

Middle School Phenomenon Model - Course II Summary

Storyline/Narrative: This course model arranges the Performance Expectations (PEs) outlined in the second year of the middle school conceptual progressions model from Appendix K of the Next Generation Science Standards into five different bundles of PEs using a phenomenon-based arrangement. The bundles in this model follow a conceptual flow throughout the year.

The first bundle focuses on the transfer of energy and matter between Earth's systems. The second bundle applies this understanding of energy and matter transfer to a study of climate diversity on the Earth. The third bundle focuses on gravity and Earth's place in the solar system, the fourth on cells and body systems, and the fifth on growth and reproduction. Each bundle is organized around the DCIs that would help students explain a unifying phenomenon and answer a guiding question. It is important to note that the practices and crosscutting concepts described are intended as end-of-instructional unit expectations and not curricular designations. Additional practices and crosscutting concepts should be used throughout instruction toward each bundle.

Bundle 1: Why do people live	Bundle 2: What causes climates to	Bundle 3: Why can we	Bundle 4: Why are bones	Bundle 5: Why do some
and farm on volcanoes?	be so different across the Earth?	predict solar eclipses?	so hard?	parents and offspring look
~ 6 weeks	~ 6 weeks	~ 4 weeks	~ 4 weeks	different?
				~ 6 weeks
MS-LS1-6. Construct a scientific	MS-PS4-3. Integrate qualitative scientific	MS-PS3-2. Develop and use a	MS-LS1-1. Conduct an	MS-LS1-4. Use argument based on
explanation based on evidence for the	and technical information to support the	model to describe that when the	investigation to provide evidence	empirical evidence and scientific
role of photosynthesis in the cycling of	claim that digitized signals are a more	arrangement of objects	that living things are made of	reasoning to support an explanation
matter and the flow of energy into and	reliable way to encode and transmit	interacting at a distance changes,	cells; either one cell or many	for how characteristic animal
out of organisms.	information than analog signals.	different amounts of potential	different numbers and types of	behaviors and specialized plant
MS-LS1-7. Develop a model to	MS-ESS2-5. Collect data to provide	energy are stored in the system.	cells.	structures affect the probability of
describe how food is rearranged	evidence for how the motions and complex	MS-ESS1-1. Develop and use a	MS-LS1-2. Develop and use a	successful reproduction of animals
through chemical reactions forming	interactions of air masses result in changes	model of the Earth-sun-moon	model to describe the function of	and plants respectively.
new molecules that support growth	in weather conditions.	system to describe the cyclic	a cell as a whole and ways parts	MS-LS1-5. Construct a scientific
and/or release energy as this matter	MS-ESS2-6. Develop and use a model to	patterns of lunar phases, eclipses	of cells contribute to the	explanation based on evidence for
moves through an organism.	describe how unequal heating and rotation	of the sun and moon, and	function.	how environmental and genetic
MS-LS2-3. Develop a model to	of the Earth cause patterns of atmospheric	seasons.	MS-LS1-3. Use argument	factors influence the growth of
describe the cycling of matter and	and oceanic circulation that determine	MS-ESS1-2. Develop and use a	supported by evidence for	organisms.
flow of energy among living and non-	regional climates.	model to describe the role of	how the body is a system	MS-LS3-1. Develop and use a model
living parts of an ecosystem.	MS-ESS3-2. Analyze and interpret data on	gravity in the motions within	of interacting subsystems	to describe why structural changes
MS-ESS2-1. Develop a model to	natural hazards to forecast catastrophic	galaxies and the solar system.	composed of groups of cells.	to genes (mutations) located on
describe the cycling of Earth's	events and inform the development of			chromosomes may affect proteins
materials and the flow of energy that	technologies to mitigate their effects.			and may result in harmful, beneficial,
drives this process.	MS-ETS1-1. Define the criteria and			or neutral effects to the structure
MS-ESS2-2. Construct an explanation	constraints of a design problem with			and function of the organism.
based on evidence for how	sufficient precision to ensure a successful			MS-LS3-2. Develop and use a model
geosciences processes have changed	solution, taking into account relevant			to describe why asexual
Earth's surface at varying time and	scientific principles and potential impacts.			reproduction results in offspring with
spatial scales.				identical genetic information and

Bundle 1: Why do people live and farm on volcanoes? ~6 weeks	Bundle 2: What causes climates to be so different across the Earth? ~6 weeks	Bundle 3: Why can we predict solar eclipses? ~ 4 weeks	Bundle 4: Why are bones so hard? ~4 weeks	Bundle 5: Why do some parents and offspring look different?
				~ 6 weeks
	on people and the natural environment			sexual reproduction results in
	that may limit possible solutions.			offspring with genetic variation.
	MS-ETS1-2: Evaluate competing design			
	solutions using a systematic process to			
	determine how well they meet the criteria			
	and constraints of the problem.			

Middle School Phenomenon Model Course 2 Flowchart



PS3.D as found in MS-LS1-6

• The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbonbased organic molecules and release oxygen.

PS3.D as found in MS-LS1-7

 Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.

LS1.C as found in MS-LS1-6

• Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.

to LS1.A in Bundle 4

LS1.C as found in MS-LS1-7

• Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.

LS2.B as found in MS-LS2-3

· Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. to LS1.B in Bundle 5

ESS2.A as found in MS-ESS2-1

• All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.

ESS2.A as found in MS-ESS2-2

• The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

ESS2.C as found in MS-ESS2-2

• Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.

to ESS2.C in Bundle 2



constraints can be defined, the more likely it is that

of constraints includes consideration of scientific

principles and other relevant knowledge that are

• There are systematic processes for evaluating

solutions with respect to how well they meet criteria

likely to limit possible solutions.

ETS1.B as found in MS-ETS1-2

and constraints of a problem.

the designed solution will be successful. Specification

- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to
- Patterns of the apparent motion of the sun, the described, predicted, and explained with models.
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.
- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its
- The solar system appears to have formed from a disk
- This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.

LS1.A as found in MS-LS1-1

LS1.A as found in MS-LS1-2 • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell

Bundle 4

LS1.A as found in MS-LS1-3

• In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

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LS1.B as found in MS-LS1-4

- Animals engage in characteristic behaviors that increase the odds of reproduction.
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.

LS1.B as found in MS-LS1-5

• Genetic factors as well as local conditions affect the growth of the adult plant.

LS1.B as found in MS-LS3-2

• Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.

LS3.A as found in MS-LS3-1

• Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.

LS3.A as found in MS-LS3-2

• Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.

LS3.B as found in MS-LS3-1

• In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.

LS3.B as found in MS-LS3-2

• In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.