

# Middle School Topic Model Course 1

Narrative and Rationale: This course model arranges the Performance Expectations (PEs) outlined in the first year of the California Integrated Middle School Model into four different bundles of PEs using a topical arrangement. The disciplinary core ideas of each standard were used in this model to arrange bundles that addressed the topics of human body systems, reproduction and growth, energy transfer and weather, and climates and human impacts.

The Disciplinary Core Ideas (DCIs) in physical science focus on the transfer of energy in systems and the kinetic energy of objects. In the life sciences, the DCIs address the growth and development of organisms, cell structures, and processes. Finally, in the earth and space sciences, the DCIs emphasize the role of

In this model, students begin to develop proficiency in the middle school-level Science and Engineering Practices over the course of the year, and the level of sophistication at which they are able to engage in them increases over time. 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.

<b>Bundle 1:</b> "How do the structures of	<b>Bundle 2:</b> "How do organisms grow	<b>Bundle 3:</b> "How can we measure the	<b>Bundle 4:</b> "What is contributing to
organisms enable life's functions?"	and reproduce?"	flow of energy in a system?"	the rise in global temperature?"
~6 weeks	~6 weeks	~6 weeks	~6 weeks
MS-LS1-1. Conduct an investigation to	MS-LS1-3. Use argument supported by	MS-PS3-3. Apply scientific principles to	MS-ESS2-4. Develop a model to describe the
provide evidence that living things are made	evidence for how the body is a system of	design, construct, and test a device that	cycling of water through Earth's systems
of cells; either one cell or many different	interacting subsystems composed of groups	either minimizes or maximizes thermal energy	driven by energy from the sun and the force
numbers and types of cells.	of cells. 1	transfer.*	of gravity.
MS-LS1-2. Develop and use a model to	MS-LS1-4. Use argument based on empirical	MS-PS3-4. Plan an investigation to determine	MS-ESS2-5. Collect data to provide evidence
describe the function of a cell as a whole and	evidence and scientific reasoning to support	the relationships among the energy	for how the motions and complex
ways parts of cells contribute to the function.	an explanation for how characteristic animal	transferred, the type of matter, the mass, and	interactions of air masses results in changes
MS-LS1-3. Use argument supported by	behaviors and specialized plant structures	the change in the average kinetic energy of	in weather conditions.
evidence for how the body is a system of	affect the probability of successful	the particles as measured by the temperature	MS-ESS2-6. Develop and use a model to
interacting subsystems composed of groups	reproduction of animals and plants	of the sample.	describe how unequal heating and rotation of
of cells. <sup>1</sup>	respectively.	MS-PS3-5. Construct, use, and present	the Earth cause patterns of atmospheric and
MS-LS1-8. Gather and synthesize information	MS-LS1-5. Construct a scientific explanation	arguments to support the claim that when	oceanic circulation that determine regional
that sensory receptors respond to stimuli by	based on evidence for how environmental	the kinetic energy of an object changes,	climates.
sending messages to the brain for immediate	and genetic factors influence the growth of	energy is transferred to or from the object.	MS-ESS3-3. Apply scientific principles to
behavior or storage as memories. 1	organisms.	MS-ETS1-3. Analyze data from tests to	design a method for monitoring and
<b>MS-ETS1-1.</b> Define the criteria and constraints	MS-LS1-8. Gather and synthesize information	determine similarities and differences among	minimizing a human impact on the
of a design problem with sufficient precision	that sensory receptors respond to stimuli by	several design solutions to identify the best	environment.*
to ensure a successful solution, taking into	sending messages to the brain for immediate	characteristics of each that can be combined	MS-ESS3-5. Ask questions to clarify evidence
account relevant scientific principles and	behavior or storage as memories. 1	into a new solution to better meet the criteria	of the factors that have caused the rise in
potential impacts on people and the natural	MS-LS3-2. Develop and use a model to	for success.	global temperatures over the past century.
environment that may limit possible	describe why asexual reproduction results in		MS-ETS1-2. Evaluate competing design
solutions.	offspring with identical genetic information		solutions using a systematic process to
	and sexual reproduction results in offspring		determine how well they meet the criteria
	with genetic variation.		and constraints of the problem.
	<b>MS-ETS1-1.</b> Define the criteria and constraints		
	of a design problem with sufficient precision		
	to ensure a successful solution, taking into		

water in shaping the processes of the Earth. These DCIs build conceptually throughout the year.



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organisms enable life's functions?"	and reproduce?"	flow of energy in a system?"	the rise in global temperature?"
~6 weeks	~6 weeks	~6 weeks	~6 weeks
	account relevant scientific principles and		
	potential impacts on people and the natural		
	environment that may limit possible		
	solutions.		
	MS-ETS1-2. Evaluate competing design		
	solutions using a systematic process to		
	determine how well they meet the criteria		
	and constraints of the problem.		
	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.		
	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.		

<sup>1.</sup> The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.



# **Bundle 1**

#### LS1.A as found in MS-LS1-1

 All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).

## 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.

## 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.

## LS1.D as found in MS-LS1-8

 Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain.
 The signals are then processed in the brain, resulting in immediate behaviors or memories.

### 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.

# **Bundle 2**

# 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.

## 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.

## LS1.D as found in MS-LS1-8

 Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain.
 The signals are then processed in the brain, resulting in immediate behaviors or memories.

## 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-LS3-2

 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.

## 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-ETS1-2 and MS-ETS1-3

 There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

### ETS1.B as found in MS-ETS1-4

- A solution needs to be tested, and then modified on the basis of the test results. in order to improve it.
- Models of all kinds are important for testing solutions.

# **Bundle 3**

#### PS3.A as found in MS-PS3-3 and MS-PS3-4

 Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.

## PS3.B as found in MS-PS3-3

 Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

#### PS3.B as found in HS-PS3-4

 The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

#### PS3.B as found in HS-PS3-5

 When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

### ETS1.A as found in MS-PS3-3

 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 is likely to limit possible solutions.

## ETS1.B as found in MS-PS3-3

 A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem.

## 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 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.

# **Bundle 4**

# ESS2.C as found in MS-ESS2-4

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land
- Global movements of water and its changes in form are propelled by sunlight and gravity.

#### ESS2.C as found in MS-ESS2-5

 The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.

## ESS2.C as found in MS-ESS2-6

 Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

#### ESS2.D as found in MS-ESS2-5

 Because these patterns are so complex, weather can only be predicted probabilistically.

## ESS2.D as found in MS-ESS2-6

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

## ESS3.C as found in MS-ESS3-3

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

### ESS3.D as found in MS-ESS3-5

 Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

## ETS1.B as found in MS-ETS1-2

 There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of problem.



# ETS1.B as found in MS-ETS1-3

 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.

# ETS1.C as found in MS-ETS1-4

 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.