

# 2016 WYOMING SCIENCE

## CONTENT AND PERFORMANCE STANDARDS

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**TO BE FULLY IMPLEMENTED IN DISTRICTS BY THE BEGINNING OF SCHOOL YEAR 2020-2021**

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**Jillian Balow, Superintendent of Public Instruction  
Wyoming Department of Education**

**Brent Young and Lisa Weigel, Chief Policy Officer  
Julie Magee, Division Director  
Accountability Division**

**Laurie Hernandez, Standards Team Supervisor  
Mike Cosenza, Jill Stringer, Monica Mosier, and Barb Marquer—WDE Standards Team Facilitators**

**Wyoming Department of Education  
Hathaway Building, 2nd Floor  
2300 Capitol Avenue  
Cheyenne, WY 82002-0050**

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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.

# 2016 WYOMING SCIENCE CONTENT AND PERFORMANCE STANDARDS

## 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

# 2016 WYOMING SCIENCE CONTENT AND PERFORMANCE STANDARDS

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><b>W.4.7</b> Conduct short research projects that build knowledge through investigation of different aspects of a topic.</p> <p><b>W.4.8</b> 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><b>W.4.9</b> Draw evidence from literary or informational texts to support analysis, reflection, and research.</p>	<p><b>SS5.5.2</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>MP.4</b> Model with mathematics.</p> <p><b>4.MD.A.1</b> 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

## CONTENT REVIEW COMMITTEE (2015 – 2016)

Jennifer Albrandt, Converse CSD #2

Sheila St. Amour, Laramie

Polly Beebout, Natrona CSD #1

Ryan Bennett, Laramie

Ray Bieber, Park CSD #1

Perry F. Cook, Lander

Joanne Cornelison, Cheyenne, retired Laramie CSD #1

Paul Crips, Cheyenne, retired Laramie CSD #1

Shannon Cunningham, Laramie CSD #1

Elizabeth David, Sublette CSD #1

Mauro E. Diaz, Natrona CSD #1

Sharla Dowding, Converse CSD #2

Peter Ellsworth, Laramie, retired UW

Debra Freitas, Platte CSD #1

Jane Frye, Worland, retired Washakie CSD #1

Michael Gregory, Sublette CSD #1

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Miken Harnish, Platte CSD #1

Barbara Ann Harvey, St. Stephens Indian HS

Ana Houseal, UW

Retta Hudlow, Sublette CSD #1

Jeff Hymas, Etna

London Jenks, Hot Springs CSD #1

Sarah Konrad, Ph.D., UW, WY EPSCOR

Janel Korhonen-Goff, Casper

Barb Marquer, Cheyenne

Brett McDonald, CWC

Dave Mullens, Laramie

Astrid Northrup, NWC (Petroleum Engineer)

Nikki Osterland, Cody

Jenefer Pasqua, Laramie CSD #1

Sarah Ramsey-Walters, UW

Josh Sandlian, Platte CSD #1

JoAnn Schubert, Converse CSD #2

Doug Scribner, Weston CSD #1

Michael Selmer, Laramie

Gary Shockey, Jackson

Sue Spencer, Jelm

Teresa Strube, Albany CSD #1

Bertha Tracy, Rawlins, retired Carbon CSD #1

Lesley Urasky, Carbon CSD #1

## 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 quantity
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><b>MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.</b></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><b>Crosscutting Concepts</b></p>	<p><b>Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Structure and Properties of Matter:</b></p> <ul style="list-style-type: none"> <li>Substances are made from different types of atoms, which combine with one another in various ways.</li> <li>Atoms form molecules that range in size from two to thousands of atoms.</li> <li>Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop a model to predict and/or describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.7</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>MP.4</b> Model with mathematics.</p> <p><b>6.RP.A.3</b> Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p><b>8.EE.A.3</b> 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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<b>Macroscopic patterns are related to the nature of microscopic and atomic-level structure.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>Structure and Properties of Matter:</b></p> <ul style="list-style-type: none"> <li>Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.</li> </ul> <p><b>Chemical Reactions:</b></p> <ul style="list-style-type: none"> <li>Substances react chemically in characteristic ways.</li> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Analyze and interpret data to determine similarities and differences in findings.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p><b>RST.6-8.7</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.RP.A.3</b> Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p><b>8.SP.B.4</b> Display numerical data in plots on a number line, including dot plots, histograms, and box plots.</p> <p><b>8.SP.B.5</b> Summarize numerical data sets in relation to their context.</p>



# Matter and Its Interactions [MS-PS1-3]

<b>MS</b> <b>Performance Expectations</b> <b>(Benchmark)</b>	<b>Three Dimensions of Learning</b>	
<p><b>MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.</b></p> <p><b>Clarification Statement:</b> 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><b>State Assessment Boundary:</b> Assessment is limited to qualitative information.</p> <p>Engineering, Technology &amp; Application of Science Connections            MS-ETS2-1 (pg. 170)            MS-ETS2-2 (pg. 171)</p>	<b>Crosscutting Concepts</b>	<b>Macroscopic patterns are related to the nature of microscopic and atomic-level structure.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>Structure and Properties of Matter:</b></p> <ul style="list-style-type: none"> <li>Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.</li> </ul> <p><b>Chemical Reactions:</b></p> <ul style="list-style-type: none"> <li>Substances react chemically in characteristic ways.</li> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

<b>ELA / Literacy Connections</b>	<b>Career &amp; Vocational Education Connections</b>	<b>Mathematics Connections</b>
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p><b>WHST.6-8.8</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.4.2</b> 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><b>CV8.4.4</b> 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]

<b>MS</b> <b>Performance Expectations</b> <b>(Benchmark)</b>	<b>Three Dimensions of Learning</b>	
<p><b>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.</b></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>	<b>Crosscutting Concepts</b>	<b>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>Structure and Properties of Matter:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.</li> </ul> <p><b>Definitions of Energy:</b>            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"> <li>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.</li> <li>Temperature is not a direct measure of a system’s total thermal energy.</li> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop a model to predict and/or describe phenomena</li> </ul>

## Wyoming Cross-Curricular Connections

<b>ELA / Literacy Connections</b>	<b>Mathematics Connections</b>
<p><b>WHST.6-8.7</b> 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><b>6.NS.C.5</b> 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><b>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.</b></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><b>Matter is conserved because atoms are conserved in physical and chemical processes.</b></p>
	Disciplinary Core Ideas	<p><b>Chemical Reactions:</b></p> <ul style="list-style-type: none"> <li>• Substances react chemically in characteristic ways.</li> <li>• 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.</li> <li>• The total number of each type of atom is conserved, and thus the mass does not change.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>• Develop a model to describe unobservable mechanisms.</li> </ul>
Wyoming Cross-Curricular Connections		
ELA / Literacy Connections		Mathematics Connections
<p><b>WHST.6-8.7</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>MP.4</b> Model with mathematics.</p> <p><b>6.RP.A.3</b> Use ratio and rate reasoning to solve real-world and mathematical problems.</p>



# Matter and Its Interactions [MS-PS1-6]

<b>MS</b> <b>Performance Expectations</b> <b>(Benchmark)</b>	<b>Three Dimensions of Learning</b>	
<p><b>MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.</b></p> <p><b>Clarification Statement:</b> 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><b>State Assessment Boundary:</b> Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.</p> <p>Engineering, Technology &amp; 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>	<b>Crosscutting Concepts</b>	<p><b>The transfer of energy can be tracked as energy flows through a designed or natural system.</b></p>
	<b>Disciplinary Core Ideas</b>	<p><b>Chemical Reactions:</b></p> <ul style="list-style-type: none"> <li>Some chemical reactions release energy, others store energy.</li> </ul> <p><b>Developing Possible Solutions:</b></p> <ul style="list-style-type: none"> <li>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.</li> </ul> <p><b>Optimizing the Design Solution:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.</li> </ul>

## Wyoming Cross-Curricular Connections

<b>ELA / Literacy Connections</b>	<b>Mathematics Connections</b>
<p><b>RST.6-8.3</b> Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p><b>WHST.6-8.7</b> 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><b>8.SP</b> 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><b>MS-PS2-1. Apply Newton’s third law to design a solution to a problem involving the motion of two colliding objects.</b></p> <p><b>Clarification Statement:</b> 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><b>State Assessment Boundary:</b> Assessment is limited to vertical or horizontal interactions in one dimension.</p> <p>Engineering, Technology &amp; 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><b>Forces and Motion:</b></p> <ul style="list-style-type: none"> <li>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).</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Apply scientific ideas or principles to design an object, tool, process or system.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Voc. Ed. Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p><b>RST.6-8.3</b> Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p><b>WHST.6-8.7</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media, including visually and quantitatively, as well as in words.</p>	<p><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.NS.C.5</b> 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><b>6.EE.A.2</b> Write, read, and evaluate expressions in which letters stand for numbers.</p> <p><b>7.EE.B.3</b> 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><b>7.EE.B.4</b> 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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<p><b>Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.</b></p>
	<b>Disciplinary Core Ideas</b>	<p><b>Forces and Motion:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>The greater the mass of the object, the greater the force needed to achieve the same change in motion.</li> <li>For any given object, a larger force causes a larger change in motion.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p><b>RST.6-8.3</b> Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p><b>WHST.6-8.7</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.EE.A.2</b> Write, read, and evaluate expressions in which letters stand for numbers.</p> <p><b>7.EE.B.3</b> 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><b>7.EE.B.4</b> 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><b>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</b></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><b>Types of Interactions:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

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



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

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>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.</b></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><b>Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.</b></p>
	Disciplinary Core Ideas	<p><b>Types of Interactions:</b></p> <ul style="list-style-type: none"> <li>Gravitational forces are always attractive.</li> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>WHST.6-8.1</b> Write arguments focused on discipline-specific content.</p>	<p><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.2</b> 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><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p>	<p><b>MP.2</b> Reason abstractly and quantitatively.</p>



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

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>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.</b></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><b>Types of Interactions:</b></p> <ul style="list-style-type: none"> <li>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).</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.3</b> Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p><b>WHST.6-8.7</b> 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><b>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.</b></p> <p><b>Clarification Statement:</b> 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><b>State Assessment Boundary:</b> Assessment is limited to two objects and electric, magnetic, and gravitational interactions.</p>	<p><b>Crosscutting Concepts</b></p>	<p><b>Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Definitions of Energy:</b></p> <ul style="list-style-type: none"> <li>• A system of objects may also contain stored (potential) energy, depending on their relative positions.</li> </ul> <p><b>Relationship Between Energy and Forces:</b></p> <ul style="list-style-type: none"> <li>• When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>• Develop a model to predict and/or describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>SL.8.5</b> Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>	<p><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p><b>CV8.5.3</b> 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**

**MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.**

**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.

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

Engineering, Technology & Application of Science Connections—MS-ETS1-1 (pg. 166); MS-ETS1-2 (pg. 167); MS-ETS1-3 (pg. 168)

**Crosscutting Concepts**

**The transfer of energy can be tracked as energy flows through a designed or natural system.**

**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:**

- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

**Defining and Delimiting an Engineering Problem:**

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.

**Developing Possible Solutions:**

- 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**

**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.**

- 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><b>RST.6-8.3</b> Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p><b>WHST.6-8.7</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.2</b> 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><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p><b>CV8.5.4</b> Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	<p><b>6.EE.C.9</b> 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><b>6.G.G</b> 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><b>RST.6-8.3</b> Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p><b>WHST.6-8.7</b> 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><b>CV8.3.3</b> 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><b>CV8.4.2</b> 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><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p><b>CV8.5.4</b> Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	<p><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.SP.B.5</b> Summarize numerical data sets in relation to their context.</p>

# Energy [MS-PS3-5]



Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>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.</b></p> <p>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.</p> <p>State Assessment Boundary: Assessment does not include calculations of energy.</p>	Crosscutting Concepts	Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
	Disciplinary Core Ideas	<p><b>Conservation of Energy and Energy Transfer:</b></p> <ul style="list-style-type: none"> <li>When the motion energy of an object changes, there is inevitably some other change in energy at the same time.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><b>Scientific Knowledge is Based on Empirical Evidence.</b></p> <ul style="list-style-type: none"> <li>Science knowledge is based upon logical and conceptual connections between evidence and explanations.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p><b>WHST.6-8.1</b> Write arguments focused on discipline-specific content.</p>	<p><b>CV.8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.RP.A.1</b> Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p><b>7.RP.A.2</b> Recognize and represent proportional relationships between quantities.</p> <p><b>8.F.A.3</b> Interpret the equation <math>y = mx + b</math> 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><b>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.</b></p> <p><i>Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.</i></p> <p><i>State Assessment Boundary: Assessment is limited to standard repeating waves.</i></p>	<p><b>Crosscutting Concepts</b></p>	<p><b>Graphs and charts can be used to identify patterns in data.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Waves Properties:</b></p> <ul style="list-style-type: none"> <li>A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Use mathematical representations to describe and/or support scientific conclusions and design solutions.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Fine & Performing Arts Connections	Mathematics Connections
<p><b>SL.8.5</b> Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>	<p><b>FPA8.4.M.2</b> Students describe ways in which other disciplines are interrelated with music.</p>	<p><b>MP.2</b> Reason abstractly and quantitatively.  <b>MP.4</b> Model with mathematics.  <b>6.RP.A.1</b> Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.  <b>6.RP.A.3</b> Use ratio and rate reasoning to solve real-world and mathematical problems.  <b>7.RP.A.2</b> Recognize and represent proportional relationships between quantities.  <b>8.F.A.3</b> Interpret the equation <math>y = mx + b</math> 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><b>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</b></p> <p><i>Clarification Statement: Emphasis is on both electromagnetic and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.</i></p> <p><i>State Assessment Boundary: Assessment is limited to qualitative applications pertaining to electromagnetic and mechanical waves.</i></p>	<b>Crosscutting Concepts</b>	<p><b>Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.</b></p>
	<b>Disciplinary Core Ideas</b>	<p><b>Waves Properties:</b></p> <ul style="list-style-type: none"> <li>A sound wave needs a medium through which it is transmitted.</li> </ul> <p><b>Electromagnetic Radiation:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>SL.8.5</b> Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>	<p><b>CV8.3.3</b> 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><b>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.</b></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><b>Information Technologies and Instrumentation:</b></p> <ul style="list-style-type: none"> <li>Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.</li> </ul>
	Science & Engineering Practices	<p><b>Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.</b></p> <ul style="list-style-type: none"> <li>Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.2</b> Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p> <p><b>RST.6-8.9</b> 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><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.3.</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p><b>CV8.5.4</b> Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	<p><b>MP.6</b> 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 quantity
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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<b>Phenomena that can be observed at one scale may not be observable at another scale.</b>
	<b>Disciplinary Core Ideas</b>	<b>Structure and Function:</b> <ul style="list-style-type: none"> <li>All living things are made up of cells, which is the smallest unit that can be said to be alive.</li> <li>An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<b>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.</b> <ul style="list-style-type: none"> <li>Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>WHST.6-8.7</b> 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><b>6.EE.C.9</b> 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><b>MS-LS1-2. Develop and use models to describe the parts, functions, and basic processes of cells.</b></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><b>Crosscutting Concepts</b></p>	<p><b>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.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Structure and Function:</b></p> <ul style="list-style-type: none"> <li>• Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>• Develop and use a model to describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>SL.8.5</b> Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>		<p><b>6.EE.C.9</b> 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><b>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</b></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><b>Crosscutting Concepts</b></p>	<p><b>Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Structure and Function:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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).</b></p> <ul style="list-style-type: none"> <li>Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RI.6.8</b> 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><b>WHST.6-8.1</b> Write arguments focused on discipline content.</p>		<p><b>6.EE.C.9</b> 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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<b>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>Growth and Development of Organisms:</b></p> <ul style="list-style-type: none"> <li>Animals engage in characteristic behaviors that increase the odds of reproduction.</li> <li>Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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).</b></p> <ul style="list-style-type: none"> <li>Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RI.6.8</b> 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><b>WHST.6-8.1</b> Write arguments focused on discipline content.</p>	<p><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.5.4</b> Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p>	<p><b>6.SP.A.2</b> 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><b>6.SP.B.4</b> 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><b>MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.</b></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><b>Growth and Development of Organisms:</b></p> <ul style="list-style-type: none"> <li>Genetic factors as well as local conditions affect the growth of the adult plant.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.2</b> Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p> <p><b>WHST.6-8.2</b> 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><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p>	<p><b>6.SP.A.2</b> 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><b>6.SP.B.4</b> 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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<p><b>Within a natural system, the transfer of energy drives the motion and/or cycling of matter.</b></p>
	<b>Disciplinary Core Ideas</b>	<p><b>Organization for Matter and Energy Flow in Organisms:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><b>Energy in Chemical Processes and Everyday Life:</b></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"> <li>In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts. <b>RST.6-8.2</b> Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p> <p><b>WHST.6-8.2</b> 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><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research.</p>		<p><b>6.EE.C.9</b> 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><b>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.</b></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><b>Matter is conserved because atoms are conserved in physical and chemical processes.</b></p>
	Disciplinary Core Ideas	<p><b>Organization for Matter and Energy Flow in Organisms:</b></p> <ul style="list-style-type: none"> <li>• 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.</li> </ul> <p><b>Energy in Chemical Processes and Everyday Life:</b></p> <ul style="list-style-type: none"> <li>• 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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>• Develop a model to describe unobservable mechanisms.</li> </ul>
Wyoming Cross-Curricular Connections		
<b>ELA / Literacy Connections</b>		<b>Mathematics Connections</b>
<p><b>SL.8.5</b> 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><b>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.</b></p> <p>State Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.</p>	<p><b>Crosscutting Concepts</b></p>	<p><b>Cause and effect relationships may be used to predict phenomena in natural systems.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Information Processing:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
Wyoming Cross-Curricular Connections		
<p><b>ELA / Literacy Connections</b></p>		<p><b>Mathematics Connections</b></p>
<p><b>WHST.6-8.8</b> 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><b>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.</b></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><b>Crosscutting Concepts</b></p>	<p><b>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Interdependent Relationships in Ecosystems:</b></p> <ul style="list-style-type: none"> <li>Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.</li> <li>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.</li> <li>Growth of organisms and population increases are limited by access to resources.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Analyze and interpret data to provide evidence for phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.7</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.2</b> 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><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p>	<p><b>MP.4</b> Model with mathematics.</p>



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

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.</b></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>	<b>Crosscutting Concepts</b>	<b>Patterns can be used to identify cause and effect relationships.</b>
	<b>Disciplinary Core Ideas</b>	<b>Interdependent Relationships in Ecosystems:</b> <ul style="list-style-type: none"> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<b>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.</b> <ul style="list-style-type: none"> <li>Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>WHST.6-8.2</b> 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><b>WHST.6-8.9</b> Draw evidence from literary or informational texts to support analysis, reflection, and research.</p> <p><b>SL.8.1</b> 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><b>SL.8.4</b> 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><b>SS8.5.1</b> Use and create models of the Earth to analyze the interactions of physical and human systems to demonstrate global interconnectedness.</p>	<p><b>6.SP.B.5</b> 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><b>MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.</b></p> <p><b>Clarification Statement:</b> 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><b>State Assessment Boundary:</b> Assessment does not include the use of chemical reactions to describe the processes.</p>	<b>Crosscutting Concepts</b>	<p><b>The transfer of energy can be tracked as energy flows through a natural system.</b></p>
	<b>Disciplinary Core Ideas</b>	<p><b>Cycle of Matter and Energy Transfer in Ecosystems:</b></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Transfers of matter into and out of the physical environment occur at every level.</li> <li>• Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments.</li> <li>• The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>• Develop a model to describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p><b>SL.8.5</b> Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.</p>	<p><b>SS8.5.1</b> Use and create models of the Earth to analyze the interactions of physical and human systems to demonstrate global interconnectedness.</p>	<p><b>6.EE.C.9</b> 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><b>MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.</b></p> <p><i>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.</i></p> 	Crosscutting Concepts	Small changes in one part a system might cause large changes in another part.
	Disciplinary Core Ideas	<p><b>Ecosystem Dynamics, Functioning, and Resilience:</b></p> <ul style="list-style-type: none"> <li>Ecosystems are dynamic in nature; their characteristics can vary over time.</li> <li>Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.</li> </ul>
	Science & Engineering Practices	<p><b>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).</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RI.8.8</b> 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><b>WHST.6-8.1</b> Write arguments to support claims with clear reasons and relevant evidence.</p> <p><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research.</p>		<p><b>MP.7</b> Look for and make use of structures.</p>



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

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.</b></p> <p><b>Clarification Statement:</b> 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 &amp; 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>	<b>Crosscutting Concepts</b>	<b>Small changes in one part of a system might cause large changes in another part.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>Ecosystem Dynamics, Functioning, and Resilience:</b></p> <ul style="list-style-type: none"> <li>Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems.</li> <li>The completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health.</li> </ul> <p><b>Biodiversity and Humans:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><b>Developing Possible Solutions:</b></p> <ul style="list-style-type: none"> <li>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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).</b></p> <ul style="list-style-type: none"> <li>Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Social Studies Connections	Mathematics Connections
<p><b>RST.6-8.8</b> Distinguish among facts, reasoned judgement based on research findings, and speculation in a text.</p> <p><b>WHST.6-8.9</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.5.2</b> Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p><b>SS8.3.3</b> 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><b>SS8.3.5</b> Describe how values and beliefs influence individual, family, and business decisions (microeconomics).</p>	<p><b>MP.4</b> Model with mathematics.</p> <p><b>6.RP.A.3</b> 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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<p><b>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.</b></p>
	<b>Disciplinary Core Ideas</b>	<p><b>Inheritance of Traits:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.</li> </ul> <p><b>Variation of Traits:</b></p> <ul style="list-style-type: none"> <li>In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations.</li> <li>Though rare, mutations may result in changes to the structure and function of proteins.</li> <li>Some changes are beneficial, others harmful, and some neutral to the organism.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.4</b> 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><b>RST.6-8.7</b> 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><b>SL.8.5</b> Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>		<p><b>MP.2</b> Reason abstractly and quantitatively.</p>



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

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>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.</b></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	Cause and effect relationships may be used to predict phenomena in natural systems.
	Disciplinary Core Ideas	<p><b>Growth and Development of Organisms:</b></p> <ul style="list-style-type: none"> <li>Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.</li> </ul> <p><b>Inheritance of Traits:</b></p> <ul style="list-style-type: none"> <li>Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.</li> </ul> <p><b>Variation of Traits:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.4</b> 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><b>RST.6-8.7</b> 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><b>SL.8.5</b> Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>	<p><b>CV8.3.3</b> 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><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p>	<p><b>MP.4</b> Model with mathematics.</p> <p><b>6.SP.B.5</b> 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><b>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.</b></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><b>Graphs, charts, and images can be used to identify patterns in data.</b></p>
	Disciplinary Core Ideas	<p><b>Evidence of Common Ancestry and Diversity:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Analyze and interpret data to determine similarities and differences in findings.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p><b>RST.6-8.7</b> 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><b>6.EE.B.6</b> 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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<b>Patterns can be used to identify cause and effect relationships.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>Evidence of Common Ancestry and Diversity:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Apply scientific ideas to construct an explanation for real- world phenomena, examples, or events.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p><b>WHST.6-8.2</b> 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><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research.</p> <p><b>SL.8.1</b> 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><b>SL.8.4</b> 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><b>6.EE.B.6</b> 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](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><b>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.</b></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><b>Natural Selection:</b></p> <ul style="list-style-type: none"> <li>Natural selection leads to the predominance of certain traits in a population and the suppression of others.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Voc. Ed. Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions</p> <p><b>RST.6-8.9</b> 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><b>WHST.6-8.2</b> 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><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research.</p> <p><b>SL.8.1</b> 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><b>SL.8.4</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>6.RP.A.1</b> Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p><b>6.SP.B..5</b> Summarize numerical data sets in relation to their context.</p> <p><b>7.RP.A.2</b> Recognize and represent proportional relationships between quantities.</p>



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

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.</b></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><b>Crosscutting Concepts</b></p>	<p><b>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Natural Selection:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
<p>Engineering, Technology &amp; Application of Science Connections MS-ETS2-1 (pg. 170) MS-ETS2-2 (pg. 171)</p>	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>WHST.6-8.8</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.3</b> 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><b>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.</b></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><b>Adaptation:</b></p> <ul style="list-style-type: none"> <li>Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions.</li> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Use mathematical representations to support scientific conclusions and design solutions.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
N/A		<p><b>MP.4</b> Model with mathematics.</p> <p><b>6.RP.A.1</b> Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p><b>6.SP.B.5</b> Summarize numerical data sets in relation to their context.</p> <p><b>7.RP.A.2</b> 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 quantity
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><b>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.</b></p> <p><i>Clarifying Statement: Examples of models can be physical, graphical, or conceptual.</i></p>	<b>Crosscutting Concepts</b>	<b>Patterns can be used to identify cause-and-effect relationships.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>The Universe and Its Stars:</b></p> <ul style="list-style-type: none"> <li>Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.</li> </ul> <p><b>Earth and the Solar System:</b></p> <ul style="list-style-type: none"> <li>The model of the solar system can explain eclipses of the sun and the moon.</li> <li>Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun.</li> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

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



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

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.</b></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>	<b>Crosscutting Concepts</b>	<b>Models can be used to represent systems and their interactions.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>The Universe and Its Stars:</b></p> <ul style="list-style-type: none"> <li>Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.</li> </ul> <p><b>Earth and the Solar System:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p><b>SL.8.5</b> Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>	<p><b>MP.4</b> Model with mathematics.</p> <p><b>6.RP.A.1</b> Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p><b>6.EE.B.6</b> 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><b>7.RP.A.2</b> Recognize and represent relationships between quantities.</p> <p><b>7.EE.B.4</b> 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><b>MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.</b></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 &amp; 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><b>Earth and the Solar System:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Analyze and interpret data to determine similarities and differences in findings.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.7</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.RP.A.1</b> Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p><b>7.RP.A.2</b> 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><b>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.</b></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><b>The History of Planet Earth:</b></p> <ul style="list-style-type: none"> <li>The geologic time scale interpreted from rock strata provides a way to organize Earth's history.</li> <li>Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>WHST.6-8.2</b> 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><b>6.EE.B.6</b> 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><b>7.EE.B.4</b> 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><b>MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.</b></p> <p><b>Clarification Statement:</b> 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><b>State Assessment Boundary:</b> Assessment does not include the identification and naming of minerals.</p>	<p><b>Crosscutting Concepts</b></p>	<p><b>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.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Earth's Materials and Systems:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul>

Wyoming Cross-Curricular Connections		
ELA / Literacy Connections	Fine & Performing Arts Connections	Mathematics Connections
<p><b>SL.8.5</b> Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>	<p><b>FPA8.4.A.1</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p>



# Earth's Systems [MS-ESS2-2]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.</b></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><b>Earth's Materials and Systems:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><b>The Roles of Water in Earth's Surface Processes:</b></p> <ul style="list-style-type: none"> <li>Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>WHST.6-8.2</b> 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><b>SL.8.5</b> Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p>	<p><b>SS.8.5.4</b> Analyze the changes to and consequences of human, natural, and technological impacts on the physical environment.</p>	<p><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.EE.B.6</b> 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><b>7.EE.B.4</b> 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><b>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.</b></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><b>Crosscutting Concepts</b></p>	<p><b>Patterns in rates of change and other numerical relationships can provide information about natural systems.</b></p>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>The History of Planet Earth:</b> Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.</p> <p><b>Plate Tectonics and Large Scale System Interactions:</b></p> <ul style="list-style-type: none"> <li>• 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.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>• Analyze and interpret data to provide evidence for phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections		Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.7</b> 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><b>RST.6-8.9</b> 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><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.EE.B.6</b> 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><b>7.EE.B.4</b> 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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<b>Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.</b>
	<b>Disciplinary Core Ideas</b>	<b>The Roles of Water in Earth's Surface Processes:</b> <ul style="list-style-type: none"> <li>Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.</li> <li>Global movements of water and its changes in form are propelled by sunlight and gravity.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<b>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.</b> <ul style="list-style-type: none"> <li>Develop a model to describe unobservable mechanisms.</li> </ul>
Wyoming Cross-Curricular Connections		
<b>ELA / Literacy Connections</b>		<b>Mathematics Connections</b>
N/A		<b>MP.2</b> Reason abstractly and quantitatively.



# Earth's Systems [MS-ESS2-5]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</b></p> <p><b>Clarification Statement:</b> 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><b>State Assessment Boundary:</b> 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>	<b>Crosscutting Concepts</b>	<b>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</b>
	<b>Disciplinary Core Ideas</b>	<b>Weather and Climate:</b> <ul style="list-style-type: none"> <li>Because these patterns are so complex, weather can only be predicted probabilistically.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<b>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.</b> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.9</b> 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><b>WHST.6-8.8</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.2</b> 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><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p><b>CV8.5.4</b> Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.</p>	<p><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.NS.C.5</b> 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><b>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.</b></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><b>Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy, matter, and information flows within systems.</b></p>
	Disciplinary Core Ideas	<p><b>The Roles of Water in Earth's Surface Processes:</b></p> <ul style="list-style-type: none"> <li>Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.</li> </ul> <p><b>Weather and Climate:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

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



# Earth and Human Activity [MS-ESS3-1]

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p><b>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.</b></p> <p><b>Clarification Statement:</b> 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>	<b>Crosscutting Concepts</b>	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
	<b>Disciplinary Core Ideas</b>	<p><b>Natural Resources:</b></p> <ul style="list-style-type: none"> <li>• Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources.</li> <li>• Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes.</li> <li>• These resources are distributed unevenly around the planet as a result of past geologic processes.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>• 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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>WHST.6-8.2</b> 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><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p><b>6.EE.B.6</b> 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><b>7.EE.B.4</b> 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><b>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.</b></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	<p><b>Natural Hazards:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Analyze and interpret data to provide evidence for phenomena.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>RST.6-8.7</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.4.2</b> 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><b>CV8.4.3</b> Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.</p> <p><b>CV8.4.4</b> Career-aware students integrate and translate content presented in diverse formats and media including visually and quantitatively, as well as in words.</p> <p><b>CV8.5.2</b> Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.EE.B.6</b> 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><b>7.EE.B.4</b> 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><b>MS-ESS3-3. Apply scientific principles to design a method for monitoring, evaluating, and managing a human impact on the environment.</b></p> <p><b>Clarification Statement:</b> 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 &amp; 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>	<b>Crosscutting Concepts</b>	<b>Relationships can be classified as casual or correlational, and correlation does not necessarily imply causation.</b>
	<b>Disciplinary Core Ideas</b>	<p><b>Human Impacts on Earth Systems:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Apply scientific principles to design an object, tool, process or system.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Ed. Connections	Mathematics Connections
<p><b>WHST.6-8.7</b> 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><b>WHST.6-8.8</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.5.1</b> Career-aware students identify technical and digital systems, how the are properly and ethically used and their relationship to other systems globally.</p> <p><b>CV8.5.2</b> Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p><b>6.RP.A.1</b> Understand the concept of a ratio and use ratio language to describe a ratio between two quantities.</p> <p><b>7.RP.A.2</b> Recognize and represent proportional relationships between quantities.</p> <p><b>6.EE.B.6</b> 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><b>7.EE.B.4</b> 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]

<b>Performance Expectations</b> (Benchmark)	<b>Three Dimensions of Learning</b>	
<p><b>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.</b></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>	<b>Crosscutting Concepts</b>	<b>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</b>
	<b>Disciplinary Core Ideas</b>	<b>Human Impacts on Earth Systems:</b> <ul style="list-style-type: none"> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<b>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).</b> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

<b>ELA / Literacy</b>	<b>Social Studies Connections</b>	<b>Career &amp; Vocational Ed. Connections</b>	<b>Mathematics Connections</b>
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p> <p><b>WHST.6-8.1</b> Write arguments focused on discipline content.</p> <p><b>WHST.6-8.9</b> Draw evidence from informational texts to support analysis, reflection, and research.</p>	<p><b>SS8.3.1</b> Identify and apply basic economic concepts (e.g., supply, demand, production, exchange and consumption, labor, wages, scarcity, prices, incentives, competition, and profits).</p> <p><b>SS8.3.2</b> 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><b>SS8.3.3</b> 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><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision-making.</p> <p><b>CV8.3.3</b> 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><b>CV8.5.1</b> Career-aware students identify technical and digital systems, how they are properly and ethically used and their relationship to other systems globally.</p> <p><b>CV8.5.2</b> Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p><b>6.RP.A.1</b> Understand the concept of a ratio and use ratio language to describe a ratio between two quantities.</p> <p><b>7.RP.A.2</b> Recognize and represent proportional relationships between quantities.</p> <p><b>6.EE.B.6</b> 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><b>7.EE.B.4</b> 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><b>MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused changes in global temperatures over time.</b></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 &amp; 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><b>Global Climate Change:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Ask questions to identify and clarify evidence of an argument.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
<p><b>RST.6-8.1</b> Cite specific textual evidence to support analysis of science and technical texts.</p>	<p><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.3.3</b> 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><b>CV8.5.1</b> Career-aware students identify technical and digital systems, how they are properly and ethically used and their relationship to other systems globally.</p> <p><b>CV8.5.2</b> Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.</p>	<p><b>MP.2</b> Reason abstractly and quantitatively.</p> <p><b>6.EE.B.6</b> 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><b>7.EE.B.4</b> 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><b>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.</b></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><b>Crosscutting Concepts</b></p>	<ul style="list-style-type: none"> <li>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.</li> <li>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.</li> </ul>
	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Defining and Delimiting Engineering Problems:</b>            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><b>Science &amp; Engineering Practices</b></p>	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	<p><b>CV8.3.1</b> Career-aware students identify real-world problems and efficiently locate &amp; effectively use various sources of information for informed decision making.</p> <p><b>CV8.5.4</b> 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><b>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</b></p> <p><i>Clarification Statement: Preliminary building designs could involve overall dimensions, number of rooms, entries &amp; 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><b>Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	<p><b>CV8.5.2</b> 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><b>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.</b></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><b>Developing Possible Solutions:</b></p> <ul style="list-style-type: none"> <li>• There are systematic processes for evaluating solutions with respect to how well they met the criteria and constraints of a problem.</li> <li>• Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>• Analyze and interpret data to determine similarities and differences in findings.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Career & Vocational Education Connections	Mathematics Connections
N/A	<p><b>CV8.3.3</b> 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><b>CV8.4.3</b> 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><b>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.</b></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><b>Developing Possible Solutions:</b></p> <ul style="list-style-type: none"> <li>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.</li> <li>Models of all kinds are important for testing solutions.</li> </ul> <p><b>Optimizing the Design Solution:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	Science & Engineering Practices	<p><b>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.</b></p> <ul style="list-style-type: none"> <li>Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.</li> </ul>

## Wyoming Cross-Curricular Connections

ELA / Literacy Connections	Social Studies Connections	Mathematics Connections
N/A	<b>SS8.4.2</b> 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><b>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.</b></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>	<b>Crosscutting Concepts</b>	<b>Define the system—specifying its boundaries and make an explicit model of that system.</b>
	<b>Disciplinary Core Ideas</b>	<b>Interdependence of Science, Engineering, and Technology</b> <ul style="list-style-type: none"> <li>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.</li> </ul>
	<b>Science &amp; Engineering Practices</b>	<b>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.</b> <ul style="list-style-type: none"> <li>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.</li> </ul>

## 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><b>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.</b></p> <p><b>Clarification Statement:</b> 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.</p>	<p><b>Crosscutting Concepts</b></p>	<p><b>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</b></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>	<p><b>Disciplinary Core Ideas</b></p>	<p><b>Influence of Engineering, Technology, and Science on Society and the Natural World:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
	<p><b>Science &amp; Engineering Practices</b></p>	<p><b>Developing and using models:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>
Wyoming Cross-Curricular Connections		

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

## **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>**