Montana Science Model Curriculum Guide by Grade Level: Grades 9-12 Earth and Space Science

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opi.mt.gov Elsie Arntzen, Superintendent

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Resources	Three Dimensions		
	Disciplinary Core Ideas (DCI's)	Science and Engineering Practices (SEP's)	Crosscutting Concepts (CCC's)
Paul Anderson Videos: Details on each component of the standards Next Generation Science Standards (NGSS) at National Science Teachers Association (NSTA) Hub: Detailed explanations of the three dimensions, videos of what it looks like in the classroom, curriculum guidance, and classroom resources Evidence Statements: Observations of what students should know and be able to do when they perform the standard. Helpful for formative and summative assessments The Framework: The framework for Montana Science Standards and for the Next Generation Science Standards NGSS Storylines: These storylines explain questions that students should investigating and how by grade level; they paint the big picture of the big ideas STEM Teacher Tools: This site has every resource necessary to implement the new standards *Read more about the three dimensions in the NRC Framework online here (NGSS for States, By States)*	Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four: • Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline; • Provide a key tool for understanding or investigating more complex ideas and solving problems; • Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge; • Be teachable and learnable over multiple grades at increasing levels of depth and sophistication. Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.	The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. The National Research Council (NRC) uses the term practices instead of a term like "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC's intent is to better explain and extend what is meant by "inquiry" in science and the range of cognitive, social, and physical practices that it requires. Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through investigation, while engineering design involves the formulation of a problem that can be solved through design. Strengthening the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life. (NGSS for States, By States).	Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include: Patterns, similarity, and diversity; Cause and effect; Scale, proportion and quantity; Systems and system models; Energy and matter; Structure and function; Stability and change. The Framework emphasizes that these concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world. (NGSS for States, By States)

Grade 9-12 Earth and Space Science			
Montana Standard *Students must know and be able to:*	Disciplinary Core Ideas (DCI's)	Science and Engineering Practices (SEP's)	Crosscutting Concepts (CCC's)
develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. HS-ESS1-1. NGSS Identifier -	ESS1.A PS3.D	developing and using models	scale proportion and quantity
construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. HS-ESS1-2. NGSS Identifier	ESS1.A PS4.B	construct explanations and design solutions	energy and matter: flows, cycles and conservation
communicate scientific ideas about the way stars, over their life cycle, produce elements. HS-ESS1-3. NGSS Identifier	ESS1.A	obtaining, evaluating, and communicating information	energy and matter: flows, cycles and conservation
use mathematical or computational representations to predict the motion of orbiting objects in the solar system. HS-ESS1-4. NGSS Identifier	ESS1.B	using mathematics & computational thinking	scale proportion and quantity
evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. HS-ESS1-5. NGSS Identifier	Ess1.C Ess2.B PS1.C	engaging in argument from evidence	patterns
apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. HS-ESS1-6. NGSS Identifier	ESS1.C PS1.C	construct explanations and design solutions	stability and change

develop a model to illustrate how earth's internal and surface processes operate at different spatial and time scales to form continental and ocean-floor features. HS-ESS2-1. NGSS Identifier	ESS2.A ESS2.B	developing and using models	stability and change
analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other earth systems. HS-ESS2-2. NGSS Identifier	ESS2.A ESS2.D	analyze and interpret data	stability and change
develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. HS-ESS2-3. NGSS Identifier	ESS2.A ESS2.B PS4.A	developing and using models	energy and matter: flows, cycles and conservation
plan and conduct an investigation of the properties of water and its effects on earth materials and surface processes. HS-ESS2-5. NGSS Identifier	ESS2.C	planning and carrying out investigations	structure and function
develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-ESS2-6. NGSS Identifier	ESS2.D	developing and using models	energy and matter: flows, cycles and conservation
construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. HS-ESS2-7. NGSS Identifier	ESS2.D ESS2.E	engaging in argument from evidence	stability and change

use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. HS-ESS2-4. NGSS Identifier	ESS1.B ESS2.A ESS2.D	developing and using models	cause and effect
analyze geoscience data and the results from global climate models to make an evidence based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. HS-ESS3-5. NGSS Identifier	ESS3.D	analyze and interpret data	stability and change
construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. HS-ESS3-1. NGSS Identifier	ESS3.A ESS3.B	construct explanations and design solutions	cause and effect
evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. HS-ESS3-2. NGSS Identifier	ESS3.A ETS1.B	analyze and interpret data	stability and change
create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, biodiversity, and investigate and explain how some American Indian tribes use scientific knowledge and practices in managing natural resources. HS-ESS3-3. NGSS Identifier	ESS3.C	using mathematics & computational thinking	stability and change
evaluate or refine a technological solution that reduces impacts of human activities on natural systems. HS-ESS3-4. NGSS Identifier	ESS3.C ETS1.B	construct explanations and design solutions	stability and change