**Middle School Topic Model Course III**

**Narrative and Rationale:** This course model arranges the Performance Expectations (PEs) outline in the third year of the California Integrated Middle School Model into four different bundles of PEs using a topical arrangement. The disciplinary core ideas of each eighth grade standard were used in this model to arrange units into topics. The authors found that the 8th grade PEs fell naturally into the following topic areas: forces and energy, energy in waves, mechanisms of diversity, and the changing Earth. The bundle focused on forces and energy was placed early in the year so that students’ understandings developed may be used to explain phenomena within later units on the topics of waves, mechanisms of diversity, and the cosmos.

It is important to note that the SEPs and CCCs described are intended as end-of-unit expectations and not curricular designations. Additional SEPs and CCCs should be used throughout instruction in each unit.

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<tr>
<td>MS-PS2-1. Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.*</td>
<td>MS-PS4-1. 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.</td>
<td>MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.</td>
<td>MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.¹</td>
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<td>MS-PS2-2. Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.</td>
<td>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</td>
<td>MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.¹</td>
<td>MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclical patterns of lunar phases, eclipses of the sun and moon, and seasons.</td>
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<td>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</td>
<td>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</td>
<td>MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.¹</td>
<td>MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.</td>
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<td>MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.</td>
<td>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</td>
<td>MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evidence in the fully formed anatomy.</td>
<td>MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.</td>
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<td>MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.</td>
<td>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</td>
<td>MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving</td>
<td>MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth’s 4.6-billion-year-old history.</td>
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<td>MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.</td>
<td>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</td>
<td>MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evidence in the fully formed anatomy.</td>
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interacting at a distance changes, different amounts of potential energy are stored in the system.

**MS-ESS1-2.** Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.¹

**MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

and reproducing in a specific environment.

**MS-LS4-5.** Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

**MS-LS4-6.** Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

**MS-ESS3-4.** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems.

**MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

¹ The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.
The motion of an object is determined by the sum of the forces acting on it: if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.

All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.

Forces that act at a distance (electric and magnetic) can be mapped by their effect on a test object (a charged object, a magnet, etc.)

The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.

Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.

The geologic time scale is a chronological order (e.g., through the location of the sedimentary layers in which they are found) used to describe the history and the inference of lines of evolutionary descent.

A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.

However, because light can travel through space, it cannot be a matter wave, like sound or water waves.

Models of all kinds are important for testing solutions. Natural selection leads to the predominance of certain traits which are then passed on to offspring.

The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.

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Models of all kinds are important for testing solutions.

The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.

Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.

Animals and plants that adapt and become useful for the human condition are known as domesticated or cultivated species.
ETS1.A as found in MS-ETS1-1

- The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.

ETS1.B as found in MS-ETS1-3

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.

ETS1.C as found in MS-ETS1-3

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.

ESS1.A as found in MS-ESS1-2

- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.

ESS1.B as found in MS-ESS1-2

- 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 gravitational pull on them.
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

ESS1.C as found in MS-ESS1-2

- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.