North Dakota Science Content Standards

Grades K-12

February 2019

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Foreword

These new North Dakota academic content standards for science give our educators, school administrators, and parents the information they need about what our students should know, and be able to do, during each step of their education journey, from kindergarten through high school.

The North Dakota Constitution recognizes the importance of public education in nurturing prosperity, happiness, and a “high degree of intelligence, patriotism, integrity and morality.” Statewide academic content standards, and an assessment system that measures student progress, help us to reach these noble objectives. By using our new, challenging science standards to measure student achievement, we can monitor growth, address deficiencies, and ensure comparability of educational opportunity statewide.

While these North Dakota science standards represent a statewide reference point for teaching science content in classrooms, local school districts are encouraged to use the standards as a guide for developing their own local, customized science curriculum.

This publication is the result of months of conscientious work by 34 North Dakota science educators from our K-12 schools and university system. They agreed to devote the many hours needed to write these new standards. They represented various areas of expertise, including general education, special education, English learners, early childhood education, and higher education.

The work on these new standards began in January 2018 and continued throughout the year. The writing committee’s drafts were made available for public comment, which generated useful opinions from teachers, administrators, parents, and the community.

A panel of business people, community leaders, and representatives of the general public provided another layer of review. These included representatives of private sector business, including representatives of energy and agriculture, and people who have strong beliefs about what our science standards should include. I am grateful to those who devoted their time and talents to go over these drafts and provide their recommendations to the writing committee.

No one is better qualified to improve our North Dakota science standards than our North Dakota educators. This document is an exemplar of the best in North Dakota education – North Dakota teachers, writing statewide standards in an open, transparent and painstaking manner.

Each member of the writing team deserves our thanks for their extensive research, analysis and deliberations. Thanks to their work, these standards are ready to be used in our classrooms across the state.

Kirsten Baesler
Superintendent of Public Instruction
February 2019

Document Revision Log

Date	Page	Standard	Section	Incorrect Information	Change/Corrections
10/25/19	304	4-PS4-2	Appendix	Reference to Grade 4 standard	Removed from Appendix A
10/25/19	318	4-PS4-2	Appendix	Reference to Grade 4 standard	Removed from Appendix B
12/10/19	111	ESS1-3	Crosscutting Concepts	Title: Systems and System Models	Scale, Proportion, and Quantity
12/10/19	112	ESS1-4	Crosscutting Concepts	Title: Systems and System Models	Scale, Proportion, and Quantity
12/10/19	113	ESS2-1	Crosscutting Concepts	Title: Systems and System Models	Suitability and Change
12/10/19	114	ESS2-2	Crosscutting Concepts	Title: Systems and System Models	Scale, Proportion, and Quantity
12/10/19	116	ESS2-4	Crosscutting Concepts	Title: Systems and System Models	Energy and Matter
12/10/19	123	ESS3-5	Crosscutting Concepts	Title: Structure and Function	Stability and Change
12/10/19	125	LS1-1	Crosscutting Concepts	Title: Systems and System Models	Scale, Proportion, and Quantity
12/10/19	126	LS1-2	Crosscutting Concepts	Title: Systems and System Models	Structure and Function
12/10/19	130	LS1-6	Disciplinary Core Ideas; LS1.C	(Black type) 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	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.
12/10/19	130	LS1-6	Disciplinary Core Ideas; PS3.D	(Black type) 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.	The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen.
12/10/19	134	LS2-3	Crosscutting Concepts	Title: Systems and System Models	Energy and Matter
12/10/19	135	LS2-4	Crosscutting Concepts	Title: Cause and Effect	Stability and Change
12/10/19	152	PS2-1	Crosscutting Concepts	Title: Structure and Function	Stability and Change

Document Revision Log

Date	Page	Standard	Section	Incorrect Information	Change/Corrections
12/10/19	223	ESS1-4	Disciplinary Core Ideas	ESS1.A: The Universe and Its Stars (whole section)	ESS1.B: Earth and the Solar System Kepler's laws describe common features of motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.
12/10/19	234	ESS3-2	Disciplinary Core Ideas	ESS3.B Natural Hazards and information beneath it	ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to accounting for a range of constraints.

Changes based on email to Amanda from Standards Analyst Renee Anderson Sept. 13, 2019.

Table of Contents

Introduction

Purpose and Development:
The North Dakota Science Content Standards focus on providing hands-on practices as well as rigorous content knowledge. These standards are a collaborative effort of K-12 educators, college instructors, and curriculum advisors from across the state of North Dakota. The standards were developed using the most current research and trends in science education with a focus on embedding the science and engineering practices to develop and support critical thinking skills.
The science standards have been aligned vertically across the disciplines and grade levels to provide all students with a solid foundation. North Dakota's issues and interests have been considered and emphasized throughout the document while using the Next Generation Science Standards as well as other state science standards as a framework. These standards were developed in a manner that provide local districts and their educators the autonomy to construct curriculum to meet the needs of their students.

Disciplinary Core Ideas (DCIs)
Disciplinary Core Ideas describe the most essential ideas (content) of the performance standards that students will understand.
The DCIs are grouped into four science domains.

1. Physical Science (PS)
2. Life Science (LS)
3. Earth and Space Science (ESS)
4. Engineering and Technology (ET)

Science and Engineering Practices (SEPs)
The SEPs were used to construct the performance standards to guide instruction using practices encapsulated by these eight categories.

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

K-12 science instruction utilizing the Science and Engineering Practices will:

1. Have broad importance across multiple sciences or engineering disciplines or be a key organizing principle of a single discipline.
2. Provide a key tool for understanding or investigating more complex ideas and solving problems.
3. Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge.
4. Be scaffolded to support learning over multiple grades at increasing levels of depth and sophistication.

Crosscutting Concepts (CCs)

Crosscutting Concepts are fundamental science concepts which are embedded into each performance standard. These concepts serve the purpose of linking all the domains of science and the knowledge contained within to foster an intelligible and scientific understanding of the world around us. The CCs will be utilized at all grade levels in all domains.

The CCs include these universal scientific concepts:

1. Patterns
2. Cause and Effect
3. Scale, Proportion and Quantity
4. Systems and System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

North Dakota Connections

Opportunities to teach science directly relevant to our state are highlighted throughout the North Dakota State Science Standards as North Dakota Connections. These connections provide educators with local, regional, and state specific contexts for teaching, learning, and assessment. Educators may use these resources for investigations with students. This approach provides opportunities for educators to draw upon North Dakota’s natural environment and rich history, while utilizing resources in engineering design and scientific research to support student learning.

The following icons represent grade levels, content domains and/or high school courses.

K 1 2 3 4 5 MS HS

Anatomy

Biology

Chemistry

Earth & Space Science

Environmental Science

Life Science

Physical Science

Physics

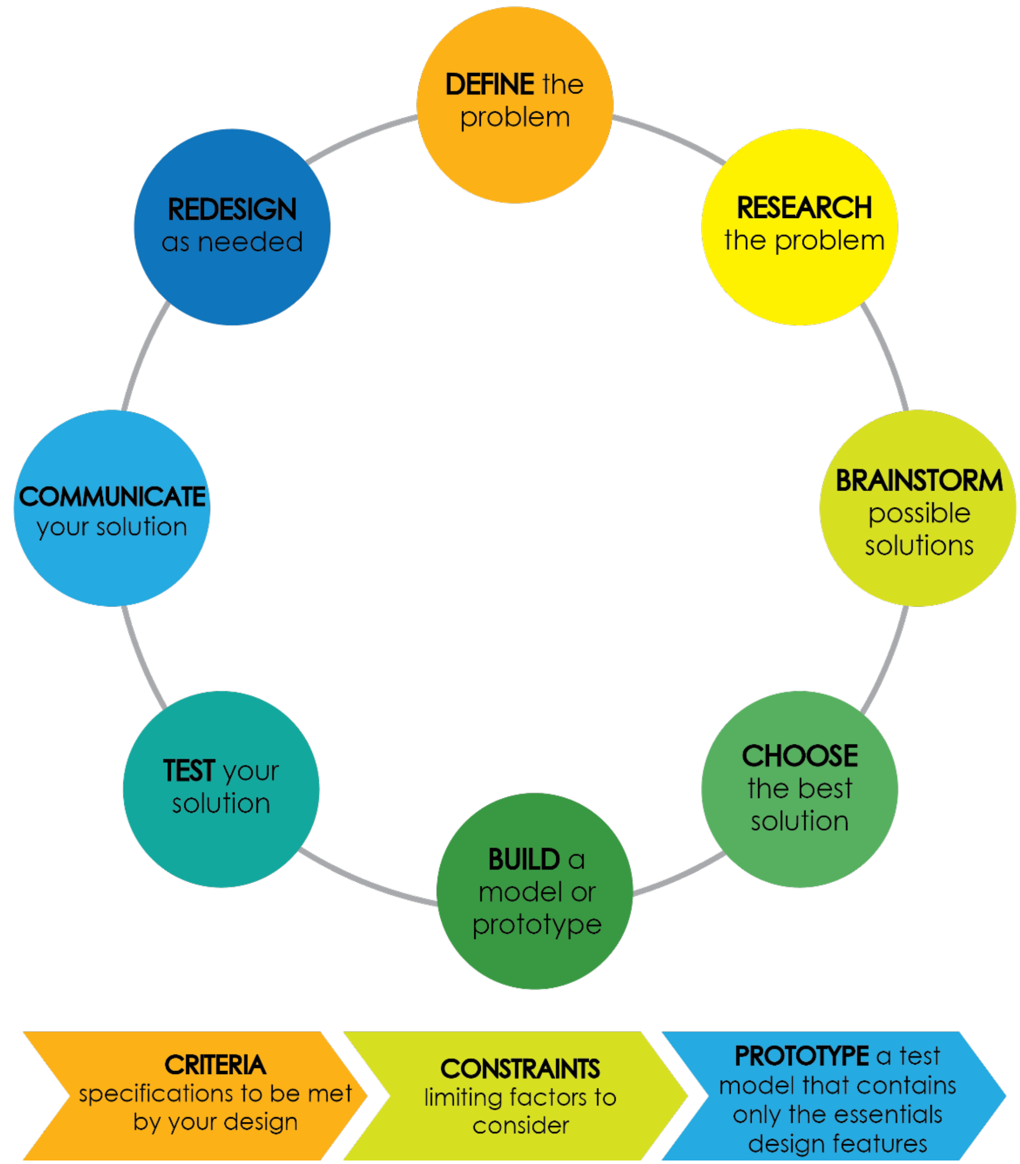
Engineering & Technology

ND Connections

Engineering & Technology

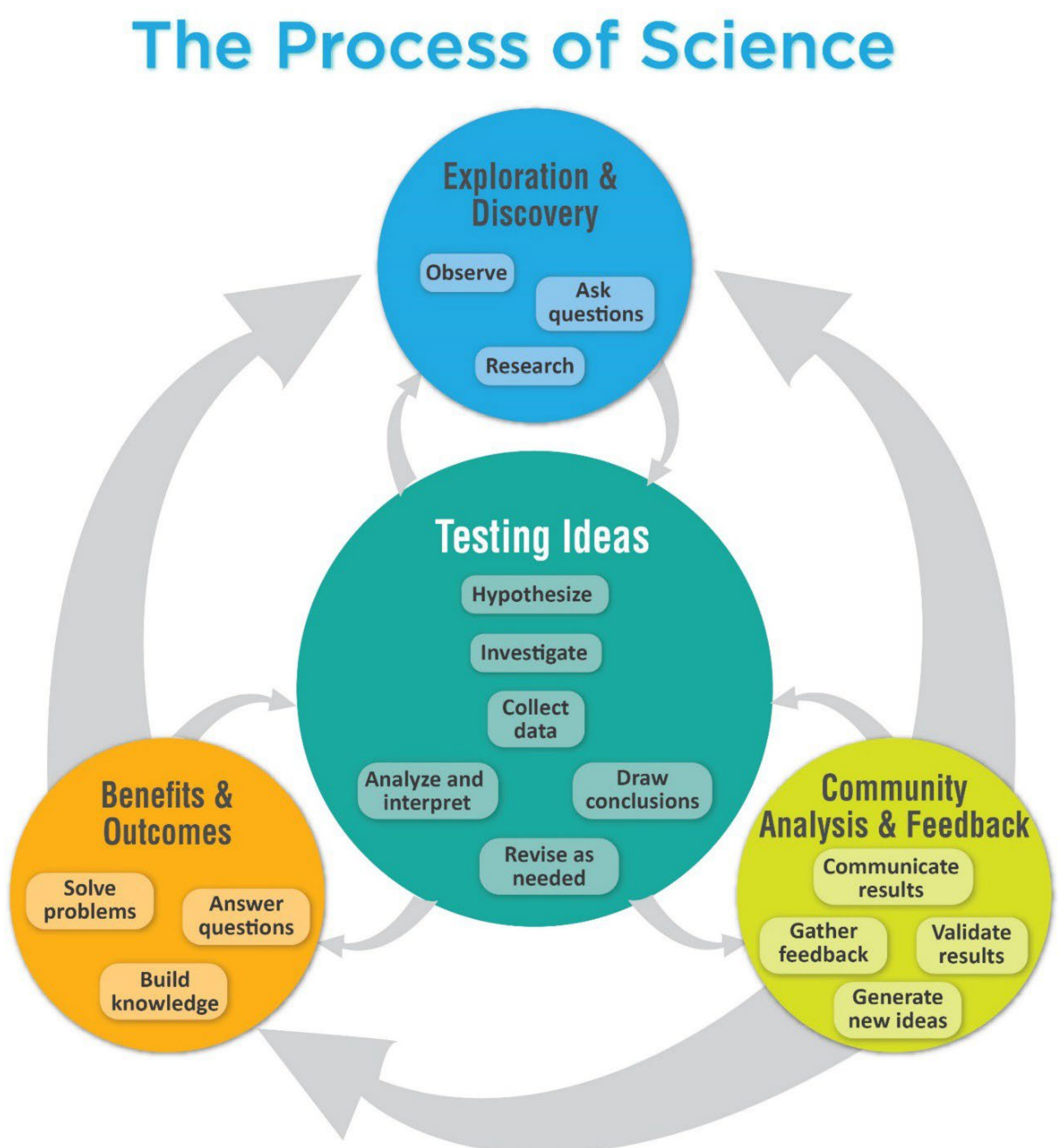
The engineering and technology standards are integrated into each grade level and discipline. The engineering and technology performance standards are based upon the application of the engineering design process (EDP). The EDP provides students with a means of doing science rather than just knowing it. These practices help students form an understanding of the crosscutting concepts and disciplinary core ideas of science. Practicing the EDP helps students understand the link between science and engineering, making their knowledge more meaningful.

Engineering Design Process



The Process of Science

Science is a process for experimentation that is used to explore observations and answer questions. The goal is to discover cause and effect relationships by making observations, asking questions, carefully gathering and examining the evidence, to determine if all the available information can be combined into a logical conclusion.



This science flowchart has been modified from www.understandingscience.org, authored by © 2007. The University of California Museum of Paleontology, Berkeley, and the Regents of the University of California.

Science and Engineering Practices:

1. Asking questions and defining problems
   - Asking questions and defining problems in K-12 builds on prior experiences and progresses to simple descriptive questions.

2. Developing and using models
   - Modeling in K-12 builds on prior experiences and progresses to include using and developing models (i.e., diagrams, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

3. Planning and carrying out investigations
   - Planning and carrying out K-12 investigations to answer questions or test solutions to problems build on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

4. Analyzing and interpreting data
   - Analyzing data in K-12 builds on prior experiences and progresses to collecting, recording, and sharing observations.

5. Using mathematics and computational thinking
   - Using mathematics and computational thinking in K-12 builds logical reasoning and problem-solving skills.

6. Constructing explanations and designing solutions
   - Constructing explanations and designing solutions in K-12 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

7. Engaging in argument from evidence
   - Engaging in argument from evidence in K-12 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).

8. Obtaining, evaluating, and communicating information
   - Obtaining, evaluating, and communicating information in K-12 builds on prior experiences and uses observations and texts to communicate new information.

Grade

Topic Number

Performance Standard

ND Connection

Science Content

3

3-PS2-1

Domain

Descriptor

ND Science Standards

Motion & Stability: Forces & Interactions

Performance standards are the benchmarks; the skills and content students should master.

Performance Standard 3-PS2-1	Plan and Conduct an investigation to prove the effects of balanced and unbalanced forces on the motion of an object.

Clarification statements provide further explanation or examples to support educators.

Clarification Statement	Examples could include an unbalanced force on one side of a ball can make it start moving; and balanced forces pushing on a box from both sides will not produce any motion at all.	
Assessment Boundary	Assessment is limited to one variable at a time: number, size, or direction of forces.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. **Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information 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. 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. Scientific Investigations Use a Variety of Methods Science investigations use a variety of methods, tools, and techniques.	Cause and effect relationships are routinely identified.
North Dakota Connection	**Apply unbalanced forces to North Dakota winters. Examples include cars sliding on ice, sleds on snow, ice skating, etc.**	
Content Resources		

Assessment Boundary: Specific limits for assessment of the performance standards.

Disciplinary Core Ideas (DCI) represent the essential ideas all students should know and understand.

Science & Engineering Practices (SEP) describe behaviors that scientists and engineers use. They help students develop problem solving skills and better understand their world through investigation.

Crosscutting Concepts (CC) represent themes that span across engineering and science disciplines. They link the different domains of science.

North Dakota Connection contains resources in North Dakota that relate to this standard.

Content Resources provides a link to evidence of content instruction necessary for performance assessment proficiency.

Elementary science standards are grouped by grade level, and each grade level is identified by an icon.

Elementary science standards include the following content domains.

- Earth and Space Science (ESS)
- Life Science (LS)
- Physical Science (PS)
- Engineering & Technology (ET)

Kindergarten

Motion and Stability: Forces and Interactions

Performance Standard K-PS2-1	Conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

Clarification Statement	Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.	
Assessment Boundary	Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion -Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. **PS2.B: Types of Interactions** -When objects touch or collide, they push on one another and can change motion. **PS3.C: Relationship Between Energy and Forces** -A bigger push or pull makes things speed up or slow down more quickly.	**3. Planning and carrying out investigations** -With guidance, plan and investigate in collaboration with peers.	**Cause and Effect** -Simple tests can be performed to gather evidence to support or refute student ideas about causes.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Motion and Stability: Forces and Interactions

Performance Standard K-PS2-2	Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

Clarification Statement	Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects (Newton's Law of Motion).	
Assessment Boundary	Assessment does not include friction as a mechanism for change in speed.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion -Pushes and pulls can have different strengths and directions. -Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. **ET1.A: Defining Engineering Problems** -A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.	**4. Analyzing and interpreting data** -Analyze data from tests of an object or tool to determine if it works as intended.	**Cause and Effect** -Simple tests can be designed to gather evidence to support or refute student ideas about causes.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Energy

Performance Standard K-PS3-1	Make observations to determine the effect of sunlight on Earth's surface.

Clarification Statement	Sunlight warms the Earth's surface and all that lives and grows.	
Assessment Boundary	Assessment of temperature is limited to relative measures such as warmer/cooler.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.B: Conservation of Energy and Energy Transfer -Sunlight warms Earth's surface.	**3. Planning and carrying out investigations** -Make observations (firsthand or from media) to collect data that can be used to make comparisons.	**Cause and Effect** -Events have causes that generate observable patterns.
North Dakota Connection	ND University Systems, North Dakota Agricultural Network (NDAN)	
Content Resources	Detailed information about this standard is in Appendix A.	

Energy

Performance Standard K-PS3-2	Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.

Clarification Statement	Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.B: Conservation of Energy and Energy Transfer -Sunlight warms Earth's surface.	**6. Constructing explanations and designing solutions** -Use tools and materials provided to design and build a device that solves a specific problem or identifies a solution to a specific problem.	**Cause and Effect** -Events have causes that generate observable patterns.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

From Molecules to Organisms: Structures and Processes

Performance Standard K-LS1-1	Describe patterns, through observation, of what plants and animals (including humans) need to survive.

Clarification Statement	Examples of patterns could include that animals need to take in food, but plants make food; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.C: Organization for Matter and Energy Flow in Organisms -All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.	**3. Analyzing and interpreting data** -Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	**Patterns** -Patterns in the natural and human designed world can be observed and used as evidence.
North Dakota Connection	ND Game and Fish, ND Natural Resource Conservation Services (ND NRCS), ND Department of Agriculture	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Systems

Performance Standard K-ESS2-1	Use and share observations of local weather conditions to describe patterns over time.

Clarification Statement	Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include the number of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.	
Assessment Boundary	Assessment of quantitative observations are limited to whole numbers and relative measures such as warmer/cooler.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.D: Weather and Climate -Weather is the combination of sunlight, wind, precipitation, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.	**4. Analyzing and interpreting data** -Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	**Patterns** -Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.
North Dakota Connection	ND Agricultural Weather Network (NDAWN), National Oceanic and Atmospheric Administration (NOAA), local meteorologist, National Weather Service	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Systems

Performance Standard K-ESS2-2	Construct an argument supported by evidence for how plants and animals (including humans) can change their environment to meet their needs.

Clarification Statement	Examples of plants and animals changing their environment could include beavers building dams, a squirrel digs in the ground to hide its food and tree roots can break concrete. Humans have developed means to heat and/or cool our homes and vehicles to protect ourselves from the elements.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.E: Biogeology -Plants and animals can change their environment. **ESS3.C: Human Impacts on Earth Systems** -Things that people do to live comfortably can affect the world around them. They can make choices that reduce their impacts on the land, water, air, and other living things.	**7. Engaging in argument from evidence** -Construct an argument with evidence to support a claim.	**Systems and System Models** -Systems in the natural and designed world have parts that work together.
North Dakota Connection	ND Game and Fish, ND Natural Resource Conservation Services (ND NRCS), ND Water Commission, local zoo, ND Lignite Energy Council	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth and Human Activity

Performance Standard K-ESS3-1	Represent the relationship between the needs of different plants and animals (including humans) and the places they live using a model.

Clarification Statement	Examples of relationships could include that deer eat buds, leaves, and grains, therefore, they may live in wooded areas and prairies. Grasses need sunlight, so they often grow in meadows. Plants, animals, and their surroundings make up a system. Models could be drawings, dioramas, and/or use of technology (e.g. iPad app: Draw and Tell).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.A: Natural Resources -Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	**2. Developing and using models** -Use a model to represent relationships in the natural world.	**Systems and System Models** -Systems in the natural and designed world have parts that work together.
North Dakota Connection	ND Game and Fish, ND Natural Resource Conservation Services (ND NRCS), state parks	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth and Human Activity

Performance Standard K-ESS3-2	Ask questions to obtain information about the purpose of weather forecasting to prepare for and respond to weather.

Clarification Statement	Emphasize ways to prepare (e.g. shelter, clothing, food) for all types of weather (e.g. local seasonal weather: tornado sirens, blizzard warnings).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.B: Natural Hazards -Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. **ET1.A: Defining and Delimiting Engineering Problems** -Asking questions, making observations, and gathering information are helpful in thinking about problems.	**1. Asking questions and defining problems** -Ask questions based on observations to find more information about the designed world. **8. Obtaining, evaluating, and communicating information** -Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.	**Cause and Effect** -Events have causes that generate observable patterns.
North Dakota Connection	ND Agricultural Weather Network (NDAWN), National Oceanic and Atmospheric Administration (NOAA), local meteorologist, National Weather Service	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth and Human Activity

Performance Standard K-ESS3-3	Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Clarification Statement	Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include planting trees, reusing paper, and recycling cans and bottles.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.C: Human Impacts on Earth Systems -Things that people do to live comfortably can affect the world around them. They can make choices that reduce their impacts on the land, water, air, and other living things for sustainability. **ET1.B: Developing Possible Solutions** -Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**8. Obtaining, evaluating, and communicating information** -Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas.	**Cause and Effect** -Events have causes that generate observable patterns.
North Dakota Connection	ND Natural Resource Conservation Services (ND NRCS), ND Forest Service, ND Water Commission, ND Game and Fish	
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-1	Ask questions, make observations, and gather information to define a simple problem (a situation people want to change) that can be solved through the development of a new or improved object or tool.

Clarification Statement	Students can solve a given simple problem by asking questions, making observations, and gathering information.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.A: Defining and Delimiting Engineering Problems -A situation that people want to change or create can be approached as a problem to be solved through engineering. -Asking questions, making observations, and gathering information are helpful in thinking about problems. -Before beginning to design a solution, it is important to clearly understand the problem.	**1. Asking questions and defining problems** - Ask questions based on observations to find more information about the natural and/or designed world(s). -Define a simple problem that can be solved through the development of a new or improved object or tool.	
North Dakota Connection	Local engineering firms	
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Clarification Statement	Create a model that will show how a shape of an object helps its function (e.g. build the tallest tower using multiple materials).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**2. Developing and using models** -Develop a simple model based on evidence to represent a proposed object or tool.	**Structure and Function** -The shape and stability of structures of natural and designed objects are related to their function(s).
North Dakota Connection	Local engineering firms	
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Clarification Statement	Use data from Performance Standards K-2-ET1-1 and/or K-2-ET1-2.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.C: Optimizing the Design Solution -Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	**4. Analyzing and interpreting data** -Analyze tests of an object or tool to determine if it works as needed.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

First Grade

Waves and Their Applications in Technologies for Information Transfer

Performance Standard 1-PS4-1	Plan and conduct investigations to provide evidence that sound can make materials vibrate and that vibrating materials can make sound.

Clarification Statement	Examples of vibrating materials that make sound could include tuning forks and/or plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and/or holding an object near a vibrating tuning fork.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.A: Wave Properties -Sound can make matter vibrate, and vibrating matter can make sound.	**3. Planning and carrying out investigations** -Plan and conduct investigations collaboratively to produce evidence to answer a question.	**Cause and Effect** -Simple tests can be designed to gather evidence to support or refute student ideas about causes.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Waves and Their Applications in Technologies for Information Transfer

Performance Standard 1-PS4-2	Construct an evidence-based account, through observation, that objects can be seen only when illuminated.

Clarification Statement	Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.B: Electromagnetic Radiation -Objects can be seen if light is available to illuminate them or if they give off their own light.	**6. Constructing explanations and designing solutions** -Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	**Cause and Effect** -Simple tests can be designed to gather evidence to support or refute student ideas about causes.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Waves and Their Applications in Technologies for Information Transfer

Performance Standard 1-PS4-3	Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.

Clarification Statement	Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).	
Assessment Boundary	Assessment does not include the speed of light.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.B: Electromagnetic Radiation -Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.)	**3. Planning and carrying out investigations** -Plan and conduct investigations collaboratively to produce evidence to answer a question.	**Cause and Effect** -Simple tests can be designed to gather evidence to support or refute student ideas about causes.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Waves and Their Applications in Technologies for Information Transfer

Performance Standard 1-PS4-4	Design and build a device that uses light or sound to solve the problem of communicating over a distance.

Clarification Statement	Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats to build understanding of how sound travels.	
Assessment Boundary	Assessment does not include technological details for how communication devices work.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.C: Information Technologies and Instrumentation -People use a variety of devices to communicate (send and receive information) over long distances.	**6. Constructing explanations and designing solutions** -Use tools and materials provided to design a device that solves a specific problem.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

From Molecules to Organisms: Structures and Processes

Performance Standard 1-LS1-1	Construct an evidence-based argument with the use of a drawing or a model that illustrates how structures of plants or animals help them survive in their habitat.

Clarification Statement	An example could include how the parts of a turtle's body help it survive (e.g. shell protects its body, webbed feet for swimming, claws for climbing).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function -All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. **LS1.D: Information Processing** -Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.	**2. Developing and using models** -Develop a simple model based on evidence. **6. Constructing explanations and designing solutions** -Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. **7. Engaging in argument from evidence** -Construct an argument with evidence to support a claim.	**Structure and Function** -The shape and stability of structures and natural and designed objects are related to their function(s). **Patterns** -Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
North Dakota Connection	ND Game and Fish, ND Natural Resource Conservation Services (ND NRCS), ND University Systems	
Content Resources	Detailed information about this standard is in Appendix A.	

From Molecules to Organisms: Structures and Processes

Performance Standard 1-LS1-2	Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.

Clarification Statement	Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.B: Growth and Development of Organisms -Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.	**8. Obtaining, evaluating, and communicating information** -Read grade-appropriate text and use media to obtain scientific information to determine patterns in the natural world.	**Patterns** -Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
North Dakota Connection	ND Game and Fish, ND Natural Resource Conservation Services (ND NRCS), ND University Systems, local zoo	
Content Resources	Detailed information about this standard is in Appendix A.	

Heredity: Inheritance and Variation of Traits

Performance Standard 1-LS3-1	Construct an evidence-based account, through observation, that young plants and animals are alike, but not exactly like, their parents.

Clarification Statement	Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.	
Assessment Boundary	Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS3.A: Inheritance of Traits -Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly, like their parents. **LS3.B: Variation of Traits** -Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.	**6. Constructing explanations and designing solutions** -Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	**Patterns** -Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
North Dakota Connection	ND Game and Fish, ND Natural Resource Conservation Services (ND NRCS), ND University Systems	
Content Resources	Detailed information about this standard is in Appendix A.	

1-ESS1-1

ND Science Standards

Earth's Place in the Universe

Performance Standard 1-ESS1-1	Describe patterns that can be predicted through observations of the sun, moon, and stars.

Clarification Statement	Examples are the sun and moon rising in different parts of the sky, and that stars other than our sun are visible at night, but not during the day. This could be investigated using iPad apps.	
Assessment Boundary	Assessment of star patterns is limited to stars being seen at night and not during the day.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.A: The Universe and its Stars -Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	**4. Analyzing and interpreting data** -Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	**Patterns** -Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
North Dakota Connection	ND University Systems, National Aeronautics and Space Administration (NASA), planetarium, Star Lab, Discovery Dome	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Place in the Universe

Performance Standard 1-ESS1-2	Make observations at different times of the year to relate the amount of daylight to the time of year.

Clarification Statement	Emphasis is on comparing of the amount of daylight in different seasons due to the tilt of the Earth's axis.	
Assessment Boundary	Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.B: Earth and the Solar System -Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	**3. Planning and carrying out investigations** -Make observations (firsthand or from media) to collect data that can be used to make comparisons.	**Patterns** -Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
North Dakota Connection	NASA, National Weather Service	
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-1	**Ask questions, make observations, and gather information to define a simple problem (a situation people want to change) that can be solved through the development of a new or improved object or tool.**

Clarification Statement	For example, students are challenged to create a structure that will protect them from the effects of the sun on the playground; students are challenged to create a house that will have sun exposure throughout the day.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.A: Defining and Delimiting Engineering Problems -A situation that people want to change or create can be approached as a problem to be solved through engineering. -Asking questions, making observations, and gathering information are helpful in thinking about problems. -Before beginning to design a solution, it is important to clearly understand the problem.	**1. Asking questions and defining problems** -Ask questions based on observations to find more information about the natural and/or designed world(s). -Define a simple problem that can be solve through the development of a new or improved object or tool.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Clarification Statement	Draw or create a model that will show how a shape of an object helps it function (e.g. how a tree's roots anchor it to the ground).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**2. Developing and using models** -Develop a simple model based on evidence to represent a proposed object or tool.	**Structure and Function** -The shape and stability of structures of natural and designed objects are related to their function(s).
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Clarification Statement	Students compare results with peers from a previous experiment. Consider using data from the previous experiment using different materials and their transparency. Use data from Performance Standards K-2-ET1-1 and/or K-2-ET1-2.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.C: Optimizing the Design Solution -Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	**4. Analyzing and interpreting data** -Analyze tests of an object or tool to determine if it works as needed.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Second Grade

Matter & Its Interactions

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

Clarification Statement	Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -Different kinds of matter exist and many of them can be either solid, liquid, or gas, depending on temperature. Matter can be described and classified by its observable properties.	**3. Planning and carrying out investigations** -Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.	**Patterns** -Patterns in the natural and human designed world can be observed.
North Dakota Connection	ND Geological Survey – rocks	
Content Resources	Detailed information about this standard is in Appendix A.	

Matter & Its Interactions

Performance Standard 2-PS1-2	Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Clarification Statement	Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.	
Assessment Boundary	Assessment of quantitative measurements is limited to length.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -Different properties are suited to different purposes.	**4. Analyzing and interpreting data** -Analyze data from tests of an object or tool to determine if it works as intended.	**Cause and Effect** -Simple tests can be designed to gather evidence to support or refute student ideas about causes.
North Dakota Connection	ND Geological Survey - rocks	
Content Resources	Detailed information about this standard is in Appendix A.	

Matter & Its Interactions

Performance Standard 2-PS1-3	**Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.**

Clarification Statement	Examples of pieces could include blocks, building bricks, or other assorted small objects (Law of Conservation of Mass: matter can be neither created or destroyed, but just changes shape).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -Different properties are suited to different purposes. -A great variety of objects can be built up from a small set of pieces.	**6. Constructing explanations and designing solutions** -Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	**Energy and Matter** -Objects may break into smaller pieces and be put together into larger pieces or change shapes.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Matter & Its Interactions

Performance Standard 2-PS1-4	Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Clarification Statement	Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and burning paper.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.B: Chemical Reactions -Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.	**7. Engaging in argument from evidence** -Construct an argument with evidence to support a claim.	**Cause and Effect** -Events have causes that generate observable patterns.
North Dakota Connection	Lignite Energy Council - coal	
Content Resources	Detailed information about this standard is in Appendix A.	

Ecosystems: Interactions, Energy, and Dynamics

Performance Standard 2-LS2-1	Plan an investigation to determine if plants need sunlight and water to grow.

Clarification Statement		
Assessment Boundary	Assessment is limited to testing one variable at a time.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.A: Interdependent Relationships in Ecosystems -Plants depend on water and light to grow.	**3. Planning and carrying out investigations** -Plan and investigate collaboratively to produce data to serve as the basis for evidence to answer a question.	**Cause and Effect** -Events have causes that generate observable patterns.
North Dakota Connection	ND Game and Fish – native plants, ND Natural Resource Conservation Services (ND NRCS), ND Department of Agriculture, ND University Systems	
Content Resources	Detailed information about this standard is in Appendix A.	

Ecosystems: Interactions, Energy, and Dynamics

Performance Standard 2-LS2-2	Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

Clarification Statement	Have various materials available to simulate how animals aid in pollination.
Assessment Boundary	

Disciplinary Core Ideas	Science & Engineering Practices	Crosscutting Concepts
LS2.A: Interdependent Relationships in Ecosystems -Plants depend on animals for pollination or to move their seeds around. **ET1.B: Developing Possible Solutions** -Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**2. Developing and using models** -Develop a simple model based on evidence to represent a proposed object or tool.	**Structure and Function** -The shape and stability of structures of natural and designed objects are related to their function(s).

North Dakota Connection	ND Game and Fish, ND Natural Resource Conservation Services (ND NRCS), ND University Systems
Content Resources	Detailed information about this standard is in Appendix A.

Biological Evolution: Unity and Diversity

Performance Standard 2-LS4-1	**Make observations of plants and animals to compare the diversity of life in different habitats.**

Clarification Statement	Emphasis is on the diversity of living things in each of a variety of different habitats.	
Assessment Boundary	Assessment does not include specific animal and plant names in specific habitats.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.D: Biodiversity and Humans -There are many kinds of living things in any area, and they exist in different places on land and in water.	**3. Planning and carrying out investigations** -Make observations (firsthand or from media) to collect data which can be used to make comparisons.	
North Dakota Connection	ND Game and Fish, ND Natural Resource Conservation Service (NDRCS)	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Place in the Universe

Performance Standard 2-ESS1-1	Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

Clarification Statement	Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.	
Assessment Boundary	Assessment does not include quantitative measurements of timescales.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.C: The History of Planet Earth -Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.	**6. Constructing explanations and designing solutions** -Make observations from several sources to construct an evidence-based account for natural phenomena.	**Stability and Change** -Things may change slowly or rapidly.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

2

2-ESS2-1

ND Science Standards

Earth's Systems

Performance Standard 2-ESS2-1	Compare and contrast multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

Clarification Statement	Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.A: Earth Materials and Systems -Wind and water can change the shape of the land. **ET1.C: Optimizing the Design Solution** -Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	**6. Constructing explanations and designing solutions** -Compare multiple solutions to a problem.	**Stability and Change** -Things may change slowly or rapidly.
North Dakota Connection	ND Soil Conservation, ND Natural Resource Conservation Services (ND NRCS), ND Department of Agriculture	
Content Resources	Detailed information about this standard is in Appendix A.	

2-ESS2-2

ND Science Standards

Earth's Systems

Performance Standard 2-ESS2-2	Develop a model to represent the shapes and kinds of land and bodies of water in an area.

Clarification Statement		
Assessment Boundary	Assessment does not include quantitative scaling in models.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.B: Plate Tectonics and Large-Scale System Interactions -Maps show where things are located. One can map the shapes and kinds of land and water in any area.	**2. Developing and using models** -Develop a model to represent patterns in the natural world.	**Patterns** -Patterns in the natural world can be observed.
North Dakota Connection	ND Soil and Conservation, ND Natural Resource Conservation Services (ND NRCS), National Oceanic and Atmospheric Administration (NOAA), ND Geological Survey	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Systems

Performance Standard 2-ESS2-3	Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Clarification Statement	Multimedia sources (e.g. Google Earth) may be used to obtain the information. Location effects whether water is solid or liquid.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.C: The Roles of Water in Earth's Surface Processes -Water is found in the ocean, rivers, lakes and ponds. Water exists as solid ice and in liquid form.	**8. Obtaining, evaluating, and communicating information** -Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.	**Patterns** -Patterns in the natural and/or designed world can be observed.
North Dakota Connection	National Oceanic and Atmospheric Administration (NOAA), ND Geological Survey	
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-1	**Ask questions, make observations, and gather information to define a simple problem (a situation people want to change) that can be solved through the development of a new or improved object or tool.**

Clarification Statement	Use the engineering design process.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.A: Defining and Delimiting Engineering Problems -A situation that people want to change or create can be approached as a problem to be solved through engineering. -Asking questions, making observations, and gathering information are helpful in thinking about problems. -Before beginning to design a solution, it is important to clearly understand the problem.	**1. Asking questions and defining problems** -Ask questions based on observations to find more information about the natural and/or designed world(s). -Define a simple problem that can be solved through the development of a new or improved object or tool.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-2	**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**

Clarification Statement	Use the engineering design process.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**2. Developing and using models** -Develop a simple model based on evidence to represent a proposed object or tool.	**Structure and Function** -The shape and stability of structures of natural and designed objects are related to their function(s).
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard K-2-ET1-3	**Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

Clarification Statement	Use the engineering design process.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.C: Optimizing the Design Solution -Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	**4. Analyzing and interpreting data** -Analyze data from tests of an object or tool to determine if it works as needed.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Third Grade

Motion & Stability: Forces & Interactions

Performance Standard 3-PS2-1	Plan and conduct an investigation to prove the effects of balanced and unbalanced forces on the motion of an object.

Clarification Statement	Examples could include an unbalanced force on one side of a ball can make it start moving; and balanced forces pushing on a box from both sides will not produce any motion at all.	
Assessment Boundary	Assessment is limited to one variable at a time: number, size, or direction of forces.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion -Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. **PS2.B: Types of Interactions** -Objects in contact exert forces on each other.	**3. Planning and carrying out investigations** -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.	**Cause and Effect** -Cause and effect relationships are routinely identified.
North Dakota Connection	Apply concept of unbalanced forces to North Dakota winters. Examples include cars sliding on ice, sleds on snow, ice skating, etc.	
Content Resources	Detailed information about this standard is in Appendix A.	

Motion & Stability: Forces & Interactions

Performance Standard 3-PS2-2	Make observations and metric measurements of an object's motion to prove that a pattern can be used to predict future motion.

Clarification Statement	Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.	
Assessment Boundary	Assessment includes observing and/or measuring input motion and predicting and/or measuring output motion of a repeating pattern of motion. Assessment does not include technical terms, such as magnitude, period, frequency, velocity, momentum, and vector quantity, but the concept that some quantities need both size and direction to be described is developed.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion -The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.	**3. Planning and carrying out investigations** -Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. -Science findings are based on recognizing patterns.	**Patterns** -Patterns of change can be used to make predictions.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Motion & Stability: Forces & Interactions

Performance Standard 3-PS2-3	**Ask questions to determine cause and effect relationships of static electricity or magnetic interactions between two objects not in contact with each other.**

Clarification Statement	Examples of static electricity are the force on hair from an electrically charged balloon, a charged rod and pieces of paper; examples of a magnetic force are the force between two magnets, the force between an electromagnet and steel paperclips. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.	
Assessment Boundary	Assessment is limited to forces produced by objects that can be manipulated by students.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.B: Types of Interactions -Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	**1. Asking questions and defining problems** -Ask questions that can be investigated based on patterns such as cause and effect relationships.	**Cause and Effect** -Cause and effect relationships are routinely identified, tested, and used to explain change.
North Dakota Connection	Connect to the dry air in North Dakota winters. Examples include static electricity in bedding, clothing, and hair covered by a hat. Additional examples would be lightning in a summer storm.	
Content Resources	Detailed information about this standard is in Appendix A.	

Motion & Stability: Forces & Interactions

Performance Standard 3-PS2-4	Define a simple design problem that can be solved by applying scientific ideas about magnets.

Clarification Statement	Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.B: Types of Interactions -Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	**1. Asking questions and defining problems** -Define a simple problem that can be solved through the development of a new or improved object or tool.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

From Molecules to Organisms: Structures and Processes

Performance Standard 3-LS1-1	Develop models to describe that organisms have unique and diverse life cycles but all experience birth, growth, reproduction, and death.

Clarification Statement	Changes organisms go through during their life form a pattern.	
Assessment Boundary	Assessment should include a variety of models of life cycles of many organisms. Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.B: Growth and Development of Organisms -Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.	**2. Developing and using models** -Develop models to describe phenomena.	**Patterns** -Patterns of change can be used to make predictions.
North Dakota Connection	Consider contacting an expert at local vector controls and extension services, ND Game and Fish office, and colleges or universities etc. Example could include the life cycle of the mosquito.	
Content Resources	Detailed information about this standard is in Appendix A.	

Ecosystems: Interactions, Energy, Dynamics

Performance Standard 3-LS2-1	Construct an argument that some animals form groups that help members survive.

Clarification Statement	Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.D: Social Interactions and Group Behavior -Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.	**7. Engaging an argument from evidence** -Construct an argument with evidence, data, and/or a model.	**Cause and Effect** -Cause and effect relationships are routinely identified and used to explain change.
North Dakota Connection	Consider contacting an expert at local extension services, ND Game and Fish office, and/or colleges universities	
Content Resources	Detailed information about this standard is in Appendix A.	

Heredity: Inheritance & Variations of Traits

Performance Standard 3-LS3-1	Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

Clarification Statement	Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.	
Assessment Boundary	Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS3.A: Inheritance of Traits -Many characteristics of organisms are inherited from their parents. **LS3.B: Variation of Traits** -Different organisms vary in how they look and function because they have different inherited information.	**4. Analyzing and interpreting data** -Analyze and interpret data to make sense of phenomena using logical reasoning.	**Patterns** -Similarities and differences in patterns can be used to sort and classify natural phenomena.
North Dakota Connection	Consider the agriculture industry and how offspring such as calves may have the same traits as their parents. Examples include coat color, body shape, birth marks etc.	
Content Resources	Detailed information about this standard is in Appendix A.	

Heredity: Inheritance & Variations of Traits

Performance Standard 3-LS3-2	Use evidence to support the explanation that the environment can influence the expression of traits.

Clarification Statement	Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted. Environmental exposures may alter an organism's DNA.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS3.A: Inheritance of Traits -Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. **LS3.B: Variation of Traits** -Environmental factors such as toxins may affect the traits that an organism develops.	**6. Constructing explanations and designing solutions** -Use evidence (e.g., observations, patterns) to support an explanation.	**Cause and Effect** -Cause and effect relationships are routinely identified and used to explain change.
North Dakota Connection	Examples could include the agricultural industry by comparing vegetation during a wet season versus a dry season. Genetically modified crops exist in an attempt to limit the effect of environmental conditions.	
Content Resources	Detailed information about this standard is in Appendix A.	

Biological Evolution: Unity & Diversity

Performance Standard 3-LS4-1	Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.

Clarification Statement	Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.	
Assessment Boundary	Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.A: Evidence of Common Ancestry and Diversity -Some kinds of plants and animals that once lived on Earth are no longer found anywhere. Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.	**4. Analyzing and interpreting data** -Analyze and interpret data to make sense of phenomena using logical reasoning.	**Scale, Proportion, and Quantity** -Observable phenomena that exists from very short to very long time periods.
North Dakota Connection	Consider reaching out to oil, natural gas, and coal industries. Connect ND natural resources to fossilization. North Dakota fossil distribution map can be found at https://www.dmr.nd.gov/ndfossil/poster/poster.asp	
Content Resources	Detailed information about this standard is in Appendix A.	

Biological Evolution: Unity & Diversity

Performance Standard 3-LS4-2	Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Clarification Statement	Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.B: Natural Selection -Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.	**6. Constructing explanations and designing solutions** -Use evidence (e.g. observations, patterns) to construct an explanation	**Cause and Effect** -Cause and effect relationships are routinely identified and used to explain change.
North Dakota Connection	Contact your local North Dakota Game and Fish office. Consider contacting an expert at local extension services, ND Game and Fish office, and colleges or universities.	
Content Resources	Detailed information about this standard is in Appendix A.	

Biological Evolution: Unity & Diversity

Performance Standard 3-LS4-3	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

Clarification Statement	Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.C: Adaptation -Adaptation for any environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	**7. Engaging in argument from evidence** -Construct an argument with evidence.	**Cause and Effect** -Cause and effect relationships are routinely identified and used to explain change.
North Dakota Connection	Wetland destruction and urban sprawl can cause loss to habitats and wildlife.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Systems

Performance Standard 3-ESS2-1	Represent data in tables and graphical displays to describe and predict typical weather conditions expected during a particular season.

Clarification Statement	Examples of data could include average temperature, precipitation, and wind direction.	
Assessment Boundary	Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.D: Weather and Climate -Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.	**4. Analyzing and interpreting data** -Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.	**Patterns** -Patterns of change can be used to make predictions.
North Dakota Connection	Collect weather data using the National Weather Service or National Oceanic and Atmospheric Administration (NOAA) to make predictions.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Systems

Performance Standard 3-ESS2-2	Obtain and combine information to describe climates in different regions of the world.

Clarification Statement	Examples of climate in different regions, how climate predicts weather conditions, and climate variations around the world.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.D: Weather and Climate -Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.	**8. Obtaining, evaluating, and communicating information** -Obtain and combine information from books and other reliable media to explain phenomena.	**Patterns** -Patterns of change can be used to make predictions.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Earth & Human Activity

Performance Standard 3-ESS3-1	Evaluate the feasibility of a design solution that reduces the impacts of a weather-related hazard.

Clarification Statement	Examples of design solutions to weather-related hazards could include barriers to prevent flooding and wind resistant roofs.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.B: Natural Hazards -A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.	**7. Engaging in argument from evidence** -Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	**Cause and Effect** -Cause and effect relationships are routinely identified, tested, and used to explain change.
North Dakota Connection	North Dakota natural hazards include flooding, blizzards, hail, wind damage, tornadoes, erosion, etc.	
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 3-ET1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart. Design ideas may be quite simple. This could include an object, tool, process, or system either at home or school that may make life easier or more efficient. Identifying a problem impacting the student will be the most influential.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.A: Defining and Delimiting Engineering Problems -Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	**1. Asking questions and defining problems** -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.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 3-ET1-2	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.

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. -At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	**6. Constructing explanations and designing solutions** -Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 3-ET1-3	**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.**

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ET1.C: Optimizing the Design Solution** -Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	**3. Planning and carrying out investigations** -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.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Fourth Grade

Energy

Performance Standard 4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Clarification Statement	Emphasis on relative speeds of objects and the connection between motion and energy.	
Assessment Boundary	Assessment does not include quantitative measures of changes in the speed of an object.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: Definitions of Energy -The faster a given object is moving, the more energy it possesses.	**6. Constructing explanations and designing solutions** -Use evidence (e.g. observations or patterns) to construct an explanation.	**Energy and Matter** -Energy can be transferred in various ways and between objects.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Energy

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

Clarification Statement	Emphasis is on the transfer of energy whenever objects are moving. Examples include how sound, light, and heat can transfer energy.	
Assessment Boundary	Assessment does not include quantitative measurements of energy.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: Definitions of Energy -Energy can be transferred from place to place by moving objects or through sound, light, or electric currents. **PS3.B: 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 causing a change in motion. In such collisions, some energy is also transferred to the surrounding air as heat or sound. -Energy can also be transferred from place to place by electric currents to produce motion, sound, heat, or light.	**3. Planning and carrying out investigations** -Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	**Energy and Matter** -Energy can be transferred in various ways and between objects.
North Dakota Connection	Consider contacting local electric cooperative.	
Content Resources	Detailed information about this standard is in Appendix A.	

Energy

Performance Standard 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.	
Assessment Boundary	Assessment does not include quantitative measurements of energy.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: Definitions of Energy -Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **PS3.B: 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. **PS3.C: Relationship Between Energy and Forces** -When objects collide, the contact forces transfer energy to change the objects' motions.	**1. Asking questions and defining problems** -Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.	**Energy and Matter** -Energy can be transferred in various ways and between objects.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Energy

Performance Standard 4-PS3-4	Using the engineering design process build a device that converts energy from one form to another.

Clarification Statement	Examples of devices could include a greenhouse model such as a glass jar in direct sunlight, electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater (solar oven) that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. Use engineering design process flow chart.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.B: Conservation of Energy and Energy Transfer -Energy can also be transferred from place to place by electric currents, which can be used to produce motion, sound, heat, or light. **PS3.D: 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.	**6. Constructing explanations and designing solutions** -Apply scientific ideas to solve design problems.	**Energy and Matter** -Energy can be transferred in various ways and between objects.
North Dakota Connection	Wind turbines are manufactured and placed across North Dakota. Consider contacting your local electric cooperative for examples of solar cells being used for a variety of purposes.	
Content Resources	Detailed information about this standard is in Appendix A.	

Waves and Their Applications in Technologies for Information Transfer

Performance Standard 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.

Clarification Statement	Examples of models could include diagrams, analogies, and physical models to illustrate wavelength and amplitude of waves (e.g. waves could be modeled using rope, wire, slinky, fabric, water).	
Assessment Boundary	Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.A: Wave Properties -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).	**2. Developing and using models** -Develop a model using an analogy, example, or abstract representation to describe a scientific principle.	**Patterns** -Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.
North Dakota Connection	Consider past events where extreme wave actions have resulted in damage to structures including moving large objects from the water. For example, Devils Lake and Lake Sakakawea.	
Content Resources	Detailed information about this standard is in Appendix A.	

Waves and Their Applications in Technologies for Information Transfer

Performance Standard 4-PS4-3	Construct a code to convey information by researching past and present methods of transmitting information.

Clarification Statement	Examples of past methods could include a string between two cans, Morse code, rotary dial telephones. Examples of current methods include fiber optics, digitized signals, wireless communication, Bluetooth, and using code.org for exploration of computer coding patterns.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.C: Information Technologies and Instrumentation -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.	**6. Constructing explanations and designing solutions** -Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	**Patterns** -Similarities and differences in patterns can be used to sort and classify designed products.
North Dakota Connection	Consider contacting local telephone companies for a demonstration on fiber optics.	
Content Resources	Detailed information about this standard is in Appendix A.	

From Molecules to Organisms: Structures and Processes

Performance Standard 4-LS1-1	Construct an argument that plants, and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Clarification Statement	Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, skin, quills, horns, tusks, scales, etc.	
Assessment Boundary	Assessment is limited to macroscopic structures within plant and animal systems.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function -Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	**7. Engaging in argument from evidence** -Construct an argument with evidence, data, and/or a model.	**Systems and System Models** -A system can be described in terms of its components and their interactions.
North Dakota Connection	Contact a taxidermist or the local game and fish for examples and possible demonstrations.	
Content Resources	Detailed information about this standard is in Appendix A.	

From Molecules to Organisms: Structures and Processes

Performance Standard 4-LS1-2	Form an explanation 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.

Clarification Statement	Emphasis is on systems of information transfer. Examples include responses to stimuli such as a hot surface and pulling your hand away, animals running from predators, animals communicating with each other through signals to express danger, reproduction, and for food.	
Assessment Boundary	Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.D: Information Processing -Different sense receptors are specialized for information, which may be processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.	**2. Developing and using models** -Use a model to test interactions concerning the functioning of a natural system.	**Systems and System Models** -A system can be described in terms of its components and their interactions.
North Dakota Connection	Consider contacting ND Game and Fish for more animal examples of responses to stimuli. Discussion could include hunting and the attempt to limit the animal's response to human presence (camouflage, scent-masking agents, etc.)	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Place in the Universe

Performance Standard 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 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.	
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.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.C: 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.	**6. Constructing explanations and designing solutions** -Identify the evidence that supports particular points in an explanation.	**Patterns** -Patterns can be used as evidence to support an explanation.
North Dakota Connection	Theodore Roosevelt National Park shows the layering of sediment by the exposure of the Badlands. Contact the state Geographic Alliance, Geological Society, and local colleges and universities for more resources. Local museums are also a valuable resource.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth & Space Science

Performance Standard 4-ESS2-1	**Make observations and metric measurements to provide evidence of the effects of weathering and the rate of erosion by water, ice, wind, or vegetation.**

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.	
Assessment Boundary	Assessment is limited to a single form of weathering or erosion.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.A: Earth Materials and Systems -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. **ESS2.E: Biogeology** -Living things affect the physical characteristics of their regions.	**3. Planning and carrying out investigations** -Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	**Cause and Effect** -Cause and Effect relationships are routinely identified, tested, and used to explain change.
North Dakota Connection	The exposure of the Badlands (Theodore Roosevelt National Park website) is due to weathering and erosion from flowing water and wind. Consider the soil conservation districts for presentations on preventing erosion. Much of ND has been shaped by glaciers. North Dakota Geological Survey.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Systems

Performance Standard 4-ESS2-2	Analyze and interpret data from maps to describe patterns of Earth's features.

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.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.B: Plate Tectonics and Large-Scale System Interactions -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.	**4. Analyzing and interpreting data** -Analyze and interpret data to make sense of phenomena using logical reasoning.	**Patterns** -Patterns can be used as evidence to support an explanation.
North Dakota Connection	North Dakota has an abundance of topographical features of interest. Examples include the depth of water erosion in the badlands, the Red River and Mouse/Souris River which flow north due to elevation. Contact the North Dakota Geological Survey for topographic maps.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth and Human Activity

Performance Standard 4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

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. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.A: Natural Resources -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.	**8. Obtaining, evaluating, and communicating information** -Obtain and combine information from books and other reliable media to explain phenomena.	**Cause & Effect** -Cause and effect relationships are routinely identified and used to explain change.
North Dakota Connection	Contact the North Dakota petroleum council, energy council, or lignite council for information on our natural resources.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth and Human Activity

Performance Standard 4-ESS3-2	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Clarification Statement	Examples of solutions could include designing flood control methods, earthquake, tornado, or hurricane resistant buildings, and improving predictions and forecasts.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.B: Natural Hazards -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.	**6. Constructing explanations and designing solutions** -Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	**Cause and Effect** -Cause and effect relationships are routinely identified, tested, and used to explain change.
North Dakota Connection	The national weather service could provide resources for predicting and managing natural disasters. ND has numerous concerns for natural disasters across the state.	
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 4-ET1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart. They could include an object, tool, process, or system either at home or school that may make life easier or more efficient.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.A: Defining and Delimiting Engineering Problems -Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	**1. Asking questions and defining problems** -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.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 4-ET1-2	**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.**

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart. This is a continuation of the previous standard.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	**6. Constructing explanations and designing solutions** -Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 4-ET1-3	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.

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart. This is a continuation of 4-ET1-2.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ET1.C: Optimizing the Design Solution** -Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	**3. Planning and carrying out investigations** -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.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Fifth Grade

Matter and its Interactions

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

Clarification Statement	Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water. Drawings of simple molecules such as water, sugar, carbon dioxide would be appropriate.	
Assessment Boundary	Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -Matter of any type can be subdivided into particles that are too small to see, but the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.	**2. Developing and using models** -Use models to describe phenomena.	**Scale, Proportion, and Quantity** -Natural objects exist from the very small to the immensely large.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Matter and its Interactions

Performance Standard 5-PS1-2	**Measure and graph metric quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total mass of matter is conserved.**

Clarification Statement	Examples of reactions or changes could include dissolving, and mixing. Examples of physical changes could include ice melting into water. Distinguish between mass and weight. Weight is a measure of gravitational force on an object. Weight of an object can change depending upon gravitational force. Ex. Earth vs. the moon. Mass is the amount of matter in an object.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -The mass of matter is conserved when it changes form, even in transitions in which it seems to vanish. **PS1.B: Chemical Reactions** -No matter what reaction or change in properties occurs, the total mass of the substances does not change.	**5. Using mathematical and computational thinking** -Measure (metric) and graph quantities such as mass to address scientific and engineering questions and problems.	**Scale, Proportion, and Quantity** -Metric units are used to measure and describe physical quantities such as mass, length, temperature, and volume.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Matter and its Interactions

Performance Standard 5-PS1-3	Make observations and measurements to identify materials based on their properties.

Clarification Statement	Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include density, color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility.	
Assessment Boundary	At this grade level no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -Measurements of a variety of properties can be used to identify materials.	**3. Planning and carrying out investigations** -Make observations and metric measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	**Scale, Proportion, and Quantity** -Metric units are used to measure and describe physical quantities such as weight, temperature, and volume.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Matter and its Interactions

Performance Standard 5-PS1-4	Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Clarification Statement	Examples of mixtures, not new substances, could be mixing of salt or sugar and water. Examples of new substances include making gelatin, chocolate milk, cookies, and cakes.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.B: Chemical Reactions -When two or more different substances are mixed, a new substance with different properties may be formed.	**3. Planning and carrying out investigations** -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.	**Cause and Effect** -Cause and effect relationships are routinely identified and used to explain change.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Energy

Performance Standard 5-PS3-1	Use models to describe how energy from the sun is converted into food (used for body repair, growth, motion, and to maintain body warmth).

Clarification Statement	Examples of models could include food webs, diagrams, and flow charts to illustrate flow of energy.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.D: Energy in Chemical Processes and Everyday Life -The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). **LS1.C: Organization for Matter and Energy Flow in Organisms** -Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary)	**2. Developing and using models** -Use models to describe phenomena.	**Energy and Matter** -Energy can be transferred in various ways and between objects.
North Dakota Connection	ND Game and Fish may have more information on energy transfer via food webs.	
Content Resources	Detailed information about this standard is in Appendix A.	

From Molecules to Organisms: Structures and Processes

Performance Standard 5-LS1-1	Support an argument that plants get the materials they need for growth chiefly from air and water.

Clarification Statement	Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil. Consider hydroponics or the growing of plants in water.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.C: Organization for Matter and Energy Flow in Organisms -Plants acquire their material for growth from carbon dioxide, the sun, and water through the process of photosynthesis.	**7. Engaging in argument from evidence** -Support an argument with evidence, data, or a model.	**Energy and Matter** -Matter is transported into, out of, and within systems.
North Dakota Connection	Without photosynthesis North Dakota would not be an agricultural state.	
Content Resources	Detailed information about this standard is in Appendix A.	

Ecosystems: Interaction, Energy, and Dynamics

Performance Standard 5-LS2-1	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Clarification Statement	Examples of systems could include organisms, ecosystems (decay), and the Earth. Consider teaching the carbon cycle, nitrogen cycle, and water cycle. Crop rotation is often due to the amount of nitrogen in the soil. Soybeans and other legumes can pull nitrogen from the air and convert it into a usable form.	
Assessment Boundary	Assessment does not include molecular explanations	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.A: Interdependent Relationships in Ecosystems -The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. A healthy ecosystem is a balanced ecosystem. Newly introduced species can damage the balance of an ecosystem. **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** -Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die.	**2. Developing and using models** -Develop a model to describe phenomena.	**Systems and System Models** -A system can be described in terms of its components and their interactions.
North Dakota Connection	Consider contacting the ND Soybean Council. Soybeans and other legumes can pull nitrogen from the air and convert it to a form that can be used.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Place in the Universe

Performance Standard 5-ESS1-1	Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.

Clarification Statement	Examples of stars distance from Earth and their relative brightness.	
Assessment Boundary	Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.A: The Universe and its Stars -The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.	**7. Engaging in argument from evidence** -Support an argument with evidence, data, or a model.	**Scale, Proportion, and Quantity** -Natural objects exist from the very small to the immensely large.
North Dakota Connection	Consider reaching out to local colleges and universities for more information such as UND space studies program. Many have planetariums for public use.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Place in the Universe

Performance Standard 5-ESS1-2	Construct a graph to reveal patterns of daily changes in length (metric) and direction of shadows, length of day and night, and the seasonal appearance of some stars in the night sky.

Clarification Statement	Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.	
Assessment Boundary	Assessment does not include causes of seasons.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.B: Earth and the Solar System -The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.	**4. Analyzing and interpreting data** -Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	**Patterns** -Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena.
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Systems

Performance Standard 5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Clarification Statement	Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere (water cycle). The geosphere, hydrosphere, atmosphere, and biosphere are each a system.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.A: Earth Materials and Systems -Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.	**2. Developing and using models** -Develop a model using an example to describe a scientific principle.	**Systems and System Models** -A system can be described in terms of its components and their interactions.
North Dakota Connection	Consider the water, nitrogen, or carbon cycle and relate to ND agriculture.	
Content Resources	Detailed information about this standard is in Appendix A.	

Earth's Systems

Performance Standard 5-ESS2-2	Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Clarification Statement	Emphasis on freshwater and salt water in oceans, glaciers, groundwater, and surface water.
Assessment Boundary	Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.

Disciplinary Core Ideas	Science & Engineering Practices	Crosscutting Concepts
ESS2.C: The Roles of Water in Earth's Surface Processes -Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	**5. Using mathematical and computational thinking** -Describe and graph quantities such as area and volume to address scientific quantities.	**Scale, Proportion, and Quantity** -Metric system is used to measure and describe physical quantities such as length, mass, and volume.

North Dakota Connection	Consider contacting the ND Petroleum Council to collect information on the saltwater that is pumped from Earth's interior at oil well sites. The ND Geological Society and state water commission (project WET) for more resources.
Content Resources	Detailed information about this standard is in Appendix A.

Earth and Human Activity

Performance Standard 5-ESS3-1	**Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.**

Clarification Statement	Consider research on human-impact to the environment. Examples could include habitat destruction/construction, overuse of natural resources, urban development, overpopulation, cover crops, no-till farming, etc.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.C: Human Impacts on Earth Systems -Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. However, individuals and communities are doing things to help protect Earth's resources and environments.	**8. Obtaining, evaluating, and communicating information** -Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	**Systems and System Models** -A system can be described in terms of its components and their interactions.
North Dakota Connection	The NDSU extension service, NDGF for wildlife management, ND Geological Society and State Water Commission (project WET) for more resources. Land reclamation is a mission of the ND Lignite Council.	
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 5-ET1-1	**Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart. They could include an item/object either at home or school that may make life easier or more efficient.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.A: Defining and Delimiting Engineering Problems -Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	**1. Asking questions and defining problems** -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.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 5-ET1-2	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.

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart. This is a continuation of the previous standard.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. -At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	**6. Constructing explanations and designing solutions** -Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Engineering & Technology

Performance Standard 5-ET1-3	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.

Clarification Statement	Refer to the Engineering Design Process in the link above for a visual flow chart. This is a continuation of the previous standard.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ET1.C: Optimizing the Design Solution** -Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	**3. Planning and carrying out investigations** -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.	
North Dakota Connection		
Content Resources	Detailed information about this standard is in Appendix A.	

Middle School

Middle school science standards can be identified by the MS icon. These standards are grouped by content domain.

- Earth and Space Science (ESS)
- Life Science (LS)
- Physical Science (PS)
- Engineering Technology (ET)

Earth and Space Science

Earth's Place in the Universe

Performance Standard 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.

Clarification Statement	Examples of models can be physical, graphical, or conceptual.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.A: The Universe and its Stars -Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. **ESS1.B: Earth and the Solar System** -This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** -Patterns can be used to identify cause and effect relationships.
North Dakota Connection	University of North Dakota Aerospace Science, Valley City State University Medicine Wheel, Valley City State University Planetarium	

Earth's Place in the Universe

Performance Standard MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

Clarification 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).	
Assessment Boundary	Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.A: The Universe and Its Stars -Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **ESS1.B: Earth and the Solar System** -The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** -Models can be used to represent systems and their interactions.
North Dakota Connection		

Earth's Place in the Universe

Performance Standard MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.

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.	
Assessment Boundary	Assessment does not include recalling facts about properties of the planets and other solar system bodies.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.B: Earth and the Solar System -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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** -Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to development of entire industries and engineered systems.
North Dakota Connection		

Earth's Place in the Universe

Performance Standard MS-ESS1-4	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

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.	
Assessment Boundary	Assessment does not include recalling the names of specific periods or epochs and events within them.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.C: The History of Planet Earth -The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** -Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
North Dakota Connection	North Dakota Geological Survey, North Dakota Heritage Center, Dickinson Dinosaur Museum, Pioneer Trails Regional Museum, Pembina County Museum, North Dakota University Systems, Broste Rock Museum, North Dakota Geographic Alliance, Theodore Roosevelt National Park, North Dakota Industrial Commission.	

Earth's Systems

Performance Standard MS-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

Clarification Statement	Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials (e.g. rock cycle).	
Assessment Boundary	Assessment does not include the identification and naming of minerals.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.A: Earth's Materials and Systems -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.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Suitability and Change** -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.
North Dakota Connection	North Dakota Lignite Council, North Dakota Petroleum Council, Burning Coal Vein, Theodore Roosevelt National Park.	

Earth's Systems

Performance Standard MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying times and spatial scales.

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.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.A: Earth's Materials and Systems -The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **ESS2.C: The Roles of Water in Earth's Surface Processes** -Water's movements cause weathering and erosion, which change the land's surface features and create underground formations.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** -Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
North Dakota Connection	North Dakota Geologic Survey, Sheyenne National Grasslands, North Dakota University Systems, Prairie Potholes, Theodore Roosevelt National Park, North Dakota river systems	

MS-ESS2-3

ND Science Standards

Earth's Systems

Performance Standard MS-ESS2-3	**Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.**

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).	
Assessment Boundary	Paleomagnetic anomalies in oceanic and continental crust are not assessed.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.C: The History of Planet Earth -Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches (secondary). **ESS2.B: Plate Tectonics and Large-Scale System Interactions** -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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** -Patterns in rates of change and other numerical relationships can provide information about natural systems.
North Dakota Connection	North Dakota Geologic Survey, North Dakota Geographic Alliance, North Dakota University Systems	

Earth's Systems

Performance Standard 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.

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.	
Assessment Boundary	A quantitative understanding of the latent heats of vaporization and fusion is not assessed.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.C: The Roles of Water in Earth's Surface Processes -Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. Global movements of water and its changes in form are propelled by sunlight and gravity.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** -Within a natural system, the transfer of energy drives the motion and/or cycling of matter.
North Dakota Connection	North Dakota watersheds, North Dakota Project Water Education for Teachers (WET)	

Earth's Systems

Performance Standard MS-ESS2-5	Use data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

Clarification Statement	Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided for students to interpret (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (e.g.; condensation).	
Assessment Boundary	Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.C: The Roles of Water in Earth's Surface Processes -The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. **ESS2.D: Weather and Climate** -Because these patterns are so complex, weather can only be predicted probabilistically.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural or designed systems.
North Dakota Connection	National Oceanic and Atmospheric Administration, National Weather Service	

Earth's Systems

Performance Standard 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.**

Clarification 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.	
Assessment Boundary	Assessment does not include the dynamics of the Coriolis effect.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.C: The Roles of Water in Earth's Surface Processes -Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. **ESS2.D: Weather and Climate** -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.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** -Models can be used to represent systems and their interactions-such as inputs, processes, and outputs-and energy, matter, and information flows within systems.
North Dakota Connection		

Earth and Human Activity

Performance Standard 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.**

Clarification Statement	Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.A: Natural Resources -Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural or designed systems. 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.
North Dakota Connection	North Dakota Geologic Survey, North Dakota Geographic Alliance, North Dakota University Systems, North Dakota Energy Industries	

Earth and Human Activity

Performance Standard MS-ESS3-2	**Analyze and interpret data on natural hazards to forecast future catastrophic events that necessitate the development of technologies to mitigate their effects.**

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, blizzards, 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).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.B: Natural Hazards -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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** -Graphs and charts can be used to identify patterns in data. The uses of technologies and any limitations on their use are driven by individual and 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 and over time.
North Dakota Connection	Badlands and Theodore Roosevelt National Park, National Oceanic and Atmospheric Administration, National Weather Service.	

Earth and Human Activity

Performance Standard MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Clarification Statement	Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.C: Human Impacts on Earth Systems -Human activities have significantly 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 (negative and positive) for different living things. Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Relationships can be classified as casual or correlational, and correlation does not necessarily imply causation.
North Dakota Connection	Agricultural Industries, North Dakota Energy Industries, North Dakota conservation entities	

Earth and Human Activity

Performance Standard MS-ESS3-4	Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

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 increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the action society takes.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.C: Human Impacts on Earth Systems -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.	**1. Asking questions and defining problems** 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural or designed systems.
North Dakota Connection	Agricultural Industries, North Dakota Energy Industries, North Dakota conservation entities	

Earth and Human Activity

Performance Standard MS-ESS3-5	Investigate factors that have caused changes in global temperatures over time.

Clarification Statement	Examples of factors include natural processes (such as changes in incoming solar radiation or volcanic activity) and human activities (such as fossil fuel combustion, cement production, and agricultural activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.D: Global Climate Change Natural processes and human activities 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.	**1. Asking questions and defining problems** 2. Developing and using models **3. Planning and carrying out investigations** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** -Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
North Dakota Connection	Possible Reference: Glaciation in North Dakota. North Dakota Geological Survey, North Dakota Energy Industries	

Life Science

From Molecules to Organisms: Structure and Processes

Performance Standard MS-LS1-1	**Conduct an investigation to provide evidence that living things are unicellular or multicellular and may have different cell types.**

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.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function -All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** -Phenomena that can be observed at one scale may not be observable at another scale.
North Dakota Connection		

From Molecules to Organisms: Structure and Processes

Performance Standard MS-LS1-2	**Develop and use a model to describe the function of a cell as a whole and ways cell parts (organelles) contribute to the cell functions.**

Clarification Statement	Emphasis is on the cell functioning as a whole system and the primary role of identified organelle of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.	
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 or cell parts.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function -Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Structure and Function** -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.
North Dakota Connection		

From Molecules to Organisms: Structure and Processes

Performance Standard MS-LS1-3	**Use evidence to model how the body is a system of interacting subsystems composed of groups of cells.**

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.	
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.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function -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.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** **7. Engaging in argument from evidence** 8. Obtaining, evaluating, and communicating information	**Systems and System Models** -Systems may interact with other systems; they may have sub-systems and be part of larger complex systems.
North Dakota Connection		

From Molecules to Organisms: Structure and Processes

Performance Standard MS-LS1-4	**Use evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction.**

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.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.B: Growth and Development of Organisms -Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** **7. Engaging in argument from evidence** 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
North Dakota Connection		

From Molecules to Organisms: Structure and Processes

Performance Standard MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Clarification Statement	Examples of local environmental conditions could include availability of food, light, space, and water (photosynthesis). 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.	
Assessment Boundary	Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.B: Growth and Development of Organisms -Genetic factors as well as local conditions affect the growth of the adult plant.	**1. Asking questions and defining problems** 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** **7. Engaging in argument from evidence** 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
North Dakota Connection	Agricultural Industries	

From Molecules to Organisms: Structure and Processes

Performance Standard 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.

Clarification Statement	Emphasis is on tracing movement of matter and flow of energy	
Assessment Boundary	Assessment does not include details of the chemical reactions for photosynthesis.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.C: Organization for Matter and Energy Flow in Organisms -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. **PS3.D: Energy in Chemical Processes and Everyday Life** -The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** -Matter is conserved because atoms are conserved in physical and chemical processes.
North Dakota Connection		

From Molecules to Organisms: Structure and Processes

Performance Standard MS-LS1-7	Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as it moves through an organism.

Clarification Statement	Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.	
Assessment Boundary	Assessment does not include details of the chemical reactions for photosynthesis or respiration.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.C: Organization for Matter and Energy Flow in Organisms -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. **PS3.D: Energy in Chemical Processes and Everyday Life** -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.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** -Matter is conserved because atoms are conserved in physical and chemical processes.
North Dakota Connection		

Ecosystems: Interactions, Energy, and Dynamics

Performance Standard 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.

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.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.A: Interdependent Relationships in Ecosystems -Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and nonliving factors. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Growth of organisms and population increases are limited by access to resources.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural or designed systems.
North Dakota Connection		

Ecosystems: Interactions, Energy, and Dynamics

Performance Standard MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

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. Examples of types of interactions could include competitive, predatory, and mutually beneficial.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.A: Interdependent Relationships in Ecosystems -Similarly, 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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** **7. Engaging in argument from evidence** **8. Obtaining, evaluating, and communicating information**	**Patterns** -Patterns can be used to identify cause and effect relationships.
North Dakota Connection	Resources may include the Habitats of North Dakota book series.	

Ecosystems: Interactions, Energy, and Dynamics

Performance Standard MS-LS2-3	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Clarification Statement	Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.	
Assessment Boundary	Assessment does not include the use of chemical reactions to describe the processes.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.B: Cycle of Matter and Energy Transfer in Ecosystems -Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** -The transfer of energy can be tracked as energy flows through a designed or natural system.
North Dakota Connection		

Ecosystems: Interactions, Energy, and Dynamics

Performance Standard MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

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.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.C: Ecosystem Dynamics, Functioning, and Resilience -Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** 8. Obtaining, evaluating, and communicating information	**Stability and Change** -Small changes in one part of a system might cause large changes in another part.
North Dakota Connection		

MS-LS2-5

ND Science Standards

Ecosystems: Interactions, Energy, and Dynamics

Performance Standard MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Clarification Statement	Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.C: Ecosystem Dynamics, Functioning, and Resilience -Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. **LS4.D: Biodiversity and Humans** -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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating information**	**Stability and Change** -Small changes in one part of a system might cause large changes in another part. 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 and over time. Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.
North Dakota Connection	North Dakota wetlands, North Dakota Soil Conservation	

Heredity: Inheritance and Variation of Traits

Performance Standard 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.

Clarification Statement	Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.	
Assessment Boundary	Assessment does not include specific changes in the molecular level, mechanisms for protein synthesis, or specific types of mutations.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS3.A: Inheritance of Traits -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. **LS3.B: Variation of Traits** -Genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** -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.
North Dakota Connection		

Heredity: Inheritance and Variation of Traits

Performance Standard 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.

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 (mitosis, meiosis, and binary fission).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.B: Growth and Development of Organisms -Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. **LS3.A: Inheritance of Traits** -Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes inherited. **LS3.B: Variation of Traits** -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.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural systems.
North Dakota Connection		

Natural Selection and Adaptations

Performance Standard 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.

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.	
Assessment Boundary	Assessment does not include the names of individual species or geological eras in the fossil record.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.A: Evidence of Common Ancestry and Diversity -The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) 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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** -Graphs and charts can be used to identify patterns in data. Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.
North Dakota Connection	North Dakota Geological Survey, North Dakota Heritage Center, Dickinson Dinosaur Museum, Pioneer Trails Regional Museum, Pembina County Museum, North Dakota University Systems, Broste Rock Museum	

Natural Selection and Adaptations

Performance Standard 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.

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 (examples could include bone structure comparisons of different organisms).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.A: Evidence of Common Ancestry and Diversity -Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** -Patterns can be used to identify cause and effect relationships.
North Dakota Connection		

Natural Selection and Adaptations

Performance Standard MS-LS4-3	**Analyze displays of pictorial data to compare patterns of similarities and differences in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.**

Clarification Statement	Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures (examples may include fish, pigs, and chickens).	
Assessment Boundary	Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.A: Evidence of Common Ancestry and Diversity -Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** -Graphs and charts can be used to identify patterns in data.
North Dakota Connection		

Natural Selection and Adaptations

Performance Standard MS-LS4-4	**Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.**

Clarification Statement	Emphasis is on using simple probability statements and proportional reasoning to construct explanations.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.B: Natural Selection -Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
North Dakota Connection		

Natural Selection and Adaptations

Performance Standard MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

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 impacts these technologies have on society as well as the technologies leading to these scientific discoveries.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.B: Natural Selection -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.	**1. Asking questions and defining problems** 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. 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.
North Dakota Connection	North Dakota University Systems, Garrison Dam National Fish Hatchery, North Dakota Game and Fish Department	

Natural Selection and Adaptations

Performance Standard 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.**

Clarification Statement	Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.	
Assessment Boundary	Assessment does not include Hardy-Weinberg calculations.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.C: Adaptation -Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population change.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating information**	**Cause and Effect** -Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
North Dakota Connection		

Physical Science

Matter and Interaction

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

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, 3-D ball and stick structures, or computer representations showing different molecules with different types of atoms.	
Assessment Boundary	Assessment does not include valance 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 structures is not required.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** -Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
North Dakota Connection		

Matter and Interaction

Performance Standard MS-PS1-2	**Analyze and interpret data on the properties of substances before and after an interaction has occurred to determine if a chemical reaction has occurred.**

Clarification Statement	Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.	
Assessment Boundary	Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **PS1.B: Chemical Reactions** -Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** -Macroscopic patterns are related to the nature of microscopic and atomic-level structure.
North Dakota Connection		

Matter and Interaction

Performance Standard MS-PS1-3	Gather and analyze information to describe that synthetic materials come from natural resources and impact society.

Clarification Statement	Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.	
Assessment Boundary	Assessment is limited to qualitative information.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter - Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **PS1.B: Chemical Reactions** -Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating information**	**Structure and Function** -Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
North Dakota Connection	Petroleum-based products, ethanol plants, coal gasification	

Matter and Interaction

Performance Standard 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.

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.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter -The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **PS3.A: Definitions of Energy** -Heat refers to the energy transferred due to the temperature difference between two objects. The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule. The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural or designed systems.
North Dakota Connection	North Dakota Energy Industries	

Matter and Interaction

Performance Standard 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.

Clarification Statement	Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.	
Assessment Boundary	Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.B: Chemical Reactions -Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** -Matter is conserved because atoms are conserved in physical and chemical processes.
North Dakota Connection		

Matter and Interaction

Performance Standard MS-PS1-6	Design a project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

Clarification Statement	Emphasis is on the design, controlling the transfer of energy to the environment, and modification of the device using factors such as type and concentration of a substance.	
Assessment Boundary	Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.B: Chemical Reactions -Some chemical reactions release energy, others store energy. **ET1.B: Developing Possible Solutions** **ET1.C: Optimizing the Design Solution** -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. The iterative process of testing the most promising solutions and modifying what is proposed based on the test results leads to greater refinement and ultimately to an optimal solution.	**1. Asking questions and defining problems** 2. Developing and using models **3. Planning and carrying out investigations** **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** -The transfer of energy can be tracked as energy flows through a designed or natural system.
North Dakota Connection		

Motion and Stability: Forces and Interactions

Performance Standard MS-PS2-1	**Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.**

Clarification Statement	Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.	
Assessment Boundary	*Assessment is limited to vertical or horizontal interactions in one dimension.*	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion -The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** -Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.
North Dakota Connection		

Motion and Stability: Forces and Interactions

Performance Standard MS-PS2-2	Plan an investigation using Newton's First and Second Laws 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.

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.	
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.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion -The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. A larger force causes a larger change in motion. All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Structure and Function** -Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.
North Dakota Connection		

Motion and Stability: Forces and Interactions

Performance Standard MS-PS2-3	Interpret data to determine the factors that affect the strength of electric and magnetic forces.

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.	
Assessment Boundary	Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.B: Types of Interactions -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.	**1. Asking questions and defining problems** 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural or designed systems.
North Dakota Connection		

Motion and Stability: Forces and Interactions

Performance Standard MS-PS2-4	Use evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

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.	
Assessment Boundary	Assessment does not include Newton's Law of Gravitation or Kepler's Laws.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.B: Types of Interactions -Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** 8. Obtaining, evaluating, and communicating Information	**Systems and System Models** -Models can be used to represent systems and their interactions-such as inputs, processes and outputs-and energy and matter flows within systems.
North Dakota Connection		

Motion and Stability: Forces and Interactions

Performance Standard MS-PS2-5	**Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.**

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.	
Assessment Boundary	Assessment is limited to electric and magnetic fields and is limited to qualitative evidence for the existence of fields.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.B: Types of Interactions -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).	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural or designed systems.
North Dakota Connection		

ENERGY

Performance Standard MS-PS3-1	**Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and/or 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.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: 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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** -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.
North Dakota Connection		

ENERGY

Performance Standard MS-PS3-2	Using a model describe how the different amounts of potential energy in a system changes when the object's distance changes.

Clarification Statement	Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: Either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves and the Earth, 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.	
Assessment Boundary	Assessment is limited to two objects and electric, magnetic, and gravitational interactions.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: Definitions of Energy -A system of objects may also contain stored (potential) energy, depending on their relative positions. **PS3.C: Relationship Between Energy and Forces** -When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** -Models can be used to represent systems and their interactions-such as inputs, processes and outputs-and energy and matter flows within systems.
North Dakota Connection		

ENERGY

Performance Standard 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 solar cooker, and a Styrofoam cup (scientific principles could include the science and engineering practices or the engineering design process).	
Assessment Boundary	Assessment does not include calculating the total amount of thermal energy transferred.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: 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. **PS3.B: Conservation of Energy and Energy Transfer** -Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **ET1.A: 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. **ET1.B: Developing Possible Solutions**	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** -The transfer of energy can be tracked as energy flows through a designed or natural system.
North Dakota Connection	North Dakota Energy Industries	

ENERGY

Performance Standard MS-PS3-4	**Investigate to determine the relationships among the energy transferred, the type of matter, mass, and 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.	
Assessment Boundary	Assessment does not include calculating the total amount of thermal energy transferred.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: 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. **PS3.B: 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.	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion and Quantity** -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.
North Dakota Connection		

ENERGY

Performance Standard MS-PS3-5	Construct and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Clarification Statement	Examples of empirical evidence used in arguments may include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.	
Assessment Boundary	Assessment does not include calculations of energy.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.B: Conservation of Energy and Energy Transfer -When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** 8. Obtaining, evaluating, and communicating Information	**Energy and Matter** -Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
North Dakota Connection		

Waves and their Applications in Technologies for Information Transfer

Performance Standard MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

Clarification Statement	Emphasis is on describing waves with both qualitative and quantitative thinking.	
Assessment Boundary	Assessment does not include electromagnetic waves and is limited to standard repeating waves.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.A: Wave Properties -A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating Information	**Patterns** -Graphs and charts can be used to identify patterns in data.
North Dakota Connection		

Waves and their Applications in Technologies for Information Transfer

Performance Standard MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Clarification Statement	Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.	
Assessment Boundary	Assessment is limited to qualitative applications pertaining to light and mechanical waves.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.A: Wave Properties -A sound wave needs a medium through which it is transmitted. **PS4.B: Electromagnetic Radiation** -When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. However, because light can travel through space, it cannot be a matter wave, like sound or water waves.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Structure and Function** -Structures can be designed to serve specific functions by taking into account properties of different materials, and how materials can be shaped and used.
North Dakota Connection		

Waves and their Applications in Technologies for Information Transfer

Performance Standard MS-PS4-3	Evaluate how different forms of technology utilize different signals.

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 WiFi devices, and conversion of stored binary patterns to make sound or text on a computer screen.	
Assessment Boundary	Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.C: Information Technologies and Instrumentation -Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	1. Asking questions and defining problems **2. Developing and using models** 3. Planning and carrying out investigations **4. Analyzing and interpreting data** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating Information**	**Structure and Function** -Structures can be designed to serve specific functions. Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. Advances in technology influence the progress of science and science has influenced advances in technology.
North Dakota Connection	North Dakota power, telephone, and cable companies	

Engineering & Technology

Performance Standard MS-ET1-1	**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.**

Clarification Statement	This standard may be integrated into any performance standard. Ecological topics may include deforestation, overpopulation, water quality, air quality, erosion, or toxic spills.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.A: Defining and Delimiting Engineering Problems -The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	**1. Asking questions and defining problems** 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.
North Dakota Connection		

Engineering & Technology

Performance Standard MS-ET1-2	Evaluate competing design solutions using systematic process to determine how well they meet the criteria and constraints of the problem.

Clarification Statement	This standard may be integrated into any performance standard. This is a continuation of the previous standard.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating information**	
North Dakota Connection		

Engineering & Technology

Performance Standard MS-ET1-3	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.

Clarification Statement	This standard may be integrated into any performance standard. This is a continuation of the previous standard.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions. **ET1.C: Optimizing the Design Solution** -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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** -Relationships can be classified as casual or correlational, and correlation does not necessarily imply causation.
North Dakota Connection		

Engineering & Technology

Performance Standard MS-ET1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Clarification Statement	This standard may be integrated into any performance standard. This is a continuation of the previous standard.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions -A solution needs to be tested, and then modified based on test results, in order to improve it. Models of all kinds are important for testing solutions. **ET1.C: Optimizing the Design Solution** -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.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** **7.** Engaging in argument from evidence **8.** Obtaining, evaluating, and communicating information	**Cause and Effect** -Cause and effect relationships may be used to predict phenomena in natural or designed systems.
North Dakota Connection		

High School

High school standards can be identified by HS icon. High school standards (grades 9-12) are listed by discipline:

- **Life Science (LS)**
- **Physical Science (PS)**
- **Earth & Space Science (ESS)**
- **Engineering & Technology (ET)**

Life Science

FROM MOLECULES TO ORGANISM: STRUCTURES AND PROCESSES

Performance Standard HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Clarification Statement	Emphasis is on the conceptual understanding that DNA sequences determine the amino acid sequence and thus protein structure.	
Assessment Boundary	Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function Systems of specialized cells within organisms help them perform the essential functions of life. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct and revise an explanation based on valid and reliable evidence obtained from a variety of 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** 8. Engaging in argument from evidence 9. Obtaining, evaluating, and communicating information	Structure and Function Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
North Dakota Connection		

FROM MOLECULES TO ORGANISM: STRUCTURES AND PROCESSES

Performance Standard HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Clarification Statement	Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.	
Assessment Boundary	Assessment does not include interactions and functions at the molecular or chemical reaction level.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.	1. Asking questions and defining problems **2. Developing and using models** • **Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating Information	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.
North Dakota Connection		

FROM MOLECULES TO ORGANISM: STRUCTURES AND PROCESSES

Performance Standard HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Clarification Statement	Examples of investigations could include heart rate response to exercise, cell transport, etc.	
Assessment Boundary	Assessment does not include the cellular processes involved in the feedback mechanism.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** • **Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data and refine the design accordingly** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system.
North Dakota Connection		

FROM MOLECULES TO ORGANISM: STRUCTURES AND PROCESSES

Performance Standard HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Clarification Statement	Emphasis is on conceptual understanding that mitosis passes on genetically identical materials via replication, not on the details of each phase in mitosis.	
Assessment Boundary	Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.B: Growth and Development of Organisms In multicellular organisms, individual cells grow and then divide via a process called mitosis allowing the organism to grow. Each parent cell passing identical genetic material to both daughter cells. Cellular division and differentiation produce and maintain a complex organism.	1. Asking questions and defining problems **2. Developing and using models** • **Use a model based on evidence to illustrate the relationships between systems or between components of a system** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.
North Dakota Connection		

FROM MOLECULES TO ORGANISM: STRUCTURES AND PROCESSES

Performance Standard HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Clarification Statement	Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.	
Assessment Boundary	Assessment does not include specific biochemical steps.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.C: Organization for Matter and Energy Flow in Organisms The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.	1. Asking questions and defining problems **2. Developing and using models** • **Use a model based on evidence to illustrate the relationships between systems or between components of a system** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
North Dakota Connection		

FROM MOLECULES TO ORGANISM: STRUCTURES AND PROCESSES

Performance Standard HS-LS1-6	**Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen may combine with other elements to form large carbon-based molecules.**

Clarification Statement	Emphasis is on using evidence from models and simulations to support explanations.	
Assessment Boundary	Assessment does not include the details of the specific chemical reactions or identification of macromolecules.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.C: Organization for Matter and Energy Flow in Organisms Sugar molecules contain carbon, hydrogen, and oxygen. These building blocks are used to form large molecules. Chemical elements are recombined in different ways to form different products.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct and revise an explanation based on valid and reliable evidence obtained from a variety of 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** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
North Dakota Connection		

FROM MOLECULES TO ORGANISM: STRUCTURES AND PROCESSES

Performance Standard HS-LS1-7	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Clarification Statement	Emphasis is on the conceptual understanding of the inputs and outputs of the processes of aerobic and anaerobic cellular respiration. Examples of models could include diagrams, chemical equations, conceptual models and/or laboratory investigations.	
Assessment Boundary	Assessment should not include identification of the steps or specific processes involved in cellular respiration.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.C: Organization for Matter and Energy Flow in Organisms Chemical elements are recombined in different ways to form different products. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy.	1. Asking questions and defining problems **2. Developing and using models** • **Use a model based on evidence to illustrate the relationships between systems or between components of a system** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.
North Dakota Connection		

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Standard HS-LS2-1	Use mathematical and/or computational models to support explanations of factors that affect carrying capacity of ecosystems at different scales.

Clarification Statement	Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from computer simulations or historical data sets.	
Assessment Boundary	Assessment does not include deriving mathematical equations to make comparisons.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.A: Interdependent Relationships in Ecosystems Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use mathematical and/or computational representations of phenomena or design solutions to support explanations** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
North Dakota Connection	ND Game and Fish, ND colleges and universities, Natural Resource Conservation Service, USFWS	

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Standard HS-LS2-2	**Use evidence from mathematical representations to explain factors that affect population dynamics and biodiversity.**

Clarification Statement	Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.	
Assessment Boundary	Assessment is limited to provided data.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.A: Interdependent Relationships in Ecosystems Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Interactions within an ecosystem can keep its organisms relatively constant under stable conditions. A change in the ecosystem can create a change in populations.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use mathematical representations of phenomena or design solutions to support and revise explanations** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.
North Dakota Connection	ND Game and Fish, ND colleges and universities, Natural Resource Conservation Service, Forestry Service, Invasive species management: Aquatic nuisance species (e.g. zebra mussels), leafy spurge management, CRP mismanagement decreasing plant diversity.	

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Standard HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Clarification Statement	Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.	
Assessment Boundary	Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Photosynthesis and cellular respiration provide most of the energy for life processes.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources 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** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Energy drives the cycling of matter within and between systems.
North Dakota Connection		

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Standard HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Clarification Statement	Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.	
Assessment Boundary	Assessment is limited to conceptual reasoning to describe the cycling of matter and flow of energy.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems The chemical elements that make up the molecules of organisms pass through food webs (10% rule) and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use mathematical representations of phenomena or design solutions to support claims** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.
North Dakota Connection	Tillage on cropland, drought effects, disturbance releases, fires, etc. ND Connection: NDSU Research stations, extension; NRCS	

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Standard HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Clarification Statement	Examples of models could include simulations and mathematical models.	
Assessment Boundary	Assessment does not include the specific chemical steps of photosynthesis and respiration.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.	1. Asking questions and defining problems **2. Developing and using models** • **Develop a model based on evidence to illustrate the relationships between systems or components of a system** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** Models can be used to simulate systems and interactions — including energy, matter and information flows — within and between systems at different scales.
North Dakota Connection		

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Standard HS-LS2-6	**Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.**

Clarification Statement	Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise, that occur at different rates.	
Assessment Boundary	Assessment is limited to provided data.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.C: Ecosystem Dynamics, Functioning, and Resilience Interactions within an ecosystem can keep its organisms relatively constant under stable conditions. A change in the ecosystem can create a change in populations.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** • **Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments** 8. Obtaining, evaluating, and communicating information	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable.
North Dakota Connection	ND Game and Fish, ND colleges and universities, Natural Resource Conservation Service, Forestry Service	

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Standard HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Clarification Statement	Examples of human activities can include urbanization, building dams, and dissemination of invasive species.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS2.C: Ecosystem Dynamics, Functioning, and Resilience Human activity in the environment can disrupt an ecosystem. — including habitat destruction, pollution, introduction of invasive species, overexploitation, climate change, restoration, and conservation. **LS4.D: Biodiversity and Humans** Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations landscapes of recreational or inspirational value** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable.
North Dakota Connection	ND rivers, Devils Lake, ND Game and Fish, ND colleges and universities, Natural Resource Conservation Service, Forestry Service, River Keepers	

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Standard HS-LS2-8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

<table>
<tr><td>Clarification Statement</td><td colspan="2">Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.</td></tr>
<tr><td>Assessment Boundary</td><td colspan="2"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Disciplinary Core Ideas</td><td>Science & Engineering Practices</td><td>Crosscutting Concepts</td></tr>
<tr><td>LS2.D: Social Interactions and Group Behavior
Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.</td><td>1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematical and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
• Evaluate the evidence behind currently accepted explanations to determine the merits of arguments
8. Obtaining, evaluating, and communicating information</td><td>Cause and Effect
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>North Dakota Connection</td><td colspan="2">ND Game and Fish, USFWS</td></tr>
</table>

HEREDITY: INTERITANCE AND VARIATION OF TRAITS

Performance Standard HS-LS3-1	Construct an explanation to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Clarification Statement	Emphasis should be on traits including completely dominant, codominant, incompletely dominant, and sex-linked traits. Examples can include pedigrees, karyotypes, genetic disorders, Punnett squares, dihybrid crosses.	
Assessment Boundary	Assessment focuses on the conceptual understanding of meiosis.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS1.A: Structure and Function All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. **LS3.A: Inheritance of Traits** DNA make up genes that are sections on chromosomes which are the instructions for forming individual characteristics (traits). All cells of an organism have the same genetic content. Gene expression is regulated in different ways.	**1. Asking questions and defining problems** • **Ask questions that arise from examining models or a theory to clarify relationships** 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection		

HEREDITY: INTERITANCE AND VARIATION OF TRAITS

Performance Standard HS-LS3-2	**Make and defend a claim based on evidence that inheritable genetic variations result from various factors.**

Clarification Statement	Emphasis is on (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. Emphasis is also on using data to support arguments for the way variation occurs.	
Assessment Boundary	Assessment focuses on the conceptual understanding of meiosis.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS3.B: Variation of Traits Sexual reproduction (meiosis) creates variation through crossing over and independent assortment. Mutations may occur during DNA replication resulting in genetic variation or due to environmental factors. The variation and distribution of traits observed depends on both genetic and environmental factors.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** • **Make and defend a claim based on evidence about the natural world that reflects scientific knowledge and student-generated evidence** 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection		

HEREDITY: INTERITANCE AND VARIATION OF TRAITS

Performance Standard HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Clarification Statement	Emphasis is on distribution and variation of traits in a population and the use of mathematics to describe the distribution. Examples can include calculations of frequencies in Punnett squares, graphical representations.	
Assessment Boundary	Assessment does not include Hardy-Weinberg calculations or chi square test.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS3.B: Variation of Traits The variation and distribution of traits observed depends on both genetic and environmental factors.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** • **Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
North Dakota Connection		

BIOLOGICAL EVOLUTION: UNITY AND DIVERSITY

Performance Standard HS-LS4-1	Analyze and interpret scientific information that common ancestry and biological evolution is supported by multiple lines of empirical evidence.

Clarification Statement	Biological evolution is defined as changes in the traits of populations of organisms over time. Emphasis is on a conceptual understanding of the role each line of evidence (e.g., similarities in DNA sequences, order of appearance of structure during embryological development, cladograms, homologous and vestigial structures, fossil records) demonstrates as related to common ancestry and biological evolution.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.A Evidence of Common Ancestry and Diversity Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating information** • **Communicate scientific information in multiple formats**	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
North Dakota Connection	ND fossils, ND Heritage Museum	

BIOLOGICAL EVOLUTION: UNITY AND DIVERSITY

Performance Standard HS-LS4-2	Construct an explanation based on evidence that the process of biological evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Clarification Statement	Emphasis is on using evidence to explain the influence each of the four factors has on the number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.	
Assessment Boundary	Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.B: Natural Selection Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals. **LS4.C: Adaptation** Evolution is a consequence of the interaction of four factors: (1) Variations, (2) Overpopulation, (3) Adaptations, (4) Descent with modification.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct an explanation based on valid and reliable evidence obtained from a variety of sources 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** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes.
North Dakota Connection	ND fossils, ND Heritage Museum	

BIOLOGICAL EVOLUTION: UNITY AND DIVERSITY

Performance Standard HS-LS4-3	**Use mathematical models to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.**

Clarification Statement	Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.	
Assessment Boundary	Assessment is limited to graphical analysis. Assessment does not include allele frequency calculations.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.B: Natural Selection The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. **LS4.C: Adaptation** Adaptation also means that the distribution of traits in a population can change when conditions change.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** • **Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
North Dakota Connection		

BIOLOGICAL EVOLUTION: UNITY AND DIVERSITY

Performance Standard HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Clarification Statement	Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.C: Adaptation Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** • **Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection	Salt-tolerant plants and animals in sodic/saline depressions. Animals and plants adapted to cold winters. Department of Fish & Wildlife, Natural Resource Conservation Service, ND colleges and universities.	

BIOLOGICAL EVOLUTION: UNITY AND DIVERSITY

Performance Standard HS-LS4-5	**Evaluate the evidence supporting claims that changes in environmental conditions may result in increases in the number of individuals of some species, the emergence of new species over time, and the extinction of other species.**

Clarification Statement	Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, land management, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
LS4.C: Adaptation Changes in the physical environment contribute to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** • **Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments** 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection	ND Range Sciences	

BIOLOGICAL EVOLUTION: UNITY AND DIVERSITY

Performance Standard HS-LS4-6	Design and revise a solution to mitigate impacts of human activity on biodiversity.

Clarification Statement	Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.
Assessment Boundary	

Disciplinary Core Ideas	Science & Engineering Practices	Crosscutting Concepts
LS4.C: Adaptation Changes in the physical environment lead to changes in species diversity and distribution. **LS4.D: Biodiversity and Humans** Human activity impacts biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. **ETS1.B: Developing Possible Solutions** When evaluating solutions, such as restoration, conservation, and preservation, it is important to account for a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct an explanation based on valid and reliable evidence obtained from a variety of sources 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.** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

North Dakota Connection	Restoration of ecosystems, such as prairies and wetlands, Department of Fish & Wildlife, Natural Resource Conservation Service, ND colleges and universities, local, regional and state governments. Reclamation of coal mines, US Bureau of Reclamation.

Physical Science

MATTER AND ITS INTERACTIONS

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

Clarification Statement	**Physical Science:** Examples of properties that could be predicted from patterns could include metals, nonmetals, metalloids, number of valence electrons, types of bonds formed, or atomic mass. Emphasis is on main group elements. **Chemistry:** Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, atomic radius, atomic mass, or reactions with oxygen. Emphasis is on main group elements and qualitative understanding of the relative trends of ionization energy and electronegativity.	
Assessment Boundary	Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.	1. Asking questions and defining problems **2. Developing and using models** • **Use a model to predict the relationships between systems or between components of a system** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
North Dakota Connection		

MATTER AND ITS INTERACTIONS

Performance Standard HS-PS1-2	Construct an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

Clarification Statement	**Physical Science:** Examples of chemical reactions could include the reaction of sodium and chlorine, carbon and oxygen, or hydrogen and oxygen. Reaction classification includes synthesis, decomposition, single displacement, double displacement, and acid-base. **Chemistry:** Examples of chemical reactions could include the reaction of sodium and chlorine, carbon and oxygen, or carbon and hydrogen. Reaction classification aids in the prediction of products (e.g. synthesis, decomposition, single displacement, double displacement, and acid-base).	
Assessment Boundary	Identification of the main types of chemical reactions (single replacement, double replacement, synthesis, decomposition, composition).	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. **PS1.B: Chemical Reactions** The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct and revise and explanation based on valid and reliable evidence** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
North Dakota Connection		

MATTER AND ITS INTERACTIONS

Performance Standard HS-PS1-3	**Plan and conduct an investigation to gather evidence to compare the structure of substances at the macro-scale to infer the strength of electrical forces between particles.**

Clarification Statement	**Chemistry:** Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of macro-properties of substances could include the melting point and boiling point, vapor pressure, and surface tension. Quantitative calculations are beyond the scope of this standard.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** • **Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
North Dakota Connection		

MATTER AND ITS INTERACTIONS

Performance Standard HS-PS1-4	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

Clarification Statement	**Chemistry**: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.	
Assessment Boundary	Assessment does not include bond energy calculations.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.A: Structure and Properties of Matter A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. **PS1.B: Chemical Reactions** Chemical processes, their rates, and whether energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	1. Asking questions and defining problems **2. Developing and using models** • **Develop a model based on evidence to illustrate the relationships between systems or between components of a system** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
North Dakota Connection		

MATTER AND ITS INTERACTIONS

Performance Standard HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of the reacting particles on the rate at which a reaction occurs.

Clarification Statement	**Physical Science:** Emphasis is on relating factors such as temperature and concentration to reaction rate qualitatively. **Chemistry:** Emphasis is on relating factors such as temperature and concentration to reaction rate quantitatively. Catalysts and inhibitors in a qualitative understanding.	
Assessment Boundary	Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.B: Chemical Reactions Chemical processes, their rates, and whether energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, accounting for possible unanticipated effects** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
North Dakota Connection	Pipeline chemistry, water treatment, power plant scrubbers	

MATTER AND ITS INTERACTIONS

Performance Standard HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Clarification Statement	**Chemistry:** Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products. This standard includes one variable at a time and does not include calculating equilibrium constants and concentrations.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.B: Chemical Reactions In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present **ETS1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable.
North Dakota Connection		

MATTER AND ITS INTERACTIONS

Performance Standard HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Clarification Statement	**Physical Science:** Emphasis is on using mathematical ideas as they relate to balancing reactions to communicate the proportional relationships between masses of atoms in the reactants and the products. Emphasis is on assessing students' use of mathematical thinking and not on memorization. **Chemistry:** Emphasis is on using mathematical ideas as they relate to balancing reactions and stoichiometry to communicate the proportional relationships between masses of atoms in the reactants and the products. Emphasis is on assessing students' use of mathematical thinking and not on memorization.	
Assessment Boundary	Assessment is limited to balancing chemical equations. Assessment does not include complex reactions.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.B: Chemical Reactions The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use mathematical representations of phenomena to support claims** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** The total amount of energy and matter in closed systems is conserved.
North Dakota Connection		

HS-PS1-8 ND Science Standards

MATTER AND ITS INTERACTIONS

Performance Standard HS-PS1-8	**Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.**

Clarification Statement	**Physical Science:** Emphasis is only qualitative understanding between fission and fusion. **Chemistry:** Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations as well as alpha, beta, and gamma radioactive decays.	
Assessment Boundary	Assessment is limited to qualitative understanding of fission and fusion.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS1.C: Nuclear Processes Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.	1. Asking questions and defining problems **2. Developing and using models** • **Develop a model based on evidence to illustrate the relationships between systems or between components of a system** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
North Dakota Connection		

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Standard HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Clarification Statement	**Physical Science and Physics**: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force in one dimension.	
Assessment Boundary	Assessment is limited to one dimensional motion and to macroscopic objects moving at non-relativistic speeds.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion Newton's second law accurately predicts changes in the motion of macroscopic objects.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** • **Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection		

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Standard HS-PS2-2	**Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.**

Clarification Statement	**Physical Science**: Emphasis is on the quantitative calculations of momentum and the qualitative meaning of conservation of momentum. **Physics**: Emphasis is on the quantitative calculations of momentum and the qualitative meaning of conservation of momentum. Physics includes the quantitative calculations of conservation of momentum, including inelastic & elastic collisions.	
Assessment Boundary	Assessment is limited to systems of two macroscopic bodies moving in one dimension.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion Momentum is defined for a specific frame of reference; it is the mass times the velocity of the object.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use mathematical representations of phenomena to describe explanations** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.
North Dakota Connection		

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Standard HS-PS2-3	Apply scientific principles, such as Newton's 1st & 3rd Laws, and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Clarification Statement	**Physical Science**: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. **Physics**: Physics includes algebraic manipulations.	
Assessment Boundary	Assessment is limited to qualitative evaluations.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.A: Forces and Motion Momentum is conserved within the system and the surroundings. **ETS1.A: Defining and Delimiting an Engineering Problem** Criteria and constraints also include satisfying any requirements set by society, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. **ETS1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached systematically.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Systems can be designed to cause a desired effect.
North Dakota Connection		

MOTION AND STABILITY: FORCES AND INTERACTION

Performance Standard HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

Clarification Statement	**Physics:** Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields for systems with two objects.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.B: Types of Interactions Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use mathematical representations of phenomena to describe explanations** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
North Dakota Connection		

MOTION AND STABILITY: FORCES AND INTERACTION

Performance Standard HS-PS2-5	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

Clarification Statement	**Physics**: Evidence of changes within a circuit can be represented numerically, graphically, or algebraically using Ohm's law.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.B: Types of Interactions Using Newton's law of universal gravitation and Coulomb's law to describe and predict the effects of gravitational and electrostatic forces between objects. Forces at a distance are explained by fields that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. **PS3.A: Definitions of Energy** "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents.	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** • **Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection		

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Standard HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Clarification Statement	**Chemistry:** Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS2.B: Types of Interactions Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating information** • **Communicate scientific and technical information (e.g., about the process of development and the design and performance of a proposed process or system) in multiple formats (including oral, graphical, textual and mathematical)**	**Structure and Function** Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
North Dakota Connection	NDSU Environmental & Energy Research Center, Plains CO_2 Reduction Partnership, ND Lignite Council	

ENERGY

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

Clarification Statement	**Physical Science:** Emphasis is on basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and potential energy. **Chemistry:** Emphasis is on explaining the meaning of mathematical expressions used in the model. Focus is on basic algebraic expression or computations, systems of two or three components, and thermal energy. **Physics:** Emphasis is on explaining the meaning of mathematical expressions used in the model. Focus is on basic algebraic expression or computations; systems of two or three components; and thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.	
Assessment Boundary	Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and potential energy.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: Definitions of Energy Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. **PS3.B: Conservation of Energy and Energy Transfer** Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Create a computational model or simulation of a phenomenon, designed device, process, or a system** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** System Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
North Dakota Connection		

ENERGY

Performance Standard HS-PS3-2	Develop and use models to illustrate that energy is associated with motion and relative position of particles (objects).

Clarification Statement	**Physical Science:** Emphasis is on energy associated with the different states of matter. **Chemistry:** Emphasis on phenomena relating to the Kinetic Molecular Theory in all phases of matter. Possible models include diagrams, drawings, descriptions, and computer simulations. **Physics:** Emphasis on phenomena relating to the Kinetic Molecular Theory in all phases of matter. Possible models include diagrams, drawings, descriptions, and computer simulations.	
Assessment Boundary	Does not include quantitative calculations and limited to energy associated with solids, liquids, and gases.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.A: Definitions of Energy Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. .	1. Asking questions and defining problems **2. Developing and using models** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.
North Dakota Connection		

ENERGY

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

Clarification Statement	**Physical Science:** Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, generators, and types of circuits. **Chemistry:** Emphasis is on both qualitative and quantitative evaluations of devices. Constraints could include use of renewable energy forms and efficiency. Focus of quantitative evaluations is limited to total output for a given input. Examples of devices in chemistry could include hot/cold packs and batteries. **Physics:** Emphasis is on both qualitative and quantitative evaluations of devices. Constraints could include use of renewable energy forms and efficiency. Focus of quantitative evaluations is limited to total output for a given input. Examples of devices in physics could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and electric motors.	
Assessment Boundary	Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**

ENERGY

PS3.A: Definitions of Energy Energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. **PS3.D: Energy in Chemical Processes** Although energy cannot be destroyed, it can be converted to less useful forms. **ETS1.A: Defining and Delimiting an Engineering Problem** Criteria and constraints also include satisfying any requirements set by society.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated, sources of evidence, prioritized criteria, and tradeoff considerations.** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
North Dakota Connection	North Dakota wind energy, Garrison Dam, ND solar farms	

ENERGY

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

Clarification Statement	**Physical Science/Chemistry/Physics:** Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes conceptually (Chemistry & Physics includes quantitative analysis). Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.	
Assessment Boundary	Assessment is limited to investigations based on materials and tools provided to students and is limited to qualitative only.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.B: Conservation of Energy and Energy Transfer Energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. **PS3.D: Energy in Chemical Processes** Although energy cannot be destroyed, it can be converted to less useful forms — for example, to thermal energy in the surrounding environment. **ETS1.A: Defining and Delimiting an Engineering Problem** Criteria and constraints also include satisfying any requirements set by society.	1. Asking questions and defining problems 2. Developing and using models 3. **Planning and carrying out investigations** • **Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements.** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.
North Dakota Connection		

ENERGY

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

Clarification Statement	Physics: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other. Limited to systems containing two objects.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.C: Relationship Between Energy and Forces When two objects interacting through a field change relative position, the energy stored in the field is changed.	1. Asking questions and defining problems **2. Developing and using models** • **Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.
North Dakota Connection		

WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER

Performance Standard HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Clarification Statement	**Physical Science/Chemistry/Physics**: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.	
Assessment Boundary	Assessment is limited to algebraic relationships and describing those relationships qualitatively (physical science limited to qualitative only).	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.A: Wave Properties The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection		

WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER

Performance Standard HS-PS4-2	Construct an explanation using evidence to support the idea that electromagnetic radiation can be described by a wave model and a particle model.

Clarification Statement	**Chemistry/Physics**: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.	
Assessment Boundary	Assessment does not include using quantum theory.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.A: Wave Properties Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only). **PS4.B: Electromagnetic Radiation** Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** • **Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.** 8. Obtaining, evaluating, and communicating information	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions- including energy, matter, and information flows- within and between systems at different scales.
North Dakota Connection		

WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER

Performance Standard HS-PS4-3	**Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.**

Clarification Statement	**Physics:** Emphasis is on the idea that photons associated with different frequencies of light have different energies. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.	
Assessment Boundary	Assessment is limited to qualitative descriptions.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS4.B: Electromagnetic Radiation When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating information** • **Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible**	**Cause and Effect** Cause and effect relationships can be suggested and predicted for complex natural and human designs systems by examining what is known about smaller scale mechanisms within the system.
North Dakota Connection		

WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER

Performance Standard HS-PS4-4	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Clarification Statement	**Physics:** Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology. Focus in on qualitative information and does not include band theory.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
PS3.D: Energy in Chemical Processes Solar cells capture the sun's energy and produce electrical energy. **PS4.A: Wave Properties** Information can be digitized and then stored in computer memory and sent over long distances as wave pulses. **PS4.B: Electromagnetic Radiation** Photoelectric materials emit electrons when they absorb light of a high-enough frequency. **PS4.C: Information Technologies and Instrumentation** Technologies based on waves are part of everyday experiences and are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **8. Obtaining, evaluating, and communicating information** • **Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).**	**Cause and Effect** Systems can be designed to cause a desired effect.
North Dakota Connection		

Earth and Space Science

EARTH'S PLACE IN THE UNIVERSE

Performance Standard HS-ESS1-1	**Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation.**

Clarification Statement	**Earth Science:** Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.	
Assessment Boundary	Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.A: The Universe and Its Stars The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. **PS3.D: Energy in Chemical Processes and Everyday Life** Nuclear fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.	1. Asking questions and defining problems **2. Developing and using models** • **Develop a model based on evidence to illustrate the relationships between systems or between components of a system.** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
North Dakota Connection		

EARTH'S PLACE IN THE UNIVERSE

Performance Standard HS-ESS1-2	Construct an explanation for the observed expansion of the known universe based on astronomical evidence of light spectra, motion of distant galaxies, cosmic background radiation, and composition of matter in the universe.

Clarification Statement	**Earth Science:** Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, which led to the formulation of the Big Bang and other theories.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.A: The Universe and Its Stars The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. Nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. **PS4.B: Electromagnetic Radiation** Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. **Constructing explanations and designing solutions** • **Construct an explanation based on valid and reliable evidence** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems.
North Dakota Connection		

EARTH'S PLACE IN THE UNIVERSE

Performance Standard HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.

Clarification Statement	**Earth Science:** Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.	
Assessment Boundary	Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.B: The Earth and the Solar System • Kepler's laws describe common features of motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct an explanation based on valid and reliable evidence** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
North Dakota Connection		

EARTH'S PLACE IN THE UNIVERSE

Performance Standard HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Clarification Statement	Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.	
Assessment Boundary	Mathematical representations for the gravitational attraction of bodies and Kepler's laws of orbital motions should not deal with more than two bodies, nor involve calculus.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.A: The Universe and Its Stars The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use mathematical or computational representations of phenomena to describe explanations.** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Scale, Proportion, and Quantity** Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
North Dakota Connection		

EARTH'S PLACE IN THE UNIVERSE

Performance Standard HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

Clarification Statement	Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages of oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust decreasing with distance away from a central ancient core of the continental plate (a result of past plate interactions).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.C: The History of Planet Earth Continental rocks are generally much older than the rocks of the ocean floor. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. **PS1.C: Nuclear Processes** Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** • **Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.** 8. Obtaining, evaluating, and communicating information	**Patterns** Empirical evidence is needed to identify patterns.
North Dakota Connection		

EARTH'S PLACE IN THE UNIVERSE

Performance Standard HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

Clarification Statement	Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.C: The History of Planet Earth Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little. Studying these objects can provide information about Earth's formation and early history. **PS1.C: Nuclear Processes** Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable.
North Dakota Connection		

Earth's Systems

Performance Standard HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

Clarification Statement	**Earth Science:** Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).	
Assessment Boundary	Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.A: Earth Materials and Systems Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust.	1. Asking questions and defining problems **2. Developing and using models** • **Using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
North Dakota Connection		

Earth's Systems

Performance Standard HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

Clarification Statement	**Earth Science/Environmental Science:** Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands cause a decrease in local humidity that further reduces the wetland extent.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.A: Earth Materials and Systems Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **ESS2.D: Weather and Climate** The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** • **Introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system.
North Dakota Connection	Wildfires in the west affect air quality, sunlight reaching the soil surface, and temperatures in ND. Land use changes in response to Federal programs, such as the Conservation Reserve Program. Effects of changing climate, such as shifts in the pathway of the Jetstream. U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA)	

Earth's Systems

Performance Standard HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

Clarification Statement	**Earth Science:** Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.A: Earth Materials and Systems Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection.	1. Asking questions and defining problems **2. Developing and using models** • **Developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** Energy drives the cycling of matter within and between systems.
North Dakota Connection		

Earth's Systems

Performance Standard HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

Clarification Statement	**Earth Science:** Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; and 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis.	
Assessment Boundary	Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS1.B: Earth and the Solar System Cyclical changes in the shape of Earth's orbit, along with changes in the tilt of the planet's axis of rotation have altered the intensity and distribution of sunlight falling on the earth. **ESS2.A: Earth Materials and System** The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. **ESS2.D: Weather and Climate** The foundation for Earth's global climate systems is the electromagnetic radiation from the sun.	1. Asking questions and defining problems **2. Developing and using models** • **Using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection		

Earth's Systems

Performance Standard HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Clarification Statement	**Earth Science/Environmental Science:** Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.C: The Roles of Water in Earth's Surface Processes The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.	1. Asking questions and defining problems 2. Developing and using models **3. Planning and carrying out investigations** • **Builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.** 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Structure and Function** The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.
North Dakota Connection		

Earth's Systems

Performance Standard HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

Clarification Statement	**Earth Science/Environmental Science:** Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.D: Weather and Climate Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.	1. Asking questions and defining problems **2. Developing and using models** • **Using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).** 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Energy and Matter** The total amount of energy and matter in closed systems is conserved.
North Dakota Connection		

Earth's Systems

Performance Standard HS-ESS2-7	**Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.**

Clarification Statement	**Earth Science:** Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.	
Assessment Boundary	Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.D: Weather and Climate Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. **ESS2.E Biogeology** The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual coevolution of Earth's surface and the life that exists on it.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** • **Using appropriate and enough evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s).** 8. Obtaining, evaluating, and communicating information	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable.
North Dakota Connection		

EARTH AND HUMAN ACTIVITY

Performance Standard HS-ESS3-1	**Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.**

Clarification Statement	**Earth Science/Environmental Science:** Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.A: Natural Resources Resource availability has guided the development of human society. **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to account for a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct an explanation based on valid and reliable evidence** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

EARTH AND HUMAN ACTIVITY

North Dakota Connection	ND receives less water from precipitation than is lost to the atmosphere in the form of evaporation and transpiration. This is compensated for in industry, including agriculture, by sourcing groundwater and surface water from rivers (which essentially bring water from out-of-state into ND). Also, the west of ND is drier than the east. As a result, crops are grown east, while in the west of ND, cattle ranching is more prevalent. ND Department of Health (Water Division), Agricultural extension, Natural Resources Conservation Service (NRCS), US Army Corps of Engineers.

EARTH AND HUMAN ACTIVITY

Performance Standard HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

Clarification Statement	**Earth Science/Environmental Science:** Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.A: Natural Resources Resource availability has guided the development of human society. **ESS3.B: Natural Hazards** Natural hazards and other geologic events have shaped the course of human history; they have significantly altered the sizes of human populations and have driven human migrations.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions **7. Engaging in argument from evidence** • **Evaluate competing design solutions to a real-world problem** 8. Obtaining, evaluating, and communicating information	**Influence of Science, Engineering, and Technology on Society and the Natural World** Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. Analysis of costs and benefits is a critical aspect of decisions about technology.
North Dakota Connection	No-till, minimum till practices in agriculture, coal mining, oil and gas exploration, solar and wind energy. NRCS, Ag extension, ND Dept. of Health, ND Lignite Council, oil and gas companies, alternative energy companies.	

EARTH AND HUMAN ACTIVITY

Performance Standard HS-ESS3-3	**Analyze the relationships among management of natural resources, the sustainability of human populations, and biodiversity through the use of a computational simulation.**

Clarification Statement	**Earth Science/Environmental Science:** Examples of factors that affect the management of natural resources include costs of resource extraction, processing, and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.	
Assessment Boundary	Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.A: Natural Resources All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Create a computational model or simulation of a phenomenon, designed device, process, or system.** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
North Dakota Connection	No-till, minimum till practices in agriculture, coal mining, oil and gas exploration, solar and wind energy. Natural Resources Conservation Service (NRCS), Ag extension, ND Dept. of Health, ND Lignite Council, oil and gas companies, alternative energy companies.	

EARTH AND HUMAN ACTIVITY

Performance Standard HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Clarification Statement	**Earth Science/Environmental Science:** Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.A: Natural Resources Resource availability has guided the development of human society. **ESS3.B: Natural Hazards** Natural hazards and other geologic events have shaped the course of human history; they have significantly altered the sizes of human populations and have driven human migrations.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Construct an explanation based on valid and reliable evidence** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
North Dakota Connection	ND receives less water from precipitation than is lost to the atmosphere in the form of evaporation and transpiration. This is compensated for in industry, including agriculture, by sourcing groundwater and surface water from rivers (which essentially bring water from out-of-state into ND). Also, the west of ND is drier than the east. As a result, crops are grown east, while in the west of ND, cattle ranching is more prevalent. ND Department of Health (Water Division), Agriculture extension, Natural Resources Conservation Service (NRCS), US Army Corps of Engineers	

EARTH AND HUMAN ACTIVITY

Performance Standard HS-ESS3-5	**Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.**

Clarification Statement	**Earth Science/Environmental Science:** Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).	
Assessment Boundary	Assessment is limited to one example of a climate change and its associated impacts.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS3.D: Global Climate Change Even though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data** • **Analyze data using computational models in order to make valid and reliable scientific claims** 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Stability and Change** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
North Dakota Connection	Connect the effects of climate change on ND land uses. International Panel for Climate Change, National Oceanic and Atmospheric Administration (NOAA), Natural Resources Conservation Service (NRCS)	

EARTH AND HUMAN ACTIVITY

Performance Standard HS-ESS3-6	**Use data from computational representations to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.**

Clarification Statement	**Earth Science/Environmental Science:** Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere.	
Assessment Boundary	Assessment does not include running computational representations but is limited to using the published results of scientific computational models.	
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ESS2.D: Weather and Climate Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise for the foreseeable future. **ESS3.D: Global Climate Change** Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.
North Dakota Connection	Effects of climate change on ND land uses, International Panel for Climate Change, National Oceanic and Atmospheric Administration (NOAA), National Resources Conservation Service (NRCS)	

Engineering and Technology

Engineering & Technology

Performance Standard HS-ET1-1	**Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**

Clarification Statement	Course and grade level placement of this standard will be determined locally.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.A: Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.	**1. Asking questions and defining problems** • **Builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.** 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World** New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
North Dakota Connection	ND Invasive Species, ND Water Commission, ND Department of Health, ND Department of Environmental Quality	

Engineering & Technology

Performance Standard HS-ET1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Clarification Statement	Course and grade level placement of this standard will be determined locally.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	
North Dakota Connection		

Engineering & Technology

Performance Standard HS-ET1-3	**Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.**

Clarification Statement	Course and grade level placement of this standard will be determined locally.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions When evaluating solutions, it is important to consider a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematical and computational thinking **6. Constructing explanations and designing solutions** • **Builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.** 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World** New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
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Engineering & Technology

Performance Standard HS-ET1-4	**Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.**

Clarification Statement	Course and grade level placement of this standard will be determined locally.	
Assessment Boundary		
Disciplinary Core Ideas	**Science & Engineering Practices**	**Crosscutting Concepts**
ET1.B: Developing Possible Solutions Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.	1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematical and computational thinking** • **Builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows — within and between systems at different scales.
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Glossary

Analyze and Interpret Data
A method in which data are collected and organized with the goal of discovering useful information, drawing conclusions, and supporting decision-making.

Asking Questions
A process that enables scientists to conduct inquiry with the goal of understanding phenomena in the universe.

Assessment Boundary
Specific limits for assessment of the performance standards. Not meant to put limits on what can be taught or how it is taught, but to provide guidance to the content and skills assessed.

Clarification Statement
Provides examples or additional information and emphasizes the language of the performance standard.

Communicate Information
A process of sharing science and engineering-related information in a variety of interactions (e.g., laboratory reports, tables, graphs, charts, models, diagrams, data summaries, conclusions, talks, persuasive arguments).

Computational Thinking
Thought processes involved in analyzing data and identifying mathematical patterns within the data.

Content Resources
In-depth information teachers can access to understand what the standard is asking the students to be able to know and do.

Constraints
Limiting factors to consider when applying the engineering design process.

Criteria
Specifications to be met by a design when applying the engineering design process.

Crosscutting Concepts
Concepts that hold true across the natural and engineered world. Students can use them to make connections across different concepts and/or situations, connect new learning to prior experiences, engage with material across the other disciplines, and solve problems.

Curriculum
Complete programs that comprehensively support the content goals of a science class over large pieces of instructional time (e.g., semesters, years). Curriculum includes all necessary components for instruction, such as lessons, assessment opportunities, and teacher guides.

Designing Solutions
The process of solving a problem and/or phenomenon using research and evidence.

Disciplinary Core Idea
A fundamental idea necessary for understanding a given performance standard. The core ideas provide a key tool for understanding or investigating complex ideas and solving problems.

Evidence
Facts or information that support or refute a scientific theory/hypothesis.

Formative Assessment
A method used by teachers and students during instruction to provide feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes.

Hypothesis
A proposed explanation made based on limited evidence as a starting point for further investigation.

Investigations
The act or process of using a systematic approach to answer questions about the world around us.

Model
A representation illustrating a scientific, mathematical, or real-world concept (e.g., flowchart, picture, diagram, computer-generated product, diorama, or 3-D object).

Performance Standard
Instructional goals or benchmarks for student proficiency. The performance standard is the foundation of the content resources for students.

Phenomena
Observable events that students can explain using life, earth, and physical sciences.

Qualitative Data
Data that are descriptive and illustrative, not numerical. It can be based on observations (e.g., physical traits, gender, smell, food taste).

Quantitative Data
Data that are numerical measurements (e.g., time, height, temperature, distance, velocity).

Science and Engineering Practices
What students do to make sense of phenomena. The SEPs reflect the major practices that scientists and engineers use to investigate the world and design and build systems.

Validate
Proving the accuracy, reliability, and replicability of an outcome.

Appendix A: K-5 Content Resources

Appendix A provides content detail to assist K-5 educators. Table specifications are linked to each standard for easy access.

Content Resource: K Grade Earth Science K-ESS2-1 Earth's Systems

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	With guidance, students organize data from given observations (firsthand or from media) about local weather conditions using graphical displays (e.g., pictures, charts). The weather condition data include:
		i. The number of sunny, cloudy, rainy, windy, cool, or warm days.
		ii. The relative temperature at various times of the day (e.g., cooler in the morning, warmer during the day, cooler at night).
2	Identifying relationships	
	a	Students identify and describe* patterns in the organized data, including:
		i. The relative number of days of different types of weather conditions in a month.
		ii. The change in the relative temperature over the course of a day.
3	Interpreting data	
	a	Students describe* and share that:
		i. Some months have more days of certain kinds of weather than do other months (e.g., some months have more hot days, some have more rainy days).
		ii. The differences in relative temperature over the course of a day (e.g., between early morning and the afternoon, between one day and another) are directly related to the time of day.

Content Resource: K Grade Earth Science K-ESS2-2 Earth's Systems

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that plants and animals (including humans) can change the environment to meet their needs.
2	Identifying scientific evidence	
	a	Students identify and describe* the given evidence to support the claim, including:
		i. Examples of plants changing their environments (e.g., plant roots lifting sidewalks).
		ii. Examples of animals (including humans) changing their environments (e.g., ants building an ant hill, humans clearing land to build houses, birds building a nest, squirrels digging holes to hide food).
		iii. Examples of plant and animal needs (e.g., shelter, food, room to grow).
3		Evaluating and critiquing evidence
	a	Students describe* how the examples do or do not support the claim.
4	Interpreting data	
	a	Reasoning and synthesis
		Students support the claim and present an argument by logically connecting various needs of plants and animals to evidence about how plants/animals change their environments to meet their needs. Students include:
		i. Examples of how plants affect other parts of their systems by changing their environments to meet their needs (e.g., roots push soil aside as they grow to better absorb water).
4		ii. Examples of how animals affect other parts of their systems by changing their environments to meet their needs (e.g., ants, birds, rabbits, and humans use natural materials to build shelter; some animals store food for winter).

Content Resource: K Grade Earth Science K-ESS3-1 Earth and Human Activity

)bservable features of the student performance by the end of the grade:		
1	Components of the model	
	a	From the given model (e.g., representation, diagram, drawing, physical replica, diorama, dramatization, storyboard) of a phenomenon involving the needs of living things and their environments, students identify and describe* the components that are relevant to their representations, including:
		i. Different plants and animals (including humans).
		ii. The places where the different plants and animals live.
		iii. The things that plants and animals need (e.g., water, air, and land resources such as wood, soil, and rocks).
2	Relationships	
	a	Students use the given model to represent and describe* relationships between the components, including:
		i. The relationships between the different plants and animals and the materials they need to survive (e.g., fish need water to swim, deer need buds and leaves to eat, plants need water and sunlight to grow).
		ii. The relationships between places where different plants and animals live and the resources those places provide.
		iii. The relationships between specific plants and animals and where they live (e.g., fish live in water environments, deer live in forests where there are buds and leaves, rabbits live in fields and woods where there is grass to eat and space for burrows for homes, plants live in sunny and moist areas, humans get resources from nature [e.g., building materials from trees to help them live where they want to live]).
3	Connections	
	a	Students use the given model to represent and describe*, including:
		i. Students use the given model to describe* the pattern of how the needs of different plants and animals are met by the various places in which they live (e.g., plants need sunlight, so they are found in places that have sunlight; fish swim in water so they live in lakes, rivers, ponds, and oceans; deer eat buds and leaves so they live in the forest).
		ii. Students use the given model to describe* that plants and animals, the places in which they live, and the resources found in those places are each part of a system, and that these parts of systems work together and allow living things to meet their needs.

Content Resource: K Grade Earth Science K-ESS3-2 Earth and Human Activity

)bservable features of the student performance by the end of the grade:		
1		Addressing phenomena of the natural world
	a	Students formulate questions about local severe weather, the answers to which would clarify how weather forecasting can help people avoid the most serious impacts of severe weather events.
2		Identifying the scientific nature of the question
	a	Students' questions are based on their observations.
3		Obtaining information
	a	Students collect information (e.g., from questions, grade appropriate texts, media) about local severe weather warnings (e.g., tornado alerts, hurricane warnings, major thunderstorm warnings, winter storm warnings, severe drought alerts, heat wave alerts), including that:
		i. There are patterns related to local severe weather that can be observed (e.g., certain types of severe weather happen more in certain places).
		ii. Weather patterns (e.g., some events are more likely in certain regions) help scientists predict severe weather before it happens.
		iii. Severe weather warnings are used to communicate predictions about severe weather.
		iv. Weather forecasting can help people plan for, and respond to, specific types of local weather (e.g., responses: stay indoors during severe weather, go to cooling centers during heat waves; preparations: evacuate coastal areas before a hurricane, cover windows before storms).

Content Resource: K Grade Earth Science K-ESS3-3 Earth and Human Activity

Observable features of the student performance by the end of the grade:		
1		Communicating information
	a	Students use prior experiences and observations to describe* information about:
		i. How people affect the land, water, air, and/or other living things in the local environment in positive and negative ways.
		ii. Solutions that reduce the negative effects of humans on the local environment.
	b	Students communicate information about solutions that reduce the negative effects of humans on the local environment, including:
		i. Examples of things that people do to live comfortably and how those things can cause changes to the land, water, air, and/or living things in the local environment.
		ii. Examples of choices that people can make to reduce negative impacts and the effect those choices have on the local environment.
	c	Students communicate the information about solutions with others in oral and/or written form (which include using models and/or drawings.

Content Resource: K Grade Life Science K-LS1-1 Molecules to Organisms: Structures and Processes

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	With guidance, students organize the given data from observations (firsthand or from media) using graphical displays (e.g., pictures, charts), including:
		i. Different types of animals (including humans).
		ii. Data about the foods different animals eat.
		iii. Data about animals drinking water.
		iv. Data about plants' need for water (e.g., observations of the effects on plants in a classroom or school when they are not watered, observations of natural areas that are very dry).
		v. Data about plants' need for light (e.g., observations of the effect on plants in a classroom when they are kept in the dark for a long time; observations about the presence or absence of plants in very dark places, such as under rocks or porches).
2	Identifying relationships	
	a	Students identify patterns in the organized data, including that:
		i. All animals eat food.
		1. Some animals eat plants.
		2. Some animals eat other animals.
		3. Some animals eat both plants and animals.
		4. No animals do not eat food.
		ii. All animals drink water.
		iii. Plants cannot live or grow if there is no water.
		iv. Plants cannot live or grow if there is no light.
3	Interpreting data	
	a	Students describe* that the patterns they identified in the data provide evidence that:
		i. Plants need light and water to live and grow.
		ii. Animals need food and water to live and grow.
		iii. Animals get their food from plants, other animals, or both.

Content Resource: K Grade Physical Science K-PS2-1 Motion and Stability: Forces and Interactions

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon to be investigated	
	a	With guidance, students collaboratively identify the phenomenon under investigation, which includes the following idea: the effect caused by different strengths and directions of pushes and pulls on the motion of an object.
1	b	With guidance, students collaboratively identify the purpose of the investigation, which includes gathering evidence to support or refute student ideas about causes of the phenomenon by comparing the effects of different strengths of pushes and pulls on the motion of an object.
2.	Identifying the evidence to address this purpose of the investigation	
	a	With guidance, students collaboratively develop an investigation plan to investigate the relationship between the strength and direction of pushes and pulls and the motion of an object (i.e., qualitative measures or expressions of strength and direction; e.g., harder, softer, descriptions* of "which way").
2.	b	Students describe* how the observations they make connect to the purpose of the investigation, including how the observations of the effects on object motion allow causal relationships between pushes and pulls and object motion to be determined
2	c	Students predict the effect of the push of pull on the motion of the object, based on prior experiences.
3	Conducting the investigation	
	a	In the investigation plan, students describe*:
		i. The object whose motion will be investigated.
		ii. What will be in contact with the object to cause the push or pull.
		iii. The relative strengths of the push or pull that will be applied to the object to start or stop its motion or change its speed.
		iv. The relative directions of the push or pull that will be applied to the object.
		v. How the motion of the object will be observed and recorded.
		vi. How the push or pull will be applied to vary strength or direction.
4		Collecting the data
	a.	According to the investigation plan, students collaboratively make observations that would allow them to compare the effect on the motion of the object caused by changes in the strength or direction of the pushes and pulls and record their data.

Content Resource: K Grade Physical Science K-PS2-2 Motion and Stability: Forces & Interactions

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	With guidance, students organize given information using graphical or visual displays (e.g., pictures, pictographs, drawings, written observations, tables, charts). The given information students organize includes:
	a	i. The relative speed or direction of the object before a push or pull is applied (i.e., qualitative measures and expressions of speed and direction; e.g., faster, slower, descriptions* of "which way").
	a	ii. The relative speed or direction of the object after a push or pull is applied.
	a	iii. How the relative strength of a push or pull affects the speed or direction of an object (i.e., qualitative measures or expressions of strength; e.g., harder, softer).
2	Identifying relationships	
	a	Using their organization of the given information, students describe* relative changes in the speed or direction of the object caused by pushes or pulls from the design solution.
3	Interpreting data	
	a	Students describe* the goal of the design solution.
	b	Students describe* their ideas about how the push or pull from the design solution causes the change in the object's motion.
	c	Based on the relationships they observed in the data, students describe* whether the push or pull from the design solution causes the intended change in speed or direction of the object's motion.

Content Resource: K Grade Physical Science K-PS3-1 Energy

Observable features of the student performance by the end of the grade:		
1		Identifying the phenomenon to be investigated
	a	From the given investigation plan, students describe* (with guidance) the phenomenon under investigation, which includes the following idea: sunlight warms the Earth's surface.
	b	Students describe* (with guidance) the purpose of the investigation, which includes determining the effect of sunlight on Earth materials by identifying patterns of relative warmth of materials in sunlight and shade (e.g., sand, soil, rocks, water).
2		Identifying the evidence to address the purpose of the investigation
	a	Based on the given investigation plan, students describe* (with guidance) the evidence that will result from the investigation, including observations of the relative warmth of materials in the presence and absence of sunlight (i.e., qualitative measures of temperature; e.g., hotter, warmer, colder).
	b	Students describe* how the observations they make connect to the purpose of the investigation.
3		Planning the investigation
	a	Based on the given investigation plan, students describe* (with guidance):
		i. The materials on the Earth's surface to be investigated (e.g., dirt, sand, rocks, water, grass).
		ii. How the relative warmth of the materials will be observed and recorded.
4		Collecting the data
	a	According to the given investigation plan and with guidance, students collect and record data that will allow them to:
		i. Compare the warmth of Earth materials placed in sunlight and the same Earth materials placed in shade.
		ii. Identify patterns of relative warmth of materials in sunlight and in shade (i.e., qualitative measures of temperature; e.g., hotter, warmer, colder).
		iii. Describe* that sunlight warms the Earth's surface.

Content Resource: K Grade Physical Science K-PS3-2 Energy

Observable features of the student performance by the end of the grade:		
1		Using scientific knowledge to generate design solutions
	a	Students use given scientific information about sunlight's warming effect on the Earth's surface to collaboratively design and build a structure that reduces warming caused by the sun.
	b	With support, students individually describe*:
		i. The problem.
		ii. The design solution.
		iii. In what way the design solution uses the given scientific information.
2		Describing* specific features of the design solution, including quantification when appropriate
	a	Students describe* that the structure is expected to reduce warming for a designated area by providing shade.
	b	Students use only the given materials and tools when building the structure.
3		Evaluating potential solutions
	a	Students describe* whether the structure meets the expectations in terms of cause (structure blocks sunlight) and effect (less warming of the surface).

Content Resource: K Grade K-ET1-1 Engineering & Technology

1		Addressing phenomena of the natural or designed world
	a	Students ask questions and make observations to gather information about a situation that people want to change. Students' questions, observations, and information gathering are focused on:
		i. A given situation that people want to change.
		ii. Why people want the situation to change.
		iii. The desired outcome of changing the situation.
2		Identifying the scientific nature of the question
	a	Students' questions are based on observations and information gathered about scientific phenomena that are important to the situation.
3		Identifying the problem to be solved
	a	Students use the information they have gathered, including the answers to their questions, observations they have made, and scientific information, to describe* the situation people want to change in terms of a simple problem that can be solved with the development of a new or improved object or tool.
4		Defining the features of the solution
	a	With guidance, students describe* the desired features of the tool or object that would solve the problem, based on scientific information, materials available, and potential related benefits to people and other living things.

Content Resource: K Grade K-ETS1-2 Engineering & Technology

		Observable features of the student performance by the end of the grade:
1		Components of the model
	a	Students develop a representation of an object and the problem it is intended to solve. In their representation, students include the following components:
		i. The object.
		ii. The relevant shape(s) of the object.
		iii. The function of the object.
	b	Students use sketches, drawings, or physical models to convey their representations.
2		Relationships
	a	Students identify relationships between the components in their representation, including:
		i. The shape(s) of the object and the object's function.
		ii. The object and the problem it's designed to solve.
3		Connections
	a	Students use their representation (simple sketch, drawing, or physical model) to communicate the connections between the shape(s) of an object, and how the object could solve the problem.

Content Resource: K Grade K-ET1-3 Engineering & Technology

)bservable features of the student performance by the end of the grade:		
1		Organizing data
	a	With guidance, students use graphical displays (e.g., tables, pictographs, line plots) to organize given data from tests of two objects, including data about the features and relative performance of each solution.
2		Identifying relationships
	a	Students use their organization of the data to find patterns in the data, including:
		i. How each of the objects performed, relative to:
		1. The other object.
		2. The intended performance.
		ii. How various features (e.g., shape, thickness) of the objects relate to their performance (e.g., speed, strength).
3		Interpreting data
	a	Students use the patterns they found in object performance to describe*:
		i. The way (e.g., physical process, qualities of the solution) each object will solve the problem.
		ii. The strengths and weaknesses of each design.
		iii. Which object is better suited to the desired function, if both solve the problem.

Content Resource: 1st Grade Earth Science ESS1-1 Earth's Place in the Universe

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	With guidance, students use graphical displays (e.g., picture, chart) to organize data from given observations (firsthand or from media), including:
		i. Objects (i.e., sun, moon, stars) visible in the sky during the day.
		ii. Objects (i.e., sun, moon, stars) visible in the sky during the night.
		iii. The position of the sun in the sky at various times during the day.
		iv. The position of the moon in the sky at various times during the day or night.
2	Identifying relationships	
	a	Students identify and describe* patterns in the organized data, including:
		i. Stars are not seen in the sky during the day, but they are seen in the sky during the night.
		ii. The sun is at different positions in the sky at different times of the day, appearing to rise in one part of the sky in the morning and appearing to set in another part of the sky in the evening.
		iii. The moon can be seen during the day and at night, but the sun can only be seen during the day.
		iv. The moon is at different positions in the sky at different times of the day or night, appearing to rise in one part of the sky and appearing to set in another part of the sky.
3	Interpreting data	
	a	Students use the identified patterns of the motions of objects in the sky to provide evidence that future appearances of those objects can be predicted (e.g., if the moon is observed to rise in one part of the sky, a prediction can be made that the moon will move across the sky and appear to set in a different portion of the sky; if the sun is observed to rise in one part of the sky, a prediction can be made about approximately where the sun will be at different times of day).
	b	Students use patterns related to the appearance of objects in the sky to provide evidence that future appearances of those objects can be predicted (e.g., when the sun sets and can no longer be seen, a prediction can be made that the sun will rise again in the morning; a prediction can be made that stars will only be seen at night).

Content Resource: 1st Grade Earth Science ESS1-2 Earth's Place in the Universe

Observable features of the student performance by the end of the grade:		
1		Identifying the phenomenon under investigation
	a	Students identify and describe* the phenomenon and purpose of the investigation, which include the following idea: the relationship between the amount of daylight and the time of year.
2		Identifying evidence to address the purpose of the investigation
	a	Based on the given plan for the investigation, students (with support) describe* the data and evidence that will result from the investigation, including observations (firsthand or from media) of relative length of the day (sunrise to sunset) throughout the year.
	b	Students individually describe* how these observations could reveal the pattern between the amount of daylight and the time of year (i.e., relative lightness and darkness at different relative times of the day and throughout the year).
3		Planning the investigation
	a	Based on the given investigation plan, students describe* (with support):
		i. How the relative length of the day will be determined (e.g., whether it will be light or dark when waking in the morning, at breakfast, when having dinner, or going to bed at night).
		ii. When observations will be made and how they will be recorded, both within a day and across the year.
4		Collecting the data
	a	According to the given investigation plan, students collaboratively make and record observations about the relative length of the day in different seasons to make relative comparisons between the amount of daylight at different times of the year (e.g., summer, winter, fall, spring).

Content Resource: 1st Grade Life Science LS1-1 From Molecules to organisms: Structures & Processes

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students describe* the given human problem to be solved by the design.
	b	With guidance, students use given scientific information about plants and/or animals to design the solution, including:
		i. How external structures are used to help the plant and/or animal grow and/or survive.
		ii How animals use external structures to capture and convey different kinds of information they need.
		iii. How plants and/or animals respond to information they receive from the environment.
	c	Students design a device (using student-suggested materials) that provides a solution to the given human problem by mimicking how plants and/or animals use external structures to survive, grow, and/or meet their needs. This may include:
		i. Mimicking the way a plant and/or animal uses an external structure to help it survive, grow, and/or meet its needs.
		ii. Mimicking the way an external structure of an animal captures and conveys information.
		iii. Mimicking the way an animal and/or plant responds to information from the environment.
2	Describing* specific features of the design solution, including quantification when appropriate	
	a	Students describe* the specific expected or required features in their designs and devices, including:
		i. The device provides a solution to the given human problem.
		ii. The device mimics plant and/or animal external parts, and/or animal information-processing
		iii. The device uses the provided materials to develop solutions.
3	Evaluating potential solutions	
	a	Students describe* how the design solution is expected to solve the human problem.
	b	Students determine and describe* whether their device meets the specific required features.

Content Resource: 1st Grade Life Science LS1-2 From Molecules to Organisms: Structures and Processes

Observable features of the student performance by the end of the grade:		
1	Obtaining information	
	a	Students use grade-appropriate books and other reliable media to obtain the following scientific information:
		i. Information about the idea that both plants and animals can have offspring.
		ii. Information about behaviors of animal parents that help offspring survive (e.g., keeping offspring safe from predators by circling the young, feeding offspring).
		iii. Information about behaviors of animal offspring that help the offspring survive (e.g., crying, chirping, nuzzling for food).
2	Evaluating information	
	a	Students evaluate the information to determine and describe* the patterns of what animal parents and offspring do to help offspring survive (e.g., when a baby cries, the mother feeds it; when danger is present, parents protect offspring; some young animals become silent to avoid predators).

Content Resource: 1st Grade Life Science LS3-1 Heredity: Inheritance and Variation of Traits

Observable features of the student performance by the end of the grade:		
1		Articulating the explanation of phenomena
	a	Students articulate a statement that relates a given phenomenon to a scientific idea, including the idea that young plants and animals are like, but not exactly like, their parents (not to include animals that undergo complete metamorphoses, such as insects or frogs).
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.
2		Evidence
	a	Students describe* evidence from observations (firsthand or from media) about patterns of features in plants and animals, including:
		i. Key differences between different types of plants and animals (e.g., features that distinguish dogs versus those that distinguish fish; oak trees versus bean plants).
		ii. Young plants and animals of the same type have similar, but not identical features (e.g., size and shape of body parts, color and/or type of any hair, leaf shape, stem rigidity).
		iii. Adult plants and animals (i.e., parents) of the same type have similar, but not identical features (e.g., size and shape of body parts, color and/or type of any hair, leaf shape, stem rigidity).
		iv. Patterns of similarities and differences in features between parents and offspring.
3		Reasoning
	a	Students logically connect the evidence of observed patterns in features to support the evidence-based account by describing* chains of reasoning that include:
		i. Young plants and animals are very similar to their parents.
		ii. Young plants and animals are not exactly the same as their parents.
		iii. Similarities and differences in features are evidence that young plants and animals are very much, but not exactly, like their parents.
		iv. Similarities and differences in features are evidence that although individuals of the same type of animal or plant are recognizable as similar, they can also vary in many ways.

Content Resource: 1st Grade Physical Science PS4-1 Waves and Their Application in Technology

Observable features of the student performance by the end of the grade:		
1		Identifying the phenomenon under investigation
	a	Students identify and describe* the phenomenon and purpose of the investigation, which includes providing evidence to answer questions about the relationship between vibrating materials and sound.
2		Identifying the evidence to address the purpose of the investigation
	a	Students collaboratively develop an investigation plan and describe* the evidence that will result from the investigation, including:
		i. Observations that sounds can cause materials to vibrate.
		ii. Observations that vibrating materials can cause sounds.
		iii. How the data will provide evidence to support or refute ideas about the relationship between vibrating materials and sound.
	b	Students individually describe* (with support) how the evidence will address the purpose of the investigation.
3		Planning the investigation
	a	In the collaboratively developed investigation plan, students individually identify and describe*:
		i. The materials to be used.
		ii. How the materials will be made to vibrate to make sound.
		iii. How the resulting sounds will be observed and described*.
		iv. What sounds will be used to make materials vibrate.
		v. How it will be determined that a material is vibrating.
4		Collecting the data
	a	According to the investigation plan they develop, students collaboratively collect and record observations about:
		i. Sounds causing materials to vibrate.
		ii. Vibrating materials causing sounds.

Content Resource: 1st Grade Physical Science PS4-2 Waves and Their Application in Technology

Observable features of the student performance by the end of the grade:		
1	Articulating the explanation of phenomena	
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that when an object in the dark is lit (e.g., turning on a light in the dark space or from light the object itself gives off), it can be seen.
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.
2	Evidence	
	a	Students make observations (firsthand or from media) to serve as the basis for evidence, including:
		i. The appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects in a space with no light.
		ii. The appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects in a space with light.
		iii. The appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects (e.g., light bulbs, glow sticks) that give off light in a space with no other light.
	b	Students describe* how their observations provide evidence to support their explanation.
3	Reasoning	
	a	Students logically connect the evidence to support the evidence-based account of the phenomenon. Students describe* lines of reasoning that include:
		i. The presence of light in a space causes objects to be visible in that space.
		ii. Objects are not visible if there is no light to illuminate them, but the same object in the same space can be seen if a light source is introduced.
		iii. The ability of an object to give off its own light causes the object to be visible in a space where there is no other light.

Content Resource: 1st Grade Physical Science PS4-3 Waves and Their Application in Technology

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	Students identify and describe* the phenomenon and purpose of the investigation, which include:
		i. Answering a question about what happens when objects made of different materials (that allow light to pass through them in different ways) are placed in the path of a beam of light.
		ii. Designing and conducting an investigation to gather evidence to support or refute student ideas about putting objects made of different materials in the path of a beam of light.
2	Identifying the evidence to address the purpose of the investigation	
	a	Students collaboratively develop an investigation plan and describe* the data that will result from the investigation, including:
		i. Observations of the effect of placing objects made of different materials in a beam of light, including:
		1. A material that allows all light to pass through results in the background lighting up.
		2. A material that allows only some light to pass through results in the background lighting up, but looking darker than when the material allows all light in.
		3. A material that blocks all of the light will create a shadow.
		4. A material that changes the direction of the light will illuminate the surrounding space in a different direction.
	b	Students individually describe* how these observations provide evidence to answer the question under investigation.
3	Planning the investigation	
	a	In the collaboratively developed investigation plan, students individually describe* (with support):
		i. The materials to be placed in the beam of light, including:
		1. A material that allows all light to pass through (e.g., clear plastic, clear glass).
		2. A material that allows only some light to pass through (e.g., clouded plastic, wax paper).
		3. A material that blocks all of the light (e.g., cardboard, wood).
		4. A material that changes the direction of the light (e.g., mirror, aluminum foil).
		ii. How the effect of placing different materials in the beam of light will be observed and recorded.
		iii. The light source used to produce the beam of light.
4	Collecting the data	
	a	Students collaboratively collect and record observations about what happens when objects made of materials that allow light to pass through them in different ways are placed in the path of a beam of light, according to the developed investigation plan.

Content Resource: 1st Grade Physical Science PS4-4 Waves and Their Application in Technology

Observable features of the student performance by the end of the grade:		
1		Using scientific knowledge to generate design solutions
	a	Students describe* a given problem involving people communicating over long distances.
	b	With guidance, students design and build a device that uses light or sound to solve the given problem.
	c	With guidance, students describe* the scientific information they use to design the solution.
2		Describing* specific features of the design solution, including quantification when appropriate
	a	Students describe* that specific expected or required features of the design solution should include:
		i. The device is able to send or receive information over a given distance.
		ii. The device must use light or sound to communicate.
	b	Students use only the materials provided when building the device.
3		Evaluating potential solutions
	a	Students describe* whether the device:
		i. Has the expected or required features of the design solution.
		ii. Provides a solution to the problem involving people communicating over a distance by using light or sound.
	b	Students describe* how communicating over long distances helps people.

Content Resource: 1st Grade K-2 ET1-1 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Addressing phenomena of the natural or designed world
	a	Students ask questions and make observations to gather information about a situation that people want to change. Students' questions, observations, and information gathering are focused on:
		i. A given situation that people want to change.
		ii. Why people want the situation to change.
		iii. The desired outcome of changing the situation.
2		Identifying the scientific nature of the question
	a	Students' questions are based on observations and information gathered about scientific phenomena that are important to the situation.
3		Identifying the problem to be solved
	a	Students use the information they have gathered, including the answers to their questions, observations they have made, and scientific information, to describe* the situation people want to change in terms of a simple problem that can be solved with the development of a new or improved object or tool.
4		Defining the features of the solution
	a	With guidance, students describe* the desired features of the tool or object that would solve the problem, based on scientific information, materials available, and potential related benefits to people and other living things.

Content Resource: 1st Grade K-2 ET1-2 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Components of the model
	a	Students develop a representation of an object and the problem it is intended to solve. In their representation, students include the following components:
		i. The object.
		ii. The relevant shape(s) of the object.
		iii. The function of the object.
	b	Students use sketches, drawings, or physical models to convey their representations.
2		Relationships
	a	Students identify relationships between the components in their representation, including:
		i. The shape(s) of the object and the object's function.
		ii. The object and the problem it's designed to solve.
3		Connections
	a	Students use their representation (simple sketch, drawing, or physical model) to communicate the connections between the shape(s) of an object, and how the object could solve the problem.

Content Resource: 1st Grade K-2 ETS1-3 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Organizing data
	a	With guidance, students use graphical displays (e.g., tables, pictographs, line plots) to organize given data from tests of two objects, including data about the features and relative performance of each solution.
2		Identifying relationships
	a	Students use their organization of the data to find patterns in the data, including:
		i. How each of the objects performed, relative to:
		1. The other object.
		2. The intended performance.
		ii. How various features (e.g., shape, thickness) of the objects relate to their performance (e.g., speed, strength).
3		Interpreting data
	a	Students use the patterns they found in object performance to describe*:
		i. The way (e.g., physical process, qualities of the solution) each object will solve the problem.
		ii. The strengths and weaknesses of each design.
		iii. Which object is better suited to the desired function, if both solve the problem.

Content Resource: 2nd Grade Earth Science ESS1-1 Earth's Place in the Universe

Observable features of the student performance by the end of the grade:		
1	Articulating the explanation of phenomena	
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that Earth events can occur very quickly or very slowly.
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.
2	Evidence	
	a	Students describe* the evidence from observations (firsthand or from media; e.g., books, videos, pictures, historical photos), including:
		i. That some Earth events occur quickly (e.g., the occurrence of flood, severe storm, volcanic eruption, earthquake, landslides, erosion of soil).
		ii. That some Earth events occur slowly.
		iii. Some results of Earth events that occur quickly.
		iv. Some results of Earth events that occur slowly (e.g., erosion of rocks, weathering of rocks).
		v. The relative amount of time it takes for the given Earth events to occur (e.g., slowly, quickly, hours, days, years).
	b	Students make observations using at least three sources.
3	Reasoning	
	a	Students use reasoning to logically connect the evidence to construct an evidence-based account. Students describe* their reasoning, including:
		i. In some cases, Earth events and the resulting changes can be directly observed; therefore, those events must occur rapidly.
		ii. In other cases, the resulting changes of Earth events can be observed only after long periods of time; therefore, these Earth events occur slowly, and change happens over a time period that is much longer than one can observe.

Content Resource: 2nd Grade Earth Science ESS2-1 Earth's Systems

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students describe* the given problem, which includes the idea that wind or water can change the shape of the land by washing away soil or sand.
	b	Students describe* at least two given solutions in terms of how to slow or prevent wind or water from changing the shape of the land.
2	Describing* specific features of the design solution, including quantification where appropriate	
	a	Students describe* the specific expected or required features for the solutions that would solve the given problem, including:
		i. Slowing or preventing wind or water from washing away soil or sand.
		ii. Addressing problems created by both slow and rapid changes in the environment (such as many mild rainstorms or a severe storm and flood).
3	Evaluating potential solutions	
	a	Students evaluate each given solution against the desired features to determine and describe* whether and how well the features are met by each solution.
	b	Using their evaluation, students compare and contrast the given solutions to each other.

Content Resource: 2nd Grade Earth Science ESS2-2 Earth's Systems

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model (i.e., a map) that identifies the relevant components, including components that represent both land and bodies of water in an area.
2	Relationships	
	a	In the model, students identify and describe* relationships between components using a representation of the specific shapes and kinds of land (e.g., playground, park, hill) and specific bodies of water (e.g., creek, ocean, lake, river) within a given area.
	b	Students use the model to describe* the patterns of water and land in a given area (e.g., an area may have many small bodies of water; an area may have many different kinds of land that come in different shapes).
3	Connections	
	a	Students describe* that because they can map the shapes and kinds of land and water in any area, maps can be used to represent many different types of areas.

Content Resource: 2nd Grade Earth Science ESS2-3 Earth's Systems

Observable features of the student performance by the end of the grade:		
1	Obtaining information	
	a	Students use books and other reliable media as sources for scientific information to answer scientific questions about:
		i. Where water is found on Earth, including in oceans, rivers, lakes, and ponds.
		ii. The idea that water can be found on Earth as liquid or solid ice (e.g., a frozen pond, liquid pond, frozen lake).
		iii. Patterns of where water is found, and what form it is in.
2	Evaluating Information	
	a	Students identify which sources of information are likely to provide scientific information (e.g., versus opinion).

Content Resource: 2nd Grade Life Science LS2-1 Ecosystems: Interactions, Energy and Dynamics

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a. Students identify and describe* the phenomenon and purpose of the investigation, which include answering a question about whether plants need sunlight and water to grow.	
2	Identifying the evidence to address the purpose of the investigation	
	a	Students describe* the evidence to be collected, including:
		i. Plant growth with both light and water.
		ii. Plant growth without light but with water.
		iii. Plant growth without water but with light.
		iv. Plant growth without water and without light.
	b	Students describe* how the evidence will allow them to determine whether plants need light and water to grow.
3	Planning the investigation	
	a	Students collaboratively develop an investigation plan. In the investigation plan, students describe* the features to be part of the investigation, including:
		i. The plants to be used.
		ii. The source of light.
		iii. How plants will be kept with/without light in both the light/dark test and the water/no water test.
		iv. The amount of water plants will be given in both the light/dark test and the water/no water test.
		v. How plant growth will be determined (e.g., observations of plant height, number and size of leaves, thickness of the stem, number of branches).
	b	Students individually describe* how this plan allows them to answer the question.
4	Collecting the data	
	a	According to the investigation plan developed, students collaboratively collect and record data on the effects on plant growth by:
		i. Providing both light and water;
		ii. Withholding light but providing water;
		iii. Withholding water but providing light; or
		iv. Withholding both water and light.

Content Resource: 2nd Grade Life Science LS2-2 Ecosystems: Interactions, Energy and Dynamics

Observable features of the student performance by the end of the grade:		
1		Components of the model
	a	Students develop a simple model that mimics the function of an animal in seed dispersal or pollination of plants. Students identify the relevant components of their model, including those components that mimic the natural structure of an animal that helps disperse seeds (e.g., hair that snares seeds, squirrel cheek pouches that transport seeds) or that mimic the natural structure of an animal that helps pollinate plants (e.g., bees have fuzzy bodies to which pollen sticks, hummingbirds have bills that transport pollen). The relevant components of the model include:
		ii. Relevant structures of the animal.
		ii. Relevant structures of the plant.
		iii. Pollen or seeds from plants.
2		Relationships
	a	In the model, students describe* relationships between components, including evidence that the developed model mimics how plant and animal structures interact to move pollen or disperse seeds.
		i. Students describe* the relationships between components that allow for movement of pollen or seeds.
		ii. Students describe* the relationships between the parts of the model they are developing and the parts of the animal they are mimicking.
3		Connections
	a	Students use the model to describe*:
		i. How the structure of the model gives rise to its function.
		ii. Structure-function relationships in the natural world that allow some animals to disperse seeds or pollinate plants.

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Content Resource: 2nd Grade Life Science LS4-1 Biological Evolution

Observable features of the student performance by the end of the grade:		
1		Identifying the phenomenon under investigation
	a	Students identify and describe* the phenomenon and purpose of the investigation, which includes comparisons of plant and animal diversity of life in different habitats.
2		Identifying the evidence to address the purpose of the investigation
	a	Based on the given plan for the investigation, students describe* the following evidence to be collected:
		i. Descriptions* based on observations (firsthand or from media) of habitats, including land habitats (e.g., playground, garden, forest, parking lot) and water habitats (e.g., pond, stream, lake).
		ii. Descriptions* based on observations (firsthand or from media) of different types of living things in each habitat (e.g., trees, grasses, bushes, flowering plants, lizards, squirrels, ants, fish, clams).
		iii. Comparisons of the different types of living things that can be found in different habitats.
	b	Students describe* how these observations provide evidence for patterns of plant and animal diversity across habitats.
3		Planning the investigation
	a	Based on the given investigation plan, students describe* how the different plants and animals in the habitats will be observed, recorded, and organized.
4		Collecting the data
	a	Students collect, record, and organize data on different types of plants and animals in the habitats.

Content Resource: 2nd Grade Physical Science PS1-1 Matter and Its Interactions

Observable features of the student performance by the end of the grade:		
1		Identifying the phenomenon under investigation
	a	Students identify and describe* the phenomenon under investigation, which includes the following idea: different kinds of matter have different properties, and sometimes the same kind of matter has different properties depending on temperature.
	b	Students identify and describe* the purpose of the investigation, which includes answering a question about the phenomenon under investigation by describing* and classifying different kinds of materials by their observable properties.
2		Identifying the evidence to address the purpose of the investigation
	a	Students collaboratively develop an investigation plan and describe* the evidence that will be collected, including the properties of matter (e.g., color, texture, hardness, flexibility, whether is it a solid or a liquid) of the materials that would allow for classification, and the temperature at which those properties are observed.
	b	Students individually describe* that:
		i. The observations of the materials provide evidence about the properties of different kinds of materials.
		ii. Observable patterns in the properties of materials provide evidence to classify the different kinds of materials.
3		Planning the investigation
	a	In the collaboratively developed investigation plan, students include:
		i. Which materials will be described* and classified (e.g., different kinds of metals, rocks, wood, soil, powders).
		ii. Which materials will be observed at different temperatures, and how those temperatures will be determined (e.g., using ice to cool and a lamp to warm) and measured (e.g., qualitatively or quantitatively).
		iii. How the properties of the materials will be determined.
		iv. How the materials will be classified (i.e., sorted) by the pattern of the properties.
	b	Students individually describe* how the properties of materials, and the method for classifying them, are relevant to answering the question.
4		Collecting the data
	a	According to the developed investigation plan, students collaboratively collect and record data on the properties of the materials.

Content Resource: 2nd Grade Physical Science PS1-2 Matter and Its Interactions

Observable features of the student performance by the end of the grade:		
1		Organizing data
	a	Using graphical displays (e.g., pictures, charts, grade-appropriate graphs), students use the given data from tests of different materials to organize those materials by their properties (e.g., strength, flexibility, hardness, texture, ability to absorb).
2		Identifying relationships
	a	Students describe* relationships between materials and their properties (e.g., metal is strong, paper is absorbent, rocks are hard, sandpaper is rough).
	b	Students identify and describe* relationships between properties of materials and some potential purposes (e.g., hardness is good for breaking objects or supporting objects; roughness is good for keeping objects in place; flexibility is good to keep materials from breaking, but not good for keeping materials rigidly in place).
3		Interpreting data
	a	Students describe* which properties allow a material to be well suited for a given intended use (e.g., ability to absorb for cleaning up spills, strength for building material, hardness for breaking a nut).
	b	Students use their organized data to support or refute their ideas about which properties of materials allow the object or tool to be best suited for the given intended purpose relative to the other given objects/tools (e.g., students could support the idea that hardness allows a wooden shelf to be better suited for supporting materials placed on it than a sponge would be, based on the patterns relating property to a purpose; students could refute an idea that a thin piece of glass is better suited to be a shelf than a wooden plank would be because it is harder than the wood by using data from tests of hardness and strength to give evidence that the glass is less strong than the wood).
	c	Students describe* how the given data from the test provided evidence of the suitability of different materials for the intended purpose.

Content Resource: 2nd Grade Physical Science PS1-3 Matter & Its Interactions

Observable features of the student performance by the end of the grade:		
1		Articulating the explanation of phenomena
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that an object made of a small set of pieces can be disassembled and made into a new object.
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.
2		Evidence
	a	Students describe* evidence from observations (firsthand or from media), including:
		i. The characteristics (e.g., size, shape, arrangement of parts) of the original object.
		ii. That the original object was disassembled into pieces.
		iii. That the pieces were reassembled into a new object or objects.
		iv. The characteristics (e.g., size, shape, arrangement of parts) of the new object or objects.
3		Reasoning
	a	Students use reasoning to connect the evidence to support an explanation. Students describe* a chain of reasoning that includes:
		i. The original object was disassembled into its pieces and is reassembled into a new object or objects.
		ii. Many different objects can be built from the same set of pieces.
		iii. Compared to the original object, the new object or objects can have different characteristics, even though they were made of the same set of pieces.

Content Resource: 2nd Grade Physical Science PS1-4 Matter & Its Interactions

Observable features of the student performance by the end of the grade:		
1		Supported claims
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that some changes caused by heating or cooling can be reversed and some cannot.
2		Identifying scientific evidence
	a	Students describe* the given evidence, including:
		i. The characteristics of the material before heating or cooling.
		ii. The characteristics of the material after heating or cooling.
		iii. The characteristics of the material when the heating or cooling is reversed.
3		Evaluating and critiquing the evidence
	a	Students evaluate the evidence to determine:
		i. The change in the material after heating (e.g., ice becomes water, an egg becomes solid, solid chocolate becomes liquid).
		ii. Whether the change in the material after heating is reversible (e.g., water becomes ice again, a cooked egg remains a solid, liquid chocolate becomes solid but can be a different shape).
		iii. The change in the material after cooling (e.g., when frozen, water becomes ice, a plant leaf dies).
		iv. Whether the change in the material after cooling is reversible (e.g., ice becomes water again, a plant leaf does not return to normal).
	b	Students describe* whether the given evidence supports the claim and whether additional evidence is needed.
4		Reasoning and synthesis
	a	Students use reasoning to connect the evidence to the claim. Students describe* the following chain of reasoning:
		i. Some changes caused by heating or cooling can be reversed by cooling or heating (e.g., ice that is heated can melt into water, but the water can be cooled and can freeze back into ice [and vice versa]).
		ii. Some changes caused by heating or cooling cannot be reversed by cooling or heating (e.g., a raw egg that is cooked by heating cannot be turned back into a raw egg by cooling the cooked egg, cookie dough that is baked does not return to its uncooked form when cooled, charcoal that is formed by heating wood does not return to its original form when cooled).

Content Resource: *2nd* Grade K-2-ET1-1. Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Addressing phenomena of the natural or designed world
	a	Students ask questions and make observations to gather information about a situation that people want to change. Students' questions, observations, and information gathering are focused on:
		i. A given situation that people want to change.
		ii. Why people want the situation to change.
		iii. The desired outcome of changing the situation.
2		Identifying the scientific nature of the question
	a	Students' questions are based on observations and information gathered about scientific phenomena that are important to the situation.
3		Identifying the problem to be solved
	a	Students use the information they have gathered, including the answers to their questions, observations they have made, and scientific information, to describe* the situation people want to change in terms of a simple problem that can be solved with the development of a new or improved object or tool.
4		Defining the features of the solution
	a	With guidance, students describe* the desired features of the tool or object that would solve the problem, based on scientific information, materials available, and potential related benefits to people and other living things.

Content Resource: 2nd Grade K-2-ET1-2. Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Components of the model
	a	Students develop a representation of an object and the problem it is intended to solve. In their representation, students include the following components:
		i. The object.
		ii. The relevant shape(s) of the object.
		iii. The function of the object.
	b	Students use sketches, drawings, or physical models to convey their representations.
2		Relationships
	a	Students identify relationships between the components in their representation, including:
		i. The shape(s) of the object and the object's function.
		ii. The object and the problem it's designed to solve.
3		Connections
	a	Students use their representation (simple sketch, drawing, or physical model) to communicate the connections between the shape(s) of an object, and how the object could solve the problem.

Content Resource: 2nd Grade K-2-ET1-3. Engineering & Technology

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	With guidance, students use graphical displays (e.g., tables, pictographs, line plots) to organize given data from tests of two objects, including data about the features and relative performance of each solution.
2	Identifying relationships	
	a	Students use their organization of the data to find patterns in the data, including:
		i. How each of the objects performed, relative to:
		1. The other object.
		2. The intended performance.
		ii. How various features (e.g., shape, thickness) of the objects relate to their performance (e.g., speed, strength).
3	Interpreting data	
	a	Students use the patterns they found in object performance to describe*:
		i. The way (e.g., physical process, qualities of the solution) each object will solve the problem.
		ii. The strengths and weaknesses of each design.
		iii. Which object is better suited to the desired function, if both solve the problem.

Content Resource: 3rd Grade 3-5 ET1-1 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1	Identifying the problem to be solved	
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
	c	Students describe* that people's needs and wants change over time.
2	Defining the boundaries of the system	
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.
3	Defining the criteria and constraints	
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.
	b	Students describe* the constraints or limitations on their design, which may include:
		i. Cost.
		ii. Materials.
		iii. Time.

Content Resource: 3rd Grade 3-5 ET1-2 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
	c	Students specify how each design solution solves the problem.
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [Note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe*:
		i. The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		ii. How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions	
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

Content Resource: 3rd Grade 3-5 ET1-3 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Identifying the purpose of the investigation
	a	Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.
2		Identifying the evidence to be address the purpose of the investigation
	a	Students describe* the evidence to be collected, including:
		i. How well the model/prototype performs against the given criteria and constraints.
		ii. Specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
		iii. Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
	b	Students describe* how the evidence is relevant to the purpose of the investigation.
3		Planning the investigation
	a	Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:
		i. The specific criterion or constraint to be used.
		ii. What is to be changed in each trial (the independent variable).
		iii. The outcome (dependent variable) that will be measured to determine success.
		iv. What tools and methods are to be used for collecting data.
		v. What is to be kept the same from trial to trial to ensure a fair test.
4		Collecting the data
	a	Students carry out the investigation, collecting and recording data according to the developed plan.

Content Resource: 3rd Grade Earth Science ESS2-1 Earth's Systems

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Students use graphical displays (e.g., table, chart, graph) to organize the given data by season using tables, pictographs, and/or bar charts, including:
		i. Weather condition data from the same area across multiple seasons (e.g., average temperature, precipitation, wind direction).
		ii. Weather condition data from different areas (e.g., hometown and nonlocal areas, such as a town in another state).
2	Identifying relationships	
	a	Students identify and describe* patterns of weather conditions across:
		i. Different seasons (e.g., cold and dry in the winter, hot and wet in the summer; more or less wind in a particular season).
		ii. Different areas (e.g., certain areas (defined by location, such as a town in the Pacific Northwest), have high precipitation, while a different area (based on location or type, such as a town in the Southwest) have very little precipitation).
3	Interpreting data	
	a	Students use patterns of weather conditions in different seasons and different areas to predict:
		i. The typical weather conditions expected during a particular season (e.g., "In our town, the summer is typically hot, as indicated on a bar graph over time, while in the winter it is typically cold; therefore, the prediction is that next summer will be hot and next winter will be cold.").
		ii. The typical weather conditions expected during a particular season in different areas.

Content Resource: 3rd Grade Earth Science ESS2-2 Earth's Systems

Observable features of the student performance by the end of the grade:		
1	Obtaining information	
	a	Students use books and other reliable media to gather information about:
		i. Climates in different regions of the world (e.g., equatorial, polar, coastal, mid-continental).
		ii. Variations in climates within different regions of the world (e.g., variations could include an area's average temperatures and precipitation during various months over several years or an area's average rainfall and temperatures during the rainy season over several years).
2	Evaluating information	
	a	Students combine obtained information to provide evidence about the climate pattern in a region that can be used to make predictions about typical weather conditions in that region.
3	Communicating information	
	a	Students use the information they obtained and combined to describe*:
		i. Climates in different regions of the world.
		ii. Examples of how patterns in climate could be used to predict typical weather conditions.
		iii. That climate can vary over years in different regions of the world.

Content Resource: 3rd Grade Earth Science ESS3-1 Earth and Human Activity

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim about the merit of a given design solution that reduces the impact of a weather-related hazard.
2	Identifying scientific evidence	
	a	Students describe* the given evidence about the design solution, including evidence about:
		i. The given weather-related hazard (e.g., heavy rain or snow, strong winds, lightning, flooding along river banks).
		ii. Problems caused by the weather-related hazard (e.g., heavy rains cause flooding, lightning causes fires).
		iii. How the proposed solution addresses the problem (e.g., dams and levees are designed to control flooding, lightning rods reduce the chance of fires) [Note: mechanisms are limited to simple observable relationships that rely on logical reasoning].
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence using given criteria and constraints to determine:
		i. How the proposed solution addresses the problem, including the impact of the weather-related hazard after the design solution has been implemented.
		ii. The merits of a given solution in reducing the impact of a weather-related hazard (i.e., whether the design solution meets the given criteria and constraints).
		iii. The benefits and risks a given solution poses when responding to the societal demand to reduce the impact of a hazard.

Content Resource: 3rd Grade Life Science LS1-1 From Molecules to Organisms: Structures & Processes

Observable features of the student performance by the end of the grade:		
1		Components of the model
	a	Students develop models (e.g., conceptual, physical, drawing) to describe* the phenomenon. In their models, students identify the relevant components of their models including:
		i. Organisms (both plant and animal).
		ii. Birth.
		iii. Growth.
		iv. Reproduction.
		v. Death.
2		Relationships
	a	In the models, students describe* relationships between components, including:
		i. Organisms are born, grow, and die in a pattern known as a life cycle.
		ii. Different organisms' life cycles can look very different.
		iii. A causal direction of the cycle (e.g., without birth, there is no growth; without reproduction, there are no births).
3		Connections
	a	Students use the models to describe* that although organisms can display life cycles that look different, they all follow the same pattern.
	b	Students use the models to make predictions related to the phenomenon, based on patterns identified among life cycles (e.g., prediction could include that if there are no births, deaths will continue and eventually there will be no more of that type of organism).

Content Resource: 3rd Grade Life Science LS2-1 Ecosystems: Interactions, Energy & Dynamics

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that some animals form groups and that being a member of that group helps each member survive.
2.	Identifying scientific evidence	
	a	Students describe* the given evidence, data, and/or models necessary to support the claim, including:
		i. Identifying types of animals that form or live in groups of varying sizes.
		ii. Multiple examples of animals in groups of various sizes:
		1. Obtaining more food for each individual animal compared to the same type of animal looking for food individually.
		2. Displaying more success in defending themselves than those same animals acting alone.
		3. Making faster or better adjustments to harmful changes in their ecosystem than would those same animals acting alone.
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence to determine its relevance, and whether it supports the claim that being a member of a group has a survival advantage.
	b	Students describe* whether the given evidence is sufficient to support the claim and whether additional evidence is needed.
4		Reasoning and synthesis
	a.	Students use reasoning to construct an argument connecting the evidence, data, and/or models to the claim. Students describe* the following reasoning in their argument:
		i. The causal evidence that being part of a group can have the effect of animals being more successful in obtaining food, defending themselves, and coping with change supports the claim that being a member of a group helps animals survive.
		ii. The causal evidence that an animal losing its group status can have the effect of the animal obtaining less food, not being able to defend itself, and not being able to cope with change supports the claim that being a member of a group helps animals survive.

Content Resource: 3rd Grade Life Science LS3-1 Heredity: Inheritance and Variation of Traits

		Observable features of the student performance by the end of the grade:
1		Organizing data
	a	Students organize the data (e.g., from students' previous work, grade-appropriate existing datasets) using graphical displays (e.g., table, chart, graph). The organized data include:
		i. Traits of plant and animal parents.
		ii. Traits of plant and animal offspring.
		iii. Variations in similar traits in a grouping of similar organisms.
2		Identifying relationships
	a	Students identify and describe* patterns in the data, including:
		i. Similarities in the traits of a parent and the traits of an offspring (e.g., tall plants typically have tall offspring).
		ii. Similarities in traits among siblings (e.g., siblings often resemble each other).
		iii. Differences in traits in a group of similar organisms (e.g., dogs come in many shapes and sizes, a field of corn plants have plants of different heights).
		iv. Differences in traits of parents and offspring (e.g., offspring do not look exactly like their parents).
		v. Differences in traits among siblings (e.g., kittens from the same mother may not look exactly like their mother).
3		Interpreting data
	a	Students describe* that the pattern of similarities in traits between parents, offspring, and siblings provides evidence that traits are inherited.
	b	Students describe* that the pattern of differences in traits between parents, offspring, and siblings provides evidence that inherited traits can vary.
	c	Students describe* that the variation in inherited traits results in a pattern of variation in traits in groups of organisms that are of a similar type.

Content Resource: 3rd Grade Life Science LS3-2 Heredity: Inheritance and Variation of Traits

		Observable features of the student performance by the end of the grade:
1		Articulating the explanation of phenomena
	a	Students identify the given explanation to be supported, including a statement that relates the phenomenon to a scientific idea, including that many inherited traits can be influenced by the environment.
2		Evidence
	a	Students describe* the given evidence that supports the explanation, including:
		i. Environmental factors that vary for organisms of the same type (e.g., amount or food, amount of water, amount of exercise an animal gets, chemicals in the water) that may influence organisms' traits.
		ii. Inherited traits that vary between organisms of the same type (e.g., height or weight of a plant or animal, color or quantity of the flowers).
		iii. Observable inherited traits of organisms in varied environmental conditions
3		Reasoning
	a	Students use reasoning to connect the evidence and support an explanation about environmental influences on inherited traits in organisms. In their chain of reasoning, students describe* a cause-and-effect relationship between a specific causal environmental factor and its effect of a given variation in a trait (e.g., not enough water produces plants that are shorter and have fewer flowers than plants that had more water available).

Content Resource: 3rd Grade Life Science LS4-1 Biological Natural Selection: Unity and Diversity

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Students use graphical displays (e.g., table, chart, graph) to organize the given data, including data about:
		i. Fossils of animals (e.g., information on type, size, type of land on which it was found).
		ii. Fossils of plants (e.g., information on type, size, type of land on which it was found).
		iii. The relative ages of fossils (e.g., from a very long time ago).
		iv. Existence of modern counterparts to the fossilized plants and animals and information on where they currently live.
2	Identifying relationships	
	a	Students identify and describe* relationships in the data, including:
		i. That fossils represent plants and animals that lived long ago.
		ii. The relationships between the fossils of organisms and the environments in which they lived (e.g., marine organisms, like fish, must have lived in water environments).
		iii. The relationships between types of fossils (e.g., those of marine animals) and the current environments where similar organisms are found.
		iv. That some fossils represent organisms that lived long ago and have no modern counterparts.
		v. The relationships between fossils of organisms that lived long ago and their modern counterparts.
		vi. The relationships between existing animals and the environments in which they currently live.
3	Interpreting data	
	a	Students describe* that:
		i. Fossils provide evidence of organisms that lived long ago but have become extinct (e.g., dinosaurs, mammoths, other organisms that have no clear modern counterpart).
		ii. Features of fossils provide evidence of organisms that lived long ago and of what types of environments those organisms must have lived in (e.g., fossilized seashells indicate shelled organisms that lived in aquatic environments).
3	a	iii. By comparing data about where fossils are found and what those environments are like, fossilized plants and animals can be used to provide evidence that some environments look very different now than they did a long time ago (e.g., fossilized seashells found on land that is now dry suggest that the area in which those fossils were found used to be aquatic; tropical plant fossils found in Antarctica, where tropical plants cannot live today, suggests that the area used to be tropical).

Content Resource: 3rd Grade Life Science LS4-2 Biological Natural Selection: Unity and Diversity

Observable features of the student performance by the end of the grade:		
	Articulating the explanation of phenomena	
1	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
1	b	Students use evidence and reasoning to construct an explanation for the phenomenon.
	2 Evidence	
2	a	Students describe* the given evidence necessary for the explanation, including:
		i. A given characteristic of a species (e.g., thorns on a plant, camouflage of an animal, the coloration of moths).
		ii. The patterns of variation of a given characteristic among individuals in a species (e.g., longer or shorter thorns on individual plants, dark or light coloration of animals).
		iii. Potential benefits of a given variation of the characteristic (e.g., the light coloration of some moths makes them difficult to see on the bark of a tree).
	Reasoning	
3	a	Students use reasoning to logically connect the evidence to support the explanation for the phenomenon. Students describe* a chain of reasoning that includes:
		i. That certain variations in characteristics make it harder or easier for an animal to survive, find mates, and reproduce (e.g., longer thorns prevent predators more effectively and increase the likelihood of survival; light coloration of some moths provides camouflage in certain environments, making it more likely that they will live long enough to be able to mate and reproduce).
		ii. That the characteristics that make it easier for some organisms to survive, find mates, and reproduce give those organisms an advantage over other organisms of the same species that don't have those traits.
3	a	iii. That there can be a cause-and-effect relationship between a specific variation in a characteristic (e.g., longer thorns, coloration of moths) and its effect on the ability of the individual organism to survive and reproduce (e.g., plants with longer thorns are less likely to be eaten, darker moths are less likely to be seen and eaten on dark trees).

Content Resource: 3rd Grade Life Science LS4-3 Biological Evolution: Unity and Diversity

		Observable features of the student performance by the end of the grade:
1		Supported claims
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that in a particular habitat, some organisms can survive well, some can survive less well, and some cannot survive at all.
2		Identifying scientific evidence
	a	Students describe* the given evidence necessary for supporting the claim, including:
		i. Characteristics of a given particular environment (e.g., soft earth, trees and shrubs, seasonal flowering plants).
		ii. Characteristics of a particular organism (e.g., plants with long, sharp leaves; rabbit coloration).
		iii. Needs of a particular organism (e.g., shelter from predators, food, water).
3		Evaluating and critiquing evidence
	a	Students evaluate the evidence to determine:
		i. The characteristics of organisms that might affect survival.
		ii. The similarities and differences in needs among at least three types of organisms.
		iii. How and what features of the habitat meet the needs of each of the organisms (i.e., the degree to which a habitat meets the needs of an organism).
		iv. How and what features of the habitat do not meet the needs of each of the organisms (i.e., the degree to which a habitat does not meet the needs of an organism).
	b	Students evaluate the evidence to determine whether it is relevant to and supports the claim.
	c	Students describe* whether the given evidence is sufficient to support the claim, and whether additional evidence is needed.
4		Reasoning and synthesis
	a	Students use reasoning to construct an argument, connecting the relevant and appropriate evidence to the claim, including describing* that any particular environment meets different organisms' needs to different degrees due to the characteristics of that environment and the needs of the organisms. Students describe* a chain of reasoning in their argument, including the following cause-and-effect relationships:
		i. If an environment fully meets the needs of an organism, that organism can survive well within that environment.
		ii. If an environment partially meets the needs of an organism, that organism can survive less well (e.g., lower survival rate, increased sickliness, shorter lifespan) than organisms whose needs are met within that environment.

Content Resource: 3rd Grade Life Science LS4-4 Biological Evolution: Unity and Diversity

Observable features of the student performance by the end of the grade:		
1		Supported claims
	a	Students make a claim about the merit of a given solution to a problem that is caused when the environment changes, which results in changes in the types of plants and animals that live there.
2		Identifying scientific evidence
	a	Students describe* the given evidence about how the solution meets the given criteria and constraints. This evidence includes:
		i. A system of plants, animals, and a given environment within which they live before the given environmental change occurs.
		ii. A given change in the environment.
		iii. How the change in the given environment causes a problem for the existing plants and animals living within that area.
		iv. The effect of the solution on the plants and animals within the environment.
		v. The resulting changes to plants and animals living within that changed environment after the solution has been implemented.
3		Evaluating and critiquing evidence
	a	Students evaluate the solution to the problem to determine the merit of the solution. Students describe* how well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system, including:
		i. How well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system, including:
		1. How the solution makes changes to one part (e.g., a feature of the environment) of the system, affecting the other parts of the system (e.g., plants and animals).
		2. How the solution affects plants and animals.
	b	Students evaluate the evidence to determine whether it is relevant to and supports the claim.
	c	Students describe* whether the given evidence is sufficient to support the claim, and whether additional evidence is needed.

Content Resource: 3rd Grade Physical Science PS2-1 Motion and Stability: Forces & Interactions

Observable features of the student performance by the end of the grade:		
1		Identifying the phenomenon under investigation
	a	Students identify and describe* the phenomenon under investigation, which includes the effects of different forces on an object's motion (e.g., starting, stopping, or changing direction).
	b	Students describe* the purpose of the investigation, which includes producing data to serve as the basis for evidence for how balanced and unbalanced forces determine an object's motion.
2		Identifying the evidence to address the purpose of the investigation
	a	Students collaboratively develop an investigation plan. In the investigation plan, students describe* the data to be collected, including:
		i. The change in motion of an object at rest after:
		1. Different strengths and directions of balanced forces (forces that sum to zero) are applied to the object.
		2. Different strengths and directions of unbalanced forces (forces that do not sum to zero) are applied to the object (e.g., strong force on the right, weak force or the left).
		ii. What causes the forces on the object.
	b	Students individually describe* how the evidence to be collected will be relevant to determining the effects of balanced and unbalanced forces on an object's motion.
3		Planning the investigation
	a	In the collaboratively developed investigation plan, students describe* how the motion of the object will be observed and recorded, including defining the following features:
		i. The object whose motion will be investigated.

Content Resource: 3rd Grade Physical Science PS2-2 Motion and Stability: Forces & Interactions

Observable features of the student performance by the end of the grade:		
1		Identifying the phenomenon under investigation
	a	From the given investigation plan, students identify and describe* the phenomenon under investigation, which includes observable patterns in the motion of an object.
	b	Students identify and describe* the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon that includes the idea that patterns of motion can be used to predict future motion of an object.
2		Identifying the evidence to address the purpose of the investigation
	a	Based on a given investigation plan, students identify and describe* the data to be collected through observations and/or measurements, including data on the motion of the object as it repeats a pattern over time (e.g., a pendulum swinging, a ball moving on a curved track, a magnet repelling another magnet).
	b	Students describe* how the data will serve as evidence of a pattern in the motion of an object and how that pattern can be used to predict future motion.
3		Planning the investigation
	a	From the given investigation plan, students identify and describe* how the data will be collected, including how:
		i. The motion of the object will be observed and measured.
		ii. Evidence of a pattern in the motion of the object will be identified from the data on the motion of the object.
		iii. The pattern in the motion of the object can be used to predict future motion.
4		Collecting the data
	a	Students make observations and/or measurements of the motion of the object, according to the given investigation plan, to identify a pattern that can be used to predict future motion.

Content Resource: 3rd Grade Physical Science PS2-3 Motion and Stability: Forces & Interactions

Observable features of the student performance by the end of the grade:		
1		Addressing phenomena of the natural world
	a	Students ask questions that arise from observations of two objects not in contact with each other interacting through electric or magnetic forces, the answers to which would clarify the cause-and- effect relationships between:
		i. The sizes of the forces on the two interacting objects due to the distance between the two objects.
		ii. The relative orientation of two magnets and whether the force between the magnets is attractive or repulsive.
		iii. The presence of a magnet and the force the magnet exerts on other objects.
		iv. Electrically charged objects and an electric force.
2		Identifying the scientific nature of the question
	a	Students' questions can be investigated within the scope of the classroom.

Content Resource: 3rd Grade Physical Science PS2-4 Motion and Stability: Forces & Interactions

Observable features of the student performance by the end of the grade:		
1	Identifying the problem to be solved	
	a	Students identify and describe* a simple design problem that can be solved by applying a scientific understanding of the forces between interacting magnets.
	b	Students identify and describe* the scientific ideas necessary for solving the problem, including:
		i. Force between objects do not require that those objects be in contact with each other
		ii. The size of the force depends on the properties of objects, distance between the objects, and orientation of magnetic objects relative to one another.
2	Defining the criteria and constraints	
	a	Students identify and describe* the criteria (desirable features) for a successful solution to the problem.
	b	Students identify and describe* the constraints (limits) such as:
		i. Time.
		ii. Cost.
		iii. Materials.

Content Resource: 3rd Grade Physical Science PS2-5 Motion & Stability: Forces and Interaction

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students identify a given claim to be supported about a phenomenon. The claim includes the idea that the gravitational force exerted by Earth on objects is directed down toward the center of Earth.
2.	Identifying scientific evidence	
	a	Students identify and describe* the given evidence, data, and/or models that support the claim, including:
		i. Multiple lines of evidence that indicate that the Earth's shape is spherical (e.g., observation of ships sailing beyond the horizon, the shape of the Earth's shadow on the moon during an eclipse, the changing height of the North Star above the horizon as people travel north and south).
		ii. That objects dropped appear to fall straight down.
		iii. That people live all around the spherical Earth, and they all observe that objects appear to fall straight down.
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence to determine whether it is sufficient and relevant to supporting the claim.
	b	Students describe* whether any additional evidence is needed to support the claim.
4		Reasoning and synthesis
	a.	Students use reasoning to connect the relevant and appropriate evidence to support the claim with argumentation. Students describe* a chain of reasoning that includes:
		i. If Earth is spherical, and all observers see objects near them falling directly "down" to the Earth's surface, then all observers would agree that objects fall toward the Earth's center.
		ii. Since an object that is initially stationary when held moves downward when it is released, there must be a force (gravity) acting on the object that pulls the object toward the center of Earth.

Content Resource: 4rd Grade Earth Science ESS1-1 Earth's Place in the Universe.

Observable features of the student performance by the end of the grade:		
1		Articulating the explanation of phenomena
	a	From a given model, students identify and describe* the relevant components for testing interactions concerning the functioning of a given natural system, including:
		Students identify the given explanation for a phenomenon, which includes a statement about the idea that landscapes change over time.
1	b	From the given explanation, students identify the specific aspects of the explanation they are supporting with evidence.
2		Evidence
	a	Students identify the evidence relevant to supporting the explanation, including local and regional patterns in the following:
		i. Different rock layers found in an area (e.g., rock layers taken from the same location show marine fossils in some layers and land fossils in other layers).
		ii. Ordering of rock layers (e.g., layer with marine fossils is found below layer with land fossils).
		iii. Presence of particular fossils (e.g., shells, land plants) in specific rock layers.
		iv. The occurrence of events (e.g., earthquakes) due to Earth forces.
3		Reasoning
	a	Students use reasoning to connect the evidence to support particular points of the explanation, including the identification of a specific pattern of rock layers and fossils (e.g., a rock layer containing shells and fish below a rock layer containing fossils of land animals and plants is a pattern indicating that, at one point, the landscape had been covered by water and later it was dry land). Students describe* reasoning for how the evidence supports particular points of the explanation, including:
		i. Specific rock layers in the same location show specific fossil patterns (e.g., some lower rock layers have marine fossils, while some higher rock layers have fossils of land plants).
		ii. Since lower layers were formed first then covered by upper layers, this pattern indicates that the landscape of the area was transformed into the landscape indicated by the upper layer (e.g., lower marine fossils indicate that, at one point, the landscape was covered by water, and upper land fossils indicate that later the landscape was dry land).
		iii. Irregularities in the patterns of rock layers indicate disruptions due to Earth forces (e.g., 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).

Content Resource: 4rd Grade Earth Science ESS2-2 Earth's Systems

Observable features of the student performance by the end of the grade:		
	Organizing data	
1	a	Students organize data using graphical displays (e.g., table, chart, graph) from maps of Earth's features (e.g., locations of mountains, continental boundaries, volcanoes, earthquakes, deep ocean trenches, ocean floor structures).
	Identifying relationships	
2	a	Students identify patterns in the location of Earth features, including the locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes. These relationships include:
		i. Volcanoes and earthquakes occur in bands that are often along the boundaries between continents and oceans.
		ii. Major mountain chains form inside continents or near their edges.
	Interpreting data	
3	a	Students use logical reasoning based on the organized data to make sense of and describe* a phenomenon. In their description*, students include that Earth features occur in patterns that reflect information about how they are formed or occur (e.g., mountain ranges tend to occur on the edges of continents or inside them, the Pacific Ocean is surrounded by a ring of volcanoes, all continents are surrounded by water [assume Europe and Asia are identified as Eurasia]).

Content Resource: 4rd Grade Earth Science ESS3-1 Earth and Human Activity

Observable features of the student performance by the end of the grade:		
	Obtaining information	
1	a	Students gather information from books and other reliable media about energy resources and fossil fuels (e.g., fossil fuels, solar, wind, water, nuclear), including:
		i. How they are derived from natural sources (e.g., which natural resource they are derived from) [Note: mechanisms should be limited to grade appropriate descriptions*, such as comparing the different ways energy resources are each derived from a natural resource].
		ii. How they address human energy needs.
		iii. The positive and negative environmental effects of using each energy resource.
	Evaluating information	
2	a	Students combine the obtained information to provide evidence about:
		i. The effects on the environment of using a given energy resource.
		ii. Whether the energy resource is renewable.
		iii. The role of technology, including new and improved technology, in improving or mediating the environmental effects of using a given resource.
	Communicating information	
3	a	Students use the information they obtained and combined to describe* the causal relationships between:
		ii. Energy resources and the environmental effects of using that energy source.
		ii. The role of technology in extracting and using an energy resource.

Content Resource: 4rd Grade Earth Science ESS3-2 Earth and Human Activity

		Observable features of the student performance by the end of the grade:
1		Using scientific knowledge to generate design solutions
	a	Given a natural Earth process that can have a negative effect on humans (e.g., an earthquake, volcano, flood, landslide), students use scientific information about that Earth process and its effects to design at least two solutions that reduce its effect on humans.
	b	In their design solutions, students describe* and use cause and effect relationships between the Earth process and its observed effect.
2		Describing* criteria and constraints, including quantification when appropriate
	a	Students describe* the given criteria for the design solutions, including using scientific information about the Earth process to describe* how well the design must alleviate the effect of the Earth process on humans.
	b	Students describe* the given constraints of the solution (e.g., cost, materials, time, relevant scientific information), including performance under a range of likely conditions.
3		Evaluating potential solutions
	a	Students evaluate each design solution based on whether and how well it meets the each of the given criteria and constraints.
	b	Students compare the design solutions to each other based on how well each meets the given criteria and constraints.
	c	Students describe* the design solutions in terms of how each alters the effect of the Earth process on humans.

Content Resource: 4th Grade 3-5-ET1-1. Engineering & Technology

		Observable features of the student performance by the end of the grade:
1		Identifying the problem to be solved
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
	c	Students describe* that people’s needs and wants change over time.
2		Defining the boundaries of the system
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.
3		Defining the criteria and constraints
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.
	b	Students describe* the constraints or limitations on their design, which may include:
		i. Cost.
		ii. Materials.
		iii. Time.

Content Resource: 4th Grade 3-5-ET1-2. Engineering & Technology

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
	c	Students specify how each design solution solves the problem.
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [Note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe*:
		i. The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		ii. How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions	
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

Content Resource: 4th Grade 3-5-ET1-3. Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Identifying the purpose of the investigation
	a	Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model/prototype that can be improved.
2		Identifying the evidence to be address the purpose of the investigation
	a	Students describe* the evidence to be collected, including:
		i. How well the model/prototype performs against the given criteria and constraints.
		ii. Specific aspects of the model/prototype that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
		iii. Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
	b	Students describe* how the evidence is relevant to the purpose of the investigation.
3		Planning the investigation
	a	Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:
		i. The specific criterion or constraint to be used.
		ii. What is to be changed in each trial (the independent variable).
		iii. The outcome (dependent variable) that will be measured to determine success.
		iv. What tools and methods are to be used for collecting data.
		v. What is to be kept the same from trial to trial to ensure a fair test.
4		Collecting the data
	a	Students carry out the investigation by collecting and recording data according to the developed plan.

Content Resource: 4rd Grade Life Science 4-LS1-1. From Molecules to Organisms: Structures & Processes

Observable features of the student performance by the end of the grade:		
1		Supported claims
	a	Students make a claim to be supported about a phenomenon. In the claim, students include the idea that plants and animals have internal and external structures that function together as part of a system to support survival, growth, behavior, and reproduction.
2		Identifying scientific evidence
	a	Students describe* the given evidence, including:
		i. The internal and external structures of selected plants and animals.
		ii. The primary functions of those structures.
3		Evaluating and critiquing evidence
	a	Students determine the strengths and weaknesses of the evidence, including whether the evidence is relevant and sufficient to support a claim about the role of internal and external structures of plants and animals in supporting survival, growth, behavior, and/or reproduction.
4		Reasoning and synthesis
	a	Students use reasoning to connect the relevant and appropriate evidence and construct an argument that includes the idea that plants and animals have structures that, together, support survival, growth, behavior, and/or reproduction. Students describe* a chain of reasoning that includes:
		i. Internal and external structures serve specific functions within plants and animals (e.g., the heart pumps blood to the body, thorns discourage predators).
		ii. The functions of internal and external structures can support survival, growth, behavior, and/or reproduction in plants and animals (e.g., the heart pumps blood throughout the body, which allows the entire body access to oxygen and nutrients; thorns prevent predation, which allows the plant to grow and reproduce).
		iii. Different structures work together as part of a system to support survival, growth, behavior, and/or reproduction (e.g., the heart works with the lungs to carry oxygenated blood throughout the body; thorns protect the plant, allowing reproduction via stamens and pollen to occur).

Content Resource: 4rd Grade Life Science LS1-2 From Molecules to Organisms: Structures & Processes

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	From a given model, students identify and describe* the relevant components for testing interactions concerning the functioning of a given natural system, including:
		i. Different types of information about the surroundings (e.g., sound, light, odor, temperature).
		ii. Sense receptors able to detect different types of information from the environment.
		iii. Brain.
		iv. Animals' actions.
2	Relationships	
	a	Students describe* the relationships between components in the model, including:
		i. Different types of sense receptors detect specific types of information within the environment.
		ii. Sense receptors send information about the surroundings to the brain.
		iii. Information that is transmitted to the brain by sense receptors can be processed immediately as perception of the environment and/or stored as memories.
		iv. Immediate perceptions or memories processed by the brain influence an animal's action or responses to features in the environment.
3	Connections	
	a	Students use the model to describe* that:
		i. Information in the environment interacts with animal behavioral output via interactions mediated by the brain.
		ii. Different types of sensory information are relayed to the brain via different sensory receptors, allowing experiences to be perceived, stored as memories, and influence behavior (e.g., an animal sees a brown, rotten fruit and smells a bad odor — this sensory information allows the animal to use information about other fruits that appear to be rotting to make decisions about what to eat; an animal sees a red fruit and a green fruit — after eating them both, the animal learns that the red fruit is sweet and the green fruit is bitter and then uses this sensory information, perceived and stored as memories, to guide fruit selection next time).
		iii. Sensory input, the brain, and behavioral output are all parts of a system that allow animals to engage in appropriate behaviors.
	b	Students use the model to test interactions involving sensory perception and its influence on animal behavior within a natural system, including interactions between:
		i. Information in the environment.
		ii. Different types of sense receptors.
		iii. Perception and memory of sensory information.
		iv. Animal behavior.

Content Resource: 4rd Grade Physical Science PS3-1 Energy

Observable features of the student performance by the end of the grade:		
1		Articulating the explanation of phenomena
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that the speed of a given object is related to the energy of the object (e.g., the faster an object is moving, the more energy it possesses).
	b	Students use the evidence and reasoning to construct an explanation for the phenomenon.
2		Evidence
	a	Students identify and describe* the relevant given evidence for the explanation, including:
		i The relative speed of the object (e.g., faster vs. slower objects).
		ii. Qualitative indicators of the amount of energy of the object, as determined by a transfer of energy from that object (e.g., more or less sound produced in a collision, more or less heat produced when objects rub together, relative speed of a ball that was stationary following a collision with a moving object, more or less distance a stationary object is moved).
3		Reasoning
	a	Students use reasoning to connect the evidence to support an explanation for the phenomenon. In the explanation, students describe* a chain of reasoning that includes:
		i. Motion can indicate the energy of an object.
		ii. The faster a given object is moving, the more observable impact it can have on another object (e.g., a fast-moving ball striking something (a gong, a wall) makes more noise than does the same ball moving slowly and striking the same thing).
		iii. The observable impact of a moving object interacting with its surroundings reflects how much energy was able to be transferred between objects and therefore relates to the energy of the moving object.
		iv. Because faster objects have a larger impact on their surroundings than objects moving more slowly, they have more energy due to motion (e.g., a fast-moving ball striking a gong makes more noise than a slow-moving ball doing the same thing because it has more energy that can be transferred to the gong, producing more sound). [Note: This refers only to relative bulk motion energy, not potential energy].
		v. Therefore, the speed of an object is related to the energy of the object.

Content Resource: 4rd Grade Physical Science PS3-2 Energy

Observable features of the student performance by the end of the grade:		
1		Identifying the phenomenon under investigation
	a	From the given investigation plan, students describe* the phenomenon under investigation, which includes the following ideas:
		i. The transfer of energy, including:
		1. Collisions between objects.
		2. Light traveling from one place to another.
		3. Electric currents producing motion, sound, heat, or light.
		4. Sound traveling from one place to another.
		5. Heat passing from one object to another.
		6. Motion, sound, heat, and light causing a different type of energy to be observed after an interaction (e.g., in a collision between two objects, one object may slow down or stop, the other object may speed up, and the objects and surrounding air may be heated; a specific sound may cause the movement of an object; the energy associated with the motion of an object, via an electrical current, may be used to turn on a light).
	b	Students describe* the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon, including the idea that energy can be transferred from place to place by:
		i. Moving objects.
		ii. Sound.
		iii. Light.
		iv. Heat.
		v. Electric currents.
2		Identifying the evidence to address the purpose of the investigation
	a	From the given investigation plan, students describe* the data to be collected that will serve as the basis for evidence, including:
		i. The motion and collision of objects before and after an interaction (e.g., when a given object is moving fast, it can move another object farther than when the same object is moving more slowly).
		ii. The relative presence of sound, light, or heat (including in the surrounding air) before and after an interaction (e.g. shining a light on an object can increase the temperature of the object; a sound can move an object).
		iii. The presence of electric currents flowing through wires causally linking one form of energy output (e.g., a moving object) to another form of energy output (e.g., another moving object; turning on a light bulb).
	b	Students describe* how their observations will address the purpose of the investigation, including how the observations will provide evidence that energy, in the form of light, sound, heat, and motion, can be transferred from place to place by sound, light, heat, or electric currents (e.g., in a system in which the motion of an object generates an observable electrical current to turn on a light, energy (from the motion of an object) must be transferred to another place (energy in the form of the light bulb) via the electrical current, because the motion doesn't cause the light bulb to light up if the wire is not completing a circuit between them; when a light is directed at an object, energy (in the form of light) must be transferred from the source of the light to its destination and can be observed in the form of heat, because if the light is blocked, the object isn't warmed.
3		Planning the investigation
	a	From the given investigation plan, students identify and describe* how the data will be observed and recorded, including the tools and methods for collecting data on:
		i. The motion and collision of objects, including any sound or heat producing the motion/collision, or produced by the motion/collision.

		ii. The presence of energy in the form of sound, light, or heat in one place as a result of sound, light, or heat in a different place.
		iii. The presence of electric currents in wires and the presence of energy (in the form of sound, light, heat, or motion resulting from the flow of electric currents through a device).
	b	Students describe* the number of trials, controlled variables, and experimental set up.
4	Collecting the data	
	a	Students make and record observations according to the given investigation plan to provide evidence that:
		i. Energy is present whenever there are moving objects, sound, light, or heat.
		ii. That energy has been transferred from place to place (e.g., a bulb in a circuit is not lit until a switch is closed and it lights, indicating that energy is transferred through electric current in a wire to light the bulb; a stationary ball is struck by a moving ball, causing the stationary ball to move and the moving ball to slow down, indicating that energy has been transferred from the moving ball to the stationary one).

Content Resource: 4rd Grade Physical Science PS3-3 Energy

Observable features of the student performance by the end of the grade:		
1		Addressing phenomena of the natural world
	a	Students ask questions about the changes in energy that occur when objects collide, the answers to which would clarify:
		i. A qualitative measure of energy (e.g., relative motion, relative speed, relative brightness) of the object before the collision.
		1. The transfer of energy by contact forces between colliding objects that results in a change in the motion of the objects.
		2. The transfer of energy to the surrounding air when objects collide resulting in sound and heat.
	b	ii. Students predict reasonable outcomes about the changes in energy that occur after objects collide, based on patterns linking object collision and energy transfer between objects and the surrounding air.
2		Identifying the scientific nature of the question
	a	Students ask questions that can be investigated within the scope of the classroom or an outdoor environment.

Content Resource: 4rd Grade Physical Science PS3-4 Energy

Observable features of the student performance by the end of the grade:		
1		Using scientific knowledge to generate design solutions
	a	Given a problem to solve, students collaboratively design a solution that converts energy from one form to another. In the design, students:
		i. Specify the initial and final forms of energy (e.g., electrical energy, motion, light).
		ii. Identify the device by which the energy will be transformed (e.g., a light bulb to convert electrical energy into light energy, a motor to convert electrical energy into energy of motion).
2		Describing* criteria and constraints, including quantification when appropriate
	a	a Students describe* the given criteria and constraints of the design, which include:
		ii. Criteria:
		1. The initial and final forms of energy.
		2. Description* of how the solution functions to transfer energy from one form to another.
		ii. Constraints:
		1.The materials available for the construction of the device.
		2. Safety considerations.
3		Evaluating potential solutions
	a	Students evaluate the proposed solution according to how well it meets the specified criteria and constraints of the problem.
4		Modify the design solution
	a	Students test the device and use the results of the test to address problems in the design or improve its functioning.

Content Resource: 4[rd] Grade Physical Science PS4-1 Waves and Their Applications in Technologies for Information Transfer

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model (e.g., diagrams, analogies, examples, abstract representations, physical models) to make sense of a phenomenon that involves wave behavior. In the model, students identify the relevant components, including:
		i. Waves.
		ii. Wave amplitude.
		iii. Wavelength.
		iv. Motion of objects.
2	Relationships	
	a	Students identify and describe* the relevant relationships between components of the model, including:
		i. Waves can be described* in terms of patterns of repeating amplitude and wavelength (e.g., in a water wave there is a repeating pattern of water being higher and then lower than the baseline level of the water).
		ii. Waves can cause an object to move.
		iii. The motion of objects varies with the amplitude and wavelength of the wave carrying it.
3	Connections	
	a	Students use the model to describe*:
		i. The patterns in the relationships between a wave passing, the net motion of the wave, and the motion of an object caused by the wave as it passes.
		ii. How waves may be initiated (e.g., by disturbing surface water or shaking a rope or spring).
		iii. The repeating pattern produced as a wave is propagated.
	b	Students use the model to describe* that waves of the same type can vary in terms of amplitude and wavelength and describe* how this might affect the motion, caused by a wave, of an object.
	c	Students identify similarities and differences in patterns underlying waves and use these patterns to describe* simple relationships involving wave amplitude, wavelength, and the motion of an object (e.g., when the amplitude increases, the object moves more).

Content Resource: 4rd Grade Physical Science PS4-3 Waves and Their Applications in Technologies for Information Transfer

Observable features of the student performance by the end of the grade:		
1		Using scientific knowledge to generate design solutions
	a	Students generate at least two design solutions, for a given problem, that use patterns to transmit a given piece of information (e.g., picture, message). Students describe* how the design solution is based on:
		i. Knowledge of digitized information transfer (e.g., information can be converted from a sound wave into a digital signal such as patterns of 1s and 0s and vice versa; visual or verbal messages can be encoded in patterns of flashes of light to be decoded by someone else across the room).
		ii. Ways that high-tech devices convert and transmit information (e.g., cell phones convert sound waves into digital signals so they can be transmitted long distances, and then converted back into sound waves; a picture or message can be encoded using light signals to transmit the information over a long distance).
2		Describing* criteria and constraints, including quantification when appropriate
	a	Students describe* the given criteria for the design solutions, including the accuracy of the final transmitted information and that digitized information (patterns) transfer is used.
	b	Students describe* the given constraints of the design solutions, including:
		i. The distance over which information is transmitted.
		ii. Safety considerations.
		iii. Materials available.
3		Evaluating potential solutions
	a	Students compare the proposed solutions based on how well each meets the criteria and constraints.
	b	Students identify similarities and differences in the types of patterns used in the solutions to determine whether some ways of transmitting information are more effective than others at addressing the problem.

Content Resource: 5th Grade Earth Science ESS1-1 Earth's Place in the Universe

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students identify a given claim to be supported about a phenomenon. The claim includes the idea that the apparent brightness of the sun and stars is due to their relative distances from Earth.
2.	Identifying scientific evidence	
	a	Students identify and describe* the given evidence, data, and/or models that support the claim, including:
		i. The sun and other stars are natural bodies in the sky that give off their own light.
		ii. The apparent brightness of a variety of stars, including the sun.
		iii. A luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person (e.g., nearby streetlights appear bigger and brighter than distant streetlights).
		iv. The relative distance of the sun and stars from Earth (e.g., although the sun and other stars are all far from the Earth, the stars are very much farther away; the sun is much closer to Earth than other stars).
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence to determine whether it is relevant to supporting the claim, and sufficient to describe* the relationship between apparent size and apparent brightness of the sun and other stars and their relative distances from Earth.
	b	Students determine whether additional evidence is needed to support the claim.
4		Reasoning and synthesis
	a	Students use reasoning to connect the relevant and appropriate evidence to the claim with argumentation. Students describe* a chain of reasoning that includes:
		i. Because stars are defined as natural bodies that give off their own light, the sun is a star.
		ii. The sun is many times larger than Earth but appears small because it is very far away.
		iii. Even though the sun is very far from Earth, it is much closer than other stars.
		iv. Because the sun is closer to Earth than any other star, it appears much larger and brighter than any other star in the sky.
		v. Because objects appear smaller and dimmer the farther they are from the viewer, other stars, although immensely large compared to the Earth, seem much smaller and dimmer because they are so far away.
		vi. Although stars are immensely large compared to Earth, they appear small and dim because they are so far away.
		vii. Similar stars vary in apparent brightness, indicating that they vary in distance from Earth.

Content Resource: 5th Grade Earth Science ESS1-2 Earth's Place in the Universe

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Using graphical displays (e.g., bar graphs, pictographs), students organize data pertaining to daily and seasonal changes caused by the Earth's rotation and orbit around the sun. Students organize data that include:
		i. The length and direction of shadows observed several times during one day.
		ii. The duration of daylight throughout the year, as determined by sunrise and sunset times.
		iii. Presence or absence of selected stars and/or groups of stars that are visible in the night sky at different times of the year.
2	Identifying relationships	
	a	Students use the organized data to find and describe* relationships within the datasets, including:
	a	i. The apparent motion of the sun from east to west results in patterns of changes in length and direction of shadows throughout a day as Earth rotates on its axis.
	a	ii. The length of the day gradually changes throughout the year as Earth orbits the sun, with longer days in the summer and shorter days in the winter
	a	iii. Some stars and/or groups of stars (i.e., constellations) can be seen in the sky all year, while others appear only at certain times of the year.
	b	Students use the organized data to find and describe* relationships among the datasets, including:
	b	i. Similarities and differences in the timing of observable changes in shadows, daylight, and the appearance of stars show that events occur at different rates (e.g., Earth rotates on its axis once a day, while its orbit around the sun takes a full year).

Content Resource: 5th Grade Earth Science ESS2-1 Earth's Systems

Observable features of the student performance by the end of the grade:		
1		Components of the model
	a	Students develop a model, using a specific given example of a phenomenon, to describe* ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact. In their model, students identify the relevant components of their example, including features of two of the following systems that are relevant for the given example:
		i. Geosphere (i.e., solid and molten rock, soil, sediment, continents, mountains).
		ii. Hydrosphere (i.e., water and ice in the form of rivers, lakes, glaciers).
		iii. Atmosphere (i.e., wind, oxygen).
		iv. Biosphere (i.e., plants, animals [including humans]).
2		Relationships
	a	Students identify and describe* relationships (interactions) within and between the parts of the Earth systems identified in the model that are relevant to the example (e.g., the atmosphere and the hydrosphere interact by exchanging water through evaporation and precipitation; the hydrosphere and atmosphere interact through air temperature changes, which lead to the formation or melting of ice).
3		Connections
	a	Students use the model to describe* a variety of ways in which the parts of two major Earth systems in the specific given example interact to affect the Earth's surface materials and processes in that context. Students use the model to describe* how parts of an individual Earth system:
		i. Work together to affect the functioning of that Earth system.
		ii. Contribute to the functioning of the other relevant Earth system.

Content Resource: 5th Grade Earth Science ESS2-2 Earth's Systems

Observable features of the student performance by the end of the grade:		
1		Representation
	a	Students graph the given data (using standard units) about the amount of salt water and the amount of fresh water in each of the following reservoirs, as well as in all the reservoirs combined, to address a scientific question:
		i. Oceans.
		ii. Lakes.
		iii. Rivers.
		iv. Glaciers.
		v. Ground water.
		vi. Polar ice caps.
2		Mathematical/computational analysis
	a	Students use the graphs of the relative amounts of total salt water and total fresh water in each of the reservoirs to describe* that:
	a	i. The majority of water on Earth is found in the oceans.
		ii. Most of the Earth's fresh water is stored in glaciers or underground.
		iii. A small fraction of fresh water is found in lakes, rivers, wetlands, and the atmosphere.

Content Resource: 5th Grade Earth Science ESS3-1 Earth and Human Activity

Observable features of the student performance by the end of the grade:		
1		Obtaining information
	a	Students obtain information from books and other reliable media about:
		i. How a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
		ii. How a given community uses scientific ideas to protect a given natural resource and the environment in which the resource is found.
2		Evaluating information
	a	Students combine information from two or more sources to provide and describe* evidence about:
		i. The positive and negative effects on the environment as a result of human activities.
		ii. How individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.

Content Resource: 5th Grade 3-5 ET1-1 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Identifying the problem to be solved
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
	c	Students describe* that people's needs and wants change over time.
2		Defining the boundaries of the system
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.
3		Defining the criteria and constraints
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.
	b	Students describe* the constraints or limitations on their design, which may include:
		i. Cost.
		ii. Materials.
		iii. Time.

Content Resource: 5th Grade 3-5 ET1-2 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
	c	Students specify how each design solution solves the problem.
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [Note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe*:
		i. The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		ii. How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions	
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

Content Resource: 5th Grade 3-5 ET1-3 Engineering & Technology

Observable features of the student performance by the end of the grade:		
1		Identifying the purpose of the investigation
	a	Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.
2		Identifying the evidence to be address the purpose of the investigation
	a	Students describe* the evidence to be collected, including:
		i. How well the model/prototype performs against the given criteria and constraints.
		ii. Specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
		iii. Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
	b	Students describe* how the evidence is relevant to the purpose of the investigation.
3		Planning the investigation
	a	Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:
		i. The specific criterion or constraint to be used.
		ii. What is to be changed in each trial (the independent variable).
		iii. The outcome (dependent variable) that will be measured to determine success.
		iv. What tools and methods are to be used for collecting data.
		v. What is to be kept the same from trial to trial to ensure a fair test.
4		Collecting the data
	a	Students carry out the investigation, collecting and recording data according to the developed plan.

Content Resource: 5th Grade Life Science LS1-1 From Molecules to Organisms: Structures & Processes

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that plants acquire the materials they need for growth chiefly from air and water.
2	Identifying scientific evidence	
	a	Students describe* the given evidence, data, and/or models that support the claim, including evidence of:
		i. Plant growth over time.
		ii. Changes in the weight of soil and water within a closed system with a plant, indicating:
		1. Soil does not provide most of the material for plant growth (e.g., changes in weight of soil and a plant in a pot over time, hydroponic growth of plants).
		2. Plants' inability to grow without water.
		iii. Plants' inability to grow without air.
		iv. Air is matter (e.g., empty object vs. air filled object).
3	Evaluating and critiquing evidence	
	a	Students determine whether the evidence supports the claim, including:
		i. Whether a particular material (e.g. air, soil) is required for growth of plants.
		ii. Whether a particular material (e.g. air, soil) may provide sufficient matter to account for an observed increase in weight of a plant during growth.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the evidence to support the claim with argumentation. Students describe* a chain of reasoning that includes:
	a	i. During plant growth in soil, the weight of the soil changes very little over time, whereas the weight of the plant changes a lot. Additionally, some plants can be grown without soil at all.
	a	ii. Because some plants don't need soil to grow, and others show increases in plant matter (as measured by weight) but not accompanying decreases in soil matter, the material from soil must not enter the plant in sufficient quantities to be the chief contributor to plant growth.
	a	iii. Therefore, plants do not acquire most of the material for growth from soil.
		iv. A plant cannot grow without water or air. Because both air and water are matter and are transported into the plant system, they can provide the materials plants need for growth.
		v. Since soil cannot account for the change in weight as a plant grows and since plants take in water and air, both of which could contribute to the increase in weight during plant growth, plant growth must come chiefly from water and air.

Content Resource: 5th Grade Life Science LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model to describe* a phenomenon that includes the movement of matter within an ecosystem. In the model, students identify the relevant components, including:
		i. Matter.
		ii. Plants.
		iii. Animals.
		iv. Decomposers, such as fungi and bacteria.
		v. Environment.
2	Relationships	
	a	Students describe* the relationships among components that are relevant for describing* the phenomenon, including:
		i. The relationships in the system between organisms that consume other organisms, including:
		1. Animals that consume other animals.
		2. Animals that consume plants.
		3. Organisms that consume dead plants and animals.
		4. The movement of matter between organisms during consumption.
		ii. The relationship between organisms and the exchange of matter from and back into the environment (e.g., organisms obtain matter from their environments for life processes and release waste back into the environment, decomposers break down plant and animal remains to recycle some materials back into the soil).
3	Connections	
	a	Students use the model to describe*:
		i. The cycling of matter in the system between plants, animals, decomposers, and the environment.
		ii. How interactions in the system of plants, animals, decomposers, and the environment allow multiple species to meet their needs.
		iii. That newly introduced species can affect the balance of interactions in a system (e.g., a new animal that has no predators consumes much of another organism's food within the ecosystem).
		iv. That changing an aspect (e.g., organisms or environment) of the ecosystem will affect other aspects of the ecosystem.

Content Resource: 5th Grade Physical Science PS1-1 Matter & Its Interactions

Observable features of the student performance by the end of the grade:		
1		Components of the model
	a	Students develop a model to describe* a phenomenon that includes the idea that matter is made of particles too small to be seen. In the model, students identify the relevant components for the phenomenon, including:
		i. Bulk matter (macroscopic observable matter; e.g., as sugar, air, water).
		ii. Particles of matter that are too small to be seen.
2		Relationships
	a	In the model, students identify and describe* relevant relationships between components, including the relationships between:
		i. Bulk matter and tiny particles that cannot be seen (e.g., tiny particles of matter that cannot be seen make up bulk matter).
		ii. The behavior of a collection of many tiny particles of matter and observable phenomena involving bulk matter (e.g., an expanding balloon, evaporating liquids, substances that dissolve in a solvent, effects of wind).
3		Connections
	a	Students use the model to describe* how matter composed of tiny particles too small to be seen can account for observable phenomena (e.g., air inflating a basketball, ice melting into water).

Content Resource: 5th Grade Physical Science PS1-2 Matter and Its Interactions

Observable features of the student performance by the end of the grade:		
1		Representation
	a	Students measure and graph the given quantities using standard units, including:
		i. The weight of substances before they are heated, cooled, or mixed.
		ii. The weight of substances, including any new substances produced by a reaction, after they are heated, cooled, or mixed.
2		Mathematical/computational analysis
	a	Students measure and/or calculate the difference between the total weight of the substances (using standard units) before and after they are heated, cooled, and/or mixed.
	b	Students describe* the changes in properties they observe during and/or after heating, cooling, or mixing substances.
	c	Students use their measurements and calculations to describe* that the total weights of the substances did not change, regardless of the reaction or changes in properties that were observed.
	d	Students use measurements and descriptions* of weight, as well as the assumption of consistent patterns in natural systems, to describe* evidence to address scientific questions about the conservation of the amount of matter, including the idea that the total weight of matter is conserved after heating, cooling, or mixing substances.

Content Resource: 5th Grade Physical Science PS1-3 Matter & Its Interactions

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	From the given investigation plan, students identify the phenomenon under investigation, which includes the observable and measurable properties of materials.
	b	Students identify the purpose of the investigation, which includes collecting data to serve as the basis for evidence for an explanation about the idea that materials can be identified based on their observable and measurable properties.
2	Identifying the evidence to address the purpose of the investigation	
	a	From the given investigation plan, students describe* the evidence from data (e.g., qualitative observations and measurements) that will be collected, including:
		i. Properties of materials that can be used to identify those materials (e.g., color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility).
	b	Students describe* how the observations and measurements will provide the data necessary to address the purpose of the investigation.
3	Planning the investigation	
	a	From the given investigation plan, students describe* how the data will be collected, including how:
		i. Quantitative measures of properties, in standard units (e.g., grams, liters).
		ii. Observations of properties such as color, conductivity, and reflectivity.
		iii. Determination of conductors vs. nonconductors and magnetic vs. nonmagnetic materials.
	b	Students describe* how the observations and measurements they make will allow them to identify materials based on their properties.
4	Collecting the data	
	a	Students collect and record data, according to the given investigation plan.

Content Resource: 5th Grade Physical Science PS1-4 Matter & Its Interactions

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	From the given investigation plan, students identify the phenomenon under investigation, which includes the mixing of two or more substances.
	b	Students identify the purpose of the investigation, which includes providing evidence for whether new substances are formed by mixing two or more substances, based on the properties of the resulting substance.
2	Identifying the evidence to address the purpose of the investigation	
	a	From the given investigation plan, students describe* the evidence from data (e.g., qualitative observations and measurements) that will be collected, including:
		i. Quantitative (e.g., weight) and qualitative properties (e.g., state of matter, color, texture, odor) of the substances to be mixed.
		ii. Quantitative and qualitative properties of the resulting substances.
	b	Students describe* how the collected data can serve as evidence for whether the mixing of the two or more tested substances results in one or more new substances.
3	Planning the investigation	
	a	From the given investigation plan, students describe* how the data will be collected, including how:
		i. How quantitative and qualitative properties of the two or more substances to be mixed will be determined and measured.
		ii. How quantitative and qualitative properties of the substances that resulted from the mixture of the two or more substances will be determined and measured.
		iii. Number of trials for the investigation.
		iv. How variables will be controlled to ensure a fair test (e.g., the temperature at which the substances are mixed, the number of substances mixed together in each trial).
4	Collecting the data	
	a	According to the investigation plan, students collaboratively collect and record data, including data about the substances before and after mixing.

Content Resource: 5th Grade Physical Science PS3-1 Energy

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students use models to describe* a phenomenon that includes the idea that energy in animals' food was once energy from the sun. Students identify and describe* the components of the model that are relevant for describing* the phenomenon, including:
	a	i. Energy.
	a	ii. The sun.
	a	iii. Animals, including their bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
	a	iv. Plants.
2	Relationships	
	a	Students identify and describe* the relevant relationships between components, including:
		i. The relationship between plants and the energy they get from sunlight to produce food.
		ii. The relationship between food and the energy and materials that animals require for bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
		iii. The relationship between animals and the food they eat, which is either other animals or plants (or both), to obtain energy for bodily functions and materials for growth and repair.
3	Connections	
	a	Students use the models to describe* causal accounts of the relationships between energy from the sun and animals' needs for energy, including that:
		i. Since all food can eventually be traced back to plants, all of the energy that animals use for body repair, growth, motion, and body warmth maintenance is energy that once came from the sun.
		ii. Energy from the sun is transferred to animals through a chain of events that begins with plants producing food then being eaten by animals.

Appendix B: K-5 Crosswalk of Performance Standards by Discipline

Appendix B maps the performance standards by focus area across grades K-5 to help educators understand the progression of learning within each discipline (Physical Science, Life Science, and Earth and Space Sciences).

Physical Science

	PS1 - Matter and Its Interactions	*PS2 - Motion and Stability: Forces and Interactions*	*PS3 - Energy*	*PS4 - Waves and Their Applications in Technologies for Information Transfer*
K		**PS2-1**Compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. **PS2-2**Determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.	**PS3-1**Determine the effect of sunlight on Earth's surface. **PS3-2**Design and build a structure that will reduce the warming effect of sunlight on an area.	
1				**PS4-1**Provide evidence that vibrating materials can make sound and that sound can make materials vibrate **PS4-2**Construct an evidence-based account that objects in darkness can be seen only when illuminated. **PS4-3** Determine the effect of placing objects made with different materials in the path of a beam of light. **PS4-4**Design and build a device that uses light or sound to solve the problem of communicating over a distance.
2	**PS1-1** Describe and classify different kinds of materials by their observable properties. **PS1-2** Determine which materials have the properties that are best suited for an intended purpose **PS1-3** An object made of a small set of pieces can be disassembled and made into a new object. **PS1-4** Some changes caused by heating or cooling can be reversed and some cannot.			
3		**PS2-1** Provide evidence of the effects of balanced and unbalanced forces on the motion of an object. **PS2-2** A pattern can be used to predict future motion **PS2-3** Relationships of electric or magnetic interactions between two objects not in contact with each other **PS2-4** Simple design problem that can be solved by applying scientific ideas about magnets		
4			**PS3-1** Relating the speed of an object to the energy of that object **PS3-2** Energy can be transferred from place to place by sound, light, heat, and electric currents. **PS3-3** Changes in energy that occur when objects collide. **PS3-4** Design, test, and refine a device that converts energy from one form to another	**PS4-1** Patterns in terms of amplitude and wavelength and that waves can cause objects to move. **PS4-3** Use patterns to transfer information.
5	**PS1-1**Matter is made of particles too small to be seen. **PS1-2** Regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. **PS1-3**Identify materials based on their properties. **PS1-4**Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	**PS2-1** Gravitational force exerted by Earth on objects is directed down	**PS3-1** Energy in animals' food was once energy from the sun	

Life Science				
	LS1 – From Molecules to Organisms: Structure and Processes	***LS2 – Ecosystems: Interactions, Energy, and Dynamics***	***LS3 – Heredity: Inheritance and Variation of Traits***	***LS4 – Biological Evolution: Unity and Diversity***
K	**LS1-1** Use observations to describe patterns of what plants and animals (including humans) need to survive.			
1	**LS1-1**Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. **LS1-2**Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.		**LS3-1**Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.	
2		**LS2-1**Plan and conduct an investigation to determine if plants need sunlight and water to grow. **LS2-2**Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.		**LS4-1**Make observations of plants and animals to compare the diversity of life in different habitats.
3	**LS1-1**Develop models to describe that organisms have unique and diverse life cycles, but all have in common birth, growth, reproduction, and death.	**LS2-1**Construct an argument that some animals form groups that help members survive.	**LS3-1**Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. **LS3-2**Use evidence to support the explanation that traits can be influenced by the environment.	**LS4-1**Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. **LS4-2**Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. **LS4-3**Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. **LS4-4**Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
4	**LS1-1**Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **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.			
5	**LS1-1**Support an argument that plants get the materials they need for growth chiefly from air and water.	**LS2-1**Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.		

Earth and Space Sciences

	ESS1 – Earth's Place in the Universe	*ESS2 – Earth's Systems*	*ESS3 – Earth and Human Activity*
K		**ESS2-1** Use and share observations of local weather conditions to describe patterns over time. **ESS2-2** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.	**ESS3-1** Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. **ESS3-2** Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. **ESS3-3** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
1	**ESS1-1** Use observations of the sun, moon, and stars to describe patterns that can be predicted. **ESS1-2** Make observations at different times of year to relate the amount of daylight to the time of year.		
2	**ESS1-1** Use information from several sources to provide evidence that Earth events can occur quickly or slowly.	**ESS2-1** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. **ESS2-2** Develop a model to represent the shapes and kinds of land and bodies of water in an area. **ESS2-3** Obtain information to identify where water is found on Earth and that it can be solid or liquid.	
3		**ESS2-1** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. **ESS2-2** Obtain and combine information to describe climates in different regions of the world.	**ESS3-1** Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.
4	**ESS1-1** Identify evidence from patterns in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time.	**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. **ESS2-2** Analyze and interpret data from maps to describe patterns of Earth's features.	**ESS3-1** Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. **ESS3-2** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
5	**ESS1-1** Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth. **ESS1-2** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	**ESS2-1** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. **ESS2-2** Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	**ESS3-1** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.