p> <p>HS-LS4-6 (pg. 222)</p> <p>HS-ESS3-3 (pg. 240)</p>	Crosscutting Concepts	<p>Optimizing the Design Solution:</p> <ul style="list-style-type: none"> Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
	Disciplinary Core Ideas	<i>Intentionally Left Blank</i>
	Science & Engineering Practices	<p>Constructing Explanations and Designing Solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.</p> <ul style="list-style-type: none"> Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
N/A		MP.4 Model with mathematics.



Engineering, Technology, & Applications of Science [HS-ETS1-3]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p> <p><i>Clarification Statement: Examples could include evaluation of historical, present day, and potential future challenges which take into account shifts in cultural norms and values, societal priorities, and/or technology.</i></p> <p><u>Science Standards Connections</u></p> <p>HS-PS2-3 (pg. 184) HS-ESS3-2 (pg. 239) HS-PS4-2 (pg. 194) HS-ESS3-3 (pg. 240) HS-PS4-5 (pg. 196) HS-ESS3-4 (pg. 241) HS-LS2-7 (pg. 212) HS-LS4-6 (pg. 222)</p>	Crosscutting Concepts	<p>Influence of Science, Engineering, and Technology on Society and the Natural World:</p> <ul style="list-style-type: none"> • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
	Disciplinary Core Ideas	<p>Developing Possible Solutions:</p> <p>When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.</p>
	Science & Engineering Practices	<p>Constructing Explanations and Designing Solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.</p> <ul style="list-style-type: none"> • Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. • Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>	<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Engineering, Technology, & Applications of Science [HS-ETS1-4]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p>Clarification Statement: Examples can include using spreadsheets to modify and evaluate data, PhET simulations, GIS spatial modeling, etc.</p> <p><u>Science Standards Connections</u></p> <p>HS-PS2-3 (pg. 184) HS-LS2-2 (pg. 207) HS-PS2-6 (pg. 187) HS-LS2-7 (pg. 212) HS-PS3-1 (pg. 188) HS-LS4-6 (pg. 222) HS-PS3-3 (pg. 190) HS-ESS2-4 (pg. 234) HS-PS4-1 (pg. 193) HS-ESS2-6 (pg. 236) HS-LS2-1 (pg. 206) HS-ESS3-3 (pg. 240) HS-ESS3-4 (pg. 241)</p>	Crosscutting Concepts	<p>Systems and System Models:</p> <ul style="list-style-type: none"> Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.
	Disciplinary Core Ideas	<p>Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.</p>
	Science & Engineering Practices	<p>Using Mathematics and Computational Thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		<p>MP.2 Reason abstractly and quantitatively.</p> <p>MP.4 Model with mathematics.</p>



Engineering, Technology, & Applications of Science [HS-ETS1-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>HS-ETS1-5. Evaluate the validity and reliability of claims in a variety of materials.</p> <p><i>Clarification Statement: Examples of materials could include trade books, scientific publications, magazines, web resources, videos, and other passages that may reflect bias.</i></p> <p><u>Science Standards Connections</u></p> <p>HS-PS2-6 (pg. 187) HS-ESS2-2 (pg. 232) HS-PS4-1 (pg. 193) HS-ESS3-1 (pg. 238) HS-PS4-2 (pg. 194) HS-ESS3-2 (pg. 239) HS-LS2-6 (pg. 211) HS-ESS2-7 (pg. 237) HS-LS2-7 (pg. 212) HS-ESS3-3 (pg. 240) HS-LS3-2 (pg. 215) HS-ESS3-4 (pg. 241) HS-LS4-5 (pg. 221) HS-ESS2-4 (pg. 234)</p>	Crosscutting Concepts	<p>Cause and Effect:</p> <ul style="list-style-type: none"> Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
	Disciplinary Core Ideas	<i>Intentionally Left Blank</i>
	Science & Engineering Practices	<p>Obtaining, Evaluating, and Communicating Information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.</p> <ul style="list-style-type: none"> Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics
<p>RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.</p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</p> <p>WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.</p>	<p>MP.2 Reason abstractly and quantitatively.</p>

Appendices/Resources that are available include:

- **Appendix A - A Model of the Three Dimensions of Science Learning**
- **Appendix B - Three Dimensions of Learning Framework**
- **Appendix C - ISTE Standards (International Society of Technology in Education)**
- **Appendix D - Connections to the Literacy Standards, ELA, and Mathematics Standards**
- **Appendix E - Disciplinary Core Ideas**
- **Appendix F - Science & Engineering Practices**
- **Appendix G - Crosscutting Concepts**
- **Appendix H - Nature of Science**
- **Appendix I - Engineering, Technology, and Applications of Science**
- **Appendix J - Glossary**
- **Appendix K - Acronyms**

These and other resources can be found at

<https://edu.wyoming.gov/educators/standards/science>