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The Office of Public Instruction (OPI) is pleased to release the Essential Learning Expectations (ELE) for Science. The ELE were developed by Montana educators from June 2008 through January 2009. The ELE describe requisite content knowledge, abilities, and thinking/reasoning skills that students must comprehend and apply along the K-12 learning continuum. As standards are revised, the ELE will be developed for all content areas and at each grade level for students to successfully meet the standards and benchmarks.

For many years now, Montana educators have been asking for clarifications of the standards and for more details to assist with the development of local curriculum aligned to the standards. The ELE, while not mandatory, provide clear targets for student achievement that will assist all educators to meet the needs of students across the full spectrum from Special Education to Gifted and Talented Education.

### K-12 CONTENT STANDARDS

What all Montana students will know, understand and be able to do when they graduate from high school, ready for work and postsecondary education.

### BENCHMARKS

Check points along the K-12 continuum to assess student progress toward meeting standards.

End of Grade 4

End of Grade 8

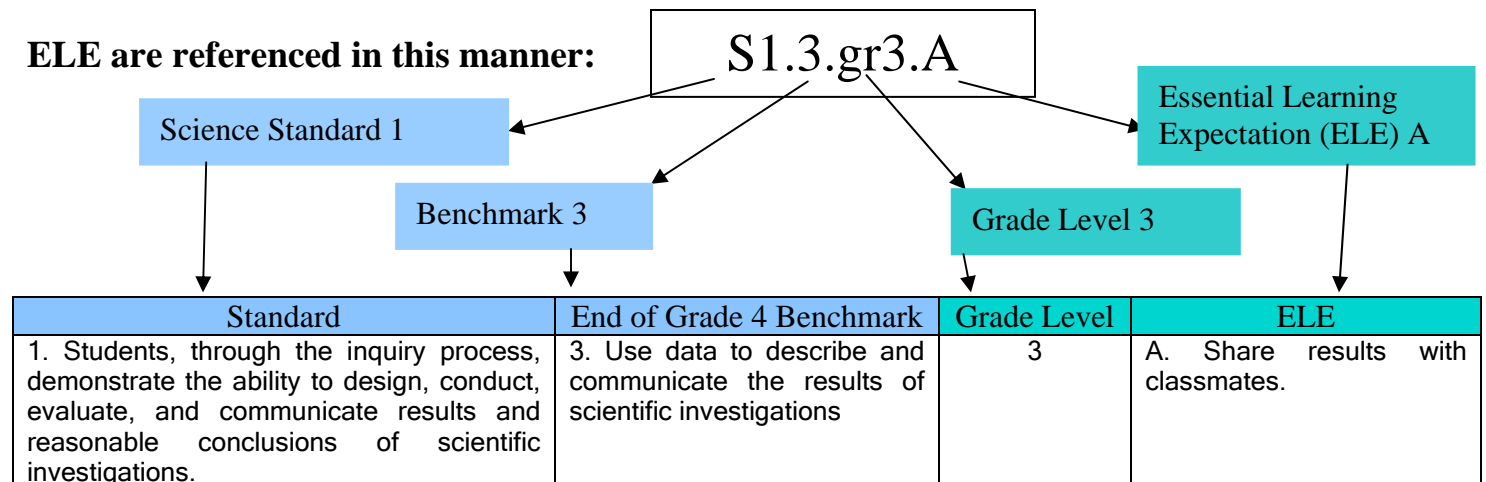
Upon Graduation

### ESSENTIAL LEARNING EXPECTATIONS

The necessary content, context and thinking/reasoning skills students must comprehend and apply along the learning continuum.

K	1	2	3	4	5	6	7	8	9	10	11	12
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ELE are referenced in this manner:



The Science ELE for grades 6-12 are arranged into two grade bands, 6-8 and 9-12. The ELE for Science are structured in this manner so as to provide guidance for a discipline-specific science curriculum or an intradisciplinary science curriculum. Science ELE that are denoted with a (10) in the 9-12 grade band designate the foundational knowledge and skills for end of grade 10. These ELE represent a grade 10 checkpoint to measure student progress towards successfully meeting the content standards and upon graduation benchmarks. This denotation provides guidance for focused instruction and assessment.

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**Montana Instructional Alignment - Science**  
**Grade Level: Kindergarten**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Develop the abilities necessary to safely conduct scientific inquiry, including (a step-by-step sequence is not implied): (a) asking questions about objects, events, and organisms in the environment, (b) planning and conducting simple investigations	A. Make observations using the five senses B. Record observations by drawing or orally explaining C. Ask a question based on their observations D. Follow appropriate safety rules E. Conduct teacher guided scientific inquiry	observe, scientist, same/different, color, size, sight, sound, touch, taste, smell, sort, record, question, experiment		
2. Select and use appropriate tools including technology to make measurements (including metric units) and represent results of basic scientific investigations	A. Identify measurement tools B. Choose the appropriate tool to measure time, temperature, mass, length, and liquid volume	clock, thermometer, magnifying glass, ruler, scale, beaker		
3. Use data to describe and communicate the results of scientific investigations	A. Communicate observations made during inquiry process.			
4. Use models that illustrate simple concepts and compare those models to the actual phenomenon	<b>Benchmark is addressed in grade 2</b>			
5. Identify a valid test in an investigation	<b>Benchmark is addressed in grade 3</b>			
6. Identify how observations of nature form an essential base of knowledge among the Montana American Indians	A. Identify objects found in nature B. Make observations of objects found in nature C. Identify examples of Montana American Indians making use of nature	nature, environment		

**Science Content Standard 2.** Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Create mixtures and separate them based on different physical properties (e.g., salt and sand, iron filings and soil, oil and water)	<b>Benchmark is addressed in grade 2</b>			
2. Examine, measure, describe, compare and classify objects in terms of common physical properties	A. Identify objects based on their color, shape and size. B. Sort objects based on their color, shape, and size.	color, shape, size, group		
3. Identify the basic characteristics of light, heat, motion, magnetism, electricity, and sound	A. Identify light vs. dark B. Identify the different ways in which objects move (such as zig zag, round and round, back and forth, and fast and slow) C. Identify objects that are attracted by a magnet. D. Describe the basic characteristics of light, magnetism, and motion	light, dark, shadow, motion, magnet, magnetism		
4. Model and explain that matter exists as solids, liquids, and gases and can change from one form to another	A. Identify liquids, solids, and gases.	liquid, solid, gas		
5. Identify that the position of an object can be described by its location relative to another object and its motions described, and measured by external forces action upon it	<b>Benchmark is addressed in grade 3</b>			
6. Identify, build, and describe mechanical systems and the forces acting within those systems	<b>Benchmark is addressed in grade 2 and 4</b>			
7. Observe, measure and manipulate forms of energy: sound, light, heat, electrical, magnetic	<b>See Benchmark 3 Essential Learning Expectations</b>			

**Science Content Standard 3.** Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Identify that plants and animals have structures and systems that serve different functions for growth, survival, and reproduction	A. List characteristics of living things B. List characteristics of nonliving things C. Compare living and nonliving things	plant, animal, living, nonliving, life cycle, food, energy, change, make new ones (reproduce), make waste (respire, excrete), respond		
2. Identify, measure, and describe basic requirements of energy and nutritional needs for an organism	<b>Benchmark is addressed in grade 1</b>			
3. Describe and use models that trace the life cycles of different plants and animals and discuss how they are differ from species to species	<b>Benchmark is addressed in grade 2</b>			
4. Explain cause and effect relationships between nonliving and living components with ecosystems; and explain individual response to the changes in the environment including identifying differences between inherited, instinctual, and learned behaviors	<b>Benchmark is addressed in grade 4</b>			
5. Create and use a classification system to group a variety of plants and animals according to their similarities and differences	A. Identify similarities and differences among a group of objects B. Group objects using a simple classification system	classify, similar, different		

**Science Content Standard 4.** Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe and give examples of earth's changing features	A. Define Earth as a planet B. List earth's features C. Identify local land and water features D. Construct a model of a local earth feature	mountain, lake, hill, valley, volcano, ocean, land, water, planet		
2. Describe and measure the physical properties of earth's basic materials (including soil, rocks, water and gases) and the resources they provide	<b>Benchmark is addressed in grade 2</b>			
3. Investigate fossils and make inferences about life, the plants, animals, and the environment at that time	<b>Benchmark is addressed in grade 2</b>			
4. Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured	<b>Benchmark is addressed in grade 1</b>			
5. Identify seasons and explain the difference between weather and climate	<b>Benchmark is addressed in grade 2</b>			
6. Identify objects (e.g., moon, stars, meteors) in the sky and their patterns of movement and explain that light and heat comes from a star called the sun	<b>Benchmark is addressed in grade 1</b>			
7. Identify technology and methods used for space exploration (e.g., star patterns, space shuttles, telescopes)	<b>Benchmark is addressed in grade 1</b>			

**Science Content Standard 5.** Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe and discuss examples of how people use science and technology	A. Identify examples of technology (products and processes) B. Demonstrate uses of technology	technology		
2. Describe a scientific or technological innovation that impacts communities, cultures, and societies	<b>Benchmark is addressed in grade 3</b>			
3. Simulate scientific collaboration by sharing and communicating ideas to identify and describe problems	<b>Benchmark is addressed in grade 4</b>			
4. Use scientific knowledge to make inferences and propose solutions for simple environmental problems	<b>Benchmark is addressed in grade 1</b>			
5. Identify how the knowledge of science and technology influences the development of the Montana American Indian cultures	A. Identify that tools are a form of technology B. Identify examples of tools that have been developed or are being developed by Montana American Indians	tool		

**Science Content Standard 6. Students understand historical developments in science and technology.**

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Give historical examples of scientific and technological contributions to communities, cultures and societies, including Montana American Indian examples	<b>Benchmark is addressed in grade 3</b>			
2. Describe how scientific inquiry has produced much knowledge about the world and a variety of contributions toward understanding events and phenomenon within the universe	A. Recognize that knowledge is gained through questioning and observations.	question, observe, knowledge		
3. Describe science as a human endeavor and an ongoing process	A. Recognize that humans use their senses to learn about the natural world	senses, sight, touch, taste, smell, hearing, natural world		



**Montana Instructional Alignment - Science**  
**Grade Level: 1**

**Content Standards**

**Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

**Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

**Content Standard 6**—Students understand historical developments in science and technology.

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

<b>Benchmark End of Grade 4</b>	<b>Essential Learning Expectation</b>	<b>Essential Vocabulary</b>	<b>Performance Rubrics</b>	<b>Materials and Resources</b>
1. Develop the abilities necessary to safely conduct scientific inquiry, including (a step-by-step sequence is not implied): (a) asking questions about objects, events, and organisms in the environment, (b) planning and conducting simple investigations	A. Record observations using the five senses B. Write a testable question with teacher guidance C. Follow appropriate safety rules D. Follow step-by-step directions in a simple guided investigation E. Identify the purpose of the investigation	procedure, question, testable, observation, investigation, experiment		
2. Select and use appropriate tools including technology to make measurements (including metric units) and represent results of basic scientific investigations	A. Identify differences and similarities between customary and metric measuring tools B. Use tools to measure time, mass, volume, length, and temperature	metric, length, temperature, mass, volume, beaker, ruler, scale, thermometer, clock		
3. Use data to describe and communicate the results of scientific investigations	A. Communicate observations made during inquiry process.			
4. Use models that illustrate simple concepts and compare those models to the actual phenomenon	<b>Benchmark is addressed in grade 2</b>			
5. Identify a valid test in an investigation	<b>Benchmark is addressed in grade 3</b>			
6. Identify how observations of nature form an essential base of knowledge among the Montana American Indians	A. Identify examples of Montana American Indians making use of natural resources B. Discuss Montana American Indians' explanations of the natural world	natural resources, natural world		

**Science Content Standard 2.** Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Create mixtures and separate them based on different physical properties (e.g., salt and sand, iron filings and soil, oil and water)	<b>Benchmark is addressed in grade 2</b>			
2. Examine, measure, describe, compare and classify objects in terms of common physical properties	A. Identify objects based on color, shape, size, texture, weight B. Describe objects based on their physical properties C. Sort objects based on their physical properties.	texture, weight		
3. Identify the basic characteristics of light, heat, motion, magnetism, electricity, and sound	A. Observe and describe the behavior of light (refraction and reflection) B. Conduct simple experiments with light (shadows)	bent (refraction), bounced (reflection), shadow, mirror, prism, magnifying lens		
4. Model and explain that matter exists as solids, liquids, and gases and can change form one form to another	A. Define measurement B. Recognize simple measurement tools C. Select appropriate tools for measurement of matter D. Manipulate tools for measurement of matter	scale, balance, thermometer, beaker, measuring tape, ruler		
5. Identify that the position of an object can be described by its location relative to another object and its motions described, and measured by external forces action upon it	<b>Benchmark is addressed in grade 3</b>			
6. Identify, build, and describe mechanical systems and the forces acting within those systems	<b>Benchmark is addressed in grade 2 and 4</b>			
7. Observe, measure and manipulate forms of energy: sound, light, heat, electrical, magnetic	<b>See Benchmark 3 Essential Learning Expectations</b>			

**Science Content Standard 3.** Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Identify that plants and animals have structures and systems that serve different functions for growth, survival, and reproduction	<b>Benchmark is addressed in grade 2</b>			
2. Identify, measure, and describe basic requirements of energy and nutritional needs for an organism	A. Define herbivore and carnivore B. Classify herbivore/carnivore C. Define a food chain D. Illustrate a food chain	food chain, herbivore, carnivore		
3. Describe and use models that trace the life cycles of different plants and animals and discuss how they are differ from species to species	<b>Benchmark is addressed in grade 2</b>			
4. Explain cause and effect relationships between nonliving and living components with ecosystems; and explain individual response to the changes in the environment including identifying differences between inherited, instinctual, and learned behaviors	<b>Benchmark is addressed in grade 4</b>			
5. Create and use a classification system to group a variety of plants and animals according to their similarities and differences	<b>Benchmark is addressed in grade 2</b>			

**Science Content Standard 4.** Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe and give examples of earth's changing features	A. Identify examples of land features B. Identify examples of water features	Earth, planet, star, sun, land, water, lake, pond, river, mountain, desert, valley, volcano, ocean		
2. Describe and measure the physical properties of earth's basic materials (including soil, rocks, water and gases) and the resources they provide	<b>Benchmark is addressed in grade 2</b>			
3. Investigate fossils and make inferences about life, the plants, animals, and the environment at that time	<b>Benchmark is addressed in grade 2</b>			
4. Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured	A. Identify elements of weather B. Observe daily weather conditions	weather, temperature, wind, rain, snow, clouds		
5. Identify seasons and explain the difference between weather and climate	<b>Benchmark is addressed in grade 2</b>			
6. Identify objects (e.g., moon, stars, meteors) in the sky and their patterns of movement and explain that light and heat comes from a star called the sun	A. Identify that there are objects in the sky, including stars, moon, and planets B. Identify the sun as a star C. Describe the cause of day and night as a result of the sun shining on Earth as it rotates D. Define a constellation as a group of stars that form a pattern E. Identify shapes of common constellations	star, moon, planet, day, night, rotate, light, dark, sky, Earth, sun, star, constellation, pattern, Big Dipper, North Star		
7. Identify technology and methods used for space exploration (e.g., star patterns, space shuttles, telescopes)	A. Identify types of technology used to observe objects in space	telescope, satellite, space shuttle, star chart		

**Science Content Standard 5.** Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe and discuss examples of how people use science and technology	A. Identify technology as the knowledge, processes and products used to solve problems and make lives easier B. Identify technology in the school C. Explain how technology is used in the school	technology		
2. Describe a scientific or technological innovation that impacts communities, cultures, and societies	<b>Benchmark is addressed in grade 3</b>			
3. Simulate scientific collaboration by sharing and communicating ideas to identify and describe problems	<b>Benchmark is addressed in grade 4</b>			
4. Use scientific knowledge to make inferences and propose solutions for simple environmental problems	A. Identify an environmental problem B. Discuss the scientific issues relevant to the environmental problem	environment, issue, problem		
5. Identify how the knowledge of science and technology influences the development of the Montana American Indian cultures	A. Identify that a process can be a form of technology B. Identify examples of processes used by Montana American Indians that served as technology.	process, technology		

**Science Content Standard 6.** Students understand historical developments in science and technology.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Give historical examples of scientific and technological contributions to communities, cultures and societies, including Montana American Indian examples	<b>Benchmark is addressed in grade 3</b>			
2. Describe how scientific inquiry has produced much knowledge about the world and a variety of contributions toward understanding events and phenomenon within the universe	A. Identify that knowledge is gained through questioning and observations.	question, observe, knowledge		
3. Describe science as a human endeavor and an ongoing process	A. Identify that everybody can do science.			

**Montana Instructional Alignment - Science**  
**Grade Level: 2**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Develop the abilities necessary to safely conduct scientific inquiry, including (a step-by-step sequence is not implied): (a) asking questions about objects, events, and organisms in the environment, (b) planning and conducting simple investigations	A. Use observations to ask questions about objects, events and organisms in the environment. B. Identify what's being measured in a simple investigation C. Identify what's staying the same in a simple investigation, with guidance D. Follow appropriate safety rules E. Follow step-by-step directions to conduct a simple guided investigation using controls and variables	procedure, question, investigation, experiment		
2. Select and use appropriate tools including technology to make measurements (including metric units) and represent results of basic scientific investigations	A. Use tools to measure time, mass, volume, length, and temperature B. Record measurements C. Display measurement using graphs	time, metric, length, temperature, mass, volume, beaker, ruler, scale, thermometer, bar graphs, line graphs		
3. Use data to describe and communicate the results of scientific investigations	A. Define data B. Present data graphically C. Explain how the data addresses the scientific investigation question	data		

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Use models that illustrate simple concepts and compare those models to the actual phenomenon	A. Define a model as a representation of an actual object B. Match models to real life examples	model		
5. Identify a valid test in an investigation	<b>Benchmark is addressed in grade 3</b>			
6. Identify how observations of nature form an essential base of knowledge among the Montana American Indians	A. Identify examples of Montana American Indians making use of natural resources B. Explain Montana American Indians' explanations of the natural world	nature, natural world		



**Science Content Standard 2.** Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Create mixtures and separate them based on different physical properties (e.g., salt and sand, iron filings and soil, oil and water)	A. Create a mixture B. Separate a mixture C. Explain what constitutes a mixture	mixture, separate		
2. Examine, measure, describe compare and classify objects in terms of common physical properties	A. List physical properties of common objects. B. Measure linear size of common objects C. Compare objects based on their similarities and differences.	physical properties, size, measure, compare, similarities, differences		
3. Identify the basic characteristics of light, heat, motion, magnetism, electricity, and sound	<b>Benchmark is addressed in grades 1 , 3 and 4</b>			
4. Model and explain that matter exists as solids, liquids, and gases and can change form one form to another	<b>Benchmark is addressed in grades K, 1, 3 and 4.</b>			
5. Identify that the position of an object can be described by its location relative to another object and its motions described, and measured by external forces action upon it	<b>Benchmark is addressed in grade 3</b>			
6. Identify, build, and describe mechanical systems and the forces acting within those systems	A. Identify simple tools B. Explain how simple tools make work easier.	tools, work		
7. Observe, measure and manipulate forms of energy: sound, light, heat, electrical, magnetic	<b>See Benchmark 3 Essential Learning Expectations</b>			

**Science Content Standard 3.** Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Identify that plants and animals have structures and systems that serve different functions for growth, survival, and reproduction	<b>Benchmark is addressed in grades 3, 4, and 5</b>			
2. Identify, measure, and describe basic requirements of energy and nutritional needs for an organism	<b>Benchmark is addressed in grade 1, 3, and 4</b>			
3. Describe and use models that trace the life cycles of different plants and animals and discuss how they are differ from species to species	A. Describe a plant life cycle (seed to plant to flower) B. Describe an animal life cycle C. Identify the stages of the life cycle (birth, growth, reproduction, death) D. Compare and contrast plant and animal life cycles.	life cycle, seed, egg, reproduce, adult, grow, change, development, plant, animal		
4. Explain cause and effect relationships between nonliving and living components with ecosystems; and explain individual response to the changes in the environment including identifying differences between inherited, instinctual, and learned behaviors	<b>Benchmark is addressed in grade 4</b>			
5. Create and use a classification system to group a variety of plants and animals according to their similarities and differences	A. Use a simple classification system for plants and animals	characteristics, classify, classification system		

**Science Content Standard 4.** Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe and give examples of earth's changing features	A. Compare and contrast the characteristics of earth's natural features B. Make a model of a variety of earth's features (land and water)	Earth, land, water, lake, pond, river, mountain, desert, valley, volcano, ocean		
2. Describe and measure the physical properties of earth's basic materials (including soil, rocks, water and gases) and the resources they provide	A. Identify that soil is made from rocks B. Identify that different rocks exist (color, texture) C. Compare and classify rocks based on color and texture.	soil, rock, classify, texture, color		
3. Investigate fossils and make inferences about life, the plants, animals, and the environment at that time	A. Recognize that there are a variety of fossil types B. Recognize that some kinds of plants and animals that once lived on earth have completely disappeared C. Define a fossil as physical evidence of past life.	fossil, plant, animal, evidence, extinct		
4. Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured	A. Recognize that all types of precipitation are different forms of water B. Identify characteristics of different types of weather conditions	precipitation, weather, water, rain, snow, temperature, wind		
5. Identify seasons and explain the difference between weather and climate	A. List the four seasons B. Identify characteristics of each season C. Compare/contrast the seasons	fall, autumn, winter, spring, summer, season		
6. Identify objects (e.g., moon, stars, meteors) in the sky and their patterns of movement and explain that light and heat comes from a star called the sun	<b>Benchmark is addressed in grades 1, 3, and 4</b>			
7. Identify technology and methods used for space exploration (e.g., star patterns, space shuttles, telescopes)	<b>Benchmark is addressed in grades 1 and 3</b>			

**Science Content Standard 5.** Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe and discuss examples of how people use science and technology	A. Identify technology as the knowledge, processes and products used to solve problems and make lives easier B. Identify various technologies in our community C. Explain how various technologies are used in the community	technology, tools, community		
2. Describe a scientific or technological innovation that impacts communities, cultures, and societies	<b>Benchmark is addressed in grade 3</b>			
3. Simulate scientific collaboration by sharing and communicating ideas to identify and describe problems	<b>Benchmark is addressed in grade 4</b>			
4. Use scientific knowledge to make inferences and propose solutions for simple environmental problems	A. Identify an environmental problem B. Discuss the scientific issues relevant to the environmental problem	environment, issue, problem		
5. Identify how the knowledge of science and technology influences the development of the Montana American Indian cultures	A. Identify how tools may be used for a specific process. B. Identify examples of tools, their uses, and how they have been developed and are being developed by Montana American Indians	tools, processes		

**Science Content Standard 6. Students, understand historical developments in science and technology.**

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Give historical examples of scientific and technological contributions to communities, cultures and societies, including Montana American Indian examples	<b>Benchmark is addressed in grade 3</b>			
2. Describe how scientific inquiry has produced much knowledge about the world and a variety of contributions toward understanding events and phenomenon within the universe	A. Demonstrate that knowledge is gained through questioning and observations. B. Identify examples of tools that enhance observations	question, observe, knowledge		
3. Describe science as a human endeavor and an ongoing process	A. Identify examples of science as a human process.			

**Montana Instructional Alignment - Science**  
**Grade Level: 3**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

<b>Benchmark End of Grade 4</b>	<b>Essential Learning Expectation</b>	<b>Essential Vocabulary</b>	<b>Performance Rubrics</b>	<b>Materials and Resources</b>
1. Develop the abilities necessary to safely conduct scientific inquiry, including (a step-by-step sequence is not implied): (a) asking questions about objects, events, and organisms in the environment, (b) planning and conducting simple investigations	A. Use observations to ask questions about objects, events and organisms in the environment. B. Recognize testable questions. C. Follow appropriate safety rules D. Design the steps of a simple investigation, with guidance E. Follow step-by-step directions to conduct a simple investigation	procedure, investigation, testable question, measure, observation		
2. Select and use appropriate tools including technology to make measurements (including metric units) and represent results of basic scientific investigations	A. Select appropriate tools for an investigation B. Demonstrate proper use of tools C. Recognize and use metric measurements D. Display measurements using simple tables and graphs.	tables, metric system, volume (milliliter, liter), mass (gram, kilogram), distance (centimeter, meter), time (seconds), graph, graduated cylinder, meter stick, thermometer (Celsius)		
3. Use data to describe and communicate the results of scientific investigations	A. Share results with classmates. B. Compare the results to the testable question	data, results		
4. Use models that illustrate simple concepts and compare those models to the actual	A. Match models to actual phenomenon B. Use models to demonstrate understanding	model		
5. Identify a valid test in an investigation	A. Define valid B. Identify components of an investigation that make it valid	valid		
6. Identify how observations of nature form an essential base of knowledge among the Montana American Indians	A. Identify ways that some American Indians used observation for survival (i.e. natural phenomenon, animal and insect behaviors, weather changes)			

**Science Content Standard 2.** Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Create mixtures and separate them based on different physical properties (e.g., salt and sand, iron filings and soil, oil and water)	A. Define a mixture B. Identify basic physical properties (size, shape, color) C. Make a mixture D. Identify methods used to separate mixtures (filtering, manual and evaporation) E. Separate a mixture	mixture, filtering, evaporation, physical properties		
2. Examine, measure, describe, compare and classify objects in terms of common physical properties	A. Describe objects according to common physical properties B. Classify objects according to their physical properties. i.e., size, shape, color, texture, mass	classify, physical properties, mass, texture		
3. Identify the basic characteristics of light, heat, motion, magnetism, electricity, and sound	A. Identify energy as the ability to cause change B. List examples of energy (light, heat, motion, magnetism, electricity, sound)	energy, light, heat, motion, magnetism, electricity, sound		
4. Model and explain that matter exists as solids, liquids, and gases and can change form one form to another	A. Classify tools that measure states of matter. i.e., balance scale, graduated cylinders, beakers, gram weights B. Describe the three states of matter i.e., solid, liquid, and gas.	balance, scale, graduated cylinder, beaker, gram weights, thermometer, solid, liquid, gas, matter		
	C. Describe the physical changes in matter, i.e., ice to water; water to vapor D. Observe and record the processes of changing states of matter (heating and cooling) E. List examples of things that heat up and cool down.	melting, freezing, evaporation, boiling		
5. Identify that the position of an object can be described by its location relative to another object and its motions described, and measured by external forces action upon it	A. Identify a force as a push or a pull B. Observe changes in speed or direction of motion are caused by forces C. Investigate how the amount of the force affects the change in motion.	force, motion, push, pull, change in motion		
6. Identify, build, and describe mechanical systems and the forces acting within those systems	<b>Benchmark is addressed in grades 2 and 4</b>			
7. Observe, measure and manipulate forms of energy: sound, light, heat, electrical, magnetic	<b>See Benchmark 3 Essential Learning Expectations</b>			

**Science Content Standard 3.** Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Identify that plants and animals have structures and systems that serve different functions for growth, survival, and reproduction	A. List the five needs of every living thing. (energy, habitat, water, nutrients, air) B. Identify plant and animal structures, i.e., plants: root, stem, leaf. animal: bones, skin	living, plant, animal, energy, habitat, nutrients, air		
3. Describe and use models that trace the life cycles of different plants and animals and discuss how they are differ from species to species	A. Identify that from food, animals obtain energy and materials for body repair and growth. B. Identify that solar energy is the primary source of energy for plants. C. Describe how and why energy sources are needed to sustain life.	energy, solar energy		
3. Describe and use models that trace the life cycles of different plants and animals and discuss how they are differ from species to species	A. Define species B. Compare the life cycle of two different organisms in the animal kingdom. C. Compare the life cycle of two different plant species.	life cycle, animal kingdom, species, organism, plant kingdom		
4. Explain cause and effect relationships between nonliving and living components with ecosystems; and explain individual response to the changes in the environment including identifying differences between inherited, instinctual, and learned behaviors	<b>Benchmark is addressed in grade 4</b>			
5. Create and use a classification system to group a variety of plants and animals according to their similarities and differences	<b>Benchmark is addressed in grade 4</b>			



**Science Content Standard 4.** Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe and give examples of earth's changing features	A. Identify examples of Earth's features, i.e., rocks and soil B. List materials that make up soil, i.e., weathered rock, humus, water, and air C. Describe the steps that rocks go through in weathering D. Identify causes of erosion	erosion, weathering, soil, rock, water, air		
2. Describe and measure the physical properties of earth's basic materials (including soil, rocks, water and gases) and the resources they provide	<b>Benchmark addressed in grade 4</b>			
3. Investigate fossils and make inferences about life, the plants, animals, and the environment at that time	<b>Benchmark is addressed in grade 4</b>			
4. Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured	A. Differentiate between melting, freezing, evaporation, condensation, and precipitation B. Illustrate or create a model of the water cycle C. Explain the changes that occur to water as it moves through the cycle	melting, freezing, evaporation, condensation, precipitation, water cycle		
	D. Identify the instruments used for measuring temperature and precipitation E. Record local temperature and precipitation F. Describe local weather using recorded data	thermometer, rain gauge, temperature, local weather, precipitation		
5. Identify seasons and explain the difference between weather and climate	A. Distinguish between weather and climate B. Describe local climate conditions for each season.	climate, weather, seasons, fall, autumn, winter, spring, summer		
6. Identify objects (e.g., moon, stars, meteors) in the sky and their patterns of movement and explain that light and heat comes from a star called the sun	A. Recognize that planets can have moons B. Identify the planets in our solar system C. Identify the relative location of planets and the sun	solar system, planets, sun, moon		
7. Identify technology and methods used for space exploration (e.g., star patterns, space shuttles, telescopes)	A. Identify the current types of technology and methods being used for space exploration B. Identify the types of information that can be learned from these methods			

<b>Science Content Standard 5.</b> Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies				
<b>Benchmark End of Grade 4</b>	<b>Essential Learning Expectation</b>	<b>Essential Vocabulary</b>	<b>Performance Rubrics</b>	<b>Materials and Resources</b>
1. Describe and discuss examples of how people use science and technology	<b>Benchmark is addressed in grades 1, 2, and 4</b>			
2. Describe a scientific or technological innovation that impacts communities, cultures, and societies	A. Identify technology as the knowledge, processes and products used to solve problems and make lives easier B. Define and discuss what constitutes a society C. Identify examples of scientific or technological discoveries that impact societies	technology, knowledge, society, processes, products, impact, discovery		
3. Simulate scientific collaboration by sharing and communicating ideas to identify and describe problems	<b>Benchmark is addressed in grade 4</b>			
4. Use scientific knowledge to make inferences and propose solutions for simple environmental problems	A. List and discuss environmental problems and concerns. B. Propose solutions for environmental problems using scientific knowledge	environment, problem, solution		
5. Identify how the knowledge of science and technology influences the development of the Montana American Indian cultures	A. Identify how tools for a specific use have changed over time. B. Identify how the change in tools have influenced Montana American Indian cultures C. Research local American Indian people who have made notable contributions D. Discuss how these works contributed to communities and society at large	tool, culture		

**Science Content Standard 6. Students, understand historical developments in science and technology.**

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Give historical examples of scientific and technological contributions to communities, cultures and societies, including Montana American Indian examples	A. Define and discuss what constitutes a community B. Identify historical examples of scientific or technological contributions that impacted societies, including Montana American Indians	society, contribution, historical, technology, impact		
2. Describe how scientific inquiry has produced much knowledge about the world and a variety of contributions toward understanding events and phenomenon within the universe	A. Identify examples where scientific inquiry is used to gain understanding of the natural world	scientific inquiry, natural world		
3. Describe science as a human endeavor and an ongoing process	A. Identify examples of science as an ongoing process.			

**Montana Instructional Alignment - Science**  
**Grade Level: 4**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Develop the abilities necessary to safely conduct scientific inquiry, including (a step-by-step sequence is not implied): (a) asking questions about objects, events, and organisms in the environment, (b) planning and conducting simple investigations	A. Ask a testable question using observations and prior knowledge B. Identify appropriate safety procedures C. Identify materials needed for an investigation D. List a step-by-step procedure for an investigation E. Conduct a student designed simple investigation	procedure, materials, investigation, testable question, measure, observation		
2. Select and use appropriate tools including technology to make measurements (including metric units) and represent results of basic scientific investigations	A. Use the appropriate tools to collect data, i.e., rulers, meter sticks, digital probes, thermometers, stop watches, scales, balances, beakers, graduated cylinders, etc. B. Record all data in metric units C. Organize data using tables D. Represent data graphically	tables, metric system, volume (milliliter, liter), mass (gram, kilogram), distance (centimeter, meter), time (seconds), graph, graduated cylinder, meter stick, thermometer (Celsius)		
3. Use data to describe and communicate the results of scientific investigations	A. Create graphs, charts, and diagrams B. Present collected graphs, charts and diagrams in a written and oral format.	graphs, charts, diagrams, increase, decrease, data, results		

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Use models that illustrate simple concepts and compare those models to the actual phenomenon	A. Identify the relative scale of a given model B. Compare and contrast how a model relates to the actual phenomenon	scale, compare, contrast, phenomenon, legend/key		
5. Identify a valid test in an investigation	A. Identify the parts of a valid test B. Identify a valid test in an investigation			
6. Identify how observations of nature form an essential base of knowledge among the Montana American Indians	A. Identify examples of Montana American Indians using observations in nature B. Describe the ways that some American Indians used observation to create knowledge (i.e., for survival)			

**Science Content Standard 2.** Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Create mixtures and separate them based on different physical properties (e.g., salt and sand, iron filings and soil, oil and water)	A. Identify substances in a mixture B. Identify examples of mixtures in everyday life. C. Create a mixture with objects that have various physical properties. D. Identify physical properties of substances in a mixture. E. Separate mixtures based on different physical properties. F. Separate mixtures using a variety of methods.	substance, mixture, physical properties, separate		
2. Examine, measure, describe, compare and classify objects in terms of common physical properties	A. Define physical property B. Identify characteristics of a physical property (size, color, shape, texture) C. Measure objects to determine differences and similarities D. Classifying objects multiple times by a variety of physical properties	physical property, characteristic, classify		

**Science Content Standard 2.** Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
3. Identify the basic characteristics of light, heat, motion, magnetism, electricity, and sound	A. Investigate attraction and repulsion with magnets. B. Describe the effect of distance on the magnetic field.	attract, repel, magnet, magnetic field		
	C. Investigate the visible spectrum D. Define reflect, refract, and absorb E. Classify materials as those that can reflect, refract or absorb light.	reflect, refract, absorb, visible spectrum, prism		
	F. Describe and list examples of a wave. G. Describe the relationship between a vibration and a sound wave. H. Model wave motion (up and down, back and forth, speed)	wave, vibration, sound, motion, speed, frequency, volume, pitch, wavelength, amplitude		
	I. Identify electricity as a flow of energy J. Compare and contrast current electricity and static electricity. K. List the safe uses of electricity. L. Construct an example of an electrical circuit.	electricity, energy, current, static, closed and open circuits, switch, parallel, series, battery (dry-cell vs. wet-cell), positive charge, negative charge.		
4. Model and explain that matter exists as solids, liquids, and gases and can change form one form to another	A. Differentiate between solids, liquids, and gases B. Identify examples of solids, liquids, and gases	solid, liquid, gas		
	C. Define physical properties and physical change D. List examples of physical changes E. Demonstrate physical changes through investigation.	physical property, physical change		
5. Identify that the position of an object can be described by its location relative to another object and its motions described and measured by external forces acting upon it	A. Investigate and describe how speed, direction, and forces affect the motion of an object.	speed, direction, force, motion		
6. Identify, build, and describe mechanical systems and the forces acting within those systems	A. Explore and identify simple machines, including real life examples. B. Build simple machines and explain how they make work easier.	simple machine, work, levers, inclined plane, wheel and axle, pulley, wedge, screw		
7. Observe, measure and manipulate forms of energy: sound, light, heat, electrical, magnetic	<b>See Benchmark 3 for Essential Learning Expectations</b>			

<b>Science Content Standard 3.</b> Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.				
<b>Benchmark End of Grade 4</b>	<b>Essential Learning Expectation</b>	<b>Essential Vocabulary</b>	<b>Performance Rubrics</b>	<b>Materials and Resources</b>
1. Identify that plants and animals have structures and systems that serve different functions for growth, survival, and reproduction	A. Identify the parts of plants. (stem, root, leaf, flower) B. Identify the parts of a flower (stamen, sepal, petal, pistil, pollen, ovule) C. Illustrate and label a plant and its parts.	stem, root, leaf, flower, stamen, sepal, pistil, pollen, ovule, petal,		
	D. Identify that animals have systems for certain functions E. Explain the relationship between basic animal systems and their functions.	system		
2. Identify, measure, and describe basic requirements of energy and nutritional needs for an organism	A. Define producer, consumer, decomposer, food chain, food web. B. Explain the difference between a food chain and a food web. C. Illustrate and describe the relationships in food chains and food webs	producer, consumer, decomposer, food chain, food web, herbivore, carnivore, omnivore		
3. Describe and use models that trace the life cycles of different plants and animals and discuss how they differ from species to species	<b>Benchmark is addressed in grade 2 and 3</b>			



**Science Content Standard 3.** Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Explain cause and effect relationships between nonliving and living components with ecosystems; and explain individual response to the changes in the environment including identifying differences between inherited, instinctual, and learned behaviors	A. Define adaptation. B. Identify adaptations in a variety of organisms that are specific to survival in their environment.	adaptation, survival, environment, organism		
	C. Define instinctual behaviors, inherited behaviors, and learned behaviors. D. Classify living things by instinctual, inherited, and learned behaviors. E. Compare and contrast the instinctual, inherited, and learned behaviors	instinctual, behavior, inherited, learned		
	F. Define predator, prey, competition G. Identify examples of predator/prey relationships and competition	predator, prey, competition		
5. Create and use a classification system to group a variety of plants and animals according to their similarities and differences	A. Define vertebrate and invertebrates. B. Identify examples of invertebrates and vertebrates C. Identify characteristics of flowering and non-flowering plants.	vertebrate, invertebrate, flowering, non-flowering		
	D. Identify rules for classification E. Place organisms into groups according to the classification rules	classify, similarities, differences, classification system		

**Science Content Standard 4.** Students through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe and give examples of earth's changing features	A. Define and illustrate the following terms: erosion, weathering, volcanoes, earthquakes, glaciations B. Describe the changes that occur to earth features in each event C. Illustrate the effects of the changes in Earth's surface	erosion, weathering, earthquakes, volcano, glaciations		
2. Describe and measure the physical properties of earth's basic materials (including soil, rocks, water and gases) and the resources they provide	A. Describe the formation of the three rock types. B. Compare and contrast the characteristics of the three basic types of rocks: sedimentary, metamorphic and igneous C. Identify specific samples of sedimentary, metamorphic and igneous rocks D. Identify everyday uses of rocks E. Classify rock samples by rock type	classification, igneous, metamorphic, sedimentary, pressure, deposition		
3. Investigate fossils and make inferences about life, the plants, animals, and the environment at that time	A. Define a fossil as physical evidence of past life B. Identify body fossils as those that contain plant and animal remains C. Identify trace fossils as those that record an impression of past life D. Explain how body and trace fossils are formed E. Compare a fossil to a plant/animal living today F. Infer what fossils tell us about past life and the environment.	fossil, body fossil, trace fossil, environment, impression		

**Science Content Standard 4.** Students through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured	A. Record temperature B. Display data on a graph C. Interpret trends and patterns of data	barometer, anemometer, weather vane, temperature, humidity, wind, precipitation, air pressure, patterns, trends		
	D. Identify and explain the use of a barometer, weather vane, and anemometer E. Collect, record and chart data from each weather instrument F. Identify the patterns G. Discuss trends within the patterns			
5. Identify seasons and explain the difference between weather and climate	<b>Benchmark is addressed in grade 3</b>			
6. Identify objects (e.g., moon, stars, meteors) in the sky and their patterns of movement and explain that light and heat comes from a star called the sun	A. Define and model revolution and rotation B. Model the orbit of the planets around the sun	orbit, rotation, revolution, planets, sun, axis		
	C. Identify the patterns of movement between a planet, its moon, and the sun. D. Identify changes in the appearance of the Earth's moon over the course of a month	moon, planet, sun, orbit, Earth		
	E. Identify other objects in the solar system (meteors, comets, and asteroids) F. Discuss the characteristics and movements of meteors, comets, and asteroids.	meteor, comet, asteroid, solar system		
7. Identify technology and methods used for space exploration (e.g., star patterns, space shuttles, telescopes)	<b>Benchmark is addressed in grades 1 and 3</b>			

<b>Science Content Standard 5.</b> Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies				
<b>Benchmark End of Grade 4</b>	<b>Essential Learning Expectation</b>	<b>Essential Vocabulary</b>	<b>Performance Rubrics</b>	<b>Materials and Resources</b>
1. Describe and discuss examples of how people use science and technology	A. Identify technology as the knowledge, processes and products used to solve problems and make lives easier B. Identify examples of technology used in modern society. C. Identify uses of technology in science, (i.e., probes, microscopes, lasers) D. Discuss how science and technology have impacted our environment.	technology, society, environment		
2. Describe a scientific or technological innovation that impacts communities, cultures, and societies	A. Define and discuss what constitutes a community, a culture, and a society B. Compare and contrast community, culture and society C. Identify and discuss examples of scientific or technological discoveries that impact a community, a culture and a society	technology, society, environment, community, culture		
3. Simulate scientific collaboration by sharing and communicating ideas to identify and describe problems	A. Identify a local current event or problem involving science B. Research and summarize the scientific issues relevant to that local current event or problem C. Present and discuss the research on the scientific issues relevant to that local current event or problem			
4. Use scientific knowledge to make inferences and propose solutions for simple environmental problems	A. List and discuss environmental problems and concerns. B. Research and summarize the scientific issues relevant to environmental problems C. Propose and discuss solutions for environmental problems using scientific knowledge	environment		
5. Identify how the knowledge of science and technology influences the development of the Montana American Indian cultures	A. Identify and discuss examples of scientific knowledge influencing the development of Montana American Indian cultures			

**Science Content Standard 6. Students, understand historical developments in science and technology.**

Benchmark End of Grade 4	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Give historical examples of scientific and technological contributions to communities, cultures and societies, including Montana American Indian examples	A. Define and discuss what constitutes a community, a culture, and a society B. Identify and discuss historical examples of scientific or technological contributions that impacted a community, a culture and a society; including Montana American Indians	society, culture, community		
2. Describe how scientific inquiry has produced much knowledge about the world and a variety of contributions toward understanding events and phenomenon within the universe	A. Research and describe examples where scientific inquiry was used to gain understanding of the natural world B. Identify and describe examples of scientific understanding that was contributed to by multiple scientists	scientific inquiry, natural world, collaborate		
3. Describe science as a human endeavor and an ongoing process	A. Identify occupations that use science including Montana American Indians. B. Identify and describe examples of science as an ongoing process.			

**Montana Instructional Alignment - Science**  
**Grade Level: 5**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth’s systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Identify a question, determine relevant variable and a control, formulate a testable hypothesis, plan and predict the outcome of an investigation, safely conduct scientific investigation, and compare and analyze data	A. Recognize and select a testable question when presented with multiple choices B. Write a testable question for an investigation C. Identify a hypothesis D. Explain the relationship between a testable question and a hypothesis E. Plan an investigation to test a hypothesis F. Identify the independent and dependent variable G. Identify a control group and explain its purpose H. List and follow appropriate safety procedures. I. Conduct the investigation	control, prediction, hypothesis, variable, testable question, independent variable, dependent variable		
2. Select and use appropriate tools including technology to make measurements (in metric units), gather, process and analyze data from scientific investigations	A. Collect data using observation and tools such as scale, balances, thermometer, beaker, digital probes, stop watch, graduated cylinder in metric units B. Record data using data tables C. Represent data using graphs	graduated cylinder, scales, Celsius thermometers, beaker, digital probes, stop watch, balances, metric units, data tables, graphs		
3. Review, communicate and defend results of investigations, including considering alternative explanations.	A. Compare data to hypothesis with guidance B. Determine if hypothesis is supported or not supported with guidance C. Communicate findings in written or oral format.	hypothesis, supported, not supported, prediction		

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Create models to illustrate scientific concepts and use the model to predict change. (e.g., computer simulation, stream table, graphic representation)	A. Explain the purpose of a model B. List various types of models including 2-D, 3-D and computer simulations C. Follow step-by-step directions to build a model	2-D, 3-D, computer simulations, legend/key		
5. Identify strengths and weakness in an investigation design.	<b>Benchmark is addressed in grades 6-8</b>			
6. Compare how observations of nature form an essential base of knowledge among the Montana American Indians.	A. Identify examples of Montana American Indians using observation to create knowledge of nature B. Explain how Montana American Indians have used observation to explain processes of nature			

**Science Content Standard 2.** Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Classify, describe, and manipulate the physical models of matter in terms of: elements, and compounds, pure substances and mixtures, atoms, and molecules	A. Identify common elements B. Define elements as pure substances C. Identify common compounds (water, carbon dioxide, salt) D. Distinguish between pure substances and mixtures E. Explain the relationship between elements, compounds, pure substances, and mixtures.	element, compound, mixture, pure substance		
2. Examine, describe, compare and classify objects and substances based on common physical properties and simple chemical properties	A. Define physical properties as properties that do not change the chemical nature of matter (i.e., color, smell, freezing point, boiling point, melting point, magnetism) B. Define chemical properties as properties that do change the chemical nature of matter (i.e., combustion, rust, decompose) C. Identify examples of chemical change (generating a gas, color change, rust)	mass, volume, chemical change, physical change, physical property, chemical property		
3. Describe energy and compare and contrast the energy transformations and the characteristics of light, heat, motion, magnetism, electricity, sound and mechanical waves	A. Identify that most matter can exist as a solid, liquid or gas depending on temperature. B. Describe the processes of sublimation, condensation, and evaporation	sublimation, evaporation, condensation, freezing point, melting point, energy, boiling point, solid, liquid, gas, matter		
	C. Explain how sound is produced, transmitted, and received. D. Describe how sound can be changed. E. Design and construct instruments that produce sound (The effects of mechanical waves are applied in Standard 4 Benchmark 1)	frequency, amplitude, pitch, wavelength, vibration, tension, medium, transmit, instrument		
	<b>Light is addressed in grades 6-8</b>			
	F. Define electricity as the flow of energy G. Distinguish the differences between simple, series, and parallel circuits H. Model series and parallel circuits I. Explain the flow of energy in a circuit.	energy, electricity, circuits (simple, parallel, series), battery, positive and negative charge		
	J. Explain the three types of heat transfer	conduction, convection, radiant energy (light), heat transfer, temperature		



**Science Content Standard 2.** Students, through the inquiry process, demonstrate the knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Model and explain that states of matter are dependent upon the quantity of energy present in the system and describe what will change and what will remain unchanged at the particulate level when matter experiences an external force or energy change	<b>This benchmark is addressed in grades 6-8</b>			
5. Describe and explain the motion of an object in terms of its position, direction, & speed as well as the forces acting upon it	A. Experiment with potential and kinetic energy, (i.e., cars/balls on ramp) B. Explain the differences between kinetic and potential energy	potential, kinetic, speed, force, mass		
	C. Identify that work is movement following application of a force. D. Demonstrate an example of work.	work, force		
6. Identify, build, describe, measure, and analyze mechanical systems (e.g., simple and complex compound machines) and describe the forces acting within those systems	<b>Benchmark is addressed in grades 6-8</b>			
7. Give examples and describe how energy is transferred and conserved (e.g. electric to light and heat [light bulb], chemical to mechanical [fuel to propulsion])	<b>Benchmark is addressed in grades 6-8</b>			

**Science Content Standard 3.** Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark End of Grade 8	Essential Learning Expectation (ELE)	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Compare the structure and function of prokaryotic cells (bacteria) and eukaryotic cells (plant, animal, etc.) including the levels of organization of the structure and function, particularly with humans	A. Describe the basic structure and function of a cell. B. Observe cells using a microscope. C. Compare plant and animals cells D. Create model/diagram of an animal and/or plant cells.	cell membrane, cell wall, nucleus, vacuoles, cytoplasm, mitochondria, chloroplast		
2. Explain how organisms and systems of organisms obtain and use energy resources to maintain stable conditions (e.g., food webs, photosynthesis, respiration)	A. Identify plant structures involved in photosynthesis and transpiration B. Identify the compounds involved in photosynthesis and transpiration C. Explain the process of photosynthesis and transpiration in terms of the key structures and compounds that are utilized. D. Explain the relationship between photosynthesis and transpiration	chlorophyll, photosynthesis, oxygen, carbon dioxide, sugar, water, light energy, transpiration, water vapor, roots, leaves		
3. Communicate the differences in the reproductive processes of a variety of plants and animals using the principles of genetic modeling (e.g., Punnet squares)	<b>Benchmark addressed in grades 6-8</b>			
4. Investigate and explain the interdependent nature of populations and communities in the environment and describe how species in these populations adapt by evolving	A. Explore and compare symbiotic relationships B. Define symbiosis C. Identify the key characteristics of an ecosystem D. Describe the interdependence between the parts of an ecosystem	symbiosis, ecosystems, population, community, environment, interdependence, diversity		
5. Create and use a basic classification scheme to identify plants and animals	A. Employ dichotomous key to separate a collection of basic objects B. Identify the kingdoms C. Know the difference between kingdom, phylum and class D. Define vertebrate/invertebrate, warm blooded/cold blooded E. Compare and contrast two characteristics of the animal kingdoms. F. Classify plants by flowering, non-flowering, mosses, ferns	dichotomous key, kingdom, phylum, class, vertebrate, invertebrate, cold-blooded, warm-blooded, mosses, ferns, flowering, non-flowering		

**Science Content Standard 4.** Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Model and explain the internal structure of the earth and describe the formation and composition of earth's external features in terms of the rock cycle and plate tectonics and constructive and destructive forces	A. Describe Earth's physical features B. Explain glaciations and weathering effects on the Earth's surface C. Define the role that plate tectonics play in changing Earth's features	glaciations, erosion, deposition, plate tectonics, continental drift, mountain, earthquake, volcano		
2. Differentiate between rocks types and minerals types and classify both by how they are formed and the utilization by humans	A. Differentiate between igneous, sedimentary, and metamorphic rocks. B. Identify that rock is composed of different kinds of minerals C. Define minerals as the building blocks of rocks. D. Compare and contrast the differences between rocks and minerals.	igneous, sedimentary, metamorphic, mineral, rock		
3. Use fossils to describe the geological timeline	A. Explain how sedimentary rock layers represent a progression of time B. Describe how the relative age of fossils can be determined from their position in sedimentary rock layers	sedimentary, fossil, relative age		

**Science Content Standard 4.** Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Describe the water cycle, the composition and structure of the atmosphere and the impact of oceans on large-scale weather patterns	A. Explain the water cycle and its application to weather. B. Identify different types of clouds and how they can be used to predict weather.	water cycle, condensation, evaporation, precipitation, forecast, meteorologist		
	C. Describe properties of air masses moving across the earth's surface D. Discuss how interactions of air masses are used to forecast the weather E. Interpret a weather map using correct symbols.	air mass, front, air pressure, warm front, cold front, precipitation, air currents		
5. Describe and model the motion and tilt of earth in relation to the sun, and explain the concepts of day, night, seasons, year, and climatic changes	A. Compare and contrast revolution and rotation B. Illustrate/model Earth's rotation in relation to the sun C. Explain how the Earth's rotation causes day and night D. Illustrate and model Earth's revolution in relation to the sun E. Describe and model the causes of seasons and year due to the revolution and tilt of the Earth in relation to the sun	revolution, rotation, tilt, axis, seasons, orbit, year		
6. Describe the earth, moon, planets and other objects in space in terms of size, force of gravity, structure, and movement in relation to the sun	A. Identify the relationship between the Earth, the sun, and the moon B. Explain how the moon is lighted by the sun C. Model the relative movements of the moon, Earth and sun D. Identify phases of the moon by how much of the lighted part of moon can be seen from Earth	Earth, planet, sun, moon, relative, phases of the moon, light, orbit		
7. Identify scientific theories about the origin and evolution of the earth and solar system	<b>Benchmark is addressed in grade 6</b>			

<b>Science Content Standard 5.</b> Through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies				
<b>Benchmark End of Grade 8</b>	<b>Essential Learning Expectation</b>	<b>Essential Vocabulary</b>	<b>Performance Rubrics</b>	<b>Materials and Resources</b>
1. Describe the specific fields of science and technology as they relate to occupations within those fields	A. Identify specific fields of science B. Identify occupations within specific fields of science C. Identify uses of technology unique to specific occupations within each field of science	life science, earth science, physical science, engineering, technology, occupations, science		
2. Apply scientific knowledge and process skills to understand issues and everyday events	A. Identify a local current event or problem involving science B. Research and summarize the scientific issues relevant to that local current event or problem	current event, issue, problem		
3. Simulate collaborative problem solving and give examples of how scientific knowledge and technology are shared with other scientists and the public	<b>Benchmark is addressed in grades 6-8</b>			
4. Use scientific knowledge to investigate problems and their proposed solutions and evaluate those solutions while considering environmental impacts	A. Identify a local issue with an environmental impact B. List possible environmental impacts C. Research and discuss proposed solutions	environmental impact		
5. Describe how the knowledge of science and technology influences the development of the Montana American Indian cultures	A. Investigate how science and technology have an impact on Montana American Indians B. Explain the impact of science and technology on Montana American Indians.			

**Science Content Standard 6. Understand historical developments in science and technology.**

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Give examples of scientific discoveries and describe the interrelationship between technological advances and scientific understanding, including Montana American Indian examples	A. Identify examples of technological advances throughout history, including Montana American Indian examples B. Identify and discuss scientific discoveries influenced by these technologies C. Discuss how technology advances science understanding	technology, scientific discoveries, advances		
2. Identify major milestones in science that have impacted science, technology, and society	A. Chart the history of scientific milestones (see Grades 6-8.) B. Discuss how milestones have impacted society over time.	milestones		
3. Describe and explain science as a human endeavor and an ongoing process	A. Investigate occupations that use science	occupation		
	B. Identify the features of science that make it a human endeavor and an ongoing process.			

**Montana Instructional Alignment - Science**  
**Grade Level: 6-8 Content Standard 1**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 8	Essential Learning Expectation (ELE)	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Identify a question, determine relevant variable and a control, formulate a testable hypothesis, plan and predict the outcome of an investigation, safely conduct scientific investigation, and compare and analyze data	A. Compare testable vs. non-testable questions B. Write a testable question for an investigation C. Explain the difference between variable and control D. Determine the variables and control for an investigation E. Distinguish between a testable question and a testable hypothesis F. Write a testable hypothesis for an investigation G. Formulate a plan to test the hypothesis that includes materials, procedures, control, variables, safety precautions, data collection and analysis methods H. Conduct investigation by following student-designed plan	hypothesis, control, variable, data		
2. Select and use appropriate tools including technology to make measurements (in metric units), gather, process and analyze data from scientific investigations	A. Identify metric base units B. Construct properly labeled data tables C. Select and use appropriate measurement tool(s) and metric units to gather data D. Identify and use the appropriate graphical representation of the data E. Analyze data using median, mean, mode, range and graphical comparisons	gram, liter, meter, Celsius, mean, median, mode, range		

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark End of Grade 8	Essential Learning Expectation (ELE)	Essential Vocabulary	Performance Rubrics	Materials and Resources
3. Review, communicate and defend results of investigations, including considering alternative explanations.	A. Identify data examples that support or refute the hypothesis B. Judge whether or not the data supports the hypothesis C. Communicate results by sharing and comparing data with others D. Compare the differences between student collected data E. Infer the reasons why student collected data may vary F. Defend conclusions by providing examples from the data G. Share and discuss alternative conclusions	supported, refute, hypothesis		
4. Create models to illustrate scientific concepts and use the model to predict change. (e.g., computer simulation, stream table, graphic representation)	A. Identify the similarities and differences between working models and representative models B. Create representative models to demonstrate knowledge of scientific concepts (i.e., biomes, cells, life systems, density, water cycle) C. Create working models to illustrate scientific concepts D. Manipulate working models to predict and make conclusions about scientific concepts E. Identify the advantages and limitations of various models	working models, representative models		
5. Identify strengths and weakness in an investigation design.	A. Identify the essential components of investigation design (i.e. sample size and selection, repetition, controls) B. Explain the purpose of each essential component and why you must plan an investigation C. Identify the strengths and weaknesses in a variety of investigations	inquiry, investigation, sample size, control, repeated trials		
6. Compare how observations of nature form an essential base of knowledge among the Montana American Indians.	A. Identify examples of various Montana American Indian tribes using observation B. Compare how observations of nature form an essential base of knowledge among the different Montana American Indian tribes (e.g., migration patterns, planting cycles, etc.)	Montana American Indian tribes: Crow, Blackfeet, Salish, Kootenai, Assiniboine Sioux, Little Shell, Northern Cheyenne, Chippewa Cree, Pend d'Oreille, and Gros Ventre		



**Montana Instructional Alignment - Science**  
**Grade Level: 6-8 Content Standard 2**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth’s systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Classify, describe, and manipulate the physical models of matter in terms of: elements, and compounds, pure substances and mixtures, atoms, and molecules	A. Classify matter as atoms, molecules, elements, compounds, pure substances, or mixtures. B. Identify common element and compounds by their symbol and chemical formula C. Create and manipulate simple models of common elements and compounds. D. Identify the relationship between atoms, molecules, elements, compounds, pure substances and mixtures.	atom, element, compound, pure substance, mixture, molecule		
2. Examine, describe, compare and classify objects and substances based on common physical properties and simple chemical properties	A. Distinguish between chemical and physical properties of matter B. Compare objects and substances based on their physical properties and simple chemical properties C. Classify objects and substances based on common physical properties and simple chemical properties	chemical property, physical property, chemical change, physical change		

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
3. Describe energy and compare and contrast the energy transformations and the characteristics of light, heat, motion, magnetism, electricity, sound and mechanical waves	A. Describe energy B. Identify examples of various forms of energy C. Compare and contrast various forms of energy D. Explain the Law of Conservation of energy using various forms of energy transformation.	energy, potential energy, kinetic energy, thermal energy, mechanical energy, radiant energy, chemical energy, nuclear energy, electric energy, Law of Conservation of Energy		
	E. Describe various types of light (visible and invisible) F. Describe the behavior of light (e.g. refraction, reflection, diffraction) G. Identify characteristics of the electromagnetic spectrum H. Explain the behavior of light (particle vs. wave, reflection, diffraction, speed)	visible spectrum, ultraviolet, infrared, reflection, refraction, electromagnetic spectrum		
	I. Compare and contrast the three types of heat transfer	radiant heat, conduction, convection		
	J. Explain the relationship between energy and motion			
	K. Describe properties of magnetic materials L. Describe the properties of electricity M. Identify how electricity is produced. N. Describe the relationship between electricity and magnetism	electromagnet, magnet, electricity, current, voltage		
	O. Identify the parts of waves P. Describe the basic properties of sound Q. Compare and contrast longitudinal and transverse waves R. Discuss the variables that affect the speed of sound (e.g., temperature, density)	crest, trough, resting position, wavelength, amplitude, intensity, frequency, pitch, resonance		
	4. Model and explain the states of matter are dependent upon the quantity of energy present in the system and describe what will change and what will remain unchanged at the particulate level when matter experiences an external force or energy change	A. Explain the three states of matter and how they relate to temperature change B. Explain the relationship between changes in thermal energy and states of matter (e.g., increase/decrease of thermal energy = change in state) C. Recognize that temperature measures the average kinetic energy of particles in a substance. D. Describe what will change and what will remain unchanged at the particulate level when matter experiences an external force or energy change	thermal energy, melting point, boiling point, solid, liquid, gas, sublimation, evaporation, condensation	

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
5. Describe and explain the motion of an object in terms of its position, direction, and speed as well as the forces acting upon it	A. Describe the basic characteristics of motion (position, direction, speed, reference point) B. Identify variables that affect the motion of an object C. Define force D. Explain different types of forces E. Explain Newton's laws of motion F. Explain, the relationship between speed, velocity, acceleration, force, mass, and momentum	gravity, balanced force, unbalanced force, friction, net force, air resistance, speed, velocity, acceleration, mass, inertia, momentum, air pressure, lift, drag, Newton's laws of motion		
6. Identify, build, describe, measure, and analyze mechanical systems (e.g., simple and complex compound machines) and describe the forces acting within those systems	A. Compare and contrast simple, complex compound machines B. Recognize that a machine makes work easier by changing the amount or direction of the force C. Identify that simple and compound machines transfer energy by doing work D. Measure and calculate efficiency, ideal and actual mechanical advantage for simple machines using the appropriate formulas (e.g., work $w=f \times d$ ) E. Create simple and complex compound machines to examine and measure the related forces	simple machine, compound machine, work, force, lever, pulley, inclined plane, wedge, screw, wheel and axle, fulcrum, pivot, mechanical advantage		
7. Give examples and describe how energy is transferred and conserved (e.g. electric to light and heat [light bulb], chemical to mechanical [fuel to propulsion])	A. Discuss that energy can be transferred (one object to another) or transformed (one form to another) B. Discuss multi-step energy transformations/transfers C. The relationship between energy transfer/transformations and conservation of energy.	energy transformation, energy conservation,		

**Montana Instructional Alignment - Science  
Grade Level: 6-8 Content Standard 3**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Compare the structure and function of prokaryotic cells (bacteria) and eukaryotic cells (plant, animal, etc.) including the levels of organization of the structure and function, particularly with humans	A. Identify and observe single-celled and multicellular organisms B. Define nucleus, prokaryotic and eukaryotic cells C. Classify cells as prokaryotic and eukaryotic D. Identify and describe the functions of cell organelles in meeting the needs of cells E. Define cell, tissue, organ, system, and organism F. Illustrate the hierarchal relationships of cells, tissues, organs, organ systems, and organisms	cell, tissue, organ, system, organism organelle, eukaryotic, prokaryotic, nucleus, bacteria		
2. Explain how organisms and systems of organisms obtain and use energy resources to maintain stable conditions (e.g., food webs, photosynthesis, respiration)	A. Describe the process by which organisms (plants and animals) use the energy from sugars to carry out life functions. B. Explain the process by which organisms obtain energy from the sun. C. Diagram the flow of energy through photosynthesis and its decomposition through respiration	photosynthesis, respiration		
	D. Analyze energy movement in biomes (food webs and pyramids) E. Classify organisms in food webs based upon characteristics (e.g., physical and behavior)	biomes, food web, food pyramid, producer, primary and secondary consumers, food chain, decomposer		

**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
3. Communicate the differences in the reproductive processes of a variety of plants and animals using the principles of genetic modeling (e.g., Punnett squares)	A. Explain the function of a chromosome B. Identify organisms that have different numbers of chromosomes C. Identify the number of chromosomes in human body cells and human sex cells	chromosome, body cell, sex cell		
	D. Identify the purposes of cell division E. Describe the key events in each phase of mitosis F. Identify the differences in mitosis and meiosis G. Differentiate between sexual reproduction and asexual reproduction	mitosis, meiosis, asexual, sexual reproduction, phase		
	H. Define and identify gene, inheritance, phenotype, and genotype I. Define and identify dominant and recessive traits J. Identify examples of inherited characteristics K. Explain why inherited characteristics of living things depend on genes	phenotype, genotype, dominant, recessive, gene, inheritance, traits		
	L. Define Punnett square and genetic cross M. Predict genetic crosses using Punnett squares N. Interpret simple genetic crosses using Punnett squares	Punnett square, genetic cross, genotype, phenotype		

**Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.**

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Investigate and explain the interdependent nature of populations and communities in the environment and describe how species in these populations adapt by evolving	A. Distinguish between a population and a community B. Identify living and non-living factors that effect populations and communities C. Identify the different types of symbiosis and their positive and negative effects D. Explain how populations are impacted by changes in living and non-living factors in the environment	population, community, symbiosis, mutualism, commensalism, parasitism, predator, prey, competition, water cycle		
	E. Explain and provide examples of adaptations F. Define natural selection G. Explain the relationship between adaptations and natural selection H. Identify natural selection as a mechanism for evolution I. Identify lines of evidence that support evolution. J. Explain how the fossil record provides evidence of life forms' appearance, diversification, and extinction	adaptation, natural selection, evolution, fossil, extinction		
5. Create and use a basic classification scheme to identify plants and animals	A. Explain the relationship between kingdom, phylum, class, order, family, genus, and species B. Identify and describe similarities and differences among organisms of different, but closely related taxa (i.e., pine trees, big cats, rodents ungulates) C. Create and use a basic classification scheme to identify plants and animals.	dichotomous key, kingdom, taxonomy, phylum, genus, species, scientific name, scheme		

**Montana Instructional Alignment - Science**  
**Grade Level: 6-8 Content Standard 4**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Model and explain the internal structure of the earth and describe the formation and composition of earth's external features in terms of the rock cycle and plate tectonics and constructive and destructive forces	A. Identify internal structures of the earth and their characteristics B. Model or diagram the internal structure of the earth	mantle, inner core, outer core, crust, lithosphere		
	C. Diagram convection currents inside of the earth D. Explain the movement of plates over time. E. Explain or model the differences between Oceanic and Continental plates. F. Model and explain constructive forces on the earth (i.e., plate tectonics).			
	G. Compare and contrast types of rocks formed from different earth processes H. Model and explain the appearance of the earth caused by destructive forces (i.e., weathering and erosion)	rock cycle, metamorphic, sedimentary, igneous, constructive, weathering, erosion		

**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
2. Differentiate between rock types and mineral types and classify both by how they are formed and the utilization by humans	A. Make use of common rock and mineral identification tests to identify rocks and minerals, including common Montana rocks and minerals B. List how rocks and minerals are used in daily life. C. Explain the importance of the mining industry in Montana and the uses of rocks and minerals.	mineral, rock, hardness, streak, luster		
	D. Diagram the interaction between igneous, sedimentary and metamorphic rocks through the rock cycle	rock cycle, metamorphic, sedimentary, igneous		
3. Use fossils to describe the geologic timeline	A. Identify major geologic divisions of time B. Categorize the predominant organisms that appear within each major division of geologic time	Cenozoic era, Mesozoic era, Paleozoic era, Precambrian		
4. Describe the water cycle, the composition and structure of the atmosphere and the impact of oceans on large-scale weather patterns	A. Identify, diagram and label the composition and structure of the atmosphere. B. Identify, diagram and label the components of the water cycle	atmosphere, precipitation, evaporation, condensation, water vapor, troposphere		
	C. Describe convection currents D. Explain how ocean currents are caused by convection currents E. Explain the impact of ocean currents on large-scale weather patterns.	convection currents, ocean currents, jet stream, el Niño, gulf stream		



**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
5. Describe and model the motion and tilt of earth in relation to the sun, and explain the concepts of day, night, seasons, year, and climatic changes	<p>A. Explain, using a model, how the Earth rotates and revolves around the sun.</p> <p>B. Identify Earth's climate zones and their key characteristics</p> <p>C. Explain how Earth's tilt and revolution affects climate zones</p> <p>D. Explain how Montana's location on earth influences Montana's climate</p> <p>E. Predict how a change in planetary movement would change Earth's days, seasons, years and climate.</p>	<p>rotation, revolution, orbit, axis, solstice, climate zone, Northern/Southern hemisphere, latitude, elevation, equator</p>		
6. Describe the earth, moon, planets and other objects in space in terms of size, force of gravity, structure, and movement in relation to the sun	<p>A. Describe the earth, moon, planets and other objects in space in terms of relative size and structure.</p> <p>B. Identify that planets in our solar system have different lengths of orbits and periods of rotation around the sun.</p> <p>C. Discuss how length of orbit and period of rotation affects length of years and days</p> <p>D Compare and contrast the length of days and years on different planets.</p> <p>E Describe the role of gravity in the orbit of moons around planets and planets around the sun.</p>	<p>planet, moon, orbit, period of rotation, year, day, gravity, force</p>		
7. Identify scientific theories about the origin and evolution of the earth and solar system	<p>A. Define scientific theory as an explanation supported by rigorous testing and multiple lines of evidence</p> <p>B. Recognize that the sun and planets formed from the accretion of dust and gases</p> <p>C. Identify how planets, such as the Earth, changed after their formation</p>	<p>scientific theory, evidence, solar system, gas, dust, accretion</p>		

**Montana Instructional Alignment - Science**  
**Grade Level: 6-8 Content Standard 5**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth’s systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe the specific fields of science and technology as they relate to occupations within those fields	A. Research a variety of science and technological fields. B. Identify and describe a variety of occupations within fields of science and technology C. Identify and describe uses of technology unique to specific occupations within each field of science	occupations, science, technology, science fields (life science, earth science, engineering, physical science)		
2. Apply scientific knowledge and process skills to understand issues and everyday events	A. Identify a local current event or problem involving science B. Research and summarize the scientific issues relevant to that local current event or problem C. Present and discuss the research on the scientific issues relevant to that local current event or problem			

**Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
3. Simulate collaborative problem solving and give examples of how scientific knowledge and technology are shared with other scientists and the public	A. Identify and describe methods scientists use to collaborate and share scientific findings with other scientists B. Identify and describe methods scientists use to share scientific findings with the public C. Identify, working in collaboration, a current event or problem involving science D. Research and summarize, working in collaboration, the scientific issues relevant to that current event or problem E. Present and discuss, working in collaboration, the scientific issues relevant to that current event or problem	current event, problem, issue, research, summarize, collaborate, relevant		
4. Use scientific knowledge to investigate problems and their proposed solutions and evaluate those solutions while considering environmental impacts	A. Identify and research a local issue with an environmental impact B. Explain possible environmental impacts C. Propose solutions	environmental impact, proposed solutions		
5. Describe how the knowledge of science and technology influences the development of the Montana American Indian cultures	A. Investigate how science and technology have impact on Montana American Indians B. Explain the impact of science and technology on Montana American Indians.			

**Montana Instructional Alignment - Science  
Grade Level: 6-8 Content Standard 6**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth’s systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 6**—Students understand historical developments in science and technology.

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Give examples of scientific discoveries and describe the interrelationship between technological advances and scientific understanding, including Montana American Indian examples	A. Identify and describe examples of technological advances throughout history, including Montana American Indian examples B. Identify and explain scientific discoveries influenced by these technologies C. Explain how technology advances science understanding			

**Content Standard 6—Students understand historical developments in science and technology.**

Benchmark End of Grade 8	Essential Learning Expectation	Essential Vocabulary	Performance Rubrics	Materials and Resources
<p>2. Identify major milestones in science that have impacted science, technology, and society</p>	<p>A. Identify and describe the importance of various physical scientists and their discoveries such as Aristotle (motion), Archimedes (levers and properties of buoyancy), Galileo, Newton &amp; Da Vinci (further researched motion), Einstein (discovered gravity's effect on light), Goddard (designed the first liquid propelled rocket)</p> <p>B. Identify and describe the importance of various life scientists and their discoveries such as Hooke &amp; Van Leeuwenhoek (development of microscope), Pasteur (pasteurization and vaccines), Mendel (heredity), Darwin (evolution), Curie (radiation), Linnaeus (binomial nomenclature), Virchow, Schwann &amp; Schleiden (cell theory), Crick &amp; Watson (DNA)</p> <p>C. Identify and describe the importance of various earth scientists and their discoveries such as Steno (recognized the importance of rock layers), Hutton (Naturalness of change theory), Boltwood (dating and timescale), Horner (fossils and Museum of the Rockies), Hubble (astronomy), Cousteau (oceanography)</p>			
<p>3. Describe and explain science as a human endeavor and an ongoing process</p>	<p>A. Describe examples of scientific knowledge changing human understanding of the natural world</p> <p>B. Describe and explain the features of science that make it a human endeavor and an ongoing process.</p>			

**Montana Instructional Alignment - Science  
Grade Level: 9-12 Content Standard 1**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Generate a question, identify dependent and independent variables, formulate testable, multiple hypotheses, plan an investigation, predict its outcome, safely conduct the scientific investigations, and collect and analyze the data.	A. Identify the various applications of scientific investigations (explore new phenomena, check on previous results, to test how well a hypothesis predicts, and to compare hypotheses) <sup>(10)</sup> B. Identify a testable question <sup>(10)</sup> C. Identify, from a set of questions, which question can be analyzed using a given set of sample data <sup>(10)</sup> D. Distinguish the independent and dependent variables by examining a scientific experiment/investigation <sup>(10)</sup> E. Write a testable question <sup>(10)</sup>	testable question, independent variable, dependent variable		
	F. Generate a valid hypothesis <sup>(10)</sup> G. Discriminate between a testable question and a hypothesis <sup>(10)</sup> H. Compare and contrast a list of hypotheses to determine if they are testable. I. Formulate a single or multiple hypotheses on any given experiment/investigation <sup>(10)</sup>	hypothesis, experiment, investigation		
	J. Use the independent and dependent variable to determine the materials, tools and techniques needed for an investigation <sup>(10)</sup> K. Formulate a sequential plan for an investigation <sup>(10)</sup> L. Identify the appropriate safety practices for an investigation <sup>(10)</sup> M. See benchmark 2 for data collection and analysis ELEs			

Science Content Standard 1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.				
Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
2. Select and use appropriate tools including technology to make measurements (in metric units), gather, process and analyze data from scientific investigations using appropriate mathematical analysis, error analysis, and graphical representation	A. Design data tables/setup and show an organizational strategy <sup>(10)</sup> B. Gather data (qualitative/quantitative) using appropriate measurements and methods <sup>(10)</sup> C. Apply the metric system by appropriate use of units and conversion factors <sup>(10)</sup>	qualitative, quantitative, error analysis		
	D. Apply appropriate mathematical analysis <sup>(10)</sup> E. Demonstrate graphing design (placement of dependent and independent variables/scaling/units/keys/titles/labels/graph types) <sup>(10)</sup> F. Identify possible sources of error <sup>(10)</sup> G. Identify and interpret trends in data using graphical analysis <sup>(10)</sup>			
3. Review evidence, communicate and defend results, and recognize that the results of a scientific investigation are always open to revision by further investigations. (e.g. through graphical representation or charts)	A. Identify techniques used to review evidence (summary, graphical organizers, models) <sup>(10)</sup> B. Identify relationship between data trends and scientific concepts <sup>(10)</sup> C. Determine appropriate communication techniques to communicate and defend results <sup>(10)</sup> D. Communicate interpretations and conclusions using scientific concepts, mathematical relationships and technology <sup>(10)</sup> E. Justify and defend conclusions based on evidence <sup>(10)</sup> F. Explain why conclusions based on evidence are open to revision upon further investigation <sup>(10)</sup>	evidence		
4. Analyze observations and explain with scientific understanding to develop a plausible model (e.g., atom, expanding universe)	A. Identify that various types of models (physical, mental, graphical, and mathematical) can be used to illustrate scientific concepts <sup>(10)</sup> B. Explain why models are used to express scientific concepts <sup>(10)</sup> C. Use models to investigate and represent scientific concepts <sup>(10)</sup> D. Generate a model based on evidence gathered in an investigation <sup>(10)</sup>	model		

**Science Content Standard 1.** Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
5. Identify strengths, weaknesses, and assess the validity of the experimental design of an investigation through analysis and evaluation	A. Identify and assess the characteristics of a valid investigation <sup>(10)</sup> B. Identify experimental error and communicate suggestions for modified or redesigned experiment <sup>(10)</sup> C. Compare and contrast the validity of various experiments designed to measure the same outcome <sup>(10)</sup>	valid, experimental design		
6. Explain how observations of nature form an essential base of knowledge among the Montana American Indians	A. Explain how observations of nature form an essential base of knowledge <sup>(10)</sup> B. Describe an example of Montana American Indians using observation to develop cultural knowledge and practices <sup>(10)</sup>			



**Montana Instructional Alignment - Science  
Grade Level: 9-12 Content Standard 2**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth’s systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Describe the structure of atoms, including knowledge of (a) subatomic particles and their relative masses, charges, and locations within the atom, (b) the electrical and nuclear forces that hold the atom together, (c) fission and fusion, and (d) radioactive decay	A. Compare and contrast subatomic particles in relation to their relative masses, charges and location <sup>(10)</sup> B. Compare and contrast the number of subatomic particles in different elements and their isotopes <sup>(10)</sup>	electron, proton, neutron, element, isotope, atomic mass, atomic number		
	C. Recognize there is an electrical force of attraction/repulsion <sup>(10)</sup> D. Recognize there are strong nuclear forces that keeps the nucleus intact	electrical force, nuclear force		
	E. Explain radioactive decay and provide examples <sup>(10)</sup> F. Explain nuclear fission and fusion and provide examples			

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
2. Explain how the particulate level structure and properties of matter affect its macroscopic properties, including the effect of (a) valence electrons on the chemical properties of elements and the resulting periodic trends in these properties, (b) chemical bonding, (c) molecular geometry and intermolecular forces, (d) kinetic molecular theory on phases of matter, and (e) carbon-carbon atom bonding on biomolecules	A. Recognize the Periodic Table is organized based on a series of repeating patterns <sup>(10)</sup> B. Utilize the periodic Table to determine the number of valence electrons of an element <sup>(10)</sup> C. Utilize the Periodic Table to predict, from neutral atoms, the formation of ions with the number of electrons gained or lost <sup>(10)</sup> D. Recognize that chemical properties of electrons change with the number of valence electrons	valence electrons, ions		
	E. Compare and contrast ionic, covalent and hydrogen bonds <sup>(10)</sup> F. Describe the significance of electrons in interactions between atoms and why they sometimes form bonds G. Explain how the chemical bonding of a molecule affects its macroscopic (physical) properties	chemical bond		
	H. Explain how the molecular geometry of a molecule (e.g. water) affects polarity and cohesive/adhesive properties <sup>(10)</sup>	polarity, cohesion, adhesion, molecular geometry		
	I. Describe the physical properties of each state of matter: solid, liquid, and gas <sup>(10)</sup> J. Describe, using the kinetic molecular theory, the behavior of particles in each state of matter: solid, liquid, and gas K. Use a phase change diagram to describe changes energy and state	melting, freezing, sublimation, deposition, condensation, vaporization (boiling and evaporation)		
	L. Explain how electrons are shared in single, double, triple bonds M. Explain how the variety of carbon-carbon bonds leads to the diversity of biomolecules	single, double, triple bonds, carbon-carbon bonds, biomolecules		

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
3. Describe the major features associated with chemical reactions, including (a) giving examples of reactions important to industry and living organisms, (b) energy changes associated with chemical changes, (c) classes of chemical reactions, (d) rates of reactions, and (e) the role of catalysts	A. Provide evidence that a chemical change has occurred <sup>(10)</sup> B. Illustrate a chemical reaction using chemical formulas <sup>(10)</sup> C. Describe properties of chemical reaction classes (combustion, decomposition, synthesis, single-replacement, and double-replacement, etc.) D. Describe the energy changes in exothermic and endothermic reactions.	reactants, products, exothermic, endothermic, combustion, synthesis, single-replacement, double-replacement, oxidation/reduction, acid/base		
	E. Describe factors that effect the rate of reactions <sup>(10)</sup>	catalyst		
	F. Give examples of chemical reactions important to industry and living organisms <sup>(10)</sup>			
4. Identify, measure, calculate, and analyze relationships associated with matter and energy transfer or transformations, and the associated conservation of mass	A. Describe the law of conservation of mass <sup>(10)</sup> B. Measure and/or calculate energy transfer for a sample set of data or experiment C. Analyze the relationship between energy transfer and physical properties of matter D. Explain the unique circumstances allowing mass to transform into energy, or energy into mass	law of conservation of mass		

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
5. Explain the interactions between motions and forces, including (a) the laws of motion and (b) an understanding of the gravitational and electromagnetic forces	A. Explain, given $F = ma$ , the relationship between force and acceleration in uniform motion <sup>(10)</sup> B. Solve simple kinematics problems using the kinematics equations for uniform acceleration: $v_{avg} = d/t$ , $a = \Delta v/t$ , and $d = 1/2 at^2$ <sup>(10)</sup> C. Distinguish between a scalar quantity and a vector quantity.	scalar quantity, vector quantity, force, mass, acceleration, velocity		
	D. List examples of different types of forces <sup>(10)</sup> E. Describe the role of friction in motion <sup>(10)</sup> F. Describe situations that illustrate Newton's three laws of motion <sup>(10)</sup> G. Explain the relationship between mass and distance in relation to gravitational force <sup>(10)</sup> H. Describe the relationship between magnetism and electricity and the resulting electromagnetic force	inertia, gravitational force, electromagnetic force		
6. Explain how energy is stored, transferred, and transformed, including (a) the conservation of energy, (b) kinetic and potential energy and energy contained by a field, (c) heat energy and atomic and molecular motion, and (d) energy tends to change from concentrated to diffuse	A. Describe the differences between kinetic energy and potential energy <sup>(10)</sup> B. Explain the relationship between kinetic energy and potential energy in a system <sup>(10)</sup> C. Discuss the conservation of energy <sup>(10)</sup>	energy, potential energy, kinetic energy		
	D. Recognize heat as a form of energy transfer <sup>(10)</sup> E. F. Explain the relationship between temperature, heat and thermal energy <sup>(10)</sup> F. Define the kinetic molecular theory and its relationship to heat (thermal energy transfer). G. Relate how energy tends to change from concentrated to diffuse states.	joules, calories, temperature, heat		

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
7. Describe how energy and matter interact, including (a) waves, (b) the electromagnetic spectrum, (c) quantization of energy, and (d) insulators and conductors	A. Identify and illustrate different types of waves <sup>(10)</sup> B. Compare and contrast the similarities and differences between longitudinal and transverse mechanical waves <sup>(10)</sup> C. Explain how waves interact with media.	amplitude, wavelength, frequency, period		
	D. Compare the various electromagnetic waves (gamma rays, x-rays, ultraviolet, visible, infrared, microwave, and radio waves) in terms of energy and wavelength <sup>(10)</sup> E. Identify practical uses of various electromagnetic waves <sup>(10)</sup> F. Compare the visible light colors in terms of energy and wavelength G. Recognize that atoms and molecules can gain or lose energy only in particular discrete amounts. H. Recognize that every substance emits and absorbs certain wavelengths I. Explain how electromagnetic waves are superposed, bent, reflected, refracted, and absorbed.	electromagnetic spectrum, photon, reflection, refraction		
	J. Describe the difference between an electrical conductor and an electrical insulator <sup>(10)</sup> K. Describe the difference between a heat conductor and a heat insulator <sup>(10)</sup> L. Explain how electricity is involved in the transfer of energy <sup>(10)</sup>	current, resistance, voltage, power, conductor, insulator		

**Montana Instructional Alignment - Science  
Grade Level: 9-12 Content Standard 3**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Investigate and use appropriate technology to demonstrate that cells have common features including differences that determine function and that they are composed of common building blocks (e.g., proteins, carbohydrates, nucleic acids, lipids)	A. Demonstrate appropriate microscopic techniques <sup>(10)</sup> B. Recognize that a variety of microscopes exist <sup>(10)</sup>	compound light microscope, micrometer, field of view, depth of field		
	C Identify common features among all cells <sup>(10)</sup> D. Compare and contrast prokaryotes and eukaryotes <sup>(10)</sup>	cell membrane, ribosome, genetic material, prokaryote, eukaryote		
	E. Compare and contrast the structure, function and relationship of key cellular components <sup>(10)</sup> F Identify key differences between plant and animal cells <sup>(10)</sup>			
	G. Explain how concentration of substances affects diffusion and osmosis <sup>(10)</sup>	diffusion, osmosis, dynamic equilibrium		
	H. Explain the role of key biologically important macromolecules <sup>(10)</sup>	organic molecule, proteins, carbohydrates, lipids, nucleic acids		

**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
2. Describe and explain the complex processes involved in energy use in cell maintenance, growth, repair and development	A. Explain and give examples of the importance of a constant internal environment <sup>(10)</sup> B. Identify processes that maintain homeostasis <sup>(10)</sup>	homeostasis		
	C. Classify, compare and contrast various organisms as a heterotroph or autotroph <sup>(10)</sup>	heterotroph, autotroph		
	D. Describe the role of ATP in the body <sup>(10)</sup> E. Identify the key components involved in the chemical reaction of cellular respiration <sup>(10)</sup> F. Describe and model the conversion of stored energy in organic molecules into usable cellular energy (ATP) <sup>(10)</sup> G. Compare and contrast aerobic and anaerobic respiration <sup>(10)</sup>	cellular respiration, ATP, ADP, aerobic, anaerobic, mitochondria		
	H. Summarize the conversion of light energy to chemical energy by photosynthetic organisms <sup>(10)</sup>	glucose, chloroplast, photosynthesis		
	I. Explain the relationship between the products and reactants of photosynthesis and cellular respiration <sup>(10)</sup>	glucose, carbon dioxide, oxygen, water, ATP		
	J. Explain the purpose of the cell cycle <sup>(10)</sup> K. Describe the stages of mitosis in plants and animals <sup>(10)</sup>	chromosome, interphase, mitosis, prophase, metaphase, anaphase, telophase		
	L. Identify the major events that occur in meiosis <sup>(10)</sup> M. Differentiate between haploid and diploid chromosome numbers <sup>(10)</sup> N. Compare and contrast the process and purpose of mitosis and meiosis <sup>(10)</sup>	meiosis I and II, gamete, diploid, haploid, homologous pairs, zygote		

**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
3. Model the structure of DNA and protein synthesis, discuss the molecular basis of heredity, and explain how it contributes to the diversity of life	A. Explain the functions of DNA and RNA <sup>(10)</sup> B. Compare and contrast the structure of DNA and RNA <sup>(10)</sup> C. Identify complementary base pairs <sup>(10)</sup>	RNA, DNA, nucleotide, adenine, cytosine, guanine, thymine, uracil, helical structure		
	D. Explain the purpose and process of DNA replication <sup>(10)</sup> E. Explain the purpose and process of transcription and translation <sup>(10)</sup>	replication, transcription, translation, ribosome, DNA, protein synthesis, gene		
	F. Explain the relationship between DNA and heredity (Central Dogma) <sup>(10)</sup> G. Summarize the law of segregation and the law of independent assortment <sup>(10)</sup> H. Summarize how the process of meiosis produces genetic recombination <sup>(10)</sup>	heredity, Law of Independent Assortment, Law of Segregation, crossing over		
	I. Explain the difference between dominant and recessive alleles <sup>(10)</sup> J. Distinguish between genotype and phenotype <sup>(10)</sup> K. Use the law of probability and Punnett squares to predict genotypic and phenotypic ratios <sup>(10)</sup>	Punnett square, monohybrid cross, dominant allele, recessive allele, homozygous, heterozygous, phenotype, genotype		
	L. Identify and explain the different ways in which alleles interact to determine the expression of traits <sup>(10)</sup> M. Distinguish between sex chromosomes and autosomes <sup>(10)</sup> N. Explain how sex linked inheritance influences some genetic traits <sup>(10)</sup>	complete dominance, incomplete dominance, codominance, autosome, sex chromosome, sex-linked inheritance, pedigree		
	O. Define genetic mutations <sup>(10)</sup> P. Identify some of the major causes of mutations <sup>(10)</sup> Q. Explain how mutations influence genetic expression <sup>(10)</sup> R. Explain the results of nondisjunction <sup>(10)</sup>	mutation, virus, nondisjunction		



**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Predict and model the interaction of biotic and abiotic factors that affect populations through natural selection, and explain how this contributes to the evolution of species over time	A. Differentiate between biotic and abiotic factors in ecosystems <sup>(10)</sup> B. Discuss how abiotic and biotic factors influence biomes <sup>(10)</sup> C. Explain biogeochemical cycles <sup>(10)</sup>	ecology, biotic, abiotic, ecosystem, biome, biogeochemical cycle		
	D. Recognize that the sun is the ultimate source of energy in MOST ecosystems <sup>(10)</sup> E. Explain the difference between a food chain and food web. <sup>(10)</sup> F. Explain trophic levels and pyramids in terms of energy transfer, biomass and number of individuals <sup>(10)</sup>	food chain, food web, trophic level, energy pyramid, biomass pyramid, pyramid of numbers		
	G. Identify and predict density dependent and density independent factors that impact a population <sup>(10)</sup> H. Describe predator-prey dynamics <sup>(10)</sup>	community, limiting factors, competition, population, niche, carrying capacity		
	I. Compare and contrast the symbiotic relationships that exist between species <sup>(10)</sup> J. Describe how communities progress through a series of changes (succession) <sup>(10)</sup>	symbiosis, commensalism, parasitism, mutualism, succession		
	K. Recognize that evolution involves a change in allele frequencies in a population across successive generations <sup>(10)</sup> L. Model and explain how natural selection can change a population <sup>(10)</sup> M. Describe the major factors that influence speciation <sup>(10)</sup> N. Explain the theory of evolution by natural selection <sup>(10)</sup> O. Explain the multiple lines of supporting scientific evidence of biological evolution <sup>(10)</sup>	natural selection, biological evolution, speciation		

**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
5. Generate and apply biological classification schemes to infer and discuss the degree of divergence between ecosystems	A. List and explain the characteristics of the three domains <sup>(10)</sup>	domain, bacteria, archaea, eukarya		
	B. Compare and contrast the key characteristics of each kingdom <sup>(10)</sup> C. Explain how similarities and differences in the key characteristics of each kingdom indicate the degree of divergence between them <sup>(10)</sup>	kingdom, eubacteria, archaeobacteria, protista, fungi, plantae, animalia,		
	D. Explain the classification of living organisms from the domain to species level <sup>(10)</sup>	classification, taxonomy, species		
	E. Explain the importance of binomial nomenclature <sup>(10)</sup> F. Generate and use a dichotomous key <sup>(10)</sup>	binomial nomenclature, dichotomous key		
	G. Differentiate between vascular and nonvascular plants H. Explain the difference between angiosperms and gymnosperms	gymnosperm, angiosperm, vascular tissue, xylem, phloem		
	I. Compare and contrast major animal phyla J. Compare and contrast body systems between major animal phyla	invertebrate, vertebrate, body system		

**Montana Instructional Alignment - Science  
Grade Level: 9-12 Content Standard 4**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth’s systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth’s systems and other objects in space.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Understand the theory of plate tectonics and how it explains the interrelationship between earthquakes, volcanoes, and sea floor spreading	A. Describe the independent movement of Earth’s crustal plates <sup>(10)</sup> B. Describe the observations and evidence that led to the formation of the theory of plate tectonics <sup>(10)</sup> C. Model the interaction of heat-driven convection and the movement of the plates <sup>(10)</sup> D. Identify the types of plate boundaries <sup>(10)</sup> E. Model ways plates interact at plate boundaries <sup>(10)</sup> F. Contrast the different types of plate boundaries and the products of these plate interactions <sup>(10)</sup>	continental drift, plate tectonics, subduction, convergent, divergent, transform, lithosphere, asthenosphere, sea floor spreading, convection		
	G. Identify the causes of earthquakes <sup>(10)</sup> H. Explain volcanic processes <sup>(10)</sup> I. Relate earthquakes and volcanic activity to plate boundaries and other geologic settings <sup>(10)</sup>	magma, viscosity, lava, seismic waves, stress, strain, fault		

**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
<p>2. Identify and classify rocks and minerals based on physical and chemical properties and the utilization by humans (e.g., natural resources, building materials)</p>	<p>A. Define mineral <sup>(10)</sup>                      B. Describe the physical and chemical properties and equipment used to identify minerals <sup>(10)</sup>                      C. Classify minerals using observable properties, tools, and reference materials <sup>(10)</sup>                      D. Describe environments and processes that lead to the formation of various minerals <sup>(10)</sup></p>			
	<p>E. Define rock <sup>(10)</sup>                      F. Summarize the rock cycle and its process <sup>(10)</sup>                      G. Describe the physical and chemical properties and equipment used to identify rocks <sup>(10)</sup>                      H. Classify rocks into rock types using observable properties, tools, and reference materials <sup>(10)</sup></p>	<p>deposition, erosion, weathering, igneous, sedimentary, metamorphic</p>		
	<p>I. Identify various mineral and rock resources, their value, their uses, and their importance to humans <sup>(10)</sup>                      J. Explain how various mineral and rock resources are obtained <sup>(10)</sup></p>	<p>ore, vein, mining</p>		
<p>3. Explain scientific theories about how fossils are used as evidence of changes over time</p>	<p>A. Explain the concept of scientific theory <sup>(10)</sup>                      B. Explain how various fossils show evidence of past life <sup>(10)</sup>                      C. Model the scale of geologic time <sup>(10)</sup>                      D. Interpret rock layers using principles of relative and absolute age dating <sup>(10)</sup>                      E. Give examples of major biologic, climactic, and geologic changes in Earth's history and provide supporting rock and fossil evidence of these changes <sup>(10)</sup>                      F. Relate major changes to the divisions of geologic time <sup>(10)</sup></p>	<p>index fossils, fossil record, extinct, geologic time</p>		

**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
4. Collect and analyze local and regional weather data to make inferences and predictions about weather patterns; explain factors influencing global weather patterns and climate; and describe the impact on earth of fluctuations in weather and climate (e.g., drought, surface and ground water, glacial instability)	A. Identify measurable weather-related variables commonly used in forecasting <sup>(10)</sup> B. Identify the instruments and technology used to collect weather data <sup>(10)</sup> C. Collect weather data and observe weather conditions <sup>(10)</sup>	temperature, relative humidity, barometric pressure, dew point, wind, precipitation		
	D. Summarize how cloud formation and precipitation are affected by changes in atmospheric conditions <sup>(10)</sup> E. Discuss the role of energy transfer in the atmosphere and its effects on weather changes <sup>(10)</sup> F. Describe the impacts of fronts, air masses, and pressure systems on local and regional weather <sup>(10)</sup> G. Analyze the effect of local geographic factors on weather <sup>(10)</sup> H. Use data to infer and predict weather patterns <sup>(10)</sup>	air mass, wind, Jet Stream, front, pressure system, weather, convection, water cycle		
	I. Identify the geographic factors that influence climate <sup>(10)</sup> J. Determine which geographic factors result in specific local and regional climate <sup>(10)</sup> K. Examine the importance of the structure and composition of the atmosphere as influencing factors on Earth's weather and climate <sup>(10)</sup> L. Describe how global wind patterns influence weather and climate <sup>(10)</sup> M. Explain the relationship between ocean currents, weather, and climate <sup>(10)</sup>	coriolis effect, wind belts, ocean currents, latitude, elevation, climate, heat transfer, El Nino/La Nina, ozone layer		
	N. Compare the conditions that generate various types of severe weather <sup>(10)</sup> O. Discuss the impacts of various types of severe weather <sup>(10)</sup>	tornado, hurricane		

**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
5. Explain the impact of terrestrial, solar, oceanic, and atmosphere conditions on global climatic patterns	A. Identify examples of natural phenomena (terrestrial, atmospheric, oceanic, and astronomical) that impact global climate patterns <sup>(10)</sup> B. Explain the short and long term-effects of these natural phenomena on global climate patterns <sup>(10)</sup> C. Examine the geologic, astronomical, and human factors that contribute to global climate change <sup>(10)</sup> E. Describe socioeconomic and environmental implications of climate change <sup>(10)</sup>	climate, climate zones, climate change		
6. Describe the origin, location, and evolution of stars and their planetary systems in respect to the solar system, the Milky Way, the local galactic group, and the universe	A. Describe the Big Bang Theory <sup>(10)</sup> B. Summarize evidence supporting the Big Bang Theory <sup>(10)</sup> C. Summarize the evolution of stars from birth to death <sup>(10)</sup> D. Identify the importance of fusion in a star's evolutionary cycle <sup>(10)</sup> E. Explain the relationship between stars and planets in a solar system <sup>(10)</sup>	Big Bang Theory, nebula, nova, nuclear fusion		
	F. Compare and contrast the characteristics of planets and stars <sup>(10)</sup> G. Explain current theories of the formation of a solar system <sup>(10)</sup> H. Explain how the formation and evolution of a solar system influences the composition and placement of objects within it <sup>(10)</sup>	planet, star, solar system, accretion		
	I. Define galaxy <sup>(10)</sup> J. Describe the shape of the Milky Way Galaxy and our place in it <sup>(10)</sup> K. Illustrate the hierarchy of stars, planets, solar systems, galaxies and galactic group in the universe <sup>(10)</sup>	galaxy		
7. Relate how evidence from advanced technology applied to scientific investigations (e.g., large telescopes and spaceborne observatories), has dramatically impacted our understanding of the origin, size, and evolution of the universe	A. Discuss how various types of technology are used to study space <sup>(10)</sup> B. Compare the advantages and disadvantages of various tools used to study space <sup>(10)</sup> C. Assess how our understanding of the universe changes as technology advances <sup>(10)</sup>			

**Montana Instructional Alignment - Science**  
**Grade Level: 9-12 Content Standard 5**

**Content Standards**

- Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.
- Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth’s systems and other objects in space.
- Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.
- Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
1. Predict how key factors (e.g., technology, competitiveness, and world events) affect the development and acceptance of scientific thought	A. Identify an example of scientific thought that has been or is affected by key factors such as technology, competitiveness (industrial, political, religious, etc.), world events, etc. <sup>(10)</sup> B. Analyze how the development and/or acceptance of this example was influenced by various factors <sup>(10)</sup> C. Justify the analysis using cited peer-reviewed sources <sup>(10)</sup> D. Predict and discuss how key factors could impact the development and acceptance of scientific thought <sup>(10)</sup>	peer-review		
2. Give examples of scientific innovation challenging commonly held perceptions	A. Identify and discuss examples of commonly held perceptions or ideas being challenged by science (i.e. heliocentrism, flat earth, spontaneous generation) <sup>(10)</sup>			

**Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resources
3. Evaluate the ongoing, collaborative scientific process by gathering and critiquing information	A. Identify and discuss the practices employed by scientists to collaborate, share, and critique scientific information <sup>(10)</sup> B. Summarize the peer review process scientists use to critique and publish scientific research <sup>(10)</sup> C. Compare and contrast the formal and informal methods by which scientists communicate with each other and the public <sup>(10)</sup>			
4. Analyze benefits, limitations, costs, consequences, and ethics involved in using scientific and technological innovations (e.g., biotechnology, environmental issues)	A. Identify various scientific and technological innovations <sup>(10)</sup> B. Compare and contrast the benefits and limitations of the various innovations <sup>(10)</sup> C. Analyze the cost and consequences of the innovations <sup>(10)</sup> D. Examine the ethical issues involved with the innovations <sup>(10)</sup>			
5. Explain how the knowledge of science and technology applies to contemporary Montana American Indian communities (e.g., natural resources development, management and conservation)	A. Identify current practices by Montana American Indian tribes that are influenced by knowledge of science and technology <sup>(10)</sup> B. Explain how tribal sovereignty affects the use of science and technology within Montana American Indian communities <sup>(10)</sup>			



**Montana Instructional Alignment - Science  
Grade Level: 9-12 Content Standard 6**

**Content Standards**

**Content Standard 1**—Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

**Content Standard 2**—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

**Content Standard 3**—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

**Content Standard 4**—Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

**Content Standard 5**—Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

**Content Standard 6**—Students understand historical developments in science and technology.

**Content Standard 6—Students understand historical developments in science and technology.**

Benchmark Upon Graduation	Essential Learning Expectation (10) denotes Foundational Knowledge and Skills for End of Grade 10	Essential Vocabulary	Performance Rubrics	Materials and Resource
1. Analyze and illustrate the historical impact of scientific and technological advances, including Montana American Indian examples	A. Identify important historical events in science and technology <sup>(10)</sup> B. Analyze the positive and negative impacts of past, present, and future science and technological advances <sup>(10)</sup>			
2. Trace developments that demonstrate scientific knowledge is subject to change as new evidence becomes available	A. Identify examples of scientific knowledge that have changed over time <sup>(10)</sup> B. Discuss the developments that contributed to the progression of the scientific knowledge <sup>(10)</sup> C. Analyze the impact of each development on the scientific knowledge <sup>(10)</sup> D. Summarize the process of the advancement of scientific knowledge <sup>(10)</sup>			
3. Describe, explain, and analyze science as a human endeavor and an ongoing process	A. Discuss the purpose of science <sup>(10)</sup> B. Summarize the parameters that guide the process of science <sup>(10)</sup> C. Examine the role of human reasoning in the process of science <sup>(10)</sup> D. Analyze how human interpretation of evidence affects the process of science <sup>(10)</sup> E. Describe how science is an ongoing process <sup>(10)</sup>			

## Montana Content Standards for Science Glossary

**Attribute** - An inherent characteristic.

**Classification** - Systematic arrangement of objects or organisms into groups or categories according to established criteria.

**Control** – A group of test subjects left untreated or unexposed to the independent variable and then compared with treated subjects in order to validate the test results; the standard for comparing experimental effects. Not all experiments have a control, though all have controlled variables (Cothorn, Giese, and Rezba 17).

**Controlled Variable** - A variable that is not changed and is kept the same for all tests; also referred to as a constant (Cothorn, Giese, and Rezba 17).

**Data** – Qualitative or quantitative values collected through observation or experimentation from which conclusions may be drawn.

**Dependent Variable** – The observed or measured variable in an experiment or study whose changes are determined by the presence or degree of one or more independent variables; also referred to as the responding variable.

**Error Analysis** – The process used to evaluate the total error throughout an experiment and indicate the accuracy of experimental results. This can be due to bias error, precision error, as well as others.

**Evidence** – Data and documentation that may either support or help refute inferences or conclusions.

**Evolution** – A process of change that explains why what is seen today is different from what existed in the past; it includes changes in the galaxies, stars, solar system, earth and life on earth. Biological evolution is any genetic and resulting phenotypic change in groups of organisms from generation to generation.

**Experiment** – The act of conducting a controlled test or investigation.

**Fossil** – Any recognizable structure originating from an organism, or any impression from such a structure, that has been preserved over geological time.

**Geologic Timeline** - a chronologic schema used by geologists and other earth scientists to describe the timing and relationships between events that have occurred during the history of Earth.

**Hypothesis** - A tentative explanation of a phenomenon, event, or the nature of an object based on prior experience, scientific background knowledge, preliminary observations, and logic. A hypothesis is testable (Fundamentals of Inquiry).

**Independent Variable** – A factor or condition that changes naturally or is intentionally manipulated by the investigator to observe the effect; also referred to as the manipulated variable.

**Inquiry** – A search for knowledge; a systematic process of teaching and learning where the learner:

- engages in scientifically oriented questions;
- gives priority to evidence in responding to questions;
- formulates explanations from evidence;
- connects explanations to scientific knowledge;
- communicates and justifies explanations.

(National Research Council 25-29).

**Investigate** - To observe or study by using a systematic inquiry approach.

**Law** - Summarizing statement of observed experimental facts that has been tested many times and is generally accepted as true.

**Model** - A description, analogy or a representation of something that helps us understand it better (e.g., a physical model, a conceptual model, a mathematical model).

**Natural Phenomenon** - An occurrence, circumstance, or fact that exists in or formed by nature and is perceptible by the senses.

**Observation** - To gather information and direct evidence about an object, event or phenomenon by using the senses and/or appropriate tools.

**Planet** - A celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighborhood around its orbit (International Astronomical Union).

**Plate Tectonics** - Movements of the Earth's crustal plates, which result in changes in the position, size, and shape of continents and oceans (NASA Jet Propulsion Laboratory).

**Prediction** – A forecast of the outcome of a specific future event based on a pattern of evidence or a hypothesis (explanation). A predication based on a hypothesis can be used in planning a test of that hypothesis (Fundamentals of Inquiry).

**Science** - Systematic knowledge of the physical or material world gained through observation and experimentation.

**Solar System** - A system of planets, moons, asteroids, comets, dust, gas, and any other objects that orbit a star, tied to it by the star's gravitational force (NASA Space Place).

**System** - An organized group of related objects or components that form a whole.

**Technology** – 1. Human innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities; 2. The innovation, change, or modification of the natural environment to satisfy perceived human needs and wants (Massachusetts Science and Technology/Engineering).

**Testable** – A statement, question, or hypothesis that can be investigated through experimentation and/or observation.

**Theory** - Systematically organized knowledge applicable in a relatively wide variety of circumstances; especially, a system of assumptions, accepted principles and rules of procedure devised to analyze, predict or otherwise explain the nature or behavior of a specified set of phenomena ("Science Glossary").

**Valid Test** – Experimental design that consist of a change in one variable and a control group.

**Variable** - An attribute of a physical or an abstract system which may change its value while it is under observation.

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