Montana Office of Public Instruction

Science Model Curriculum Guide

September 2016

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Contents

Overview of the Model Curriculum Guide

This model curriculum guide outlines the Montana Science Content Standards. These standards were adopted by the Montana Board of Public Education in September of 2016, with an effective date of July 1, 2017. This document includes discipline and grade by grade views of the standards. Several helpful resources are included in each view. See the Annotated Resources section for helpful links to additional digital resources and tools.

For professional development, please visit the OPI Professional Learning Opportunities Portal and the OPI Teacher Learning Hub.

The Three Disciplines: Earth and Space, Life, and Physical Sciences

Standards Overview

The Montana science standards encompass scientific ideas and practices that all students should learn by the end of high school in order to be prepared for college and career.

- The standards move from general content standards across all science disciplines to three distinct disciplines: earth and space science, life science, and physical science.
- The standards emphasize that students will learn science by connecting science content across the three disciplines and applying design practices and technology to solve problems.
- The standards are organized by grade level for grades K-5 and by grade band for grades 6-8 and 9-12.
    - Grade level standards for K-5 clarify learning expectations for elementary teachers who teach in all content areas.
    - Grade band standards for grades 6-8 and high school clarify expectations and allow flexibility of staffing and program delivery.
- The standards support cognitive science, rigor, and the need to promote student interest in the science, technology, engineering, and mathematics (STEM) fields.
- The standards integrate Montana's Indian Education for All.

PHYSICAL SCIENCE for which students will use crosscutting concepts, science and engineering practices, and technology while investigating how matter and energy exist in a variety of forms and how physical and chemical interactions change matter and energy

LIFE SCIENCE for which students will use crosscutting concepts, science and engineering practices, and technology while investigating the characteristics, structures, and functions of living things; the processes and diversity of life; and how living organisms interact with each other and their environments

EARTH AND SPACE SCIENCE for which students will use crosscutting concepts, science and engineering practices, and technology while investigating the composition, history, and processes that shape Earth, the solar system, and the universe

Students will learn science with integration of content area ideas, crosscutting concepts, science and engineering practices, and technology.

Content standards for science ensure integration of the history, contemporary portrayals, and contributions of American Indians, with an emphasis on Montana Indians, for all students, across all content areas. Students will understand that American Indians' use of scientific knowledge and practices are interdisciplinary and are a valid way to learn about the natural world.

DEFINITIONS

For purposes of science content standards contained in the Administrative Rules of Montana (ARM), the following definitions apply.
"Crosscutting concepts" are those that connect learning across the different areas of disciplinary content. They are:

- patterns
- cause and effect
- scale, proportion, and quantity
- systems and system models
- energy and matter, flows, cycles, and conservation
- structure and function
- stability and change

"Science and engineering practices" are methods of inquiry by which ideas are developed and refined. They are:

- asking questions as it applies to science and defining problems as it applies to engineering
- developing and using models
- planning and carrying out investigations
- analyzing and interpreting data
- using mathematics and computational thinking
- constructing explanations as it applies to science and designing solutions as it applies to engineering
- engaging in argument from evidence
- obtaining, evaluating, and communicating information

Effective date of these rules is July 1, 2017

Visit K-12 Content Standards & Instruction for more information.

Physical Science K-12

Kindergarten	1st	2nd	3rd	4th	5th	Resources
• 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 • analyze data to determine whether a design solution works as intended to change the speed or direction of an object with a push or a pull • construct an explanation based on observations of the effect of sunlight on Earth's surface • use tools and materials to design and build a structure to reduce the warming effect of sunlight on an area	• plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can cause materials to vibrate • make observations to construct an evidence-based explanation that objects can be seen only when illuminated • plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light • design a solution or build a device that facilitates communication over distance using light or sound	• plan and conduct an investigation to describe and classify various materials by their observable properties • conduct an investigation and analyze data to determine which materials have the properties best suited for an intended purpose • make observations to construct an evidence-based claim of how an object made of a small set of pieces can be disassembled and made into a new object • construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot	• plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object • observe and record qualitative and quantitative data about an object's motion to provide evidence that a pattern can be used to predict future motion • ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other • define a simple design problem that can be solved by applying scientific ideas about magnets	• use evidence to describe the relationship between the speed of an object and the energy of that object • make observations to provide evidence of transfer of energy from place to place by sound, light, heat, and electric currents • ask questions and predict outcomes about the changes in energy that occur when objects collide • apply scientific ideas to design, test, and refine a device that converts energy from one form to another • develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move • develop a model communicating that light reflected from objects into the eye allows objects to be seen • generate and compare multiple solutions that use patterns to transfer information	• develop a model to communicate that matter is made of particles too small to be seen • measure and graph quantities to provide evidence that the total mass of matter is conserved regardless of the type of change that occurs when heating, cooling, or mixing substances • observe and record qualitative and quantitative evidence to support identification of materials based on their properties • conduct an investigation that produces quantitative and qualitative data to analyze whether the mixing of two or more substances results in new substances • use models to describe that energy in animals' food was once energy from the sun • support an argument that the gravitational force exerted by Earth on objects is directed toward the center of the Earth	NGSS Glossary NGSS Search the Standards Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning 3D Toolkits OPI IEFA Resources Stem Teaching Tools

Physical Science (continued)

6th – 8th

- develop and critique models that describe the atomic composition of simple molecules and extended structures
- analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred
- gather information to describe that synthetic materials come from natural resources and impact society
- 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
- develop, use, and critique a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved
- undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes
- apply Newton's Third Law of Motion to design a solution to a problem involving the motion of two colliding objects
- 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
- ask questions about data to determine the factors affecting electric and magnetic force strengths
- construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the mass of interacting objects
- design and conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact
- construct and interpret graphic displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object
- develop and critique models to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system
- apply scientific principles to design, construct, and test a device that minimizes or maximizes thermal energy transfer
- plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample
- construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object
- use mathematical representations to describe a simple model for waves that includes how the amplitude and wavelength of a wave is related to the energy in a wave
- develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials

9th – 12th

- 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
- 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
- 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
- communicate through scientific and technical information roles of molecular-level structure in the functioning of designed materials
- construct and revise an explanation for outcomes of simple chemical reactions based on outer electron states of atoms, trends in the periodic table, and patterns of chemical properties
- develop a model to illustrate that the release or absorption of energy from chemical reactions is dependent upon changes in total bond energy
- apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs
- refine the design of a chemical system by specifying changes in conditions that would alter the amount of products at equilibrium
- use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction
- 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
- use mathematical representations to demonstrate how total momentum of a system is conserved when there is no net force on the system
- apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes forces on an object during collisions
- use a mathematical representation of Newton's Law of Gravitation and Coulomb's Law to explain gravitational and electrostatic forces between objects
- plan and conduct investigations to provide evidence that electric currents can produce magnetic fields and changing magnetic fields can produce electric currents
- 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 and energy flows in and out of the system are known
- develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles and energy associated with the relative position of particles
- design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy
- 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
- develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the change in energy of the objects due to the interaction
- use mathematical representations to support a claim regarding relationships among the frequency, amplitude, wavelength, and speed of waves traveling in various media
- 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
- evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter
- 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

Life Science K-12

Kindergarten	1st	2nd	3rd	4th	5th	Resources
• use observations to describe patterns of what plants and animals, including humans, need to survive	• use materials to design a solution to a human problem by mimicking plant and animal structures and functions that help them survive, grow, and meet their needs • use information from print and other media to identify patterns in behavior of parents and offspring that help offspring survive • make an evidence-based explanation of how young plants and animals are like, but not exactly like, their parents	• plan and conduct a cause and effect investigation to determine whether plants need sunlight and water to grow • develop a simple model that mimics the structure and function of an animal in dispersing seeds or pollinating plants • make observations of plants and animals to compare and contrast the diversity of life in different habitats	• 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 • make a claim about the effectiveness of a solution to a problem caused when the environment changes and that the types of plants and animals that live there may change • construct a cause and effect argument communicating some animals, including humans, form groups and communities that help members survive • analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago • develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death • 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 • use evidence to support the explanation that traits can be influenced by the environment • 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	• construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction • 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	• support an argument that plants get the materials they need for growth chiefly from air and water • develop and critique a model to describe the movement of matter among plants, animals, decomposers, and the environment	NGSS Glossary NGSS Search the Standards Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning 3D Toolkits OPI IEFA Resources Stem Teaching Tools

Life Science (continued)

6th -8th	9th - 12th

• conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells
• develop and use a model to describe the structure and function of a cell as a whole and ways parts of cells contribute to the function
• use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells
• 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
• develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth, release energy, or both, as this matter moves through an organism
• analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem and analyze scientific concepts used by American Indians to maintain healthy relationships with environmental sources
• develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem
• construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems
• evaluate competing design solutions for maintaining biodiversity and ecosystem services
• use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively
• construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth and development of organisms
• develop and use a model to describe why structural changes to genes, such as mutations, may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism
• 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
• gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms
• 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
• 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
• 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
• 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
• use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time
	• 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
	• develop and use a model to illustrate the organizational structure of interacting systems that provide specific functions within multicellular organisms
	• plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis
	• use a model to illustrate how photosynthesis transforms light energy into stored chemical energy
	• construct an explanation based on evidence from multiple sources for how carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur may combine with other elements to form organic macromolecules with different structures and functions
	• 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
	• construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions
	• use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem
	• use mathematical or computational representations to support arguments about environmental factors that affect carrying capacity, biodiversity, and populations in ecosystems
	• 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
	• design, evaluate, and refine a solution for reducing the direct and indirect impacts of human activities on the environment and biodiversity and analyze scientific concepts used by American Indians to maintain healthy relationships with environmental resources
	• construct an explanation using evidence from multiple sources to describe the role of cellular division and differentiation in producing and maintaining complex organisms
	• make and defend a claim based on evidence from multiple sources that inheritable genetic variations may result from:
	• new genetic combinations through meiosis
	• viable errors occurring during replication
	• mutations caused by environmental factors
	• apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population
	• evaluate and communicate scientific information about how common ancestry and biological evolution are supported by multiple lines of empirical evidence
	• construct an explanation based on evidence that the process of evolution by natural selection 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
	  • the proliferation of those organisms that are better able to survive and reproduce in the environment
	• apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait
	• construct an explanation based on evidence for how natural selection leads to adaptation of populations overtime
	• evaluate the evidence supporting claims that changes in environmental conditions may result in:
	  • changes in the number of individuals of some species
	  • the emergence of new species over time
	  • the extinction of other species
	  • investigate and explain American Indian perspectives on changes in environmental conditions and their impacts

Earth and Space Science K-12

Kindergarten	1st	2nd	3rd	4th	5th	Resources
• construct an argument supported by evidence for how plants and animals, including humans, can change the environment to meet their needs • use a model to represent the relationship between the needs of different plants or animals, including humans, and the places they live • communicate ideas about the impact of humans on the land, water, air, or other living things in the local environment • use and share observations of local weather conditions to describe patterns over time • ask questions to obtain information about the purpose of weather forecasting to predict, prepare for, and respond to weather	• use observations of the sun, moon, and stars to describe patterns that can be predicted • make observations at different times of year to relate the amount of daylight to the time of year	• use information from several sources to provide evidence that Earth events can occur quickly or slowly • construct explanations to compare multiple physical and naturally built designs which impact wind or water's effect on the shape of the land • develop models to represent the shapes and kinds of land and bodies of water in an area • obtain information to identify where water is found on Earth and that water can be solid, liquid, or gas	• obtain and represent data using tables and graphical displays to describe observed and predicted weather conditions during a particular season • obtain and combine information to describe climate patterns in different regions of the world • make a claim based on information about the merit of a design solution that reduces the impacts of a weather-related hazard	• obtain and combine information from a variety of sources to communicate that energy and fuels are derived from natural resources and their uses affect the environment • identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time • make observations or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation • analyze and interpret data from maps as evidence to make a claim about patterns of Earth's features • generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans	• develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, or atmosphere interact • graph and explain the proportion and quantities of water and fresh water in various natural and human-made reservoirs to provide evidence about the distribution of water on Earth • obtain and combine information from various sources about ways individual communities use science ideas to protect the Earth's resources, environment, and systems and describe examples of how American Indians use scientific knowledge and practices to maintain relationships with the natural world • use evidence or models to support the claim that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth • graph the daily changes in the length, shape, and direction of shadows; lengths of day and night; and the seasonal appearance of select stars to communicate the patterns of the Earth's movement and describe how astronomical knowledge is used by American Indians	NGSS Glossary NGSS Search the Standards Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning 3D Toolkits OPI IEFA Resources Stem Teaching Tools

Earth and Space Science (continued)

6th - 8th	9th- 12th
• 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 • develop and use a model to describe the role of gravity in the motions within galaxies and the solar system • analyze and interpret data to determine scale properties of objects in the solar system • 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 • construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time scales and spatial scales • analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions • develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process • develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity • 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 • collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions • 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 • ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century • analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects • apply scientific principles to design a method for monitoring and minimizing a human impact on the environment • construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems including indigenous populations	• 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 • 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 • communicate scientific ideas about the way stars, over their life cycle, produce elements • use mathematical or computational representations to predict the motion of orbiting objects in the solar system • 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 • 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 • develop a model to illustrate how Earth's internal and surface processes operate at different spatial and time scales to form continental and ocean-floor features • analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems • develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection • plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes • develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere • construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth • use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate • 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 • 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 • evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios • create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, biodiversity, and investigate and explain how some American Indian tribes use scientific knowledge and practices in managing natural resources • evaluate or refine a technological solution that reduces impacts of human activities on natural systems

Science Standards: Grade by Grade View

Kindergarten

Physical Science	Vocabulary	Resources
• 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 • analyze data to determine whether a design solution works as intended to change the speed or direction of an object with a push or a pull • construct an explanation based on observations of the effect of sunlight on Earth's surface • use tools and materials to design and build a structure to reduce the warming effect of sunlight on an area	NGSS Glossary	NGSS Kindergarten Topics Model OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning Stem Teaching Tools MPRES Toolbox
Life Science		
• use observations to describe patterns of what plants and animals, including humans, need to survive		
Earth and Space Science		
• construct an argument supported by evidence for how plants and animals, including humans, can change the environment to meet their needs • use a model to represent the relationship between the needs of different plants or animals, including humans, and the places they live • communicate ideas about the impact of humans on the land, water, air, or other living things in the local environment • use and share observations of local weather conditions to describe patterns over time • ask questions to obtain information about the purpose of weather forecasting to predict, prepare for, and respond to weather		

First Grade		
Physical Science	Vocabulary	Resources
• plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can cause materials to vibrate • make observations to construct an evidence-based explanation that objects can be seen only when illuminated • plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light • design a solution or build a device that facilitates communication over distance using light or sound	NGSS Glossary	NGSS First Grade Topic OPI IEFA Resources Science and Engineering Crosscutting Concepts Planning Curriculum 3D Learning MPRES Toolkit Stem Teaching Tools
Life Science		
• use materials to design a solution to a human problem by mimicking plant and animal structures and functions that help them survive, grow, and meet their needs • use information from print and other media to identify patterns in behavior of parents and offspring that help offspring survive • make an evidence-based explanation of how young plants and animals are like, but not exactly like, their parents		
Earth and Space Science		
• use observations of the sun, moon, and stars to describe patterns that can be predicted • make observations at different times of year to relate the amount of daylight to the time of year		

Second Grade		
Physical Science	Vocabulary	Resources
• plan and conduct an investigation to describe and classify various materials by their observable properties • conduct an investigation and analyze data to determine which materials have the properties best suited for an intended purpose • make observations to construct an evidence-based claim of how an object made of a small set of pieces can be disassembled and made into a new object • construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot	NGSS Glossary	NGSS Second Grade Topic OPI IEFA Resources Science and Engineering Crosscutting Concepts Planning Curriculum 3D Learning 3D Toolkits Stem Teaching Tools
Life Science		
• plan and conduct a cause and effect investigation to determine whether plants need sunlight and water to grow • develop a simple model that mimics the structure and function of an animal in dispersing seeds or pollinating plants • make observations of plants and animals to compare and contrast the diversity of life in different habitats		
Earth and Space Science		
• use information from several sources to provide evidence that Earth events can occur quickly or slowly • construct explanations to compare multiple physical and naturally built designs which impact wind or water's effect on the shape of the land • develop models to represent the shapes and kinds of land and bodies of water in an area • obtain information to identify where water is found on Earth and that water can be solid, liquid, or gas		

Third Grade

Physical Science	Vocabulary	Resources
• plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object • observe and record qualitative and quantitative data about an object's motion to provide evidence that a pattern can be used to predict future motion • ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other • define a simple design problem that can be solved by applying scientific ideas about magnets	NGSS Glossary	NGSS Third Grade Topic Arrangements OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning
Life Science		
• 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 • make a claim about the effectiveness of a solution to a problem caused when the environment changes and that the types of plants and animals that live there may change • construct a cause and effect argument communicating some animals, including humans, form groups and communities that help members survive • analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago • develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death • 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 • use evidence to support the explanation that traits can be influenced by the environment • 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		
Earth and Space Science		
• obtain and represent data using tables and graphical displays to describe observed and predicted weather conditions during a particular season • obtain and combine information to describe climate patterns in different regions of the world • make a claim based on information about the merit of a design solution that reduces the impacts of a weather-related hazard		

Fourth Grade

Physical Science	Vocabulary	Resources
• use evidence to describe the relationship between the speed of an object and the energy of that object • make observations to provide evidence of transfer of energy from place to place by sound, light, heat, and electric currents • ask questions and predict outcomes about the changes in energy that occur when objects collide • apply scientific ideas to design, test, and refine a device that converts energy from one form to another • develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move • develop a model communicating that light reflected from objects into the eye allows objects to be seen • generate and compare multiple solutions that use patterns to transfer information	NGSS Glossary	NGSS Fourth Grade Topic Arrangements Science and Engineering Crosscutting Concepts Planning Curriculum OPI IEFA Resources Stem Teaching Tools 3D Toolkits
Life Science		
• construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction • 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		
Earth and Space Science		
• obtain and combine information from a variety of sources to communicate that energy and fuels are derived from natural resources and their uses affect the environment • identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time • make observations or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation • analyze and interpret data from maps as evidence to make a claim about patterns of Earth's features • generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans		

Fifth Grade

Physical Science	Vocabulary	Resources
• develop a model to communicate that matter is made of particles too small to be seen • measure and graph quantities to provide evidence that the total mass of matter is conserved regardless of the type of change that occurs when heating, cooling, or mixing substances • observe and record qualitative and quantitative evidence to support identification of materials based on their properties • conduct an investigation that produces quantitative and qualitative data to analyze whether the mixing of two or more substances results in new substances • use models to describe that energy in animals' food was once energy from the sun • support an argument that the gravitational force exerted by Earth on objects is directed toward the center of the Earth	NGSS Glossary	NGSS Fifth Grade Topic Arrangements OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning 3D Toolkits Stem Teaching Tools
Life Science		
• support an argument that plants get the materials they need for growth chiefly from air and water • develop and critique a model to describe the movement of matter among plants, animals, decomposers, and the environment		
Earth and Space Science		
• develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, or atmosphere interact • graph and explain the proportion and quantities of water and fresh water in various natural and human-made reservoirs to provide evidence about the distribution of water on Earth • obtain and combine information from various sources about ways individual communities use science ideas to protect the Earth's resources, environment, and systems and describe examples of how American Indians use scientific knowledge and practices to maintain relationships with the natural world • use evidence or models to support the claim that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth • graph the daily changes in the length, shape, and direction of shadows; lengths of day and night; and the seasonal appearance of select stars to communicate the patterns of the Earth's movement and describe how astronomical knowledge is used by American Indians		

Sixth-Eighth Grade		
Physical Science	Vocabulary	Resources
• develop and critique models that describe the atomic composition of simple molecules and extended structures • analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred • gather information to describe that synthetic materials come from natural resources and impact society • 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 • develop, use, and critique a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved • undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes • apply Newton's Third Law of Motion to design a solution to a problem involving the motion of two colliding objects • 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 • ask questions about data to determine the factors affecting electric and magnetic force strengths • construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the mass of interacting objects • design and conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact • construct and interpret graphic displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object • develop and critique models to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system • apply scientific principles to design, construct, and test a device that minimizes or maximizes thermal energy transfer • plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample • construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object • use mathematical representations to describe a simple model for waves that includes how the amplitude and wavelength of a wave is related to the energy in a wave • develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials	NGSS Glossary	NGSS Middle School (6-8) Physical Sciences OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning 3D Toolkits STEM Teaching Tools

Sixth-Eighth Grade		
Life Science	Vocabulary	Resources
• conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells • develop and use a model to describe the structure and function of a cell as a whole and ways parts of cells contribute to the function • use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells • 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 • develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth, release energy, or both, as this matter moves through an organism • analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem and analyze scientific concepts used by American Indians to maintain healthy relationships with environmental sources • develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem • construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems • evaluate competing design solutions for maintaining biodiversity and ecosystem services • use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively • construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth and development of organisms • develop and use a model to describe why structural changes to genes, such as mutations, may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism • 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 • gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms • 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	NGSS Glossary	NGSS Middle School (6-8) Life Sciences OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning 3D Toolkits Stem Teaching Tools

Sixth-Eighth Grade		
Life Science	Vocabulary	Resources
• 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 • 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 • 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 • use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time		

Sixth-Eighth Grade		
Earth and Space Science	Vocabulary	Resources
• 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 • develop and use a model to describe the role of gravity in the motions within galaxies and the solar system • analyze and interpret data to determine scale properties of objects in the solar system • 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 • construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time scales and spatial scales • analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions • develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process • develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity • 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 • collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions • 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 • ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century • analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects • apply scientific principles to design a method for monitoring and minimizing a human impact on the environment • construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems including indigenous populations	NGSS Glossary	NGSS Middle School (6-8) Earth and Space Sciences OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning STEM Teaching Tools

Ninth-Twelfth Grade		
Physical Science	Vocabulary	Resources
• 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 • 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 • 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 • communicate through scientific and technical information roles of molecular-level structure in the functioning of designed materials • construct and revise an explanation for outcomes of simple chemical reactions based on outer electron states of atoms, trends in the periodic table, and patterns of chemical properties • develop a model to illustrate that the release or absorption of energy from chemical reactions is dependent upon changes in total bond energy • apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs • refine the design of a chemical system by specifying changes in conditions that would alter the amount of products at equilibrium • use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction • 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 • use mathematical representations to demonstrate how total momentum of a system is conserved when there is no net force on the system • apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes forces on an object during collisions • use a mathematical representation of Newton's Law of Gravitation and Coulomb's Law to explain gravitational and electrostatic forces between objects • plan and conduct investigations to provide evidence that electric currents can produce magnetic fields and changing magnetic fields can produce electric currents • 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 and energy flows in and out of the system are known • develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles and energy associated with the relative position of particles	NGSS Glossary	NGSS HS Physical Sciences by Topic OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning STEM Teaching Tools 3D Toolkit

Ninth-Twelfth Grade		
Physical Science	Vocabulary	Resources
• design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy • 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 • develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the change in energy of the objects due to the interaction • use mathematical representations to support a claim regarding relationships among the frequency, amplitude, wavelength, and speed of waves traveling in various media • 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 • evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter • 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		

Ninth-Twelfth Grade		
Life Science	Vocabulary	Resources
• 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 • develop and use a model to illustrate the organizational structure of interacting systems that provide specific functions within multicellular organisms • plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis • use a model to illustrate how photosynthesis transforms light energy into stored chemical energy • construct an explanation based on evidence from multiple sources for how carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur may combine with other elements to form organic macromolecules with different structures and functions • 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 • construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions • use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem • use mathematical or computational representations to support arguments about environmental factors that affect carrying capacity, biodiversity, and populations in ecosystems • design, evaluate, and refine a solution for reducing the direct and indirect impacts of human activities on the environment and biodiversity and analyze scientific concepts used by American Indians to maintain healthy relationships with environmental resources • construct an explanation using evidence from multiple sources to describe the role of cellular division and differentiation in producing and maintaining complex organisms • make and defend a claim based on evidence from multiple sources that inheritable genetic variations may result from: ▪ new genetic combinations through meiosis ▪ viable errors occurring during replication ▪ mutations caused by environmental factors • apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population	NGSS Glossary	NGSS HS Life Sciences by Topic OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning 3D Toolkits

Ninth-Twelfth Grade		
Life Science	Vocabulary	Resources
• evaluate and communicate scientific information about how common ancestry and biological evolution are supported by multiple lines of empirical evidence • construct an explanation based on evidence that the process of evolution by natural selection 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 ▪ the proliferation of those organisms that are better able to survive and reproduce in the environment • apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait • construct an explanation based on evidence for how natural selection leads to adaptation of populations over time • evaluate the evidence supporting claims that changes in environmental conditions may result in: ▪ changes in the number of individuals of some species ▪ the emergence of new species over time ▪ the extinction of other species ▪ investigate and explain American Indian perspectives on changes in environmental conditions and their impacts		

Ninth-Twelfth Grade		
Earth and Space Science	Vocabulary	Resources
• 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 • 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 • communicate scientific ideas about the way stars, over their life cycle, produce elements • use mathematical or computational representations to predict the motion of orbiting objects in the solar system • 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 • 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 • develop a model to illustrate how Earth's internal and surface processes operate at different spatial and time scales to form continental and ocean-floor features • analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems • develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection • plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes • develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere • construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth • use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate • 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 • 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 • evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios • create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, biodiversity, and investigate and explain how some American Indian tribes use scientific knowledge and practices in managing natural resources • evaluate or refine a technological solution that reduces impacts of human activities on natural systems	NGSS Glossary	NGSS HS Earth and Space Sciences by Topic OPI IEFA Resources Science and Engineering Practices Crosscutting Concepts Planning Curriculum 3D Learning Stem Teaching Tools 3D Toolkit

Annotated Resources

Title	Author/Organization	Description	URL
3D Learning	Next Generation Science Standards	The National Research Council's (NRC) *Framework* describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence-based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents three dimensions that will be combined to form each standard: Practices, Disciplinary Core Ideas, Crosscutting Concepts	http://www.nextgenscience.org/three-dimensions
3D Toolkits	Montana Partnership with Regions for Excellence in STEM (MPRES)	Each Practice is outlined in the toolkit following the predicted continuum of change for teacher growth through both reflective questions and activities for the Practice in the classroom, connected to relevant Crosscutting Concepts. The Toolkit is not intended to be used as curriculum for classroom instruction, and it will not work as a recipe box that can be transfixed to specific classrooms. The tools provided here, along with a professional development trainer's expertise, will help you bend and shape your classroom pedagogy into a 3-Dimensional form that is successful for your grade level, content, and style.	http://www.mtscienceeducation.org/?page_id=2
Ask a Scientist	Cornell Center for Materials Research	Ask questions and get answers from real scientists.	http://www.ccmr.cornell.edu/education/educational-resources/ask-a-scientist/
Bundling Standards	Next Generation Science Standards	**What is bundling?** "Bundles" are groups of standards arranged together to create the endpoints for units of instruction. Bundling is just one step in a curriculum development process; many other steps are required to create instructional materials designed for the NGSS. **Why bundle?** Bundling is helpful step in implementing standards because it helps students see connections between concepts and can allow more efficient use of instructional time.	http://www.nextgenscience.org/resources/bundling-NGSS
Crosscutting Concepts	Next Generation Science Standards	Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. — Framework p. 233	http://www.nextgenscience.org/sites/default/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf
Grade Band and Topic NGSS	Next Generation Science Standards	The Topics are in tables by Grade Band, and then further broken down into columns of Life Science, Earth & Space Science, and Physical Science. The Engineering Design topic is located at the end of the respective grade band.	http://ngss.nsta.org/AccessStandardsByTopic.aspx
Lesson Planning, Ambitious Science Teaching	Tools for Ambitious Science Teaching	If you are interested in designing full units that are grounded in an anchoring event, then you will want to look at three tools we have for planning unit-length experiences for students.	http://ambitiousscienceteaching.org/tools-planning/
Mastering Scientific Practices with Technology	National Science Teachers Association	NSTA video blog by Ben Smith and Jared Mader.	http://nstacommunities.org/blog/2016/02/04/mastering-scientific-practices-with-technology/

Title	Author/Organization	Description	URL
Montana Science Professional Development	Montana Partnership with Regions for Excellence in STEM (MPRES)	MPRES Professional Development courses for credit (either continuing education, graduate-level, or OPI renewal units) are managed through the MSU-Billings Extended Campus, and interested teachers and administrators should register through the Extended Campus website. For any professional development option with an online education component, online course administration is also managed through the MSU-Billings Extended Campus utilizing the MPRES Toolkit available on this website as the primary course text. To learn about available professional development options, for registration assistance, or for additional information, contact your nearest MPRES Trainer.	http://www.mtscienceeducation.org/?page_id=49
NGSS Glossary	Next Generation Science Standards	Glossary developed for the Next Generation Science Standards	http://www.nextgenscience.org/glossary
NGSS Search the Standards	Next Generation Science Standards	Search the NGSS by keyword.	http://www.nextgenscience.org/search-standards
NGSS Videos	Paul Andersen, Bozeman Science	This video series covers the concepts contained within the K-12 Science Framework. It contains 8 practices, 7 crosscutting concepts, and 44 disciplinary core ideas.	https://www.youtube.com/playlist?list=PLllVwaZQkS2rtZG_L7ho89oFsaYL3kUWq
NSTA Conferences	National Science Teachers Association	Listing of conferences.	http://nstacommunities.org/blog/category/conferences/
OPI Academic Standards	Office of Public Instruction	Access content standards documents on this page.	https://opi.mt.gov/Educators/Teaching-Learning/K-12-Content-Standards-Revision
OPI IEFA Resources	Office of Public Instruction	Integrating quality Indian Education for All Content with rigorous, standards-based instruction in all curriculum areas. Search this site for science lesson plans and resources.	https://opi.mt.gov/Educators/Teaching-Learning/Indian-Education
OPI Professional Learning Opportunities Portal	Office of Public Instruction	The Learning Opportunities Portal shares information about the workshops and training happening across the state from the OPI and Montana's many other professional learning providers.	http://mtplportal.org/
OPI Teacher Learning Hub	Office of Public Instruction	The Hub is a learning network on the Moodle platform dedicated to providing free, high quality professional learning for all K-12 educators across Montana. It aims to minimize the time teachers spend away from their classrooms to attend training, as well as save school districts money on professional learning. Get started by creating an account or browsing through the course offerings. The courses are divided by subject area and listed in the Course Catalog.	http://learninghub.mrooms.net/
Planning Curriculum	Next Generation Science Standards	The steps outlined in this source show how to develop an NGSS curriculum that spans multiple years and grade levels. You will form a team to examine how the standards are grouped together and sequenced and where they fit into your curriculum. You will also think about instructional strategies and resources you will need to implement them in your school or district.	http://ngss.nsta.org/planning-an-ngss-curriculum.aspx

Performance Expectation Finder	National Science Teachers Association	Search the NGSS by performance expectation.	http://ngss.nsta.org/performanceSearchResults.aspx

Title	Author/Organization	Description	URL
Safety	National Science Teachers Association	Access NSTA's safety resource archive.	http://nstacommunities.org/blog/category/safety/
Science and Engineering Practices	Next Generation Science Standards	APPENDIX F – Science and Engineering Practices in the NGSS	http://www.nextgenscience.org/sites/default/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf
Science Classrooms Video Gallery	Tools for Ambitious Science Teaching	You can choose from a series of videos that demonstrate ambitious teaching.	http://ambitiousscienceteaching.org/video-series/
STEM Classroom	National Science Teachers Association	The STEM Classroom addresses the integration of STEM into today's K–12 classrooms.	http://nstacommunities.org/blog/category/stemclassroom/
Support for College and Career Readiness	Next Generation Science Standards	NGSS Fact Sheet.	https://www.nextgenscience.org/sites/default/files/NGSS%20Appendix%20C%20Final%20072613.pdf
Supporting Common Core State Mathematics	Next Generation Science Standards	APPENDIX L – Connections to the Common Core State Standards for Mathematics	http://ngss.nsta.org/documents/AppendixL-CCSSMathConnections.pdf
Using Science to Support Literacy in English Language Arts	Next Generation Science Standards	APPENDIX M – Connections to the Common Core State Standards for Literacy in Science and Technical Subjects	http://ngss.nsta.org/documents/AppendixM-ConnectionsToTheCCSSForLiteracy.pdf
Videos and Lessons	National Science Teachers Association	A collection of lesson plans.	http://nstacommunities.org/blog/category/videos-and-lessons/page/2/
STEM Teaching Tools			http://stemteachingtools.org/

Montana Program Standards

10.55.901 BASIC EDUCATION PROGRAM: ELEMENTARY

(1) An elementary school shall have an education program aligned to the program area standards that enables students to meet the content standards and content-specific grade-level learning progressions.

History: 20-2-114, MCA; IMP, 20-2-121, 20-3-106, 20-7-101, MCA; NEW, 1989 MAR p. 342, Eff. 7/1/89; AMD, 1998 MAR p. 2707, Eff. 10/9/98; AMD, 2000 MAR p. 3340, Eff. 12/8/00; AMD, 2012 MAR p. 2042, Eff. 7/1/13.

10.55.902 BASIC EDUCATION PROGRAM: MIDDLE GRADES

(1) A school with middle grades must have an education program aligned to the program area standards that enables all students to meet the content standards and content-specific grade-level learning progressions.

(2) The Board of Public Education, upon recommendation of the Superintendent of Public Instruction, may approve a 7 and 8 grade program that must follow either the middle school philosophy and components described in (3) or the departmentalized philosophy and components described in (4).

(3) The Board of Public Education, upon recommendation of the Superintendent of Public Instruction, may approve a middle school program that:

(a) addresses the unique nature of middle-grade children by focusing on their intellectual, social, emotional, and physical development. To put such philosophy into practice, a middle school must have flexibility to:

(i) approach instruction, scheduling, and teaching in a variety of ways;

(ii) undertake interdisciplinary work; and

(iii) plan blocks of coursework deriving from the intellectual, social, emotional, and physical needs of middle school students.

(b) incorporates critical and creative thinking, career awareness, lifelong learning, and safety;

(c) incorporates instruction in reading literacy and writing literacy into all required and elective program areas as required in the Montana Common Core Standards, ARM Title 10, chapter 53;

(d) includes, at a minimum, the following program areas, required of all students yearly:

(i) English language arts;

(ii) mathematics;

(iii) physical and life sciences;

(iv) social studies; and

(v) health enhancement.

(e) at a minimum maintains the following required program areas:

(i) visual arts including, but not limited to art history, art criticism, aesthetic perception, and production;

(ii) music including, but not limited to general, instrumental, and vocal (emphasizing comprehensive music elements, music history, criticism, aesthetic perception, and musical production);

(iii) career and technical education courses or pathways such as agriculture, business education, family and consumer sciences, health occupations and industrial technology education; and

(iv) world languages.

(f) offers as electives to all students exploratory courses such as creative writing, dance, drama, financial education, photography, and leadership.

(4) A junior high (grades 7-9) or 7-8 school must offer an educational program, aligned to the program area standards, that enables all students to meet the content standards and content-specific grade-level progressions.

(a) Instruction in reading literacy and writing literacy shall be incorporated into all required and elective program areas as required in the Montana Common Core Standards, ARM Title 10, chapter 53.

(b) All students shall complete the following program areas each year:

(i) English language arts--1 unit;

(ii) social studies--1 unit;

(iii) mathematics--1 unit;

(iv) science--1 unit; and

(v) health enhancement--1/2 unit.

(c) All students must be allowed to elect from the following program area offerings:

(i) visual arts--1/2 unit;

(ii) music--1/2 unit;

(iii) career and technical education--1/2 unit; and

(iv) world languages and cultures--1/2 unit.

(d) A unit is defined as the equivalent of at least 8100 minutes for one school year.

(e) Time to pass between classes may be counted toward the standard school day but shall not be counted toward class time.

History: 20-2-114, MCA; IMP, 20-2-121, 20-3-106, 20-7-101, MCA; NEW, 1989 MAR p. 342, Eff. 7/1/89; AMD, 1998 MAR p. 2707, Eff. 10/9/98; AMD, 2000 MAR p. 3340, Eff. 12/8/00; AMD, 2012 MAR p. 2042, Eff. 7/1/13.

10.55.904 BASIC EDUCATION PROGRAM OFFERINGS: HIGH SCHOOL

(1) The basic education program, aligned to the program area standards, for grades 9 through 12 shall be at least 20 units of coursework that enable all students to meet the content standards and content-specific grade-level learning progressions.

(2) Instruction in reading literacy and writing literacy shall be incorporated into all required and elective program areas as required in the Montana Common Core Standards, ARM Title 10, chapter 53.

(3) Minimum offerings shall include at least the following:

(a) 4 units of English language arts;

(b) 3 units of mathematics;

(c) 3 units of science;

(d) 3 units of social studies;

(e) 2 units of career and technical education;

(f) 2 units of arts;

(g) 1 unit of health enhancement;

(h) 2 units of world languages; and

(i) 2 units of electives.

History: 20-2-114, MCA; IMP, 20-2-121, 20-3-106, 20-7-101, MCA; NEW, 1989 MAR p. 342, Eff. 7/1/89; AMD, 1998 MAR p. 2707, Eff. 10/9/98; AMD, 2000 MAR p. 3340, Eff. 12/8/00; AMD, 2012 MAR p. 2042, Eff. 7/1/13.

10.55.1501 SCIENCE PROGRAM DELIVERY STANDARDS

(1) In general, a basic program in science shall:

(a) meet the following conditions:

(i) maintain an environment that recognizes scientific knowledge as the product of inquiry and is continually subject to review, verification, and revision; and

(ii) foster an environment that embraces the interactions of science, technology, and society.

(b) include the following practices:

(i) investigate problems of individual, social, and ethical importance in the natural world through the selection and application of appropriate scientific techniques;

(ii) connect initial inquiry and discovery to prior knowledge;

(iii) employ varied strategies for investigation, allowing students to understand science as a process, experience practical problem-solving, and develop critical thinking skills;

(iv) emphasize experimentation, data analysis, and the communication of findings to build new understandings by classifying ongoing observations, modeling natural phenomena, and developing the capacity to make inferences about unexplored concepts; and

(v) use technology for collaborative inquiries to extend curricular experiences within the school and to other schools, communities, and businesses.

History: Sec. 20-2-114, MCA; IMP, Sec. 20-2-121, 20-3-106, 20-7-101, MCA; NEW, 1989 MAR p. 342, Eff. 7/1/89; AMD, 2001 MAR p. 953, Eff. 6/8/01.

(vi) See the Administrative Rules of Montana, Chapter 55 for additional information about accreditation and program delivery standards.