Sunlight Warms Earth’s Surface

Physical Science (Energy), Kindergarten

Kindergarten students explore the effect of sunlight on Earth’s natural surfaces of sand, soil, rock and water. Students learn that surfaces in sunlight are warmer than those surfaces in the shade. In addition, students explore how the color and material of a surface affects how warm it gets after being in sunlight. Students use tools and materials to build a prototype that reduces the warming effect of sunlight.

This Model Curriculum Unit is designed to illustrate effective curriculum that lead to expectations outlined in the Draft Revised Science and Technology/Engineering Standards (www.doe.mass.edu/STEM/review.html) as well as the MA Curriculum Frameworks for English Language Arts/Literacy and Mathematics. This unit includes lesson plans, a Curriculum Embedded Performance Assessment, and related resources. In using this unit it is important to consider the variability of learners in your class and make adaptations as necessary.
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Unit Assumptions and Comments on Sequence

This kindergarten unit does not require assumptions about prior academic learning in preschool or earlier units in kindergarten, but does assume that students have used basic tools, such as scissors and glue, and can read a very basic map. Students can engage more successfully with the first standard (K-PS3-1) if they already have a sense of different materials that make up surfaces around their school, but they do learn about these through the unit. The key focus of this unit is the effect of sunlight on the warming of different materials. No mention is made of sunlight as a form of energy, nor that sunlight is converted to heat; these will be explicated in later grades, particularly grade 4.

Unit STE Standards
(students will learn these through the unit)

K-PS3-1. Make observations to determine that sunlight warms materials on Earth’s surface. [Clarification Statement: Examples of materials on 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 to design and build a prototype of a structure that will reduce the warming effect of sunlight on an area.*

Subsequent STE Standards
(facility with the unit standards will contribute to learning these later)

4-PS3-2. Make observations to show that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
### Stage 1 — Desired Results

#### ESTABLISHED GOALS

**Science, Technology, and Engineering**

[NOTE: These are draft revised STE standards (as of 12/20/13); final adopted STE standards may be slightly different.]

**K-PS3-1** Make observations to determine that sunlight warms materials on Earth’s surface. [Clarification Statement: Examples of materials on 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 to design and build a prototype of a structure that will reduce the warming effect of sunlight on an area.*

#### ELA/Literacy

**SL.K.1** Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and large groups.

- a. Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
- b. Continue a conversation through multiple exchanges.

#### Transfer

**Students will be able to independently use their learning to...**

- **T** Analyze mechanisms of cause and effect in natural and designed systems based on physical and chemical principles.

#### Meaning

**UNDERSTANDINGS**

**Students will understand that...**

**U1** Sunlight warms Earth’s surfaces.

**U2** Different materials on Earth are warmed by sunlight by different amounts.

**U3** Collaborative conversations are necessary to review and develop scientific ideas.

#### ESSENTIAL QUESTIONS

**Q1** Why are different areas of the playground hotter than others on a sunny day?

**Q2** How can we stay cool at the beach on a sunny day?

#### Acquisition

**Students will know...**

**K1** Dark and light colored surfaces in sunlight are warmed by different amounts and at different rates.

**K2** Different materials in sunlight are warmed by different amounts and at different rates.

**K3** Structures create shade; they block sunlight.

**K4** For a given surface, the more sunlight it is exposed to, the warmer the surface.

**K5** Vocabulary: **warmer, cooler, temperature, surface, sand, soil, water, rocks, shade, sunlight, tent, cave, tunnel, umbrella, burrow, heat, material, tool, prototype, structure, collaborative conversation, safety, explanation, solution, thermometer.**

**Students will be skilled at...**

**S1** Observing the relative warming effect of sunlight on Earth’s materials.

**S2** Comparing the relative warmth of surfaces in and out of sunlight.

**S3** Safely using tools and materials to design and build a prototype.

**S4** Engaging in collaborative conversations to discuss their explorations, designs, and to generate and test explanations.
### Stage 2 — Evidence

<table>
<thead>
<tr>
<th>Evaluative Criteria</th>
<th>Assessment Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presents a viable solution to address design challenge</td>
<td>CURRICULUM EMBEDDED PERFORMANCE ASSESSMENT (PERFORMANCE TASKS) PT Beach Shelter Prototype</td>
</tr>
<tr>
<td>Makes observations to compare temperatures</td>
<td>The students are asked to use the model of a beach that they designed earlier in the unit to create a scene where one small-scale figure would stay cool and another would stay warm. Small groups of students are given a bag of materials per group, such as spoons, craft sticks, scissors, plastic knives, a paintbrush (to spread glue), straws, pipe cleaners, pieces of cloth, tape/glue, play-dough/clay (to simulate rocks), a black marker, and two small-scale figures with which to build a prototype of a shade structure. They are allowed to use any or all of the materials in the bag and they must engage in collaborative conversations to explain and defend their solutions using what they have learned through the unit.</td>
</tr>
<tr>
<td>Provides an explanation based in relevant scientific knowledge</td>
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<tr>
<td>Uses scientific vocabulary</td>
<td></td>
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<tr>
<td>Engages in collaborative conversations</td>
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</tbody>
</table>

#### OTHER EVIDENCE:
- Teacher observations, class discussion.
- Material graphic organizer.
- Map of surface materials.

### Stage 3 — Learning Plan

**Summary of Key Learning Events and Instruction**

**Lesson 1: Earth's Materials (40 minutes)**
- Overview: Students will explore attributes of sand, soil, water, and rock.
- Objective: Students will be able to identify sand, soil, water and rock as different materials.

**Lesson 2: Schoolyard/Playground Surfaces (30 minutes)**
- Overview: Students will explore and map the schoolyard or playground to describe different types of materials on Earth's surface.
- Objective: Students will be able to identify different surfaces based on the types of materials present.

**Lesson 3: Warmer and Cooler Areas around the Schoolyard/Playground (30 minutes)**
- Overview: Students will identify areas of the playground that have different temperatures and explore why some are warmer than others.
- Objective: Students will be able to predict and explain which areas of the schoolyard/playground will be warmer or cooler based on data comparing temperatures of materials in sun and shade.

**Lesson 4: Effect of Sunlight on Rocks and Soil (2 blocks of 30 minutes/one at start of day, one at end of day)**
- Overview: Students will compare the relative temperature of different colored (light/dark) materials placed in the sun.
- Objective: Students will observe how different colored materials in the sun and shade will warm at different rates.
Lesson 5: Effect of Sunlight on Sand and Water (30 minutes)
- Overview: Students will compare water and sand in the sun and shade to observe that these materials warm at different rates in sunlight.
- Objective: Students will observe that different materials will warm up from sunlight in different amounts and at different rates.

Lesson 6: Using Tools to Build a Model (60 minutes)
- Overview: Students will use tools and materials to build a model of a beach.
- Objective: Students will be able to cooperatively use tools and materials to work to design and build a model.

CEPA: Beach Shelter Prototype (60 minutes)
- Overview: Small groups of students design and build a prototype of a structure to help people stay cool on a sunny day and through collaborative conversations explain why their solution is viable.

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Lesson 1: Earth’s Materials

Brief Overview of Lesson: Students will explore attributes of sand, soil, water, and rock. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Estimated Time: 40 minutes

Standard(s)/Unit Goal(s) to be addressed in this lesson:
- K-PS3-1 Make observations to determine that sunlight warms materials on Earth’s surface. [Clarification Statement: Examples of materials on Earth’s surface could include sand, soil, rocks, and water.] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]
- SL.K.1. Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and large groups.
  a) Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
  b) Continue a conversation through multiple exchanges.

Essential Question(s) addressed in this lesson:
- Why are different areas of the playground hotter than others on a sunny day?

Objectives:
- Students will be able to identify sand, soil, water, and rock as different materials.

Language Objectives:
- Use scientific vocabulary to identify and describe different materials.
- Speak in complete sentences to communicate information.
- WIDA: Levels 1/2
  o Repeat scientific words to identify different materials.
  o Repeat sentences.
- WIDA: Levels 3/4
o Use scientific vocabulary to identify and describe different materials using sentence starters.

**Targeted Academic Language:**
- material, sand, soil, water, rock

**What students should know and be able to do before starting this lesson:**
- Observe attributes of materials (e.g., color, texture, size).

**Anticipated Student Preconceptions/Misconceptions:**
- “Dirt” is the same thing as “soil.”

**Instructional Materials/Resources/Tools:**
- Sand, soil, water, and rocks in separate containers
- Magnifying lenses (if desired)
- Books or website with pictures of 4 materials
- Crayons
- Chart paper, markers
- Earth materials graphic organizer (found in Unit Resources) for students, and one on chart paper

**Instructional Tips/Strategies/Suggestions for Teacher:**
- Set up four different stations, each with samples of one of the four materials (sand, soil, water, rocks). Make magnifying lenses available if desired. Pictures or other images of additional samples of each material can be included. Multiple stations of each material can be set up to accommodate more groups; each student explores each material only once.
- Put students into groups that will rotate through the four stations.
- While students are at the stations, provide feedback on the nature and quality of their observations and drawings.
- If magnifying glasses are provided to aid observation, ensure that students know how to use them and watch that they do not (accidentally or intentionally) use them to focus sunlight on burnable materials or on living things.
- Provide a graphic organizer to each student (in unit resources). Make sure all students color the materials in the graphic organizer accurately for use in Lesson 2.
- In this lesson and Lesson 3, support students in developing collaborative conversation skills.
Assessment:
- Class discussion and accurately completed graphic organizers.

Lesson Details:

Lesson Opening (10 minutes)
Introduce sand, soil, water, and rocks as four common materials on Earth’s surface. Elicit prior knowledge through a Turn and Talk: “Where do we have you soil, water, rocks, and sand around the school?” If possible, show pictures using books or a computer projector of where else these materials are found on Earth (different landscapes/scenes).

During the Lesson (20 minutes)
In small groups, students will observe one material (sand, soil, water, or rock) at each center. After touching and observing the material, students will draw and color it on the graphic organizer. Students will then move to the next station until they complete all four (five minutes at each station).

As students work, move around the stations and encourage students to participate in discussions to communicate their observations, by taking turns, listening to each other, sharing ideas, and following rules of conversation.

Lesson Closing (10 minutes)
Ask each group to share one observation about one material with the class, rotating among the student groups. Record their shared observations on a chart-paper version of the graphic organizer students used. Emphasize the color of each material (and possible variations) for the next lesson as well as the key vocabulary material, soil, sand, water, and rock. On the class chart, assign specific colors for each material to create a color key that will be used in the next lesson (e.g., sand::yellow, soil::brown, water::blue, rocks::gray).
Lesson 2: Schoolyard/Playground Surfaces

**Brief Overview of Lesson:** Students will explore and map the schoolyard or playground to describe different types of materials on Earth’s surface. As you plan, consider the variability of learners in your class and make adaptations as necessary.

**Estimated Time:** 30 minutes

**Standard(s)/Unit Goal(s) to be addressed in this lesson:**
- K-PS3-1 Make observations to determine that sunlight warms materials on Earth’s surface. [Clarification Statement: Examples of materials on Earth’s surface could include sand, soil, rocks, and water.] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]

**Essential Question(s) addressed in this lesson:**
- Why are different areas of the playground hotter than others on a sunny day?

**Objectives:**
- Students will be able to identify different surfaces based on the types of materials present.

**Language Objectives:**
- Use scientific vocabulary when describing different materials or surfaces.
- Speak in complete sentences.
- WIDA: Levels 1/2
  - Repeat scientific words when describing different surfaces.
  - Repeat sentences.
- WIDA: Levels 3/4
  - Use scientific vocabulary to identify different surfaces.
  - Speak in complete sentences using sentence starters.

**Targeted Academic Language:**
- surface, material, sand, soil, water, rock
What students should know and be able to do before starting this lesson:

- How to read and use a very basic map

Anticipated Student Preconceptions/Misconceptions:

- Students may believe that the schoolyard/playground has surfaces that are all the same (such as pavement or wood chips). While some playgrounds have one material that make up the playground surface, there are generally additional surface types (materials) that surround the playground and can be found around the schoolyard.

Instructional Materials/Resources/Tools:

- Graphic organizer from previous lesson with color key
- Basic map of the schoolyard/playground
- Clipboards
- Crayons

Instructional Tips/Strategies/Suggestions for Teacher:

- The opening can be done in the classroom or outside; in either case, the main portion of the lesson is conducted on the schoolyard/playground. If students are introduced to the activity before recess, they could complete it either during or immediately after recess.
- You may wish to create a basic map of the schoolyard/playground, without words and without color.
- Exploring materials and surfaces and coloring the map engages students in investigation skills, particularly observation and data collection.
- You may want to allow pavement and cement to be “counted” as rock; if so, remind them that those materials are not actually rock but behave like rock for the purpose of this unit in terms of how the material is warmed in sunlight.

Assessment:

- Class discussion and accurately completed maps
Lesson Details:

Lesson Opening (5 minutes)
Introduce the basic map of the schoolyard/playground. Orient students to the different components, structures, or areas that are included on the map. Tell students that they will be collecting information to create a map for use tomorrow. Outline today's activity and model how to match and color (using the color key created yesterday) an area on the map to indicate a particular surface (composed of a material or set of materials). For example, show a sandbox on map and color that area yellow.

During the Lesson
In pairs, students will identify playground surfaces, looking for the materials that they explored in Lesson One. Students color their maps using the color keys from their graphic organizers. Additional colors may be needed for additional materials (such as grass or wood chips) or combinations of materials.

Lesson Closing
Introduce essential question #1: Why are different areas of the playground hotter than others on a sunny day? Ask students to consider whether the type of material might affect how hot a particular area of the schoolyard/playground can be.
Lesson 3: Warmer and Cooler Areas around the Schoolyard/Playground

**Brief Overview of Lesson:** Students will identify areas of the playground that have different temperatures and explore why some are warmer than others. As you plan, consider the variability of learners in your class and make adaptations as necessary.

**Estimated Time:** 30 minutes

**Standard(s)/Unit Goal(s) to be addressed in this lesson:**
- K-PS3-1 Make observations to determine that sunlight warms materials on Earth’s surface. [Clarification Statement: Examples of materials on Earth’s surface could include sand, soil, rocks, and water.] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]
- SL.K.1. Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and large groups.
  c) Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
  d) Continue a conversation through multiple exchanges.

**Essential Question(s) addressed in this lesson:**
- Why are different areas of the playground hotter than others on a sunny day?
- How can we stay cool at the beach on a sunny day?

**Objectives:**
- Students will be able to predict and explain which areas of the schoolyard/playground will be warmer or cooler based on data comparing temperatures of materials in sun and shade.

**Language Objectives:**
- Define the problem using complete sentences.
- Use academic vocabulary when making predictions.
- Complete maps to illustrate observations.
- Discuss the effects of sun on surfaces.
- WIDA: Levels 1/2
  - Restate the problem.
  - Predict the temperature of surfaces using the terms *warm* and *cool*.
  - Complete maps to illustrate observations.
- WIDA: Levels 3/4
  - Restate the problem.
  - Predict the temperature of surfaces.
  - Complete maps to illustrate observations.

**Targeted Academic Language:**
- warmer, cooler, compare, temperature, shady, sunlight, thermometer

**What students should know and be able to do before starting this lesson:**
- Identify warmer and cooler using their hands.
- Identify sand, soil, water, and rock as different materials or surfaces

**Anticipated Student Preconceptions/Misconceptions:**
- Students may think that all areas of the playground are the same temperature or that sunny and shady areas will have the same temperature.

**Instructional Materials/Resources/Tools:**
- Student maps from Lesson One
- Crayons
- Clipboards
- Read aloud book: *Go Away, Sun* by Pam Bull (Found at ReadingA-Z.com Grade 2 Level M; Projectable book)
- Chart paper version of class map
Instructional Tips/Strategies/Suggestions for Teacher:

- The focus of the lesson is on how sunny areas are warmer than shady ones, and different materials warm in different amounts. The summarizing discussion is crucial and should not be cut out. Remember, that as the sun moves and sunny places become shady ones, surfaces retain heat for a period of time; therefore, a shady place may feel warm immediately after the sun has gone.
- This lesson needs to be done on a sunny day. If the day is not sunny, switch this lesson with Lesson 6, which involves building a beach model, or with Lessons 4 or 5, which can be done with lamps rather than sunlight.
- As an extension, discuss with students how “warming” and “cooling” of surfaces are processes. This contrasts with warmer and cooler, which describe the state of the surface’s temperature at a particular time.
- There are two options for introducing this lesson. One requires Reading A-Z access: readinga-z.com
- The outdoor activity engages students in collecting data. Help them record this data as they work.
- As in Lesson 1, support students in developing collaborative conversation skills in this lesson.

Assessment:

- Class discussion and teacher observation

Lesson Details:

Lesson Opening (2 options)

To elicit prior knowledge, have students Turn and Talk: Is the sand in the sandbox on the playground the same temperature all the time? How could you find out?

a. Discuss concept and terms of temperature, warmer and cooler. For example: You can see the weather forecaster on television telling us what areas in New England will be warmer and cooler. Weather forecasters use a thermometer to measure how warm or cold the weather is. The temperature tells us exactly how warm or cool it may be.

or

b. Read Go Away, Sun by Pam Bull.

During the Lesson

Take children with their maps outside to an area on the playground that has the same surface in the sun and shade. Have a few students come forward and touch both the sunny and shady surface. Ask them which is warmer and which is cooler. Once students understand the activity, challenge them to find other places on the playground that have the same surface but different temperatures and mark the sites on their map.
When students return from outdoors, have them sit at their tables and participate in discussions about these questions: “Was every surface the same temperature? Where were there differences?” Remind them that they should be taking turns, listening to each other, sharing ideas, and following rules of conversation.

Using the class map, have students share their findings. Then prompt them by asking, “Why do you think some areas of the same surface are warmer and others are cooler?” Try to scaffold students to conclude that sunny areas were warmer than shady ones and that some materials warm faster than others. Encourage students to use the evidence from their time outside as they explain their reasoning and to keep the discussion grounded in the activity.

**Lesson Closing**
Close by telling students that tomorrow they will try to discover the effects of sunlight on rocks and soil.
Lesson 4: Effect of Sunlight on Rocks and Soil

Brief Overview of Lesson: Students will compare the relative temperature of different colored (light/dark) materials placed in the sun. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Estimated Time: Two 30-minute blocks (at beginning and end of day)

Standard(s)/Unit Goal(s) to be addressed in this lesson:
- K-PS3-1 Make observations to determine that sunlight warms materials on Earth’s surface. [Clarification Statement: Examples of materials on Earth’s surface could include sand, soil, rocks, and water.] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]

Essential Question(s) addressed in this lesson:
- Why are different areas of the playground hotter than others on a sunny day?

Objectives:
- Students will observe how different colored materials in the sun and shade will warm at different rates.

Language Objectives:
- Use scientific vocabulary when describing different materials or surfaces.
- Speak in complete sentences,
- WIDA: Level 1/2
  o Repeat scientific words when describing different surfaces.
  o Repeat sentences.
- WIDA: Levels 3/4
  o Use scientific vocabulary to identify different surfaces.
  o Speak in complete sentences using sentence starters.

Targeted Academic Language:
- warmer, cooler, temperature, compare, sunlight, heat
What students should know and be able to do before starting this lesson:

- How to compare temperatures with their hands (warmer/cooler).
- Identify sand, soil, water and rock as different materials or surfaces.
- Compare temperatures of materials in sun or shade.

Anticipated Student Preconceptions/Misconceptions:

- Students may think that color does not influence how heat from sunlight affects surfaces or that rocks and soil will heat at the same rate in the sun.

Instructional Materials/Resources/Tools:

- Black rocks, white rocks
- Rocks in two containers (large enough for students to put their palms in), and soil in two containers
- Sticky notes, crayons, chart paper if desired

Instructional Tips/Strategies/Suggestions for Teacher:

- The lesson opening is meant to be a “hook” to interest the students and give them context. The opening is meant to be 5 to 10 minutes at most. Be careful not to let it derail the lesson. Photos are a necessary component of the lesson. Without the visuals students will not be able to access the material.
- Check craft stores for black and white rocks.
- Ensure that all materials have been kept out of the sun and away from a direct heat source prior to the lesson so that all materials start at the same temperature and those materials put in the sun for the lesson will warm up.
- If there is not sun during the day/lesson, a lamp with a 60-watt (or higher) incandescent bulb can be used.
- The materials need time to warm up under the presence of sunlight (or a light bulb) for some time in order to feel a difference in temperature. As such, the lesson needs to be introduced early in the day, then returned to later in the day.
- For a scientific explanation of why black absorbs more heat, refer to: [http://scienceline.ucsb.edu/getkey.php?key=1464](http://scienceline.ucsb.edu/getkey.php?key=1464)

Assessment:

- Class discussion of pictures or charts created in closing
- Quality of collaborative conversation
Lesson Details:

Lesson Opening (10 minutes)
To elicit prior knowledge, show students picture men painting a roof white: http://www.examiner.com/images/blog/wysiwyg/image/painting-roof-white.jpg. Tell the students there a new movement to paint roofs of buildings in hot climates white like this. Do a Think-Pair-Share focused on “Why do think that is?”

During the Lesson

Part 1, early in the day: Place white and black rocks in the sunny window. Students feel with their hands that the two rock piles start at the same temperature. Using containers that are large enough for students to place their hands in with the palms flat, place some rocks in one container in the sun and one container in the shade. Do the same with soil. Students feel with their hands that the two containers of rocks start at the same temperature, as do the two containers of soil. Record their observations (drawings or descriptions).

Part 2, later in the day: Have students feel the two rock groups to observe and change in temperature (the black should be warmer) and feel the remaining containers to discover that the materials in the sun are warmer and the ones in the shade are cooler.

Give each pair of students four sticky notes. On the first sticky note, they should draw rocks in sun; on the second, rocks with no sun; on the third, soil in sun; on the fourth, soil with no sun. Challenge pairs of students to put the sticky notes in order from coolest to warmest. On the board, make a four-column chart labeled coolest to hottest. Have student stick their notes in the columns they think are appropriate. Review the set to articulate the relationship between warmth of each material and sun/shade.

Lesson Closing
Orchestrate a share out that focuses on the fact that each surface in the sun was warmer than the one in the shade. However, the effect of the sunlight's heat may vary depending upon the surface. Discuss why that might be. There are many variables (such how much air or water is in the soil sample) but color is also a factor. Have students use evidence from the activity as they explain their thinking. Remind them to follow the rules of conversation. Discuss with students that the color black (or darker colors) absorb more sunlight than white (or lighter colors). White and lighter colors reflect, or have the light bounce off, more than black or darker colors.
Lesson 5: Effect of Sunlight on Sand and Water

**Brief Overview of Lesson:** Students will compare water and sand in the sun and shade to observe that these materials warm at different rates in sunlight. As you plan, consider the variability of learners in your class and make adaptations as necessary.

**Estimated Time:** 30 minutes

**Standard(s)/Unit Goal(s) to be addressed in this lesson:**
- K-PS3-1 Make observations to determine that sunlight warms materials on Earth’s surface. [Clarification Statement: Examples of materials on Earth’s surface could include sand, soil, rocks, and water.] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]

**Essential Question(s) addressed in this lesson:**
- Why are different areas of the playground hotter than others on a sunny day?
- How can we stay cool at the beach on a sunny day?

**Objectives:**
- Students will observe that different materials will warm up from sunlight in different amounts and at different rates.

**Language Objectives:**
- Use scientific vocabulary when describing different materials or surfaces.
- Speak in complete sentences.
- WIDA: Level 1/2
  - Repeat scientific words when describing different surfaces.
  - Repeat sentences.
- WIDA: Levels 3/4
  - Use scientific vocabulary to identify different surfaces.
  - Speak in complete sentences using sentence starters,
Targeted Academic Language:

- warmer, cooler, temperature, compare, sunlight, heat

What students should know and be able to do before starting this lesson:

- How to compare temperatures with their hands (warmer/cooler)
- Identify sand, soil, water and rock as different materials or surfaces
- Compare temperatures of materials in sun or shade

Anticipated Student Preconceptions/Misconceptions:

- Students may think that water and sand will heat at the same rate in the sun.

Instructional Materials/Resources/Tools:

- Sand in two containers (large enough for students to put their palms in), and water in two containers
- Sticky notes, crayons, chart paper (if desired)

Instructional Tips/Strategies/Suggestions for Teacher:

- Students should leave this lesson understanding that sand warms more dramatically in sunlight than water does. Consequently, even if the order of the material’s relative temperature is: shady water, sunny water, shady sand, sunny sand, a discussion can be held about why the sunny sand (or even shady sand) is hotter than sunny water. This idea will be key later in the CEPA.
- Ensure that all materials have been kept out of the sun and away from a direct heat source prior to the lesson so that all materials start at the same temperature and those materials put in the sun for the lesson will warm up.
- If there is not sun during the day/lesson, a lamp with a 60-watt (or higher) incandescent bulb can be used.
- The materials need time to warm up under the presence of sunlight (or a light bulb) for some time in order to feel a difference in temperature. As such, the lesson needs to be introduced early in the day, then returned to later in the day.
- Aim at analyzing the data rather than just creating a chart in order to engage students in the practice of analyzing and interpreting data. If you only make a chart you are not reaching that practice.

Assessment:

- Class discussion of chart created in closing
Lesson Details

Lesson Opening
Discuss the findings of yesterday that rocks and soil do not warm at the same rate when placed in the sunlight. To elicit prior knowledge, ask students to predict whether water and sand will warm at the same rate. Students may have more background knowledge to draw upon for this scenario. On chart paper note why they think the particular material will become the warmest in the sunlight. Elicit their reasoning for their thinking.

During the Lesson

Part 1, early in the day: Place some sand in one container in the sun and one container in the shade. Do the same with water. Students feel with their hands that the two containers of sand start at the same temperature, as do the two containers of water. Record their observations (drawings or descriptions).

Part 2, later in the day: Have students feel the containers to observe that the sand and water in the sun are warmer and the ones in the shade are cooler.

Give pairs of students four sticky notes: on first sticky note draw sand in sun; on the second, sand with no sun; on the third, water in sun; and on the fourth, water with no sun. Ask pairs of students to put the sticky notes in order from coolest to hottest.

On the board, make a four-column chart labeled coolest to hottest. Have students stick their notes in the columns they think are appropriate.

Lesson Closing
Orchestrate a share out that focuses on the fact that each surface/material that was in the sun was warmer than its counterpart in the shade. However, the sunny sand (or even the shady sand) may be warmer than the sunny water. (Even if the shady sand is warmer than the sunny water, the sunny sand is warmer than the sunny water. Both of the following orders would be correct: shady water, sunny water, shady sand, sunny sand OR shady water, shady sand, sunny water, sunny sand.) Students describe their results and explain their thinking about the reasons for that order. Wrap up by comparing previous predictions with actual outcomes of observations.
Lesson 6: Using Tools to Build a Model

Brief Overview of Lesson: Students will use tools and materials to build a model of a beach. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Estimated Time: 60 minutes

Standard(s)/Unit Goal(s) to be addressed in this lesson:
- K-PS3-2 Use tools and materials to design and build a prototype of a structure that will reduce the warming effect of sunlight on an area.*

Essential Question(s) addressed in this lesson:
- How can we stay cool at the beach on a sunny day?

Objectives:
- Students will be able to cooperatively use tools and materials to work to design and build a model.

Language Objectives:
- Present findings using scientific vocabulary.
- Speak in complete sentences.
- WIDA: Levels 1/2
  - Repeat scientific words when presenting.
- WIDA: Levels 3/4
  - Present findings using scientific vocabulary.
  - Speak in complete sentences using sentence starters.

Targeted Academic Language:
- warmer, cooler, temperature, shady, sunlight, sand, water
What students should know and be able to do before starting this lesson:
- How to use clay, cut, and paste
- How to use of basic tools and materials, such as scissors and glue

Anticipated Student Preconceptions/Misconceptions:
- Students may not know what a beach looks like or what materials are typically there.

Instructional Materials/Resources/Tools:
- A digital slide presentation or photos of various types of beaches
- Bag of materials per group such as: craft sticks, scissors, plastic knives, a paintbrush to spread glue, straws, pipe cleaners, pieces of cloth, tape or glue, modeling clay to simulate rocks, a black marker, a piece of cardstock or cardboard, and a container of water

Instructional Tips/Strategies/Suggestions for Teacher:
- Partner children so that everyone participates.
- For the images of the beaches, ensure that a variety of beaches are representative of a range of beaches, including some that are more sandy and some that are more rocky, some that are lighter in color and some that are darker in color.

Assessment:
- Class discussion with scientific language, and teacher observation.
- Observations of safe use of tools and materials.

Lesson Details

Lesson Opening
Have students close their eyes and imagine that they are at the beach. What do they see? Have students Turn and Talk about what they imagine. Now show students a slide presentation of different types of beaches. Tell students that they will be working in groups, and they will be given a bag of tools and materials with which to design and build their beach model. Tell them that they are not making a real beach but a model of a beach.
During the Lesson
Arrange students in groups of no more than three. Give each group a bag of materials such as sand, spoons, craft sticks, scissors, plastic knives, a paintbrush to spread glue, straws, pipe cleaners, pieces of cloth, tape or glue, modeling clay to simulate rocks, a black marker, cocktail sticks, a piece of cardstock or cardboard, and a container of water to represent the ocean. Children working in groups need to agree with each other on the design of the beach, and all need to participate in the building.

Lesson Closing
Carousel: Groups of students walk around to see each other's beach scenes. Ask each group to explain the rationale for their design and why they chose the materials they did (e.g., Why did you use a rock face? stony beach? white sand? rock pools? Grasses?).
Curriculum Embedded Performance Assessment (CEPA)
Teacher Instructions: Beach Shelter Prototype

Small groups of students design and build a prototype of a structure to help people stay cool on a sunny day and through collaborative conversations explain why their solution is viable.

Materials:
- One bag of materials per group, such as craft sticks, scissors, plastic knives, a paintbrush to spread glue, straws, pipe cleaners, pieces of cloth, tape or glue, modeling clay to simulate rocks, and a black marker.
- Two small-scale figures.
- The beach scenario as created by each group in the previous lesson.
- A container of water to simulate ocean water when placing scenarios in sun.

Explanation of CEPA:
- In small groups, students design and create a prototype of a structure that helps people stay cool on a sunny day at the beach. The students are asked to use a model of a beach—which they designed earlier in the unit—to create a scene where one small-scale figure would stay cool and another would stay warm. Small groups of students are given a bag of materials per group such as: a spoon, craft sticks, scissors, plastic knives, a paintbrush to spread glue, straws, pipe cleaners, pieces of cloth, tape or glue, modeling clay to simulate rocks, a black marker, and two small-scale figures with which to build a prototype of a shade structure. They are allowed to use any or all of the materials in the bag and they must engage in collaborative conversations to explain and defend their solutions using what they have learned through the unit.
- Anticipated time: 60 minutes.

What students should know and be able to do before starting this lesson:
- Different materials and, therefore, different surfaces absorb heat from sunlight differently. Tools need to be used safely. A prototype of a structure needs to function.

Instructional Tips/Strategies/Suggestions for Teacher:
- Students wanting to create a tunnel or burrow could cut the paper or indicate an entrance with the marker. For the placement in the sun, the small figure could be put under the cardboard.
• Finishing time will vary with solutions. Have alternative activities prepared for fast finishers.
• Ensure that all materials have been kept out of the sun and away from a direct heat source prior to the lesson so that all materials start at the same temperature and those materials put in the sun for the lesson will warm up.

Lesson Opening
Yesterday, you all built a model of a beach scene. Today we will be using that beach scene to solve a problem for two brothers, Harry Hot and Cool Carl.

Story to frame task: Two brothers, Harry Hot and Cool Carl, are spending the day at your beach. Harry is happy being hot. Carl likes to stay cool. Using what you have learned in this unit, how can you create an area where Harry can be hot and an area where Carl can be cool?

Directions: Remind students that there may be more than one solution to this problem. Walk them through the contents of the materials bag and tell them that they are not required to use these items but can use any of the items or tools in the bag that they want. However, they are required to use both Harry Hot and Cool Carl and predict and observe the different temperature in two areas. Do not hand out the bags until they have had time to discuss their plan in small groups. They also have to be able to explain why their solution would work.

Tell students that scientists call the models they build prototypes. Tell them that a prototype is a model that works like the real thing. Encourage students to say and use the word throughout the lesson, including when describing their solution and presenting their explanation of why they built it as they did.

During the Lesson
Students discuss collaboratively and design an initial plan in their groups (without bag of materials). When they can explain their plan, provide them with materials. Students create their prototype.

When solution is ready and the two figures are in position, place their beach scenario in the sun. For example, Cool Carl may be under a structure, under the cardboard (tunnel/burrow), or in a container of water next to their scene. As they wait (about 10 to 15 minutes), students should prepare their presentation. Explain to students that their task during their presentation is to answer the essential question: How can we stay cool at the beach on a sunny day? Their presentation must include:
• The scientific reasoning for their design (What was the thinking behind your design?)
• If their prototype worked (Did it work?)
• How they know their prototype worked or didn’t work [Did the temperature go down? How do you know?]
• Scientific vocabulary (Use science words we’ve learned.)
After a period of time, have the students feel the temperature of the areas where the two men are and state which is warmer and which is cooler.

**Lesson Closing**
Groups of students present their solutions to the class using their beach scene to explain why it was or was not a viable solution. Encourage all students in the group to participate and answer questions using complete sentences. Possible solutions may include:

- block sunlight (structure, tent, umbrella, cave, burrow, tunnel).
- use materials that do not warm up as quickly (such as water).

If some solutions are not created, discuss those missing options with class.
## CEPA Rubric

<table>
<thead>
<tr>
<th>Creates viable solution</th>
<th>Exceeds Standard (4)</th>
<th>Meets Standard (3)</th>
<th>Approaches Standard (2)</th>
<th>Needs Additional Support (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model uses multiple strategies to reduce heating of the materials</td>
<td>Model uses one strategy: block sunlight or use materials that do not warm quickly to create a cooler area</td>
<td>Model attempts to use strategies but does not manage to keep temperature from getting too hot</td>
<td>Model does not attempt to use strategies and does not keep temperature from getting too hot</td>
<td></td>
</tr>
</tbody>
</table>

| Makes observations to compare temperatures | Observes warm and cool and is able to compare temperatures of the two men as well as to other materials in scenario | Observes warm and cool and is able to compare temperatures of different materials | Is able to observe warm and cool but cannot compare temperatures of different materials | Is unable to observe warm and cool or compare temperatures |

| Explains solution based in scientific knowledge | Explanation of reasoning for their design appropriately demonstrates the relationship between sunlight and the warming of materials and includes a comparison of the effect of sunlight on Cool Carl’s location with Hot Harry’s | Explanation of reasoning for their design appropriately demonstrates the relationship between sunlight and the warming of each material as it applies to Cool Carl | Unable to explain their reasoning in terms of the effect of sunlight on different materials | Unable to explain reasoning based on scientific knowledge. |

| Engagement in collaborative conversations | Regularly engages in collaborative conversations to agree, disagree, or add to another’s thinking, or asks questions to clarify partners’ ideas | Successfully demonstrates ability to listen and take turns over multiple exchanges that are on topic | Does not successfully engage in turn taking or repeated exchanges; occasionally is off-topic | Does not engage in turn taking or repeated exchanges and is unable to remain on topic |

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| Uses scientific vocabulary | Exceptional use of scientific terms* such as nearly all those listed below | Consistent use of scientific terms* when appropriate such as warmer, cooler, shady, and sunlight | Limited use of scientific terms* such as hot/cold | Cannot explain the meanings of vocabulary terms |

*Scientific terms used in unit as described in K5 of Stage 1: warmer, cooler, temperature, surface, sand, water, rocks, shady, sunlight, tent, cave, tunnel, umbrella, burrow, heat
Unit Resources

Lesson 1:
- Earth Materials graphic organizer
- Sand, soil, water, and rocks in separate containers
- Magnifying lenses (if desired)
- Books or website with pictures of 4 materials
- Crayons
- Chart paper, markers
- Earth materials graphic organizer (found in Unit Resources) for students, and one on chart paper

Lesson 2:
- Graphic organizer from previous lesson with color key
- Basic map of the schoolyard/playground
- Clipboards
- Crayons

Lesson 3:
- Student maps from Lesson 1
- Crayons
- Clipboards
- Read aloud book: Go Away, Sun by Pam Bull (Found at ReadingA-Z.com Grade 2 Level M; Projectable book)
- Chart paper version of class map

Lesson 4:
- Black rocks, white rocks
- Rocks in two containers (large enough for students to put their palms in), and soil in two containers
- Sticky notes, crayons, chart paper, if desired
Lesson 5:
• Sand in two containers (large enough for students to put their palms in), and water in two containers
• Sticky notes, crayons, chart paper (if desired)

Lesson 6:
• A digital slide presentation or photos of various types of beaches
• Bag of materials per group, such as: craft sticks, scissors, plastic knives, a paintbrush to spread glue, straws, pipe cleaners, pieces of cloth, tape or glue, modeling clay to simulate rocks, a black marker, a piece of cardstock or cardboard, and a container of water

CEPA
• One bag of materials per group, such as craft sticks, scissors, plastic knives, a paintbrush to spread glue, straws, pipe cleaners, pieces of cloth, tape or glue, modeling clay to simulate rocks, and a black marker.
• Two small-scale figures.
• The beach scenario as created by each group in the previous lesson.
• A container of water to simulate ocean water when placing scenarios in sun.
### Earth Materials

<table>
<thead>
<tr>
<th>SAND</th>
<th>SOIL</th>
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<tr>
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<table>
<thead>
<tr>
<th>WATER</th>
<th>ROCKS</th>
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