

2016 WYOMING SCIENCE

CONTENT AND PERFORMANCE STANDARDS

WYOMING STATE BOARD OF EDUCATION

Pete Gosar, Chairman

Sue Belish

Kathryn Sessions

Kathy Coon, Vice Chair.

Nate Breen

Robin Schamber

Ken Rathbun, Treasurer

Hugh Hageman

Walt Wilcox

Jillian Balow, State
Superintendent

Scotty Ratliff

Belenda Willson

Jim Rose, ex officio

Effective September 23, 2016

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

ACKNOWLEDGEMENT

The Wyoming State Board of Education would like to thank the Wyoming Department of Education, as well as educators, parents and community members, business and industry representatives, community college representatives, and the University of Wyoming representatives for their help with the development of these science standards.

**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**

The Wyoming Department of Education does not discriminate on the basis of race, color, national origin, sex, age, or disability in admission or access to, or treatment or employment in its educational programs or activities. Inquiries concerning Title VI, Title IX, Section 504, and the Americans with Disabilities Act may be referred to the Wyoming Department of Education, Office for Civil Rights Coordinator, 2nd floor, Hathaway Building, Cheyenne, Wyoming 82002-0050 or (307) 777-6252, or the Office for Civil Rights, Region VIII, U. S. Department of Education, Federal Building, Suite 310, 1244 Speer Boulevard, Denver, CO 80204-3582, or (303) 844-5695 or TDD (303) 844-3417. This publication will be provided in an alternative format upon request.

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

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

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

W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

Social Studies Connections

SS5.5.2 Explain how physical features, patterns, and systems impact different regions and how these features may help us generalize and compare areas within the state, nation, or world.

Mathematics Connections

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

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

Jennifer Hammock, Fremont CSD #38

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

Elementary Standards

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

Fourth Grade



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

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

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

Crosscutting Concepts

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

Connections to Engineering, Technology, and Applications of Science

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

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

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

Energy [4-PS3-1]



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

Wyoming Cross-Curricular Connections

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

Energy [4-PS3-2]



Performance Expectations (Benchmark)

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

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

Three Dimensions of Learning

Crosscutting Concepts

Energy can be transferred in various ways and between objects.

Disciplinary Core Ideas

Definitions of Energy:

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

Conservation of Energy and Energy Transfer:

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

Science & Engineering Practices

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

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

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

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

Mathematics Connections

N/A

Energy [4-PS3-3]



Performance Expectations (Benchmark)

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

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

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

Three Dimensions of Learning

Crosscutting Concepts

Energy can be transferred in various ways and between objects.

Disciplinary Core Ideas

Definitions of Energy:

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

Conservation of Energy and Energy Transfer:

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

Relationship Between Energy and Forces:

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

Science & Engineering Practices

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

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

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

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

Mathematics Connections

N/A

Energy [4-PS3-4]



4th

Performance Expectations (Benchmark)

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

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

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

Engineering, Technology & Application of Science
Connections

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

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

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

Three Dimensions of Learning

Crosscutting Concepts

Energy can be transferred in various ways and between objects.

Disciplinary Core Ideas

Conservation of Energy and Energy Transfer:

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

Energy in Chemical Processes and Everyday Life:

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

Defining Engineering Problems:

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

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

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

- Engineers improve existing technologies or develop new ones.

Science & Engineering Practices

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

- Apply scientific ideas to solve design problems.

Wyoming Cross-Curricular Connections

ELA / Literacy Connections

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

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

Mathematics Connections

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



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

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

Wyoming Cross-Curricular Connections

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



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

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

Wyoming Cross-Curricular Connections

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

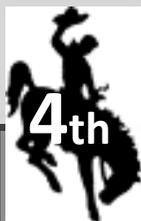


Waves and Their Applications in Technology for Information Transfer [4-PS4-3]

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

Wyoming Cross-Curricular Connections

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



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

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

Wyoming Cross-Curricular Connections

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



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

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



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

Performance Expectations (Benchmark)	Three Dimensions of Learning	
<p>4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.</p> <p><i>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.</i></p> <p><i>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.</i></p>	<p>Crosscutting Concepts</p>	<p>Patterns can be used as evidence to support an explanation.</p>
	<p>Disciplinary Core Ideas</p>	<p>The History of Planet Earth:</p> <ul style="list-style-type: none"> Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.
	<p>Science & Engineering Practices</p>	<p>Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> Identify the evidence that supports particular points in an explanation.

Wyoming Cross-Curricular Connections

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



Earth's Systems [4-ESS2-1]

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

Wyoming Cross-Curricular Connections

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



Earth's Systems [4-ESS2-2]

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

Wyoming Cross-Curricular Connections

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



Earth and Human Activity [4-ESS3-1]

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

Wyoming Cross-Curricular Connections

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



Earth and Human Activity [4-ESS3-2]

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

Wyoming Cross-Curricular Connections

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



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

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

Wyoming Cross-Curricular Connections

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



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

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



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

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

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>