Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

Grade Level Competency: Kindergarten
Students will create and use models to demonstrate understanding of a scientific concept.

Criteria	Extending	Proficient	In Progress	Beginning
Conceptual Representations Representations may include diagrams, physical models, illustrations, flowcharts, chemical equations, etc.	A complex performance or application of learning that is transferred to new or novel situations beyond the content area, makes extended or abstract connections to authentic, real-world, multifaceted situations, and/or constructs entirely new ideas that are transformational.	I can create a simple model to show a part of a scientific concept.	I can create a simple model.	I can create parts of a simple model.

MDE grade level benchmarks embedded explicitly in the rubric

Kindergarten

0L.3.1.1.1 Develop a simple model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. (P: 2, CC: 4, CI: LS2)

OP.3.2.2.1 0P.3.2.2.1 Design and build a structure to reduce the warming effect of sunlight on Earth's surface.* (P: 6, CC: 2, CI: PS3, ETS1)

Learning Progressions
Kindergarten
☐
Supporting Benchmarks
Kindergarten

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

Grade Level Competency: Grades 1-2
Students will create and use models to demonstrate understanding of a scientific concept.

Criteria	Extending	Proficient	In Progress	Beginning
Conceptual Representations Representations may include diagrams, physical models, illustrations, flowcharts, chemical equations, etc.	A complex performance or application of learning that is transferred to new or novel situations beyond the content area, makes extended or abstract connections to authentic, real-world, multifaceted situations, and/or constructs entirely new ideas that are transformational.	I can create and explain a simple model that shows key parts of a scientific concept. ☐ Grade 1 ☐ Grade 2	I can create a simple model that shows key parts of a scientific concept. ☐ Grade 1 ☐ Grade 2	I can create a simple model to show a part of a scientific concept. ☐ Grade 1 ☐ Grade 2

Science: Modeling

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MDE grade level benchmarks embedded explicitly in the rubric	
Grade 1 1L.3.1.1.1 Develop a simple model based on evidence to represent how plants or animals use their external parts to help them survive, grow, and meet their needs. (P: 2, CC: 6, CI: LS1) 1P.3.2.2.1 Design and build a device that uses light or sound to solve the problem of communicating over a distance.* (P: 6, CC: 6, CI: PS4, ETS1, ETS2)	**Grade 2** 2P.3.1.1.1 Develop a simple diagram or physical model to illustrate how some changes caused by heating or cooling can be reversed and some cannot.** (P: 2, CC: 2, CI: PS3) 2L.3.2.2.1 Engineer a device that mimics the structures and functions of plants or animals in seed dispersal.* (P: 6, CC: 6, CI: LS2, ETS1)

Learning Progressions	
Grade 1	**Grade 2**
☐ I can correctly label the parts of a model. (1L.3.1.1.1)	☐ I can describe the function of the parts of a model. (2P.3.1.1.1)
Supporting Benchmarks	
Grade 1	**Grade 2**
1E.2.2.1.1 Use quantitative data to identify and describe patterns in the amount of time it takes for Earth processes to occur and determine whether they occur quickly or slowly. (P: 5, CC: 7, CI: ESS1)	2P.2.2.1.1 Identify and predict quantitative patterns of the effects of balanced and unbalanced forces on the motion of an object.** (P: 5, CC: 1, CI: PS2)

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

Grade Level Competency: Grades 3-4 Students will create and use models to demonstrate understanding of a scientific concept.				
Criteria	Extending	Proficient	In Progress	Beginning
Conceptual Representations Representations may include diagrams, physical models, illustrations, flowcharts, chemical equations, etc.	A complex performance or application of learning that is transferred to new or novel situations beyond the content area, makes extended or abstract connections to authentic, real-world, multifaceted situations, and/or constructs entirely new ideas that are transformational.	I can design and use a model to represent components and relationships between aspects of scientific phenomena. ☐ Grade 3 ☐ Grade 4	I can use a model to represent some components and relationships of a scientific concept. ☐ Grade 3 ☐ Grade 4	I can use a model to represent some components and relationships of a scientific concept with help. ☐ Grade 3 ☐ Grade 4

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

MDE grade level benchmarks embedded explicitly in the rubric	
Grade 3 3P.3.1.1.1 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (P: 2, CC: 2, CI: PS4) 3L.3.1.1.2 Develop multiple models to describe how organisms have unique and diverse life cycles but all have birth, growth, reproduction, and death in common. (P: 2, CC: 4, CI: LS1)	**Grade 4** 4E.3.1.1.1 Develop a model based in part on student observations or data to describe ways the geosphere, biosphere, hydrosphere, and atmosphere interact. (P: 2, CC: 4, CI: ESS2)

Learning Progressions	
Grade 3	**Grade 4**
Supporting Benchmarks	
Grade 3	**Grade 4**

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

Grade Level Competency: Grades 5-6:
Students will develop appropriate models to demonstrate an understanding of scientific concepts.

Criteria	Extending	Proficient	In Progress	Beginning
Conceptual Representations Representations may include diagrams, physical models, illustrations, flowcharts, chemical equations, etc.	A complex performance or application of learning that is transferred to new or novel situations beyond the content area, makes extended or abstract connections to authentic, real-world, multifaceted situations, and/or constructs entirely new ideas that are transformational.	I can design a model that demonstrates key components and relationships and apply it to explain a scientific phenomenon. ☐ Grade 5 ☐ Grade 6	I can design an accurate model to represent components and relationships between aspects of scientific phenomena. ☐ Grade 5 ☐ Grade 6	I can design and use a model to represent components and relationships between aspects of scientific phenomena. ☐ Grade 5 ☐ Grade 6
Mathematical Representations Representations may include equations or formulas, graphs, statistical analysis, etc.		I can design and apply an accurate mathematical model to demonstrate the key components and functions of scientific phenomena. ☐ Grade 5 ☐ Grade 6	I can design an accurate mathematical model to demonstrate the key functions of scientific phenomena. ☐ Grade 5 ☐ Grade 6	I can design a simple mathematical model to demonstrate aspects of a scientific phenomena. ☐ Grade 5 ☐ Grade 6

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

MDE grade level benchmarks embedded explicitly in the rubric	
Grade 5 5P.2.2.1.1 Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. (P: 5, CC: 3, CI: PS1) 5P.3.1.1.2 Use models to describe that energy in animals' food (used for body repair, growth, and motion, and to maintain body warmth) was once energy from the Sun. (P: 2, CC: 5, CI: PS3)	**Grade 6** 6E.3.1.1.1 Develop and use scale models of solar system objects to describe the sizes of objects, the location of objects, and the motion of the objects; and include the role that gravity and inertia play in controlling that motion. (P: 2, CC: 3, CI: ESS1) 6E.3.1.1.2 Develop a model, based on observational evidence, to describe the cycling and movement of Earth's rock material and the energy that drives these processes. (P: 2, CC: 5, CI: ESS2) 6E.3.1.1.3 Develop a model, based on observational and experimental evidence, to describe the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity. (P: 2, CC: 5, CI: ESS2) 6E.4.2.2.1 Communicate how a series of models, including those used by Minnesota American Indian Tribes and communities and other cultures, are used to explain how motion in the Earth-Sun-Moon system causes the cyclic patterns of lunar phases, eclipses and seasons. (P: 8, CC: 1, CI: ESS1)

Learning Progressions	
Grade 5	**Grade 6**
☐ Develop and refine a model to describe that matter is made of particles too small to be seen. (P: 2, CC: 3, CI: PS1, 5P.3.1.1.1)	
Supporting Benchmarks	
Grade 5	**Grade 6**
5L.3.1.1.3 Create an electronic visualization of the movement of matter among plants, animals, decomposers, and the environment.** (P: 2, CC: 4, CI: LS2)	

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

Grade Level Competency: Grades 7-8
Students will develop appropriate models to demonstrate an understanding of scientific concepts.

Criteria	Extending	Proficient	In Progress	Beginning
Conceptual Representations Representations may include diagrams, physical models, illustrations, flowcharts, chemical equations, etc.	A complex performance or application of learning that is transferred to new or novel situations beyond the content area, makes extended or abstract connections to authentic, real-world, multifaceted situations, and/or constructs entirely new ideas that are transformational.	I can design a complete and accurate model to demonstrate the key components and relationships of scientific phenomena. ☐ Grade 7 ☐ Grade 8	I can design a model demonstrating all of the key components and attempted relevant scientific relationships. ☐ Grade 7 ☐ Grade 8	I can design a basic model demonstrating some of the key components of a scientific phenomenon. ☐ Grade 7 ☐ Grade 8
Mathematical Representations Representations may include equations or formulas, graphs, statistical analysis, etc.		I can design a complete and accurate mathematical model to demonstrate the key components and functions of scientific phenomena. ☐ Grade 7 ☐ Grade 8	I can design a mathematical model demonstrating all of the key components and attempted relevant scientific relationships. ☐ Grade 7 ☐ Grade 8	I can design a basic mathematical model demonstrating some of the key components of a scientific phenomenon. ☐ Grade 7 ☐ Grade 8

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

MDE grade level benchmarks embedded explicitly in the rubric	
Grade 7 7L.2.2.1.1 Use an algorithm to explain how natural selection may lead to increases and decreases of specific traits in populations.** (P: 5, CC: 2, CI: LS4) 7L.3.1.1.1 Develop and use a model to describe a science phenomenon.the function of a cell as a whole and describe the way cell parts contribute to the cell's function. (P: 2, CC: 6, CI: LS1) 7L.3.1.1.2 Develop and use a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. (P: 2, CC: 5, CI: LS1) 7L.3.1.1.3 Develop and use a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (P: 2, CC: 5, CI: LS2) 7L.3.1.1.4 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. (P: 2, CC: 2, CI: LS3)	**Grade 8** 8P.3.1.1.4 Develop and use a model. 8P.2.1.1.2 Construct and interpret graphical displays of data to describe the relationship of kinetic energy to the mass and speed of an object. (P: 4, CC: 3, CI: PS3) 8P.2.2.1.1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. (P: 5, CC: 1, CI: PS4) 8P.2.2.1.2 Create a computer program to illustrate the transfer of energy within a system where energy changes form.** (P: 5, CC: 7, CI: PS3 8P.3.1.1.1 Develop models to describe the atomic composition of simple molecules and crystals. (P: 2, CC: 3, CI: PS1) 8P.3.1.1.2 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. (P: 2, CC: 5, CI: PS1) 8P.3.1.1.3 Develop and revise a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. (P: 2, CC: 5, CI: PS3) 8P.3.1.1.4 Develop and use a model to qualitatively describe that waves are reflected, absorbed, or transmitted through various materials. (P: 2, CC: 4, CI: PS4)

Learning Progressions	
Grade 7	**Grade 8**
	☐ Describe the difference between reflection, absorption, and transmission of waves through materials. 8P.3.1.1.4
Supporting Benchmarks	
Grade 7	**Grade 8**

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

Grade Level Competency: Grades 9-12 Students will create accurate models that describe real-world phenomena utilizing scientific concepts.				
Criteria	Extending	Proficient	In Progress	Beginning
Conceptual Representations Representations may include diagrams, physical models, illustrations, flowcharts, chemical equations, etc.	A complex performance or application of learning that is transferred to new or novel situations beyond the content area, makes extended or abstract connections to authentic, real-world, multifaceted situations, and/or constructs entirely new ideas that are transformational.	I can design an accurate and comprehensive conceptual model to represent a problem or phenomenon.	I can design a conceptual model that contains relevant scientific concepts to partially explain a problem or phenomenon.	I can design a conceptual model that contains elements of relevant scientific concepts.
Mathematical Representations Representations may include equations or formulas, graphs, statistical analysis, etc.		I can design accurate and comprehensive mathematical models to represent a problem or phenomenon.	I can design a mathematical model that contains relevant scientific concepts to partially represent a problem or phenomenon.	I can design a mathematical model that contains elements of relevant scientific concepts.

Science: Modeling

Competency: Developing and using models to explore scientific concepts and represent real-world phenomena.

MDE grade level benchmarks embedded explicitly in the rubric
Earth/Space: 9E.2.2.1.1 Use mathematical and computational representations to predict the motion of natural and human made objects that are in orbit in the solar system.** (P: 5, CC: 3, CI: ESS1, ETS2) 9E.2.2.1.2 Develop a computational model, based on observational data, experimental evidence, and chemical theory, to describe the cycling of carbon among Earth's systems.** (P: 2, CC: 5, CI: ESS2) 9E.2.2.1.3 Develop or use an algorithmic representation, based on investigations of causes and effects in complex Earth systems, to illustrate the relationships within some part of the Earth system and how human activity might affect those relationships. (P: 5, CC: 4, CI: ESS3, ETS2) 9E.3.1.1.1 Develop and use 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. (P: 2, CC: 3, CI: ESS1) 9E.3.1.1.2 Develop and use a model based on evidence to explain how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean floor features. (P: 2, CC: 7, CI: ESS2) 9E.3.1.1.3 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. (P: 2, CC: 4, CI: ESS2) 9E.3.1.1.4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. (P: 2, CC: 2, CI: ESS2) **Biology:** 9L.2.1.1.1 Apply concepts of probability to explain and predict the variation and distribution of expressed traits in a population. (P: 4, CC: 3, CI: LS3) 9L.2.1.1.2 Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. (P: 4, CC: 1, CI: LS4) 9L.2.2.1.1 Use a computational model to support or revise an evidence-based explanation for factors that have ecological and economic impacts on different sized ecosystems, including factors caused by the practices of various human groups.** (P: 5, CC: 3, CI: LS2) 9L.2.2.1.2 Use a computational model to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.** (P: 5, CC: 5, CI: LS2) 9L.3.1.1.1 Develop and use a model to illustrate the levels of organization of interacting systems and how that translates into specific functions in multicellular organisms. (P: 2, CC: 6, CI: LS1) 9L.3.1.1.2 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. (P: 2, CC: 2, CI: LS1) 9L.3.1.1.3 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. (P: 2, CC: 4, CI: LS1) 9L.3.1.1.4 Use a model to illustrate that cellular respiration is a chemical process in which energy from food is used to create new compounds. (P: 2, CC: 5, CI: LS1) **Chemistry:** 9C.2.2.1.2 Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. (P: 5, CC: 5, CI: PS1) 9C.3.1.1.2 Develop a model based on evidence to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond

energy. (P: 2, CC: 5, CI: PS1)
9C.3.1.1.3 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. (P: 2, CC: 5, CI: PS1)
9C.2.2.1.1 Develop a data simulation, based on observations and experimental data of how the pressure, volume, temperature, and mass of a gas are related to each other, to predict the effect on a system of changing one of those variables.** (P: 5, CC: 2, CI: PS1)

Physics:

9P.2.2.1.1 Apply mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. (P: 5, CC: 4, CI: PS2)
9P.2.2.1.2 Apply mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. (P: 5, CC: 1, CI: PS2)
9P.3.1.1.1 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). (P: 2, CC: 5, CI: PS3)
9P.3.1.1.2 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between the two objects and the changes in energy of the two objects due to the interaction and describe how these forces are present in phenomena. (P: 2, CC: 2, CI: PS3)
9P.3.2.2.1 Develop a computer simulation to demonstrate the impact of a proposed solution that minimizes the force on a macroscopic object during a collision.** (P: 6, CC: 2, CI: PS2, ETS1)

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Learning Progressions	
Earth Space	**Biology**
	☐ Use a Punett square to predict the probability that organisms with certain heritable traits will increase in a population. (9L.2.1.1.2) ☐ Illustrate cellular division (mitosis) (9L.3.1.1.2) ☐ Write the equation for photosynthesis (9L.3.1.1.3) ☐ Write the equation for cellular respiration (9L.3.1.1.4) ☐ Diagram the flow of Carbon an ecosystem. (9L.2.2.1.2)
Supporting Benchmarks	
Earth/Space	**Biology**
	Write and Identify if a genotype is dominant (Homozygous or Heterozygous) or recessive (9L.2.1.1.1) Write and identify phenotypes is dominant or recessive (9L.2.1.1.1)Use a model to illustrate the levels of organization of interacting systems and how that translates into specific functions in multicellular organisms. (9L.3.1.1.) Understand the process meiosis and how it creates genetic variation (9L.2.1.1.1) Calculate ratios of individuals with genotypes and phenotype (9L.2.1.1.1)

Learning Progressions	
Chemistry	**Physics**
☐ Write and balance chemical equations utilizing principles of conservation of mass (9C.2.2.1.2) ☐ Use gas laws and gas relationships (9C.2.2.1.1)	☐ Be able to solve simple problems using Conservation of Momentum. (9P.2.2.1.1) ☐ Recognize what energies are present at different points in the motion of an object (9P.2.2.1.3) ☐ Be able to solve simple problems using Conservation of Energy. (9P.2.2.1.3) ☐ Use conservation of energy to analyze an object on a roller coaster. (9P.3.1.1.1) ☐ Use conservation of energy to analyze a 1D collision of two objects.

	(9P.3.1.1.1) ☐ Be able to explain the importance of the Impulse-Momentum Theorem. (9P.3.2.2.1)
Supporting Benchmarks	
Chemistry	**Physics**
Explain endothermic and exothermic processes (9C.3.1.1.2)	9P.2.2.1.3 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in or out of the system are known.** (P: 5, CC: 4, CI: PS3) 9P.2.2.1.2 Understand that both Newton's Law of Gravitation and Coulomb's Law are inverse square laws.