

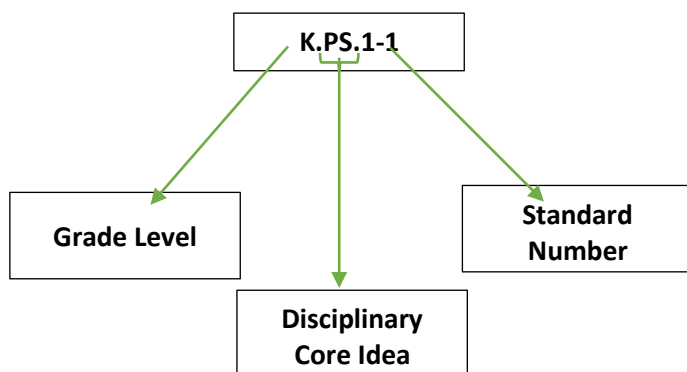
## How the Draft Sisseton-Wahpeton K-12 Science Standards are Organized

The Draft Sisseton-Wahpeton K-12 Science Standards are adapted from the Next Generation Science Standards (NGSS), the Marzano Research Critical Concepts for Science and the South Dakota Science Standards.

The Draft Sisseton-Wahpeton K-12 Science Standards include all concepts from the above resources but have fewer individual standards and include language to clarify what students should be able to do.

Standards are grouped together by **NGSS Cluster Topic** to help teachers put together units that cover related topics.

### Physical Science: Forces and Interactions - Pushes and Pulls



Grade Codes	
<b>K</b>	Kindergarten
<b>1</b>	First Grade
<b>2</b>	Second Grade
<b>3</b>	Third Grade
<b>4</b>	Fourth Grade
<b>5</b>	Fifth Grade
<b>MS.PS</b>	Middle School Physical Science
<b>MS.LS</b>	Middle School Life Science
<b>MS.ESS</b>	Middle School Earth Science and Space
<b>BIO</b>	High School Biology
<b>ESS</b>	High School Earth and Space Science
<b>CHEM</b>	High School Chemistry
<b>PHYS</b>	High School Physics

Disciplinary Core Ideas	
<b>PS</b>	Physical Science
<b>LS</b>	Life Science
<b>ESS</b>	Earth Science and Space Science

#### What are NGSS Performance Expectations?

**K.PS.1-1:** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

**(NGSS-K-PS2-1)** → **NGSS Performance Expectations.**

**NGSS Performance Expectations** are references to the Next Generation Science Standards (NGSS) to help teachers find and use resources that are aligned to them.

**These are clarification statements on what students should be able to do to meet the standard.**

- *Determine* that pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.

## Śiceca Nakahañ Uñspewicakiyapi (Kindergarten)

Taku waunŕspeiçiciyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the Śiceca Nakahañ Uñspewicakiyapi standards include:

- Motion and Stability: Forces and Interactions
- Waves and Their Applications
- Energy
- From Molecules to Organisms: Structures and Processes
- Earth’s Systems
- Earth and Human Activity

### Key Vocabulary in Dakota and English

See Appendix One

### Physical Science: Forces and Interactions - Pushes and Pulls

#### K.PS.1: Force and Motion

**K.PS.1-1:** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. (NGSS-K-PS2-1)

- *Determine* that pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.
- *Determine* that when objects touch or collide, they push on one another and can change motion.

**K.PS.1-2:** 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. (NGSS-K-PS2-2)

#### K.PS.2: Wave Properties

**K.PS.2-1:** Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. (NGSS-1-PS4-1)

**K.PS.2-2:** Make observations to construct an evidence-based account that objects can be seen only when illuminated. (NGSS-1-PS4-2)

- *Determine* that objects can be seen if light is available to illuminate them or if they give off their own light.

**K.PS.2-3:** Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. (NGSS-1-PS4-3)

- *Determine* that 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.

### Life Science: Interdependent Relationships in Ecosystems - Animals, Plants and Their Environment

#### K.LS.1: Organization for Matter and Energy Flow in Organisms

**K.LS.1-1:** Use observations to describe patterns of what plants and animals (including humans) need to survive. (NGSS-K-LS1-1)

- *Explain* that all animals need food and water in order to live and grow and that they obtain their food from plants or from other animals. Plants need light and water to live and grow. Teaching a simple cycle of the interaction of plants and animals.

**K.LS.1-2:** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. (NGSS-K-ESS2-2)

- *Explain* that burrowing animals, building houses, stores, parking lots, etc. and plants invade the space they need.

**K.LS.1-3:** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. (NGSS-K-ESS3-1)

### **K.LS.2: Human Impacts on the Environment**

**K.LS.2-1:** Communicate solutions that will reduce the impact of humans on the land, water, air and/or other living things in the local environment. (NGSS-K-ESS3-3)

## Oadi Iwanji (Grade 1)

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the Oadi iwanji standards include:

- From Molecules to Organisms: Structures and Processes
- Heredity: Inheritance and Variation of Traits
- Earth’s Place in the Universe

### Key Vocabulary in Dakotah and English

See Appendix Two

### Life Science: Organisms - Structure, Function and Growth

#### 1.LS.1: Structure and Function

**1.LS.1-1:** Make observations to determine how plants and/or animals use their external parts to help them survive, grow and meet their needs. (NGSS-1-LS1-1)

- *Determine* that 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.
- *Know* that plants have different parts that help them survive and grow.

**1.LS.1-2:** Determine patterns in behavior of offspring and the responses of parents that help offspring survive. (NGSS-1-LS1-2)

- *Understand* that adult animals can have offspring and parents of the offspring can engage in behaviors that help the offspring to survive, such as feeding and comforting a crying child. Plants will protect seeds by having a shell on them. Some plants will have young remain attached until old enough to survive on its own.

#### 1.LS.2: Inheritance of Traits

**1.LS.2-1:** Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. (NGSS-1-LS3-1)

- *Determine* through observation how young animals and plants are very much, but not exactly, like their parents – example of a puppy looking like its parents but not being exactly like the parent.

### Earth Science: Space Systems - Patterns and Cycles

#### 1.ES.1: The Universe, Stars and Solar System

**1.ES.1-1:** Use observations of the sun, moon and stars to describe patterns that can be predicted. (NGSS-1-ESS1-1)

**1.ES.1-2:** Make observations of sunrise and sunset at different times of year to relate the amount of daylight to the season or time of year. (NGSS-1-ESS1-2)

## Earth Science: Weather and Climate

### 1.ES.2: Weather, Climate and Natural Hazards

**1.ES.2-1:** Make observations to determine the effect of sunlight on earth's surface. (NGSS-K-PS3-1)

**1.ES.2-2:** Use and share observations of local weather conditions to describe patterns over time. (NGSS-K-ESS2-1)

- *Understand* that weather is the combination of sunlight, wind, snow or rain and temperature in a particular region at a particular time and patterns can be recorded.

**1.ES.2-3:** Ask questions to obtain information about the purpose of weather forecasting to prepare for and respond to, severe weather. (NGSS-K-ESS3-2)

- *Determine* that some kinds of severe weather are more likely than others in a given region and severe weather can be forecasted so that the communities can prepare for and respond to these events.

## Oadi Inuᅇpa (Grade 2)

Taku waunᅇspeiᅇiciyapi hena sdodyapi yaciᅇ he?

### Overview

The Core Ideas of the Oadi Inuᅇpa standards include:

- Matter and Its Interactions
- Ecosystems: Interactions, Energy and Dynamics
- Biological Unity and Diversity
- Earth's History
- Earth's Systems

### Key Vocabulary in Dakota and English

See Appendix Three

### Physical Science: Structure and Properties of Matter

#### 2.PS.1: Structure and Properties of Matter

**2.PS.1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. (NGSS-2-PS1-1)

- *Determine* that different kinds of matter exist and many of them can be either solid or liquid, depending on temperature and have different observable properties.

**2.PS.1-2:** Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. (NGSS-2-PS1-4)

**2.PS.1-3:** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. (NGSS-2-PS1-2)

### Life Science: Interdependent Relationships in Ecosystems

#### 2.LS.1: Ecosystems and Biodiversity

**2.LS.1-1:** Conduct an investigation to determine if plants need sunlight and water to grow. (NGSS-2-LS2-1)

**2.LS.1-2:** Develop a simple model that mimics the function of an animal or insect in dispersing seeds or pollinating plants. (NGSS-2-LS2-2)

**2.LS.1-3:** Make observations of plants and animals to compare the diversity of life in different habitats. (NGSS-2-LS4-1)

### Earth Science: Earth's Systems - Processes that Shape the Earth

#### 2.ES.1: The History of Planet Earth

**2.ES.1-1:** Use information from several sources to provide evidence that earth events can occur quickly or slowly. (NGSS-2-ESS1-1)

**2.ES.1-2:** Make observations of wind and water changing the shape of the land. (NGSS-2-ESS2-1)

**2.ES.1-3:** Develop a model to represent the shapes and kinds of land and bodies of water in an area. (NGSS-2-ESS2-2)

**2.ES.1-4:** Identify where water is found on earth and that it can be solid, liquid or vapor. (NGSS-2-ESS2-3)

- *Determine* that water is found in the ocean, rivers, lakes and ponds. Water exists as solid ice, vapor and in liquid form.



## Oadi Iyamni (Grade 3)

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the Oadi Iyamni standards include:

- Motion and Stability: Forces and Interactions
- From Molecules to Organisms: Structures and Processes
- Ecosystems: Interactions, Energy and Dynamics
- Heredity: Inheritance and Variation of Traits
- Biological Unity and Diversity
- Earth's Systems
- Earth and Human Activity

### Key Vocabulary in Dakotah and English

See Appendix Four

### Physical Science: Forces and Interactions

#### 3.PS.1: Force and Motion

**3.PS.1-1:** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. (NGSS-3-PS2-1)

**3.PS.1-2:** Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. (NGSS-3-PS2-2)

- *Predict* if the toy car will take the same path each time it rolls down a ramp or on a track.

#### 3.PS.2: Types of Interactions

**3.PS.2-1:** Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. (NGSS-3-PS2-3)

- *Determine* that the sizes of the forces in each situation depends on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

**3.PS.2-2:** Define a simple design problem that can be solved by applying scientific ideas about magnets. (NGSS-3-PS2-4)

### Life Science: Inheritance and Variation of Traits - Life Cycles and Traits

#### 3.LS.1: Growth and Development of Organisms

**3.LS.1-1:** Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction and death. (NGSS-3-LS1-1)

**3.LS.1-2:** Construct an argument that some animals form groups that help members survive. (NGSS-3-LS2-1)

- *Determine* that 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.

### 3.LS.2: Inheritance and Variation of Traits

**3.LS.2-1:** 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. (NGSS-3-LS3-1)

**3.LS.2-2:** Use evidence to explain that traits can be influenced by the environment. (NGSS-3-LS3-2)

**3.LS.2-3:** 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. (NGSS-3-LS4-2)

### 3.LS.3: Structure and Function

**3.LS.3-1:** 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. (NGSS-3-LS4-3)

**3.LS.3-2:** 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. (NGSS-3-LS4-4)

- *Understand* that populations live in a variety of habitats and change in those habitats affects the organisms living there.

## Earth Science: Weather and Climate

### 3.ES.1: Weather, Climate and Natural Hazards

**3.ES.1-1:** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. (NGSS-3-ESS2-1)

- *Determine* that 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.

**3.ES.1-2:** Obtain and combine information to describe climates in different regions of the world. (NGSS-3-ESS2-2)

- *Determine* that climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

**3.ES.1-3:** Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard. (NGSS-3-ESS3-1)

- *Determine* that a variety of natural hazards result from natural processes and that humans cannot eliminate natural hazards but can take steps to reduce their impacts.

## Oadi Itopa (Grade 4)

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the Oadi Itopa standards include:

- Energy
- Transfer of Energy
- From Molecules to Organisms: Structures and Processes
- Earth's History
- Earth's Systems
- Earth and Human Activity

### Key Vocabulary in Dakota and English

See Appendix Five

### Physical Science: Energy

#### 4.PS.1: Definitions of Energy

**4.PS.1-1:** Use evidence to construct an explanation relating the speed of an object to the energy of that object. (NGSS-4-PS3-1)

- *Determine* the faster a given object is moving, the more energy it possesses.

**4.PS.1-2:** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat and electric currents. (NGSS-4-PS3-2)

#### 4.PS.2: Conservation of Energy and Energy Transfer

**4.PS.2-1:** Ask questions and predict outcomes about the changes in energy that occur when objects collide. (NGSS-4-PS3-3)

- *Determine* that when objects collide, energy can be transferred from one object to another, thereby changing their motion and that some energy is typically transferred to the surrounding air; as a result, the air gets heated and sound is produced.

**4.PS.2-2:** Apply scientific ideas to design, test and refine a device that converts energy from one form to another. (NGSS-4-PS3-4)

- *Determine* that energy can be transferred from one place to another by electric currents, which can then be used locally to produce motion, sound, heat or light.

**4.PS.2-3:** Describe that energy and fuels are derived from natural resources and that their uses affect the environment. (NGSS-4-ESS3-1)

### Life Science: Interdependent Relationships in Ecosystems

#### 4.LS.1: Ecosystem Dynamics, Functioning and Resilience

**4.LS.1-1:** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction. (NGSS-4-LS1-1)

**4.LS.1-2:** 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. (NGSS-4-LS1-2)

## Earth Science: Earth's Systems - Processes that Shape the Earth

### 4.ES.1: The History of Planet Earth

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

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

**4.ES.1-2:** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind or vegetation. (NGSS-4-ESS2-1)

### 4.ES.2: System Interactions

**4.ES.2-1:** Analyze and interpret data from maps to describe patterns of earth's features. (NGSS-4-ESS2-2)

- *Investigate* the locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes and volcanoes.
- *Determine* that these locations occur in patterns and maps can help locate the different land and water features of earth.

**4.ES.2-2:** Generate and compare multiple solutions to reduce the impacts of natural earth processes on humans. (NGSS-4-ESS3-2)

- *Understand* that a variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions) and humans cannot eliminate the hazards but can take steps to reduce their impacts.

## Oadi Izaptaŋ (Grade 5)

Taku waunŋspeiçiyapi hena sdodyapi yaciŋ he?

### Overview

The Core Ideas of the Oadi Izaptaŋ standards include:

- Matter and Its Interactions
- From Molecules to Organisms: Structures and Processes
- Ecosystems: Interactions, Energy and Dynamics
- Earth’s Place in the Universe
- Earth’s Systems
- Earth and Human Activity

### Key Vocabulary in Dakota and English

See Appendix Six

### Physical Science: Structure and Properties of Matter

#### 5.PS.1: Structure and Properties of Matter

**5.PS.1-1:** Develop a model to describe that matter is made of particles too small to be seen. (NGSS-5-PS1-1)

- *Understand* that matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means.

**5.PS.1-2:** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling or mixing substances, the total weight of matter is conserved. (NGSS-5-PS1-2)

**5.PS.1-3:** Make observations and measurements to identify materials based on their properties. (NGSS-5-PS1-3)

#### 5.PS.2: Chemical Reactions

**5.PS.2-1:** Conduct an investigation to determine whether the mixing of two or more substances will result in new substances. (NGSS-5-PS1-4)

### Life Science: Matter and Energy in Organisms and Ecosystems

#### 5.LS.1: Matter and Energy Flow and Relationships in Ecosystems

**5.LS.1-1:** Use models to describe that energy in animals’ food (used for body repair, growth, motion and to maintain body warmth) was once energy from the sun. (NGSS-5-PS3-1)

**5.LS.1-2:** Support an argument that plants get the materials they need for growth chiefly from air and water. (NGSS-5-LS1-1)

**5.LS.1-3:** Develop a model to describe the movement of matter among plants, animals, decomposers and the environment. (NGSS-5-LS2-1)

- *Determine* that matter cycles between the air and soil and among plants, animals and microbes as these organisms live and die.

## Earth Science: Earth's Systems

### 5.ES.1: Earth Materials and System

**5.ES.1-1:** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere and/or atmosphere interact. (NGSS-5-ESS2-1)

- *Understand* that these systems interact in multiple ways to affect earth's surface materials and processes.

**5.ES.1-2:** Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on earth. (NGSS-5-ESS2-2)

- *Determine* that 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.ES.1-3:** Obtain and combine information about ways individual communities use science ideas to protect the earth's resources and environment. (NGSS-5-ESS3-1)

- *Determine* that human activities in agriculture, industry and everyday life have had major effects on the land, vegetation, streams, ocean, air and even outer space and that individuals and communities are doing things to help protect earth's resources and environments.

## Earth Science: Space Systems - Stars and the Solar System

### 5.ES.2: Stars and Our Solar System

**5.ES.2-1:** Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from earth. (NGSS-5-ESS1-1)

**5.ES.2-2:** 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. (NGSS-5-ESS1-2)

## Middle School Physical Science

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the Middle School Physical Science standards include:

- From Molecules to Organisms: Structures and Processes
- Matter and Its Interactions
- Motion and Stability: Forces and Interactions
- Energy
- Waves and Their Application in Technologies for Information Transfer
- Earth's Place in the Universe

### Key Vocabulary in Dakota and English

See Appendix Seven

### Physical Science: Matter and Its Interactions

#### MS.PS.1: Structures and Properties of Matter

**MS.PS.1-1:** Develop models to describe the atomic composition of simple molecules and extended structures. (NGSS-MS-PS1-1)

- *Understand* that substances are made of different types of atoms which combine with one another in various ways.

**MS.PS.1-2:** 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. (NGSS-MS-PS1-4)

- *Determine* that, in a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.

**MS.PS.1-3:** Design, construct and test a device that either minimizes or maximizes thermal energy transfer. (NGSS-MS-PS3-3)

- *Predict* that the relationship between the temperature and the total energy of a system depends on the types, states and amounts of matter present.

**MS.PS.1-4:** Obtain and evaluate information to describe that synthetic materials come from natural resources and impact society. (NGSS-MS-PS1-3)

- *Describe* how some substances are made of natural resources that undergo a chemical process to form the synthetic material that we use daily.

### Physical Science: Forces, Interactions and Energy

#### MS.PS.2: Types of Interactions

**MS.PS.2-1:** Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. (NGSS-MS-PS2-3)

- *Predict* behavior of electromagnetic forces based on the magnitudes of the charges, currents or magnetic strengths involved and on the distances between the interacting objects.

**MS.PS.2-2:** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects not in contact exert forces on each other. (NGSS-MS-PS2-5)

- *Demonstrate* that forces that act at a distance (electric, magnetic, gravitational) can be explained by fields that extend through space and can be mapped by their effect on an object.

### MS.PS.3: Energy

**MS.PS.3-1:** Construct and analyze graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. (NGSS-MS-PS3-1)

- *Explain* that motion energy (kinetic energy) is proportional to the mass of the moving object and grows with the square of its speed.

**MS.PS.3-2:** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. (NGSS-MS-PS3-2)

## Physical Science: Waves and Electromagnetic Radiation

### MS.PS.4: Wave Properties

**MS.PS.4-1:** 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. (NGSS-MS-PS4-1)

**MS.PS.4-2:** Develop and use a model to describe how waves are reflected, absorbed or transmitted through various materials. (NGSS-MS-PS4-2)

- *Differentiate* between the characteristics of matter waves (ex: sound or wave) and light waves.

**MS.PS.4-3:** Obtain, evaluate and communicate information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. (NGSS-MS-PS4-3)

## Physical Science: Matter and Its Interactions

### MS.PS.5: Structures and Properties of Matter

**MS.PS.5-1:** Introduce the periodic table and its uses, for example the use of atomic numbers, the symbols, the arrangement, etc.

**MS.PS.5-2:** Develop models to describe the atomic composition of simple molecules and extended structures. (NGSS-MS-PS1-1)

- *Compare* different types of atoms (pure substances) by their chemical and physical properties and how they can be combined together.

**MS.PS.5-3:** 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. (NGSS-MS-PS1-4)



- *Demonstrate* changes in the molecules of solids, liquids and gases when there is a change in temperature or pressure.

### MS.PS.6: Chemical Reactions

**MS.PS.6-1:** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. (NGSS-MS-PS1-2)

**MS.PS.6-2:** 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. (NGSS-MS-PS1-5)

**MS.PS.6-3:** Design, construct, test and modify a device that either releases or absorbs thermal energy by chemical processes. (NGSS-MS-PS1-6)

- *Demonstrate* that some chemical reactions release energy, others store energy.

**MS.PS.6-4:** Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. (NGSS-MS-PS2-4)

### Physical Science: Forces, Interactions and Energy

#### MS.PS.7: Forces and Motion

**MS.PS.7-1:** Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. (NGSS-MS-PS2-1)

- *Demonstrate* that for any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).

**MS.PS.7-2:** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. (NGSS-MS-PS2-2)

**MS.PS.7-3:** Construct and analyze graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. (NGSS-MS-PS3-1)

- *Calculate* and *graph* that motion energy (kinetic energy) is proportional to the mass of the moving object and grows with the square of its speed.

**MS.PS.7-4:** Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. (NGSS-MS-PS2-4)

## Middle School Life Science

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the Middle School Life Science standards include:

- From Molecules to Organisms: Structures and Processes
- Ecosystems: Interactions, Energy and Dynamics
- Hereditary: Inheritance and Variations of Traits
- Biological Unity and Diversity

### Key Vocabulary in Dakotah and English

See Appendix Eight

### Life Science: Structures and Processes

#### MS.LS.1: Structures and Functions

**MS.LS.1-1:** Plan and carry out an investigation to provide evidence that living things are made of cells; either one cell or many different types and numbers of cells. (NGSS-MS-LS1-1)

- *Recognize* all living things are made up of cells.
- *Compare* unicellular and multicellular organisms.

**MS.LS.1-2:** Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. (NGSS-MS-LS1-2)

- *Describe* the cellular structures are responsible for particular functions within a cell.

**MS.LS.1-3:** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. (NGSS-MS-LS1-8)

- *Describe* how sense receptors respond to different inputs (electromagnetic, mechanical, chemical), resulting in immediate behaviors or memories.

**MS.LS.1-4:** Construct an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. (NGSS-MS-LS1-3)

- *Categorize* cells, tissues and functions into subsystems of the body.
- *Describe* the organizational flow of cells to tissues to organs to organ systems to organism.

### Life Science: Ecosystems - Energy, Interactions and Dynamics

#### MS.LS.2: Cycles of Matter and Energy Transfer in Ecosystems

**MS.LS.2-1:** 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. (NGSS-MS-LS1-6)

- *Explain* the process by which organisms use energy from light to make sugars used for growth.

**MS.LS.2-2:** Develop a model to describe how food molecules are broken down and rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. (NGSS-MS-LS1-7)

- *Summarize* a series of chemical reactions that break down food and transform it into useable products for growth or to release energy, including cellular respiration in plants and animals.

**MS.LS.2-3:** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (NGSS-MS-LS2-3)

- *Utilize* food webs and energy pyramids to model how matter and energy are transferred in and out of ecosystems through interactions.

### **MS.LS.3: Interdependent Relationships and Interactions in Ecosystems**

**MS.LS.3-1:** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (NGSS-MS-LS2-1)

- *Demonstrate* interactions between living and nonliving factors in an environment and *evaluate* how that impacts competition, growth and reproduction.

**MS.LS.3-2:** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. (NGSS-MS-LS2-2)

- *Describe* a variety of interactions among organisms and *predict* their impacts to ecosystems.

**MS.LS.3-3:** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. (NGSS-MS-LS2-4)

- *Predict* how disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.

**MS.LS.3-4:** Evaluate competing design solutions for maintaining biodiversity and ecosystem services. (NGSS-MS-LS2-5)

- *Evaluate* how biodiversity is connected to the health of an ecosystem.
- *Predict* how changes in biodiversity can impact humans' resources such as food, energy and medicines.
- *Predict* how human impact on biodiversity can impact humans' resources such as food, energy and medicines.

## **Life Science: Growth, Development and Reproduction**

### **MS.LS.4: Growth and Development of Organisms**

**MS.LS.4-1:** Construct an argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. (NGSS-MS-LS1-4)

- *Predict* probability of inheritance of traits using Punnett squares.

**MS.LS.4-2:** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the traits and growth of organisms. (NGSS-MS-LS1-5)

## MS.LS.5: Inheritance of Traits

**MS.LS.5-1:** 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. (NGSS-MS-LS3-1)

- *Demonstrate* that genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes that control the traits of the individual and genetic information can be altered because of mutations.
- *Demonstrate* an understanding of what Genetically Modified Organisms (GMO's) are and where they exist.

**MS.LS.5-2:** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. (NGSS-MS-LS1-5)

- *Demonstrate* that genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes that control the traits of the individual and genetic information can be altered because of mutations.
- *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 outcomes.

**MS.LS.5-3:** Develop a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. (NGSS-MS-LS3-2)

## Life Science: Natural Selection and Adaptations

### MS.LS.6: Ancestry and Diversity

**MS.LS.6-1:** 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. (NGSS-MS-LS4-1)

- *Explain* scientific evidence used to place fossils in chronologic order in the fossil record.

**MS.LS.6-2:** Apply scientific ideas to construct an explanation for similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. (NGSS-MS-LS4-2)

- *Access* anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record to reconstruction of evolutionary history and make inferences of lines of evolutionary descent.

**MS.LS.6-3:** Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. (NGSS-MS-LS4-3)

## Middle School Earth Science and Space

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the Middle School Earth Science and Space standards include:

- Matter and Its Interactions
- Ecosystems: Interactions, Energy and Dynamics
- Motion and Stability: Forces and Interactions
- Energy Transfer
- Earth’s Place in the Universe
- Earth’s Systems
- Earth and Human Activity
- Hereditary: Inheritance and Variations of Traits
- Biological Unity and Diversity

### Key Vocabulary in Dakota and English

See Appendix Nine

### Earth Science: Earth Systems

#### MS.ESS.1: The History of Planet Earth

**MS.ESS.1-1:** 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. (NGSS-MS-ESS1-4)

**MS.ESS.1-2:** Construct an explanation based on evidence for how geoscience processes have changed earth’s surface at varying time and spatial scales. (NGSS-MS-ESS2-2)

**MS.ESS.1-3:** Analyze and interpret data on the age of the earth, distribution of fossils and rocks, continental shapes and seafloor structures to provide evidence of the past plate motions. (NGSS-MS-ESS2-3)

- *Demonstrate* that tectonic processes and investigations of rocks and fossils make clear how earth’s plates have moved great distances, collided and spread apart.

#### MS.ESS.2: Earth’s Materials and Systems

**MS.ESS.2-1:** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (NGSS-MS-ESS3-2)

- *Explain* how mapping the history of natural hazards in a region and understanding of related geologic forces can help forecast the locations and likelihoods of future events.

**MS.ESS.2-2:** 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. (NGSS-MS-ESS3-1)

- *Relate* human dependence on earth’s land, ocean, atmosphere and biosphere for different resources that are distributed unevenly on the planet as a result of geologic processes.

## Earth Science: Space Systems

### MS.ESS.3: Earth's Place in the Universe

**MS.ESS.3-1:** Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. (NGSS-MS-ESS1-2)

- *Relate* the position of the earth and its solar system to the Milky Way galaxy, which is one of many galaxies in the universe.

### MS.ESS.4: Earth and the Solar System

**MS.ESS.4-1:** 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. (NGSS-MS-ESS1-1)

- *Predict* and *explain* patterns of the apparent motion of the sun, the moon and stars in the sky.

**MS.ESS.4-2:** Analyze and interpret data to determine scale properties of objects in 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. (NGSS-MS-ESS1-3)

## Earth Science and Space: Weather and Climate

### MS.ESS.5: Water, Weather and Climate

**MS.ESS.5-1:** Develop a model to describe the cycling of water through earth's systems driven by energy from the sun and the force of gravity. (NGSS-MS-ESS2-4)

**MS.ESS.5-2:** Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. (NGSS-MS-ESS2-5)

**MS.ESS.5-3:** 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. (NGSS-MS-ESS2-6)

### MS.ESS.6: Human Impacts

**MS.ESS.6-1:** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (NGSS-MS-ESS3-2)

**MS.ESS.6-2:** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (NGSS-MS-ESS3-3)

**MS.ESS.6-3:** Construct an argument supported by evidence for how increases in human population per-capita consumption of natural resources impact Earth's systems. (NGSS-MS-ESS3-4)

- *Explain* the factors that may have caused a change global temperatures over the past century.

## High School Biology

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the High School Biology standards include:

- From Molecules to Organisms: Structures and Processes
- Ecosystems: Interactions, Energy and Dynamics
- Hereditary: Inheritance and Variation of Traits
- Biological Unity and Diversity

### Key Vocabulary in Dakotah and English

See Appendix Ten

### Structure and Processes

#### BIO.1: Structure and Function

**BIO.1-1:** 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. (NGSS-HS-LS1-1)

**BIO.1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. (NGSS-HS-LS1-2)

**BIO.1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. (NGSS-HS-LS1-3)

- *Describe* how positive and negative feedback mechanisms can influence internal conditions and behaviors even as external conditions change within some range.

**BIO.1-4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. (NGSS-HS-LS1-4)

**BIO.1-5:** Construct and revise an explanation based on evidence for how carbon, hydrogen and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. (NGSS-HS-LS1-6)

- *Explain* how hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA).

### Ecosystems: Interactions, Energy and Dynamics

#### BIO.2: Interdependent Relationships in Ecosystems

**BIO.2-1:** Use mathematical and/or computational representations to support explanations of living and non-living factors that affect carrying capacity of ecosystems at different scales. (NGSS-HS-LS2-1)

**BIO.2-2:** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. (NGSS-HS-LS2-2)

#### BIO.3: Cycles of Matter and Energy Transfer in Ecosystems

**BIO.3-1:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic condition. (NGSS-HS-LS2-3)

- *Explain* the process of photosynthesis and cellular respiration (including anaerobic processes) and *understand* how they provide most of the energy for life processes.

**BIO.3-2:** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. (NGSS-HS-LS2-4)

**BIO.3-3:** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere and geosphere. (NGSS-HS-LS2-5)

#### **BIO.4: Ecosystem Dynamics, Functioning and Resilience**

**BIO.4-1:** Evaluate 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. (NGSS-HS-LS2-6)

**BIO.4-2:** Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity by increasing speciation and reducing the loss of species (extinction). (NGSS-HS-LS2-7)

**BIO.4-3:** Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce. (NGSS-HS-LS2-8)

### **Heredity: Inheritance and Variation of Traits**

#### **BIO.5: Inheritance of Traits**

**BIO.5-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. (NGSS-HS-LS3-1)

- *Understand* that all cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways.

#### **BIO.6: Variation of Traits**

**BIO.6-1:** Make and defend a claim based on evidence that inheritable genetic variations may result from new genetic combinations through meiosis, viable errors occurring during replication and/or mutations caused by environmental factors. (NGSS-HS-LS3-2)

**BIO.6-2:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. (NGSS-HS-LS3-3)

- *Understand* that the variation and distribution of traits observed depends on both genetic and environmental factors.

### **Biological Evolution: Unity and Diversity**

#### **BIO.7: Evidence of Common Ancestry and Diversity**

**BIO.7-1:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. (NGSS-HS-LS4-1)



## BIO.8: Natural Selection and Adaptations

**BIO.8-1:** Construct an explanation that the process of evolution primarily results from four factors: the potential for a species to increase in number, the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, competition for limited resources and the proliferation of those organisms that are better able to survive/reproduce in the environment. (NGSS-HS-LS4-2)

**BIO.8-2:** Apply statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. (NGSS-HS-LS4-3)

**BIO.8-3:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. (NGSS-HS-LS4-4)

- *Connect* that 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.

**BIO.8-4:** 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. (NGSS-HS-LS4-5)

## High School Earth and Space Science

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the High School Earth and Space Science standards include:

- Earth's Place in the Universe
- Earth's Systems
- Earth and Human Activity

### Key Vocabulary in Dakota and English

See Appendix Eleven

### Earth's Place in the Universe

#### ESS.1: The Universe and Its Stars

**ESS.1-1:** Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches earth in the form of radiation. (NGSS-HS-ESS1-1)

**ESS.1-2:** Communicate scientific ideas about the way stars, over their life cycle, produce elements. (NGSS-HS-ESS1-3)

- *Explain* how the stars' light spectra and brightness is used to identify compositional elements of stars, their movements and their distances from earth.

**ESS.1-3:** Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies and composition of matter in the universe. (NGSS-HS-ESS1-2)

#### ESS.2: Earth and the Solar System

**ESS.2-1:** Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. (NGSS-HS-ESS1-4)

- *Utilize* Kepler's laws to describe common features of the motions of orbiting objects, including their elliptical paths around the sun and that orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.

**ESS.2-2:** 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. (NGSS-HS-ESS1-6)

### Earth's Systems

#### ESS.3: Plate Tectonics and Large-Scale System Interactions

**ESS.3-1:** 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. (NGSS-HS-ESS1-5)

**ESS.3-2:** Develop a model based on evidence of earth's interior to describe the cycling of matter by thermal convection. (NGSS-HS-ESS2-3)

- *Cite evidence* from deep probes and seismic waves for the historical changes in earth's surface and its magnetic field.
- *Understand* that 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.

**ESS.3-3:** 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. (NGSS-HS-ESS2-1)

- *Explain* plate tectonics as 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.

**ESS.3-4:** Analyze geoscience data to make the claim that one change to earth's surface can create feedbacks that cause changes to other earth systems. (NGSS-HS-ESS2-2)

#### **ESS.4: The Roles of Water in Earth's Surface Processes**

**ESS.4-1:** Plan and conduct an investigation of the properties of water and its effects on earth materials and surface processes. (NGSS-HS-ESS2-5)

- *Explain* the unique combination of physical and chemical properties of water that are central to the planet's dynamics.

#### **ESS.5: Weather and Climate**

**ESS.5-1:** Use a model to describe how variations in the flow of energy into and out of earth's systems result in changes in climate. (NGSS-HS-ESS2-4)

- *Describe* how 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 influence the earth's climate system.

**ESS.5-2:** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere and biosphere. (NGSS-HS-ESS2-6)

- *Differentiate* between the gradual atmospheric changes were due to plants and other organisms that capture carbon dioxide and release oxygen and the changes in the atmosphere due to human activity that have increased carbon dioxide concentrations and thus affect climate.

**ESS.5-3:** 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's systems. (NGSS-HS-ESS3-5)

#### **ESS.6: Biogeology**

**ESS.6-1:** Construct an argument based on evidence about the simultaneous coevolution of earth's systems and life on earth. (NGSS-HS-ESS2-7)

- *Describe* the many dynamic and delicate feedbacks between the biosphere and other earth systems cause a continual co-evolution of earth's surface and the life that exists on it.

## Earth and Human Activity

### ESS.7: Natural Resources

**ESS.7-1:** 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. (NGSS-HS-ESS3-1)

**ESS.7-2:** Evaluate competing design solutions for developing, managing and utilizing energy and mineral resources based on cost-benefit ratios. (NGSS-HS-ESS3-2)

- *Understand* the associated economic, social, environmental and geopolitical costs and risks as well as benefits of energy production and resource extraction and the impact of new technologies and social regulations on the balance of these factors.

### ESS.8: Human Impacts on Earth System

**ESS.8-1:** Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations and biodiversity. (NGSS-HS-ESS3-3)

**ESS.8-2:** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. (NGSS-HS-ESS3-4)

- *Understand* new technologies that produce less pollution and waste and that preclude ecosystem degradation.

**ESS.8-3:** Use a computational representation to illustrate the relationships among earth systems and how those relationships are being modified due to human activity. (NGSS-HS-ESS3-6)

- *Evaluate* computer simulations and other studies and understand important discoveries are still being made about how the ocean, the atmosphere and the biosphere interact and are modified in response to human activities.

## High School Okpaṅna Wouṅspe (Chemistry)

Taku waṅspeiṅiyapi hena sdodyapi yaciṅ he?

### Overview

The Core Ideas of the High School Okpaṅna Wouṅspe standards include:

- Matter and Its Interactions
- Energy

### Key Vocabulary in Dakotah and English

See Appendix Twelve

### Matter and Its Interactions

#### CHEM.1: Structure and Properties of Matter

**CHEM.1-1:** 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. (NGSS-HS-PS1-1)

- *Understand* the structure of the parts of an atom and the organization of the periodic table based on the atomic structure and how that influences interactions.

**CHEM.1-2:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. (NGSS-HS-PS1-3)

- *Know* the 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.

**CHEM.1-3:** 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. (NGSS-HS-PS1-4)

#### CHEM.2: Chemical Reactions

**CHEM.2-1:** Construct and revise 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. (NGSS-HS-PS1-2)

**CHEM.2-2:** Apply scientific principles and evidence to explain the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. (NGSS-HS-PS1-5)

**CHEM.2-3:** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. (NGSS-HS-PS1-6)

**CHEM.2-4:** Use mathematical representations to support the claim that atoms and therefore mass, are conserved during a chemical reaction. (NGSS-HS-PS1-7)

- *Describe* and *predict* chemical reactions based on the fact that atoms are conserved and the knowledge of the chemical properties of the elements involved.

### CHEM.3: Nuclear Processes

**CHEM.3-1:** 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. (NGSS-HS-PS1-8)

### Forces and Interactions

#### CHEM.4: Energy

**CHEM.4-1:** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. (NGSS-HS-PS3-1)

- *Understand* that energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system and the fact that it is conserved.

**CHEM.4-2:** 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 (second law of thermodynamics). (NGSS-HS-PS3-4)

**CHEM.4-3:** Design, build and refine a device that works within given constraints to convert one form of energy into another form of energy. (NGSS-HS-PS3-3)

### From Molecules to Organisms: Structures and Processes

#### CHEM.5: Organization for Matter and Energy Flow in Organisms

**CHEM.5-1:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. (NGSS-HS-LS1-5)

**CHEM.5-2:** 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. (NGSS-HS-LS1-7)

## High School Physics

Taku waun̄speičiyapi hena sdodyapi yaciñ he?

### Overview

The Core Ideas of the High School Physics standards include:

- Motion and Stability: Forces and Interactions
- Energy
- Waves and Their Application in Technologies for Information Transfer

### Key Vocabulary in Dakotah and English

See Appendix Thirteen

### Motion and Stability: Forces and Interactions

#### PHYS.1: Forces and Motion

**PHYS.1-1:** 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. (NGSS-HS-PS2-1)

**PHYS.1-2:** 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. (NGSS-HS-PS2-2)

**PHYS.1-3:** Apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision. (NGSS-HS-PS2-3)

- *Understand* that if a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.

#### PHYS.2: Types of Interactions

**PHYS.2-1:** Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects. (NGSS-HS-PS2-4)

**PHYS.2-2:** 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. (NGSS-HS-PS2-5)

- *Understand* forces at a distance are explained by fields (gravitational, electric and magnetic) permeating space that can transfer energy through space.

**PHYS.2-3:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. (NGSS-HS-PS2-6)

- *Describe* how the 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.

### PHYS.3: Energy and Forces

**PHYS.3-1:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects). (NGSS-HS-PS3-2)

**PHYS.3-2:** 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. (NGSS-HS-PS3-5)

- *Understand* that when two objects interacting through a field change relative position, the energy stored in the field is changed.

### Waves and Their Applications in Technologies for Information Transfer

#### PHYS.4: Wave Properties

**PHYS.4-1:** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength and speed of waves traveling in various media. (NGSS-HS-PS4-1)

- *Know* 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.

**PHYS.4-2:** Evaluate questions about the advantages of using digital transmission and storage of information. (NGSS-HS-PS4-2)

- *Understand* that information can be digitized, stored reliably in computer memory and sent over long distances as a series of wave pulses.

#### PHYS.5: Electromagnetic Radiation

**PHYS.5-1:** Evaluate the claims, evidence and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model and that for some situations one model is more useful than the other. (NGSS-HS-PS4-3)

**PHYS.5-2:** Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. (NGSS-HS-PS4-4)

- *Differentiate* between when light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat) and shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.

**PHYS.5-3:** 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. (NGSS-HS-PS4-5)

- *Describe* multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications and scanners) and in scientific research.



## **Appendices - Key Vocabulary**

## Appendix One - Šiceca Nakahañ Uñspewicakiyapi (Kindergarten)

Dakotah	English
	1. Air
Iyececa	2. Alike
Wamanica	3. Animal
Añpetu	4. Day
Tokeca	5. Different
Maka	6. Earth
	7. Energy
	8. Gas
Kadya (verb) Okate (noun)	9. Heat
Iyoaŋpa	10. Light
Mni iyececa	11. Liquid
Nipi, Ni	12. Living
Mazawiyutitaŋ	13. Magnet
	14. Matter
Haŋwi, (Haŋyetu Wi - is the proper name that is rarely used)	15. Moon
Haŋyetu	16. Night
Niuŋ šni	17. Nonliving
Iwaŋyaka	18. Observe
Wato	19. Plant
Yutitaŋ	20. Pulling
Patitaŋ	21. Pushing
Su	22. Seed
Ohaŋzi	23. Shadow
Maŋpiya	24. Sky
	25. Solid
Hotuŋ	26. Sound
Wicaŋhpi	27. Star
Wi	28. Sun
Wi uŋ iyutapi, Kad iyutapi	29. Thermometer
Añpetu tokeca	30. Weather

## Appendix Two - Oadi Iwanji (Grade 1)

Dakotah	English
Aspeya	1. Balance
	2. Energy
Pusaya	3. Evaporation
	4. Food chain
Iyopaštake	5. Force
	6. Gas
Maka woiyutitaŋ	7. Gravity
Oeti	8. Habitat
Kadya (verb), Okate (noun)	9. Heat
	10. Life cycle
Iyoyaŋpa	11. Light
Mni iyececa	12. Liquid
Niuŋ	13. Living
	14. Mass
	15. Matter
Niuŋ šni	16. Nonliving
Wicaŋhpi omani	17. Planet
Itokab oyake	18. Predict
Ake taku uŋ, Aktakta taku uŋ	19. Recycle
Woyuha	20. Resource
Iŋyaŋ	21. Rock
Omaka	22. Season
Ohaŋzi	23. Shadow
Maka	24. Soil
	25. Solid
Hotuŋ	26. Sound
Duzahaŋ	27. Speed
Wi iyutapi	28. Temperature
Caŋcaŋ?	29. Vibrate
	30. Volume

## Appendix Three - Oadi Inunpa (Grade 2)

Dakotah	English
	1. Amphibian
Iyutaŋya	2. Attract
	3. Axis
Zitkaŋna	4. Bird
	5. Consumer
	6. Energy
Taku oksaŋ	7. Environment
Sdodyapi kta uŋ ecunpi	8. Experiment
Hoŋaŋ	9. Fish
	10. Food web
Iyopaŋtake	11. Force
	12. Friction
Makawoiyutitaŋ	13. Gravity
	14. Life cycle
	15. Mammal
	16. Mass
	17. Matter
Icahitunpi	18. Mixture
	19. Moon phase
Škaŋ	20. Motion
Yušicapi	21. Pollution
Wawiyahpaye	22. Predator
	23. Prey
	24. Producer
	25. Reflect
Akoiyaya	26. Repel
	27. Reptile
	28. Rotation
Taku owas wi ahomniya	29. Solar system
Caŋcaŋ	30. Vibrate

## Appendix Four - Oadi Iyamni (Grade 3)

Dakotah	English
	1. Adaptation
	2. Axis
Tado eceena yutapi	3. Carnivore
Tiošpaye	4. Community
	5. Condensation
	6. Consumer
	7. Decomposer
	8. Ecosystem
Okšan	9. Environment
	10. Equator
	11. Erosion
Pusaya	12. Evaporation
Sdodyapi kta uŋ ecunpi	13. Experiment
Wato eceena yutapi	14. Herbivore
Toketu odepi	15. Investigation
	16. Kinetic energy
	17. Magnetism (magnetic)
Taku icahiya	18. Mixture
	19. Nonrenewable resource
Oyate wicayawapi	20. Population
	21. Potential energy
	22. Producer
	23. Renewable resource
	24. Revolution
	25. Rotation
Taku owas wi ahomniya	26. Solar system
	27. Solution
	28. System
	29. Water cycle
	30. Weathering

## Appendix Five - Oadi Itopa (Grade 4)

Dakotah	English
	1. Atmosphere
	2. Chemical change
	3. Conservation
	4. Constellation
	5. Density
	6. Deposition
Maka caṇcaṇ	7. Earthquake
Iṇyaṇhuhu	8. Fossil
	9. Fulcrum
	10. Galaxy
Woiyukcaṇ	11. Hypothesis
	12. Igneous rock
	13. Inclined plane
	14. Lever
	15. Magnetic
	16. Metamorphic rock
	17. Microscopic
	18. Physical change
	19. Protist
	20. Pulley
	21. Reflection
	22. Refraction
	23. Revolution
	24. Rotation
	25. Scientific method
	26. Sedimentary rock
	27. Universe
	28. Variable
Paha Ide	29. Volcano
	30. Wheel and axle

## Appendix Six - Oadi Izaptan (Grade 5)

Dakotah	English
	1. Atom
Uñ yutokca	2. Change of state
	3. Compound
	4. Conduction
	5. Convection
	6. Deposition
	7. Ecosystem
	8. Element
	9. Energy pyramid
	10. Energy transfer
	11. Erosion
	12. Gravitation
Woiyukcañ	13. Hypothesis
	14. Igneous rock
	15. Inertia
	16. Invertebrate
	17. Kinetic energy
	18. Metamorphic rock
	19. Nonrenewable resource
	20. Photosynthesis
	21. Potential energy
	22. Radiation
	23. Renewable resource
	24. Scientific method
	25. Sedimentary rock
	26. Tissue
	27. Topographical map (topography)
	28. Variable
	29. Vertebrate
	30. Weathering

## Appendix Seven - MS Physical Science

Dakotah	English
	1. Acceleration
	2. Amplitude
	3. Calorie
	4. Circuit
	5. Conduction
	6. Conservation of energy
	7. Convection
	8. Crest
	9. Dependent variable
	10. Deposition
	11. Electromagnetic radiation
	12. Electron
	13. Entropy
	14. Experimental control
Iyopaštake	15. Force
	16. Frequency
	17. Gravitational force
	18. Heat transfer
Woiyukcaŋ	19. Hypothesis
	20. Independent variable
	21. Inertia
Woope	22. Law
	23. Magnetic field
	24. Mass
	25. Neutron
	26. Pressure
	27. Proton
	28. Scientific method
Duzahaŋ	29. Speed
	30. Theory
	31. Thermal energy
	32. Trough
	33. Variable
	34. Velocity
	35. Volume
	36. Wavelength
Tke	37. Weight



## Appendix Eight - MS Life Science

Dakotah	English
	1. Abiotic
	2. Adaptation
	3. Allele
	4. Asexual reproduction
	5. Biodiversity
	6. Biotic
	7. Carbon cycle
	8. Cell theory
	9. Climate
	10. Dominance
	11. Ecosystem
	12. Entropy
	13. Gene
	14. Heterozygous
	15. Homozygous
Woiyukcaŋ	16. Hypothesis
Woope	17. Law
	18. Mass
	19. Meiosis
	20. Mitosis
	21. Nucleus
	22. Punnett square
	23. Recessive
	24. Sexual reproduction
	25. Tropism
	26. Virus

## Appendix Nine - MS Earth Science

Dakotah	English
	1. Atmosphere
	2. Chemical weathering
	3. Comet
	4. Convection
	5. Crust
	6. Erosion
	7. Fossil fuel
	8. Imagery
	9. Instrumentation
	10. Mantle
Wakaŋwoŋpa	11. Meteor
	12. Neap tide
	13. Ocean basin
	14. Physical weathering
Wicaŋŋpi omani	15. Planet
	16. Plate tectonics
	17. Satellites
	18. Sedimentation
	19. Seismic wave
	20. Spring tide
Wicaŋŋpi	21. Star
Aŋpetu tokeca	22. Weather

## Appendix Ten - HS Biology

Dakotah	English
	1. Accuracy
	2. Activation energy
	3. Adaptation
	4. Amino acids
	5. Catalyst
	6. Cell membrane
	7. Cell theory
	8. Cellular respiration
	9. Classification
	10. Consumer
	11. Diversity
	12. DNA
	13. Energy pyramid
	14. Flow of energy
	15. Genetic variation
	16. Genotype
	17. Half-life
	18. Meiosis
	19. Membrane
	20. Mitosis
	21. Mutation
	22. Natural selection
	23. Organic matter
	24. Permeability
	25. Phenotype
	26. Photosynthesis
	27. Precision
Wawiyahpaye	28. Predator
	29. Prey
	30. Producer
	31. Protein
	32. Protein synthesis
	33. Rate of reaction
	34. Reproduction
Wamanica obe	35. Species
	36. Stimulus

## Appendix Eleven - HS Earth and Space

Dakotah	English
	1. Adhesion
	2. Aquafer
	3. Big Bang Theory
	4. Biodiversity
	5. Black hole
	6. Collation
	7. Comets
	8. Continental drift
	9. Convection
	10. Convection currents
	11. Convergent boundary
	12. Divergent boundary
	13. Eclipse
	14. Electromagnetic radiation
	15. Elliptical orbit
	16. Extractions
	17. Fault
	18. Galaxy
	19. Geologic time scale
Kepler Tawoope	20. Kepler's law
Wakanwohpa	21. Meteor
	22. Meteorites
Nagi Ocaŋku	23. Milky Way
	24. Mineral resources
	25. Neutron star
	26. Nova
	27. Nebula
	28. Nuclear fusion
Aohomni	29. Orbit (in a circular pattern)
Maŋpiya sitomni	30. Outer space
	31. Planetary motion
Wicaŋhpi omani	32. Planets
	33. Plate tectonics
	34. Red shift
	35. Revolution
	36. Rotation
	37. Seafloor spreading
Taku owas wi ahomniya	38. Solar system
	39. Spring tide
	40. Star spectra
	41. Subduction zone

	42. Super nova
	43. Sustainability
	44. Thermal convection
	45. Water table
	46. White dwarf

## Appendix Twelve - HS Chemistry

Dakotah	English
	1. Acid
	2. Activation energy
	3. Atomic theory
	4. Base
	5. Catalyst
	6. Chemical bond
	7. Concentration
	8. Conservation of mass
	9. Covalent bond
	10. Electron configuration
	11. Element
	12. Entropy
	13. Equilibrium
	14. Heat of fusion
	15. Heat of vaporization
	16. Ion
	17. Isotope
	18. Mass
	19. Mass number
	20. Matter
	21. Molecule
	22. Periodic table
	23. pH
	24. Product
	25. Qualitative
	26. Quantitative
	27. Rate of reaction
	28. Reactant
	29. Solubility
	30. Stoichiometry

## Appendix Thirteen - HS Physics

Dakotah	English
Yuohaŋko iyaya	1. Acceleration
	2. Activation energy
	3. Atomic configuration
	4. Catalyst
	5. Centripetal force
	6. Chemical bonds
	7. Circuit
	8. Conduction
	9. Conservation of energy
	10. Conservation of mass
	11. Convection
	12. Covalent bond
	13. Dependent variable
	14. Doppler effect
	15. Electric force
	16. Electromagnetic
	17. Endothermic reaction
	18. Equilibrium
	19. Exothermic reaction
	20. Hypothesis
	21. Independent variable
	22. Inertia
	23. Law
	24. Magnetic force
	25. Mass
	26. Matter
Idusiyaya	27. Momentum
	28. Newtonian mechanics
	29. Oxidation-reduction reaction
	30. Qualitative
	31. Quantitative
	32. Rate of reaction
	33. Theory
	34. Thermodynamics
	35. Velocity
	36. Waves