Kindergarten Science, Unit 6

Effects of the Sun

Overview

Unit abstract

During this unit of study, students are able to apply an understanding of the effects of the sun on the Earth's surface. The crosscutting concepts of cause and effect and structure and function are called out as organizing concepts for this disciplinary core idea. In the kindergarten performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models; planning and carrying out investigations; analyzing and interpreting data; and designing solutions. Students are expected to use these practices to demonstrate understanding of the core ideas.

Essential questions

Please note: *There are no essential questions in the kindergarten storyline that match the content for this unit of study. The following questions are the driving questions associated with K-PS3-1 and K-PS3-2.*

- What is the effect of sunlight on the earth's surface?
- How can the warming effects of the sun be reduced?

Bristol–Warren, Central Falls, Cranston, Tiverton, and Woonsocket, with process support from The Charles A. Dana Center at the University of Texas at Austin

Written Curriculum

Next Generation Science Standards

K. Weather and Climate

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 expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. (K-PS3-1) --- ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** ▪ Scientists use different ways to study the world. (K-PS3-1)	**PS3.B: Conservation of Energy and Energy Transfer** ▪ Sunlight warms Earth's surface. (K-PS3-1)	**Cause and Effect** ▪ Events have causes that generate observable patterns. (K-PS3-1)

Connections to other DCIs in kindergarten: N/A

Articulation of DCIs across grade-levels: **1.PS4.B** (K-PS3-1); **3.ESS2.D** (K-PS3-1)

Common Core State Standards Connections:

ELA/Literacy –

W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS3-1)

Mathematics –

K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS3-1)

K. Weather and Climate

Students who demonstrate understanding can:

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

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. (K-PS3-2)	**PS3.B: Conservation of Energy and Energy Transfer** ▪ Sunlight warms Earth's surface. (K-PS3-2)	**Cause and Effect** ▪ Events have causes that generate observable patterns. (K-PS3-2)

Connections to other DCIs in kindergarten: **K.ETS1.A** (K-PS3-2); **K.ETS1.B** (K-PS3-2)

Articulation of DCIs across grade-levels: **1.PS4.B** (K-PS3-2); **2.ETS1.B** (K-PS3-2); **4.ETS1.A** (K-PS3-2)

Common Core State Standards Connections:

ELA/Literacy –

W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). *(K-PS3-2)*

Mathematics –

K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS3-2)

K-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 expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. (K-2-ETS1-2)	**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. (K-2-ETS1-2)	**Structure and Function** ▪ The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2

Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2

Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

Articulation of DCIs across grade-bands: **3-5.ETS1.A** (K-2-ETS1-2); **3-5.ETS1.B** (K-2-ETS1-2); **3-5.ETS1.C** (K-2-ETS1-2)

Common Core State Standards Connections:
ELA/Literacy –

SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. *(K-2-ETS1-2)*

K-2. Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Analyze data from tests of an object or tool to determine if it works as intended. (K-2-ETS1-3)	**ETS1.C: Optimizing the Design Solution** ▪ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	N/A

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2
Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

Articulation of DCIs across grade-bands: **3-5.ETS1.A** (K-2 -ETS1-3); **3-5.ETS1.B** (K-2-ETS1-3); **3-5.ETS1.C** (K-2-ETS1-3)

Common Core State Standards Connections:
ELA/Literacy –
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(K-2-ETS1-3)*
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. *(K-2-ETS1-3)*
Mathematics –
MP.2 Reason abstractly and quantitatively. *(K-2-ETS1-3)*
MP.4 Model with mathematics. *(K-2-ETS1-3)*
MP.5 Use appropriate tools strategically. *(K-2-ETS1-3)*
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(K-2-ETS1-3)*

Clarifying the standards

Prior learning

There are no disciplinary core ideas that are considered prior learning for the concepts in this unit of study.

Progression of current learning

Driving question 1 What is the effect of sunlight on the Earth's surface?	
Concepts • Scientists use different ways to study the world. • Events have causes that generate observable patterns. • Sunlight warms Earth's surface.	Practices • Observe patterns in events generated by cause-and-effect relationships. • Make observations (firsthand or from media) to collect data that can be used to make comparisons. • Make observations to determine the effect of sunlight on Earth's surface. (Assessment of temperature is limited to relative measures such as warmer/cooler.) Examples of Earth's surface could include – Sand – Soil – Rocks – Water

Driving question 2
How can the warming effects of the sun be reduced?

Concepts	Practices
• Events have causes that generate observable patterns. • The shape and stability of structures of natural and designed objects are related to their function(s). • 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. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs. • Sunlight warms Earth's surface.	• Observe patterns in events generated by cause-and-effect relationships. • Describe how the shape and stability of structures are related to their function. • Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. • Use tools and materials to design and build a structure (e.g., umbrellas, canopies, tents) that will reduce the warming effect of sunlight on an area. • Develop a simple model based on evidence to represent a proposed object or tool. • 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. • Analyze data from tests of an object or tool to determine if it works as intended. • Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Integration of content, practices, and crosscutting concepts

In this unit of study, students investigate the effects of the sun on the surface of the Earth. Throughout the unit, students make observations in order to describe patterns of change. With adult support, they design and build a structure that will reduce the warming effect of sunlight, and then conduct tests to determine if the structure works as intended.

Scientists use different ways to study the world. In this unit's progression of learning, students work like scientists to investigate the warming effect of sunlight on the surface of the Earth. They will conduct simple investigations in order to make observations and collect data that can be used to make comparisons. Students should test a variety of materials that are found naturally on the surface of the Earth, including sand, soil, rocks, and water. Samples of each of these materials can be placed on two separate paper plates or shallow plastic containers; one container can be placed in direct sunlight, and the other can be placed out of direct sunlight. After a period of time, students should compare the relative temperature of each. Students should record their observations, then analyze and compare the data to determine if there is a pattern. They should draw the conclusion that the sun has the same warming effect on all the materials found on the surface of the Earth.

As students come to understand that the sun warms the surface of the Earth, they should engage in the ***engineering design process*** as follows:

- Students are challenged to design and build a structure that will reduce the warming effects of the sun.
- Students brainstorm a list of objects that reduce the warming effects of the sun (e.g., shade trees, umbrellas, large hats, canopies).
- As a class, students determine what the design should be able to do (criteria). For example:
  - The structure must reduce the warming effects of the sun.
  - The structure should be built using materials provided by the teacher.
  - The structure should be easy to carry and fit through the doorway of the classroom.
- Groups of students then use simple drawings or diagrams to design a structure, and use given tools and materials to build their design. Groups should be given a predetermined amount of time to draw and build their designs.
- Groups share their designs with the class, using their drawings or diagrams, and then test their designs outside. (Groups can place their structures in a sunny area, then compare the relative temperature of the ground under the structure and the ground in direct sunlight.).
- Students make and use observations to determine if the designs worked as intended, then compare the strengths and weaknesses of how each design performed.

While engaging in this process, students should use evidence from their observations to describe how their structures reduced the warming effect of sunlight.

Integration of engineering

In this unit of study, students engage in engineering design to build a structure that minimizes the warming effect of sunlight on an area. Through this process, students learn that the shape and stability of structures of designed objects are related to their function. They will use tools and materials to design and build their structures. Because there is always more than one possible solution to a problem, students will test and compare their designs, then analyze data to determine if their structures work as intended. This process is outlined in greater detail in the previous section.

Integration of DCI from other units within this grade level

The following connections to engineering design occur in Unit 1, Weather; Unit 4, The Human Factor; and Unit 5, Pushes and Pulls. In these units of study, kindergarten student learn that:

- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.
- 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.
- Because there is always more than one possible solution to a problem it is useful to compare and test designs.

Integration of English language arts and mathematics

English language arts

Throughout this unit of study, the CCSS for English language arts are integrated in a number of ways. With guidance and support from adults, students recall information from experiences and gather information from books (read-alouds, big books) and other resources about the warming effects of the sun. Strategies such as Think-Pair-Share can be used to encourage students to think about and use information from books to answer questions and share their thinking. Kindergartners can add drawings or other visual displays to descriptions to provide additional detail about the structures they built to reduce the warming effects of the sun. With guidance and support from adults, students can use digital tools to produce and publish their descriptions and observations of the structures they designed and built.

Mathematics

To integrate the CCSS for mathematics into this unit, students make comparisons of objects using relative temperature and describe the objects as warmer or cooler. Students can classify the objects into categories (warmer/cooler), then count and compare the number of objects in each category. Data should be organized and compared so that students understand that placing objects in the sun generates an observable pattern of change (i.e., the objects get warmer). Kindergarteners attend to the meaning of various quantities using a variety of measurement tools, such as thermometers without scale markings, to determine if an object has gotten warmer when placed in the sun. They mathematically represent real-world information by organizing their data into simple graphs or charts or by diagramming the situation mathematically.

Future learning

The following disciplinary core ideas are future learning related to the concepts in this unit of study.

In Grade 1, students will know that:

- Objects can be seen if light is available to illuminate them or if they give off their own light.
- Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.)

In Grade 2, students will know that:

- 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.

In Grade 3, students will know that:

- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

By the end of the 3–5 Grade span, students will know that:

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of a design that need to be improved.
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and constraints.

Number of Instructional Days

Recommended number of instructional days: 12 (1 day = approximately 20–30 minutes)

Note—The recommended number of days is an estimate based on the information available at this time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.