Kindergarten Topic Model - Bundle 3
Patterns and Effects of Sunlight

This is the third bundle of the Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart

Bundle 1 Question: This bundle is assembled to address the question of "What can we observe about sunlight?"

Summary

The bundle organizes performance expectations around *observations of patterns and effects of sunlight*. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

Sunlight warms Earth's surface. (PS3.B as in K-PS3-1 and K-PS3-2). This concept of sunlight warming Earth's surface connects to the idea that weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1).

The concept that designs can be conveyed through sketches, drawings, or physical models (ETS1.B as in K-2-ETS1-2) could connect to multiple concepts such as sunlight warms Earth's surface (PS3.B as in K-PS3-1 and K-PS3-2) and weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1). These connections could be made through a task in which students must use a representation to convey their design of a structure that will provide a cool place for the students of their school to use when they are outside on a warm day. Students could also engage in a task in which they need to convey the design of an object that would protect them from any negative effects of wind and then reflect on the usefulness of conveying their ideas through representations.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (K-2-ETS1-2), planning and carrying out investigations (K-PS3-1), analyzing and interpreting data (K-ESS2-1), and constructing explanations and designing solutions (K-PS3-2). Many other practice elements can be used in instruction.

Bundle Crosscutting Concepts

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (K-ESS2-1), Cause and Effect (K-PS3-1 and K-PS3-2), and Structure and Function (K-2-ETS1-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	K-PS3-1. **Make observations to determine the effect of sunlight on Earth's surface. [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as* warmer/cooler.]** K-PS3-2**. Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.* [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]** K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time. [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]** K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.***
Example Phenomena	The amount of sunlight changes throughout a day and across days, weeks, months and the year. The pavement is hotter to the touch in the sunlight than in the shade.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world. Students could *ask questions based on observations **[of how] sunlight warms Earth's surface** to find more information about the natural world.* K-PS3-1 **Developing and Using Models** ● Distinguish between a model and the actual object, process, and/or events the model represents. Students could *distinguish between a model **[of a structure that reduces the effect of] sunlight warming Earth's surface** and the actual object.* K-PS3-2 ● Develop a simple model based on evidence to represent a proposed object or tool. Students could *develop a simple model based on evidence to represent a proposed **[structure that reduces the effect of] sunlight warming Earth's surface.*** K-PS3-2 **Planning and Carrying out Investigations** ● Make predictions based on prior experiences. Students could *make predictions **[that] sunlight warms Earth's surface** based on prior experiences.* K-PS3-1 and K-PS3-2 ● Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. Students could *make observations of a proposed object to determine if it meets [the] goal **[of reducing the effect of] sunlight warming Earth's surface.*** K-PS3-2

Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Use and share pictures, drawings, and/or writings of observations. Students could *use and share pictures of observations* ***[of structures that reduces the effect of] sunlight warming Earth's surface.*** K-PS3-1 and K-PS3-2 **Using Mathematical and Computational Thinking** ● Use counting and numbers to identify and describe patterns in the natural and designed world(s). Students could *use counting and use numbers to identify and describe patterns* ***[of local weather] over time***. K-ESS2-1 **Constructing Explanations and Designing Solutions** ● Generate and/or compare multiple solutions to a problem. Students can *generate and compare multiple solutions to* ***a problem [related to local] weather or sunlight warming Earth's surface.*** K-ESS2-1, K-PS3-1, and K-PS3-2 **Engaging in Argument from Evidence** ● Analyze why some evidence is relevant to a scientific question and some is not. Students could *analyze why some evidence* ***[about local] weather*** *is relevant to a scientific question and some is not.*K-ESS2-1 ● Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. Students could *make a claim about the effectiveness of an object* ***[intended to reduce the effect of] sunlight warming Earth's surface.*** K-PS3-2 **Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how specific images (e.g., a diagram showing how a structure works) support a scientific or engineering idea* ***[about how] sunlight warms Earth's surface [or a structure can reduce this effect].*** K-PS3-1 and K-PS3-2 ● Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate information or design ideas* ***[about how] sunlight warms Earth's surface [or a structure can reduce this effect]*** *with others in written forms using drawings that provide detail about scientific ideas or design ideas.* K-PS3-1 and K-PS3-2

Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Simple tests can be designed to gather evidence to support or refute student ideas about causes. Students could describe that they *can design a simple test **[about] sunlight's [role in] warming Earth's surface** to gather evidence to support or refute their ideas about causes.* K-PS3-1 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could describe that *relative scales allow them to compare and describe **[the effects of] sunlight [on] Earth's surface.*** K-ESS2-1 and K-PS3-1 **Stability and Change** ● Things may change slowly or rapidly. Students could describe that *things like **local weather conditions** may change slowly or rapidly.* K-ESS2-1
Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists search for cause and effect relationships to explain natural events. Students could describe that *scientists search for cause and effect relationships, **like sunlight [causing] Earth's surface [to] warm**, to explain natural events.* K-PS3-1 **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Many events are repeated. Students could describe and reflect on the idea *that many events [such as the]* **sunlight, wind, snow or rain, and temperature in a particular region at a particular time** *repeat.* K-ESS2-1

K-PS3-1 Energy

Students who demonstrate understanding can:

K-PS3-1. **Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations (firsthand or from media) to collect data that can be used to make comparisons.

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Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Scientists use different ways to study the world.

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer

- Sunlight warms Earth's surface.

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon to be investigated	
	a	From the given investigation plan, students describe* (with guidance) the phenomenon under investigation, which includes the following idea: sunlight warms the Earth's surface.
	b	Students describe* (with guidance) the purpose of the investigation, which includes determining the effect of sunlight on Earth materials by identifying patterns of relative warmth of materials in sunlight and shade (e.g., sand, soil, rocks, water).
2	Identifying the evidence to address the purpose of the investigation	
	a	Based on the given investigation plan, students describe* (with guidance) the evidence that will result from the investigation, including observations of the relative warmth of materials in the presence and absence of sunlight (i.e., qualitative measures of temperature; e.g., hotter, warmer, colder).
	b	Students describe* how the observations they make connect to the purpose of the investigation.
3	Planning the investigation	
	a	Based on the given investigation plan, students describe* (with guidance):
		i. The materials on the Earth's surface to be investigated (e.g., dirt, sand, rocks, water, grass).
		ii. How the relative warmth of the materials will be observed and recorded.
4	Collecting the data	
	a	According to the given investigation plan and with guidance, students collect and record data that will allow them to:
		i. Compare the warmth of Earth materials placed in sunlight and the same Earth materials placed in shade.
		ii. Identify patterns of relative warmth of materials in sunlight and in shade (i.e., qualitative measures of temperature; e.g., hotter, warmer, colder).
		iii. Describe* that sunlight warms the Earth's surface.

K-PS3-2 Energy

Students who demonstrate understanding can:

K-PS3-2. **Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer

- Sunlight warms Earth's surface.

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns.

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use given scientific information about sunlight's warming effect on the Earth's surface to collaboratively design and build a structure that reduces warming caused by the sun.
	b	With support, students individually describe*:
		i. The problem.
		ii. The design solution.
		iii. In what way the design solution uses the given scientific information.
2	Describing* specific features of the design solution, including quantification when appropriate	
	a	Students describe* that the structure is expected to reduce warming for a designated area by providing shade.
	b	Students use only the given materials and tools when building the structure.
3	Evaluating potential solutions	
	a	Students describe* whether the structure meets the expectations in terms of cause (structure blocks sunlight) and effect (less warming of the surface).

K-ESS2-1 Earth's Systems

Students who demonstrate understanding can:

K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time.** [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

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Connections to Nature of Science

Science Knowledge is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world.

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	With guidance, students organize data from given observations (firsthand or from media) about local weather conditions using graphical displays (e.g., pictures, charts). The weather condition data include:
		i. The number of sunny, cloudy, rainy, windy, cool, or warm days.
		ii. The relative temperature at various times of the day (e.g., cooler in the morning, warmer during the day, cooler at night).
2	Identifying relationships	
	a	Students identify and describe* patterns in the organized data, including:
		i. The relative number of days of different types of weather conditions in a month.
		ii. The change in the relative temperature over the course of a day.
3	Interpreting data	
	a	Students describe* and share that:
		i. Certain months have more days of some kinds of weather than do other months (e.g., some months have more hot days, some have more rainy days).
		ii. The differences in relative temperature over the course of a day (e.g., between early morning and the afternoon, between one day and another) are directly related to the time of day.

K-2-ETS1-2 Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Develop a simple model based on evidence to represent a proposed object or tool.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a representation of an object and the problem it is intended to solve. In their representation, students include the following components:
		i. The object.
		ii. The relevant shape(s) of the object.
		iii. The function of the object.
	b	Students use sketches, drawings, or physical models to convey their representations.
2	Relationships	
	a	Students identify relationships between the components in their representation, including:
		i. The shape(s) of the object and the object's function.
		ii. The object and the problem is it designed to solve.
3	Connections	
	a	Students use their representation (simple sketch, drawing, or physical model) to communicate the connections between the shape(s) of an object, and how the object could solve the problem.